REPORT
2020012463

AMEREN MISSOURI MERAMEC ENERGY CENTER
EVALUATION OF CCR UNITS
40 CFR PART 257
ST. LOUIS COUNTY, MISSOURI

Prepared for

Prepared by

October 2021

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1.0 INTRODUCTION

The Meramec Energy Center is located at the southernmost point in St. Louis County, Missouri at the confluence of the Mississippi and Meramec Rivers, approximately 2.8 miles southeast of the City of Arnold. The Meramec Energy Center has ten surface impoundments used for managing coal combustion residuals (CCR) within an approximate 138-acre area. They are designated as Ponds 489, 490, 491, 492, 493, 494, 495, 496, 498 and Inactive Pond 498. Ponds 489, 490, 491, 494, 495 and Inactive Pond 498 no longer receive CCR and are inactive. Pond 498 (MCPD) was closed in 2021. The remaining active CCR surface impoundments are Ponds 492 (MCPA), 493 (MCPB) and 496 (MCPC). Stormwater, and discharge from the active ponds is routed to the Retention Pond prior to discharge through an NPDES permitted outfall. A map showing the location of the surface impoundments and the Retention Pond is attached as Figure 1.

1.1 Purpose

The purpose of this report is to document evaluations and assessments completed for the Ameren Missouri Meramec Energy Center active CCR Units as required by select sections within 40 CFR Part 257, the final rule to regulate the disposal of CCR as solid waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA). Specifically, Reitz & Jens completed assessments and evaluations as required by:

A. §257.73(c)(1), History of Construction
B. §257.73(a)(2), Periodic Hazard Potential Classification
C. §257.73(d)(1), Periodic Structural Stability Assessment
D. §257.73(e)(1), Periodic Safety Factor Assessment
E. §257.82, Hydrologic and Hydraulic Capacity Requirements, and
F. §257.83(b), Inspection Requirements for CCR Surface Impoundments

The evaluations and assessments required by §257.73(c)(1) are discussed in the body of this report. The evaluations and assessments required by the remaining applicable sections of 40 CFR Part 257 are contained in the Appendices.

2.0 MERAMEC ENERGY CENTER CCR UNITS

2.1 Owner and Operator

The CCR Units at the Meramec Energy Center (MEC) are owned and operated by Ameren Missouri. MEC plant personnel have the primary responsibility of CCR unit operation. The MEC is located at 8200 Fine Road in St. Louis, Missouri 63129. The Ameren Missouri Dam Safety Group performs CCR unit inspections and reviews all updates to the Operations and Maintenance (O&M) Manual. A copy of the 2011 O&M manual is included in Appendix A. The Ameren Missouri Dam Safety Group is located at 11149 Lindbergh Business Court, St. Louis, Missouri 63123.

2.2 CCR Unit Location

The CCR Units are located as identified on the most recent 7.5-minute topographic quadrangle map in Section 3, Township 42N, and Range 6E. Section 3 is irregularly shaped. A plot of the USGS topographic quadrangle map showing the location of the MEC is attached as Figure 2.

2.3 CCR Unit Identification and Purpose

There are ten surface impoundments and the Retention Pond at the MEC. The Retention Pond collects stormwater and discharge from the active CCR units at the MEC. The surface impoundments are used to store CCR. The Retention Pond is used for retention and water clarification and alkalinity adjustment of stormwater and surface impoundment discharge prior to discharge through Outfall #003 of NPDES permit number MO-0000361. The name of each unit, type of impounded CCR, and operational status are listed in Table 1. New naming convention, MCPA, MCPB, and MCPC, have been assigned to the active CCR units, ponds 492, 493, and 496, respectively. In the future Ameren will refer to the active CCR units by their new names, not their pond numbers. The CCR units are not regulated as dams by the Missouri Department of Natural Resources (MDNR) because the height of the perimeter impoundments is less than 35 feet. As a result, the State of Missouri has not assigned ID numbers to these impoundments.

Table 1 – Meramec Energy Center CCR Units

CCR Unit	CCR Type	Operational Status
Pond 489	Fly Ash	**Closed**
Pond 490	Fly Ash	Inactive
Pond 491	Fly Ash	Inactive
MCPA (Pond 492)	Bottom Ash	**Active**
MCPB (Pond 493)	Bottom Ash	**Active**
Pond 494	Fly Ash	Inactive
Pond 495	Fly Ash	Inactive
MCPC (Pond 496)	Bottom Ash	**Active**
MCPD (Pond 498)	Fly Ash	**Closed**
Inactive Pond 498	Fly Ash	Inactive
Retention Pond	None	**Active**

2.4 CCR Unit Watershed

The Meramec Energy Center is located at the confluence of the Meramec and Mississippi Rivers outside of the regulatory floodway and 100-year floodplain of both rivers. According to the current Flood Insurance Rate Map, the regulatory 100-year flood elevation at the site is el. 416. The Meramec River is to the west of the CCR units and the Mississippi River is to the east, with the confluence of the two rivers directly to the south. An unnamed tributary to the Meramec River runs along the north side of the CCR units. Outfall #003 from the Retention Pond discharges into this unnamed tributary approximately 0.25 miles upstream from its confluence with the Meramec. The Meramec River has a watershed area of approximately 2,149 square miles and the Mississippi River has a watershed area of approximately 700,000 square miles at their confluence. The watershed area of the unnamed tributary is approximately 0.61 square miles. The Meramec Energy Center does not receive run-on from areas outside of the facility.

2.5 Geomorphology and Foundation Geology

The geology at the Meramec Energy Center consists of natural alluvium, approximately 100 feet thick, deposited by the Meramec and Mississippi Rivers and sedimentary rocks of the Paleozoic age.

The site lies on the northeastern flank of the Ozark dome, a major structural feature of southeast Missouri. The general dip of the rock strata is toward the northeast varying from one to two degrees. The rock below the alluvial deposits is the Middle Warsaw formation of the Lower Meramecian Series of the Lower Mississippian System. Locally, the Warsaw formation consists of interbedded gray, crinoidal limestone and shaley limestone with dark gray, fissile shale. It ranges from 70 to 90 feet in thickness in the vicinity of the site (Shannon & Wilson, 1979).

The natural alluvium consists of gray and brown, high plastic clays, silty clays and clayey silts, gray silty sands, and sands for a thickness of approximately 100 feet. A 6- to 8-foot-thick layer of sand and gravel is intermittently encountered overlying the bedrock. The stratification of the alluvium is heterogeneous.

The Meramec Energy Center sits on fill placed to bring the site up to an elevation of approximately 418.5 feet. Fill depths range from about 6 to 18 feet. Fill was borrowed from the incised portion of the surface impoundments constructed in the early 1950's. The fill is generally high plastic clay or silty clay.

Groundwater levels at the Meramec Energy Center closely follow the stage of the adjacent Mississippi River, which controls the level of the rivers at the confluence. Historic records of the Mississippi River stages indicate that the river level varies between about el. 369 and el. 406.5, except for the high river stage of el. 416.5 during the 1993 flood.

2.6 Surveillance, Maintenance and Repair of the CCR Units

The Meramec Ash Pond Embankment O&M manual outlines objectives, responsibilities, and procedures for Ameren personnel who are responsible for the management of the Meramec CCR units. The embankments of the CCR units are visually inspected weekly by Ameren plant operations staff. Ameren Missouri Dam Safety Group personnel perform annual inspections and periodic inspections or assessments with plant operations staff. In addition, the Ameren Missouri Dam Safety Group may conduct unannounced safety inspections. Descriptions of each type of inspection or assessment are included in the following sections. Checklists used during inspection of the CCR Units are included in the attached O&M manual.

2.6.1 Surveillance

2.6.1.1 Weekly Inspections

Weekly inspections are conducted by plant staff or support staff familiar with the ponds/ash pond embankments. The weekly inspections consist of visually inspecting the crest and slopes of each ash pond embankment to identify new or changed conditions. Checklists are completed and are made available to the Dam Safety Group for review.

2.6.1.2 Annual Inspection

These inspections are conducted annually by the plant staff and the Ameren Missouri Dam Safety Group staff. The annual inspection is a detailed visual inspection of the ash pond embankment crest, interior and exterior slopes, downstream toe area, inlet/outlet works, and appurtenant structures.

An inspection report is to be prepared by the Ameren Missouri Dam Safety Group staff that includes a description of the observations of the visual inspection, photographs of the facilities taken during the inspection, and a written evaluation of the results. A record of maintenance activities for the ash pond embankments is also kept current by the Ameren Missouri Dam Safety Group.

2.6.1.3 Periodic Structural Stability Assessments

The Periodic Structural Stability Assessments are conducted every 5 years by the Ameren Missouri Dam Safety Group staff to document whether the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater which can be impounded therein in general accordance with 40 CFR Part §257.73(d)(1).

Ameren Missouri Dam Safety Group staff will prepare a periodic structural stability assessment report which at a minimum will document whether the CCR unit has been designed, constructed, operated, and maintained with:

i. Stable foundations and abutments;
ii. Adequate slope protection to protect against surface erosion, wave action, and adverse effects of sudden drawdown;
iii. Dikes (embankments) mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR unit;
iv. Vegetated slopes of dikes and surrounding areas not to exceed a height of 6 inches above the slope of the dike, except for slopes which have an alternate form of slope protection;
v. A single spillway or a combination of spillways designed, constructed, operated, and maintained to adequately manage flow during and following the peak discharge from the design flood event. The spillways must be either of non-erodible construction and designed to carry sustained flows; or earth or grass-lined and designed to carry short-term, infrequent flows at non-erosive velocities where sustained flows are not expected;

vi. Hydraulic structures underlying the base of the CCR unit or passing through the dike of the CCR unit that maintain structural integrity and are free of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, and debris which may negatively affect the operation of the hydraulic structure;

vii. For CCR units with downstream slopes which can be inundated by the pool level of an adjacent water body, such as a river, stream or lake, downstream slopes that maintain structural stability during low pool of the adjacent water body or sudden drawdown of the adjacent water body.

If a deficiency or a release is identified during the periodic assessment, Ameren Missouri will remedy the deficiency or release as soon as feasible and prepare documentation detailing the corrective measures taken.

2.6.1.4 Periodic Hazard Potential Classification

Ameren Missouri Dam Safety Group staff will update the hazard potential classification every 5 years in general accordance with 40 CFR Part §257.73(a)(2). Ameren Missouri Dam Safety Group staff will prepare documentation of the hazard potential classification of each CCR unit as either high hazard potential CCR surface impoundment, a significant hazard potential CCR surface impoundment, or a low hazard potential CCR surface impoundment, and the basis for each hazard potential classification. Ameren Missouri Dam Safety Group staff will prepare and maintain a written Emergency Action Plan if it is determined that a CCR unit is either a high hazard potential surface impoundment or a significant hazard surface impoundment.

2.6.1.5 Periodic Safety Factor Assessment

Ameren Missouri Dam Safety Group staff will conduct periodic safety factor assessments every 5 years in general accordance with 40 CFR Part §257.73(e)(1). The periodic safety factor assessments will be conducted for each CCR unit and will document whether the calculated factors of safety for each CCR unit achieve the minimum safety factors specified in §257.73(e)(1) for the critical cross section of the embankment. The critical cross section is the cross section anticipated to be the most susceptible of all cross sections to structural failure based on appropriate engineering considerations, including loading conditions. The safety factor assessments will be supported by appropriate engineering calculations.

2.6.1.6 Periodic Inflow Design Flood Control System Plan

Ameren Missouri Dam Safety Group staff will prepare a inflow design flood control system plan every 5 years in general accordance with 40 CFR Part §257.82. The plan will document how the inflow design flood control system has been designed, constructed, operated and maintained to adequately manage flow by definition or regulation into the CCR surface impoundment during and following the peak discharge of the inflow design flood. The inflow design flood is the probable maximum flood for a high hazard potential CCR surface impoundment, the 1000-year flood for a significant hazard potential CCR surface impoundment, the 100-year flood for a low hazard potential CCR surface impoundment, and the 25-year flood for an incised surface impoundment.

2.6.1.7 Special Inspections

Special inspections are conducted when extreme events which may impact stability (seismic activity, severe flooding, etc.) occur. Special inspections are similar to the annual inspection but may be focused on a particular area. If conditions are discovered during a weekly or annual inspection which create concern for the MEC plant, personnel, or surrounding properties, a special inspection will be conducted. Responsibility for performance of special inspections will be evaluated based on the severity of the event and potential damage.

2.6.1.8 Unannounced Inspections

The Ameren Missouri Chief Dam Safety Engineer (CDSE) may conduct unannounced inspections at the site as deemed appropriate. The inspection may include a visual inspection of the facility, a review of the inspection documentation, and interviews with plant personnel to review their understanding of the required inspection procedures.

2.6.1.9 Inspection Findings

Observations made during the inspections are rated with a condition code as shown in the following Table 2. The timeliness of response to deficiencies observed depends on the severity of the condition.

Table 2 - Ameren Missouri Dam Safety Inspection Condition Codes

Condition Code	Description
EC	Emergency Condition. A serious dam safety condition exists that need immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, emergency repairs, work stoppage, plant stoppage.
IM	Item needing immediate maintenance to restore or ensure its safety and integrity. Remediation should be complete within 1 month or as required.
MM	Minor Maintenance. Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.
OB	Condition requires regular observation and potential future minor maintenance.
GC	Good Condition.
NO	No observation possible.
NI	Not Inspected. State reason in comment column.

2.6.2 Maintenance and Repair of the CCR Units

The O&M requires that timely repairs must be made after problem areas are identified. The plant engineer is to specify the work to be completed using Ameren's Work Control Process and provide direction to correct items noted in the operation and maintenance, and engineering inspections. The work request by the plant engineer will be reviewed with the Dam Safety Group to ensure proper emphasis has been placed on the request. The O&M specifies the minimum maintenance activities and requires that maintenance activities be documented. The O&M further specifies that no alterations or repairs to structural elements should be made without the approval of the Chief Dam Safety Engineer.

3.0 MCPA (POND 492), MCPB (POND 493) AND MCPC (POND 496)

3.1 History of Construction

MCPA, MCPB and MCPC were brought online in the 1950's. These ponds are commonly referred to as the "Bottom Ash Pond". The location of the ponds is shown in Figure 3. As-built drawings for the ponds are presented in the O&M manual in Appendix A. The ponds receive flow from the plant combined drained sump (CDS) and bottom ash sluice flow. Flow is conveyed south to north through interior ditches within the ash. From south to north flow passes through MCPC to MCPA and then to MCPB. MCPA and MCPB are separated by an interior berm, and the level in MCPA is controlled by two culverts through the berm which are fitted with knife gates. The level in MCPB is primarily controlled by an 18-inch diameter carbon steel pipe which discharges into the Retention Pond and serves as the principal spillway, and a 24-inch diameter corrugated metal pipe which serves as a secondary spillway.

MCPA and MCPC are incised and bounded on the east by the railroad loop, on the north by MCPB, on the west by inactive Pond 490 and closed Pond 498, and on the south by the plant fill. MCPB is partially incised and bounded on the north by a short section of the perimeter levee, on the west by inactive and closed Pond 498, on the south by MCPA, and on the east by the railroad loop and high ground. The railroad loop crosses through MCPB from the west to east.

A summary of pertinent data for each CCR unit are summarized in Table 3.

Table 3 – MCPA (Pond 492), MCPB (Pond 493) and MCPC (Pond 496)

CCR Unit	Maximum Pond Area (acres)	Maximum Dam Height (feet)	Minimum Crest Width (feet)	Crest Length (feet)	Upstream Slope Steepness (H:V)	Downstream Slope Steepness (H:V)
MCPB	6.9	24.7	10	1,200	Unknown	2:1
MCPA and MCPC	8.0	Incised	NA	NA	NA	NA

3.2 Modifications to Embankment Geometry and Operation

3.2.1 1970's Spillway and Embankment Modification

Plans from the late 1970's for Retention/Mixing Pond Area show that the northern portion of the MCPB embankment was raised.   The plan sheet is shown as Figure 4. The embankment was raised approximately 0.5 to 2.5 feet, and fill was added to flatten the downstream slope to 2 Horizontal (H):1Vertical (V). Compaction specifications are noted on the plan sheet for new fill placement and required fill to be placed in 6-inch layers compacted to 95% Modified Proctor Density. On the same plan sheet the existing pond overflow was shown to be abandoned. A new 18-inch diameter corrugated steel spillway pipe was shown and is currently in operation as the principal spillway. The new pipe was added to route discharge from MCPB to the Retention Pond.

3.2.2 2000 Railroad Loop Embankment Construction

Construction of the railroad loop was complete in 2000. The railroad loop embankment enlarged and flattened the downstream slope of MCPB exterior embankment for about 300 feet before the railroad embankment turned south and east and cut across MCPB. The railroad embankment then ran south and east along the edge of MCPA and 496 for approximately 900 feet before turning south and west cutting across MCPC. The railroad embankment where it intersects the MCPB exterior embankment was constructed of soil fill with 2H:1V upstream slopes and 3H:1V downstream slopes. The railroad embankment was constructed of shot-rock fill where it cuts across MCPB and MCPC. The cutoff portion of MCPB was subsequently filled with CCR to near capacity. Ameren reports that the cutoff area is still hydraulically connected to the remaining pond because of the porous railroad embankment fill, and the area is inundated by shallow water during high pool levels. The cutoff portion of MCPC was filled and currently is a gravel parking lot. Plans for construction of the railroad embankment are shown in Figures 5-11.

3.2.3 2012 Downstream Riprap Placement

In 2012, riprap was placed at 2H:1V on the downstream slope of MCPB that had been cut-off by the railroad embankment and where a tributary is adjacent to the embankment toe. The riprap was placed to improve stability and provide erosion protection. As-built plans for the riprap placement are shown in Figures 12-13. At the same time rock fill was placed for an access road adjacent to the railroad embankment on the north side of MCPB.

3.2.4 2012 Combined Drain Sump Re-Route

In 2012, the Combined Drain Sump (CDS) was re-routed so that it discharged into MCPC. Prior to re-routing the flow, the CDS discharged into Pond 489. Flow from the CDS is discharged through a 20-inch diameter DR17 HDPE pipe.

3.2.5 2013 Ash Pond Overflow

Construction of an overflow pipe and ditch from MCPB to the Retention Pond was completed in 2013. The as-built plan for this work is shown in Figure 14. The construction included 110 feet of 24-inch diameter corrugated metal pipe with an invert elevation of 409.5 feet on the upstream side, a riprap lined ditch with 2H:1V sideslopes, and 100 feet of 24-inch diameter steel casing pipe on the downstream side. The invert elevation of the steel casing pipe at the retention pond is 404 feet.

3.2.6 2015 Staff Gage and Riprap Installation

Ameren Missouri completed maintenance work on MCPB in November 2015. A staff gage was installed on the skimmer for the principal spillway to monitor the pond water level, and riprap was placed on the downstream slope of MCPB west of the riprap placed in 2012. The entire downstream slope is now armored with riprap. The area downstream of the exterior slope was also graded to create positive drainage away from the embankment.

3.2.7 2018 CCR Excavation

In 2018, Ameren Missouri removed a significant volume of CCR from MCPA and MCPC to facilitate closure of Pond 489. The CCR removal increased the amount of storage in both ponds.

3.3 Foundation and Abutment Geology

The geotechnical investigation for the railroad loop shows a soil profile running from the northwest corner of MCPB to southern portion of MCPC. This geotechnical investigation report is included in Appendix A. Boring logs on the profile show the uppermost stratum is generally lean clay with a thickness of 25 to 45 feet. The exception is at the south end of MCPC where a thin layer of sand was observed above the lean clay. Plant borings show the lean clay is generally firm to stiff. The lean clay is underlain by 6 to 35 feet of high plastic clay, which has a soft to stiff consistency. Beneath the high plastic clay, loose to dense sand and gravel was observed to the top of limestone bedrock which was encountered at elevations ranging from 306 to 310 feet.

3.4 Embankment Material

Borings through the MCPB exterior embankment in 2021 show that the embankment was primarily constructed with clay and silt fill of alluvial origin, which were presumably excavated from the incised portions of the ash ponds. The consistency of the fill is firm to stiff. Portions of the embankment of been widened or raised with medium-dense to dense bottom ash or crushed limestone. The downstream slope is lined with MoDOT Type 4 Rock Ditch Liner that has a predominant size of 19 inches.

Embankment fill placed in the 1970's raised the crown of the MCPB embankment 0.5 to 2.5 feet, and fill added to the downstream slope to flatten it to 2H:1V. The plan sheet for the fill placement noted that the fill should be placed in 6-inch layers compacted to 95% Modified Proctor Density. About 300 feet of the embankment was subsequently enlarged and approximately 200 feet of the downstream slope was flattened to 3H:1V during the rail loop construction. Fill placed for the rail loop was compacted in systematic coverages with loose lift thicknesses not exceeding 12 inches. The fill was compacted to a dry unit weight equal to at least 92% of the Standard Proctor maximum dry density. This area was subsequently armored with riprap in 2015. The remaining downstream embankment slope east of the section modified during rail loop construction was armored with riprap at a 2H:1V slope to improve stability and provide erosion protection. The upstream slopes are currently buttressed with CCR or the railroad loop for a distance of 30 to 60 feet from the centerline of the original embankment. The CCR on the upstream slope has very gradual slope steepness. Profile elevations of the top of the embankment measured by Ameren in 2015 are shown in Figure 15 and range from 413.2 to 415.3 feet.

3.5 Operating Pool Surface Elevations

The normal operating pool level is 409.5 feet for MCPB and 410.3 for MCPA and MCPC. The maximum surcharge pool elevation during the 100-year, 24-hour storm is 412.85 feet for MCPA and MCPC, and 412.05 feet for MCPB. Area-capacity curves for MCPA, MCPC, and MCPB are shown in Figures 16 and 17.

3.6 CCR Unit Outlet Works

The principal spillway for MCPB is a drop-inlet with a 764 feet long, 18-inch diameter carbon steel pipe that discharges into the Retention Pond. The pipe alignment is shown in Figure 4. A secondary spillway or "overflow pipe" consists of a 100-foot long 24-inch corrugated metal pipe. The secondary spillway pipe discharges into an overflow ditch that has a 6-foot bottom width and 2H:1V riprap armored side slopes. The overflow ditch is approximately 650 feet long and flows east, emptying into a 24-inch diameter carbon steel pipe that discharges into the Retention Pond.

The ponds receive flow from the plant combined drained sump (CDS), bottom ash sluice flow and stormwater runoff from Ponds 490 & 491, the conveyor and coal pile area, portions of closed Pond 498 and the Switchyard. Flow is conveyed south to north through MCPC to MCPA and then to MCPB. MCPA and MCPB are separated by an interior berm, with level in MCPA and MCPC controlled by two approximately 40-foot long, 24-inch diameter carbon steel culverts through the berm which are fitted with a knife gates.

Summarized in Table 4 are pertinent data for the outlet works.

Table 4 – Ponds 492, 493 and 496 Outlet Works.

CCR Unit	Description	Type	Upstream Invert Elevation (feet)	Downstream Invert Elevation (feet)
MCPB	Principal Spillway	18-inch, carbon steel pipe w/ drop inlet	408.9	400.3
MCPB	Secondary Spillway	24-inch, CMP	409.5	404.3
MCPA	Principal Spillway	(2) 24-inch, carbon steel pipe	410.3/411.4	410.1/410.1

3.7 Impounded CCR

MCPA, MCPB and MCPC impound bottom ash. Table 5 summarizes the approximate volume and depth of the CCR stored in each unit.

Table 5 - Ponds 492, 493 and 496 Approximate Volume and Depth of Impounded CCR

CCR Unit	Est. Volume of CCR (CY)	Approximate Bottom Elev. of CCR Unit (feet)	Est. Maximum CCR Elev. (feet)	Est. Average Depth of CCR (feet)	Est. Maximum Depth of CCR (feet)
MCPA	68,000	398	415	10	17
MCPB	60,000	398	413	10	14
MCPC	185,000	402	420	8	18

Particle size distribution tests on samples of bottom ash show the ash is generally well-graded from fine gravel-size to fine sand-size, with 12% to 14% fines (<0.075mm particles). The Specific Gravity of the bottom ash ranges from 2.50 to 2.65. Relative density tests on samples of bottom ash show the minimum dry unit weight ranges from 44 to 71 pcf, and the maximum dry unit weight ranges from 70 to 89 pcf.

3.8 Instrumentation

A staff gage was installed in MCPA, MCPB and MCPC in late 2015. No other instrumentation has been installed on these ponds and there are no historical records of pool levels. The new staff gage will be used to measure and record pool levels during weekly inspections.

3.9 Structural Instability

There are no records of structural instability for MCPA, MCPB and MCPC.

4.0 MCPD (POND 498)

4.1 History of Construction

MCPD was brought online in the 2002. In various historical documents the pond is also referred to as the "New Fly Ash Pond". The configuration and location of the pond is shown in Figure 18. The pond is incised with a perimeter dike. As-built drawings for MCPD are presented in the O&M manual in Appendix A. The active portion of MCPD was built within portions of Inactive Ponds 498 and 490 which were originally constructed in the 1950s and had been filled and were no longer receiving sluiced fly ash for several years prior to 2002.

MCPD no longer receives process water or CCRs, has been dewatered and is being closed. Historically MCPD received excess process water that is used to moisture condition the dry fly ash as it is disposed in the pond. There was no contributing watershed outside of the perimeter dike. The discharge into the pond was located on the south side of the pond. The inlet piping was connected to a flexible hose, and the point of discharge of the flexible hose was moved periodically to discharge into designated cells as part of pond operation. The point of discharge was moved when the cell receiving the discharge fills with CCR. Accumulated CCR was excavated from the cells and stockpiled in other locations. Excess process water generally flowed from south to north through interior ditches and accumulated in the northwest corner of MCPD at the outlet works. The outlet works have been removed or grouted closed. MCPD is lined with 60 MIL HDPE on the slopes and 40 MIL HDPE on the bottom.

A summary of pertinent data for the CCR unit is summarized in Table 6.

Table 6 - MCPD

CCR Unit	Maximum Pond Area (acres)	Maximum Dam Height (feet)	Minimum Crest Width (feet)	Length (feet)	Upstream Slope Steepness (H:V)	Downstream Slope Steepness (H:V)
MCPD (Pond 498)	13.5	19.5	15	3,320	3H:1V & 4H:1V	3H:1V

4.2 Modifications to Embankment Geometry and Operation

4.2.1 2011 Spillway Modification

The plan sheets attached as Figures 19 to 21 show the details of a timber stoplog structure that was added to the outlet works in 2011. The drop inlet structure invert elevation was set at 412 feet. The weir structure allowed for increasing the water level up to a maximum elevation of 419 feet. The stoplog structure consists of timber 6"x6" posts and 2"x12" sides. The weir plates are 2"x6" lumber. The stoplog structure was removed as part of closure construction in 2021.

4.2.2 Staff Gage (2015)

In 2015 a staff gage was installed. No other instrumentation has been installed and there are no historical records regarding pool levels. The staff gage is used to measure and record pool levels during weekly inspections. The outlet works include a timber stop log structure and drop inlet with a 24-inch HDPE pipe that discharges into the Retention Pond. The staff gage was removed as part of closure construction in 2021.

4.2.3 Closure Construction (2021)

Closure of MCPD was initiated in 2021 and is planned to be complete in the same year. Closure includes grading the remaining exposed CCR to facilitate drainage and capping the CCR with a HDPE geomembrane overlain by 2 feet of soil. The principal spillway will also be grouted closed, with all non-contact stormwater routed to the Recycle Pond or MCPA, MCPB and MCPC via overland.

4.3 Foundation and Abutment Geology

The geotechnical investigation for MCPD included 11 borings which are included in Appendix A. The foundation for the perimeter berms consists of fly ash that is underlain by lean silty clay and high plastic clay. The bottom of MCPD is founded on lean silty clay or high plastic clay. Standard penetration tests in the fly ash yielded N-values which ranged from 1 to 10 blows per foot, indicating a very loose to medium-dense relative density. A consolidated undrained triaxial test on an undisturbed sample of fly ash had an angle of internal friction (ϕ) of 32°. Unconsolidated undrained (UU) triaxial shear strength tests on sample of undisturbed fly ash yielded undrained shear strengths (s_u) which ranged from 320 to 1220 pounds per square feet (psf) and averaged 700 psf. The clay is soft to stiff, and UU tests on undisturbed samples of clay resulted in s_u which range from 600 to 2840 psf, and averaged 1200 psf.

Borings drilled for the railroad loop show that the clay extends to approximate elevations 315 to 325 feet. The clay is underlain by sand and gravel to an elevation of approximately 310 feet, where limestone is encountered.

4.4 Embankment Material

The perimeter berm for MCPD was constructed of compacted fly ash above the existing ground surface, which was generally at about elevation 417 feet. The downstream slopes are 3H:1V. The upstream slopes are 4H:1V except for the west embankment which was sloped at are 3H:1V. Additional fly ash fill was placed downstream of the perimeter berm on the west, north and south embankment slopes. The bottom of the pond was set at the top of natural clays which have an elevation of 395 to 398 feet.

Fly ash placed for the perimeter berm was moisture conditioned and compacted to a minimum of 95% of the maximum density determined by laboratory compaction characteristic tests using standard effort. Fill placement was monitored and moisture-density tests were obtained during construction.

4.5 Operating Pool Surface Elevations

The MCPD has been dewatered and is being closed.

4.6 CCR Unit Outlet Works

During closure construction the MCPD spillway stoplog structure was removed and the spillway conduit was grouted closed. The interior of MCPD has been graded and capped to route stormwater via overland flow to designated outfalls.

4.7 Impounded CCR

MCPD impounds fly ash at the approximate volume and depth shown in Table 7.

Table 7 - MCPD approximate volume and depth of impounded CCR

CCR Unit	Est. Volume of CCR (CY)	Approximate Bottom Elev. of CCR Unit (feet)	Est. Maximum CCR Elev. (feet)	Est. Average Depth of CCR (feet)	Est. Maximum Depth of CCR (feet)
MCPD	510,000	395	433	19	38

Particle size distribution tests on samples of fly ash show the ash consists of nearly uniform silt-size particles (0.075 mm to 0.02 mm). The Specific Gravity of the fly ash is about 2.95.

4.8 Instrumentation

The staff gage used for monitoring the MCPD pool level has been removed. The MCPD has been dewatered and is currently being closed.

4.9 Structural Instability

There are no records of structural instability for MCPD.

5.0 PERIODIC HAZARD POTENTIAL CLASSIFICATION

40 CFR Part 257
Periodic Hazard Potential Classification Assessments for CCR Surface Impoundments
§257.83(a)(2)

The 2020 Periodic Hazard Potential Classification Assessment was conducted for active CCR surface impoundments MCPA, MCPB and MCPC, and MCPD at the Meramec Energy Center in accordance with the requirements of 40 CFR 257.73(a). These CCR surface impoundments are low hazard potential because failure of the impoundment is not expected to cause a loss of human life, and the economic, environmental and lifeline losses are expected to be low and generally limited to the owner. The hazard potential classification was completed in general accordance with *Federal Guidelines for Dam Safety: Hazard Potential Classification for Dams* by the Federal Emergency Management Agency (January 2004).

CCR Unit	Hazard Potential Classification
MCPA, MCPB and MCPC	Low
MCPD	Low

The basis for the hazard potential classification is documented in Appendix B: Meramec Energy Center Hazard Potential Classification. A subsequent assessment of the hazard potential must be conducted within 5 years of the date of this report.

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6.0 PERIODIC STRUCTURAL STABILITY ASSESSMENT

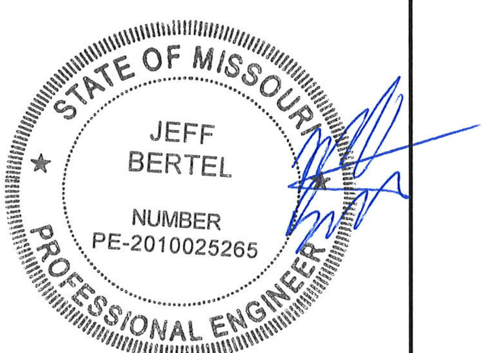
40 CFR Part 257
Periodic Structural Stability Assessment for CCR Surface Impoundments §257.73(d)(1)

The 2020 Periodic Structural Stability Assessment was conducted for the active CCR surface impoundments MCPA, MCPB, MCPC, and MCPD at the Meramec Energy Center. The structural stability assessment was completed in general accordance with 40 CFR Part §257.73(d)(1). Assessment of all these CCR Units found no structural stability deficiencies, no significant issues with the current operations and maintenance, and that the design and construction are adequate, however some corrective measures were recommended.

Requirement	MCPA, MCPB and MCPC	MCPD
Periodic assessment was completed in general accordance with the requirements of 40 CFR Part §257.73(d)(1)	Yes	Yes

Refer to Appendix C for the 2020 Periodic Structural Stability Assessment report. A subsequent Periodic Structural Stability Assessment must be conducted within 5 years of the date of this report.

Engineer's Seal



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Date: October 15, 2021

7.0 PERIODIC SAFETY FACTOR ASSESSMENT

40 CFR Part 257
Periodic Safety Factor Assessment for CCR Surface Impoundments §257.73(e)(1)

The 2020 Periodic Safety Factor Assessment was conducted for the active CCR surface impoundments MCPA, MCPB and MCPC at the Meramec Energy Center. The Periodic Safety Factor Assessment for each active CCR Unit at the Meramec Energy Center shows that the critical cross section for these Units meet or exceed the minimum factors of safety specified in 40 CFR Part §257.73(e)(1) as summarized below.

Requirement	MCPA, MCPB, and MCPC
The calculated static factor of safety under the long-term, maximum storage pool loading condition must equal or exceed 1.50.	≥1.50
The calculated static factor of safety under the maximum surcharge pool loading condition must equal or exceed 1.40.	≥1.40
The calculated seismic factor of safety must equal or exceed 1.00.	≥1.00
The calculated liquefaction factor of safety must equal or exceed 1.20.	≥1.20

Refer to Appendix D for the 2020 Periodic Safety Factor Assessment report. A subsequent Periodic Safety Factor Assessment must be conducted within 5 years of the date of this report.

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8.0 HYDROLOGIC AND HYDRAULIC CAPACITY REQUIREMENTS

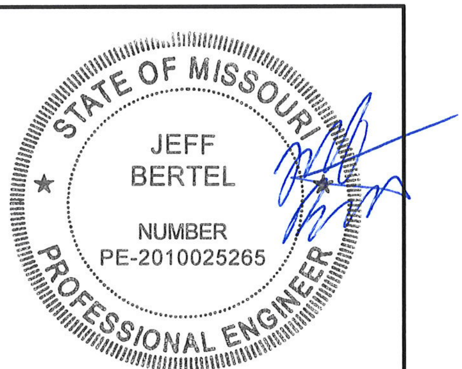
40 CFR Part 257
Hydrologic and Hydraulic Capacity Requirements for CCR Surface Impoundment §257.82

The 2020 periodic inflow design flood control system plan was completed for the active CCR surface impoundments MCPA, MCPB and MCPC at the Meramec Energy Center. The periodic inflow design flood control system plan was completed in general accordance with 40 CFR Part §257(e)(1) using the 100-year design flood for low hazard potential CCR surface impoundments.

Requirement	MCPA, MCPB, and MCPC
The periodic inflow design flood control system plan meet the requirements of 40 CFR Part §257.82	Yes

Refer to Appendix E for the 2020 Inflow Design Flood Control System Plan report. The owner or operator must prepare periodic inflow design flood control system plans every five years, or whenever there is a change in conditions that would substantially affect the plan.

Engineer's Seal



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Date: October 15, 2021

9.0 CLOSURE

The preceding history of construction is regarded as a living document. If there is a significant change to any information or there are periodic updates, Ameren must update the relevant information and place it in the facility's operating record.

10.0 REFERENCES

Ameren Missouri. (2011). "Operation and Maintenance Manual; Meramec Ash Pond Embankment, St. Louis, Missouri, St. Louis County." Dam Safety and Hydro Engineering, St. Louis, Missouri.

Environmental Protection Agency. (2015). "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities; Final Rule." 40 CFR Parts 257 and 261., Vol. 80, No. 74.

Shannon & Wilson, Inc. (1979). "Geotechnical Investigation Meramec Plant Retrofit." Union Electric Company, St. Louis, Missouri.

da_map.dwg 6/18/2021

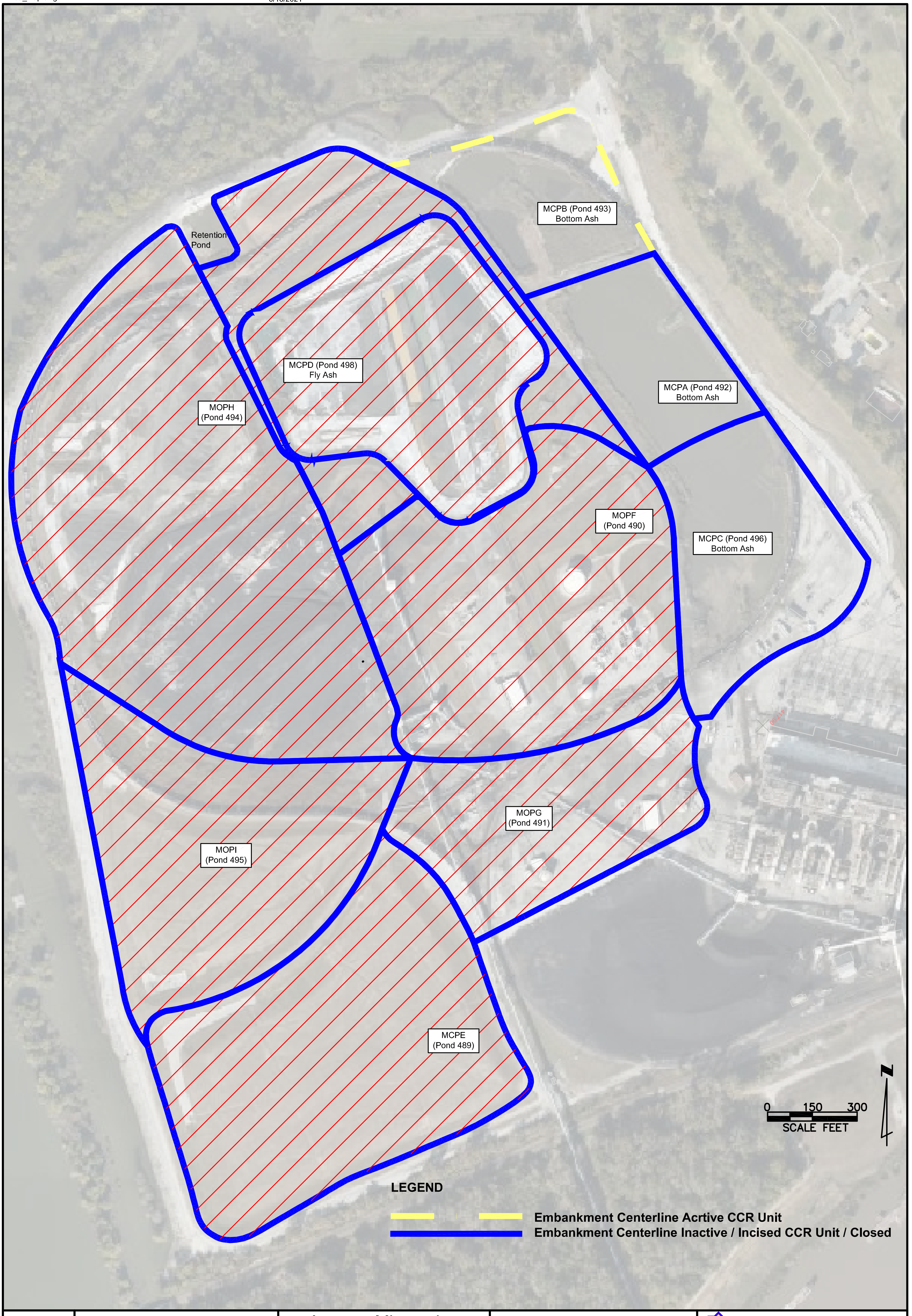
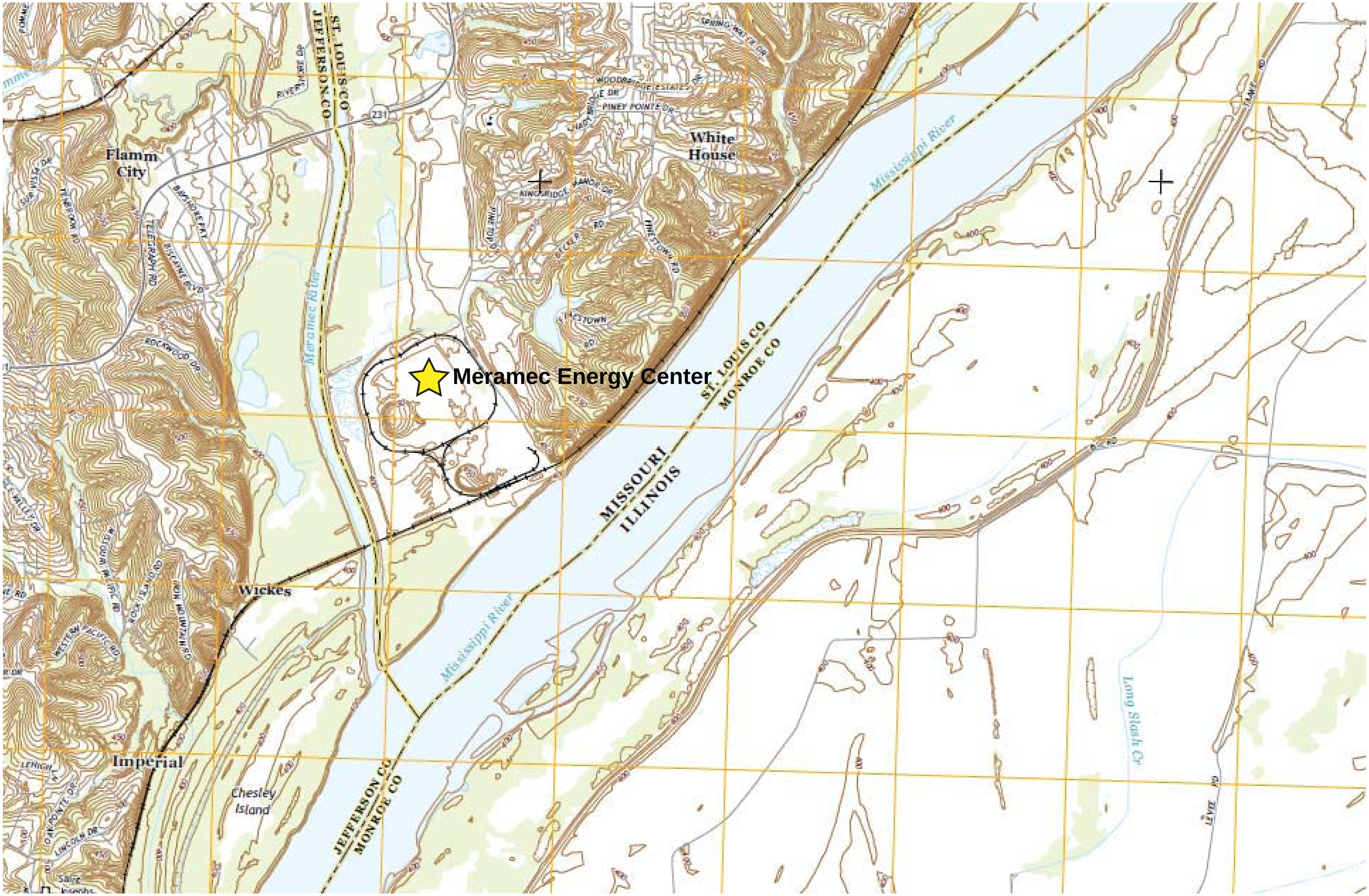


FIGURE 1	MERAMEC ENERGY CENTER ASH PONDS	Ameren Missouri 3700 S. Lindbergh St. Louis, MO 63127	Designed E.J.K. Checked Drawn E.J.K. Issued 8/13/2021	REITZ & JENS, INC. CONSULTING ENGINEERS 1055 CORPORATE SQUARE DRIVE ST. LOUIS MISSOURI 63132 (314) 993-4132 PROFESSIONAL ENGINEERING CORP., LICENSE #000215



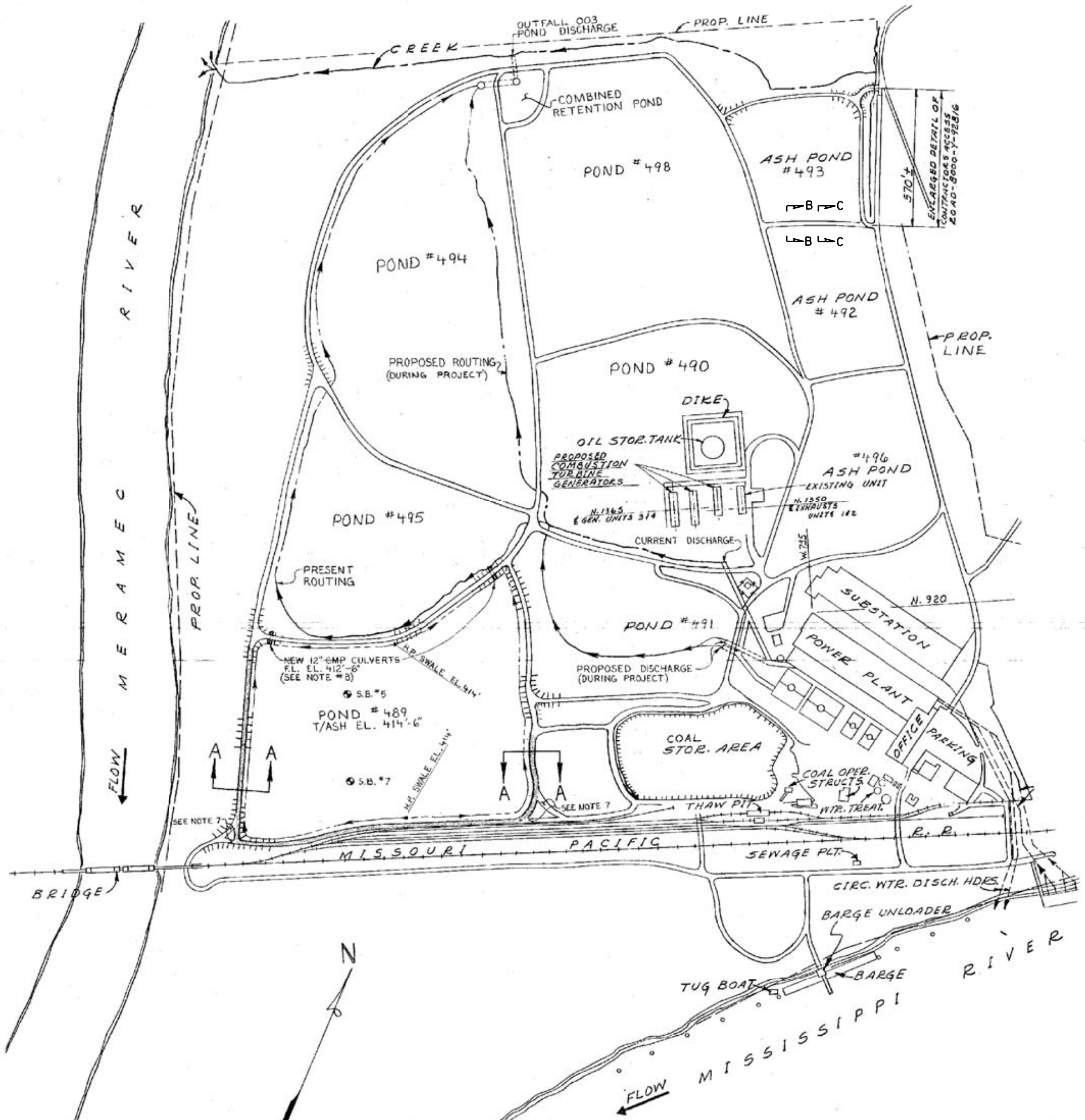
Ameren Missouri
Meramec Energy Center
CCR Unit Evaluation
USGS 7.5 minute quadrangle map

REITZ & JENS, INC.

Figure 2

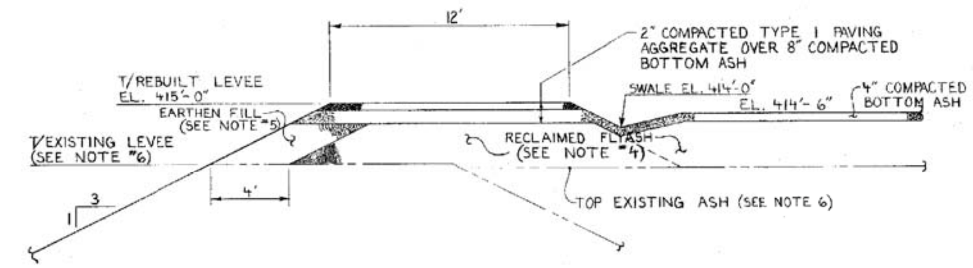
DRAWING NO.	REV.
MR-8020-Y-122626	002
SHEET NO. 001	

Figure 3

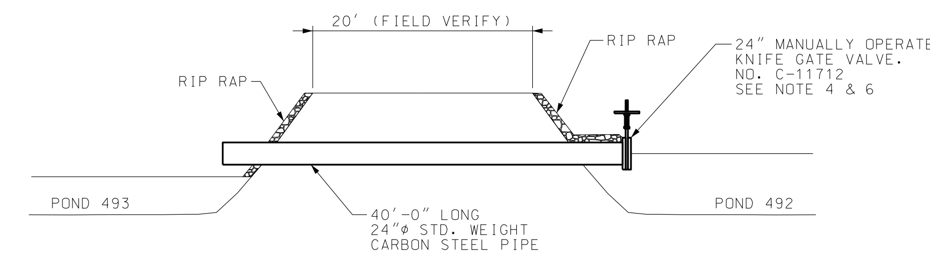


NOTES:

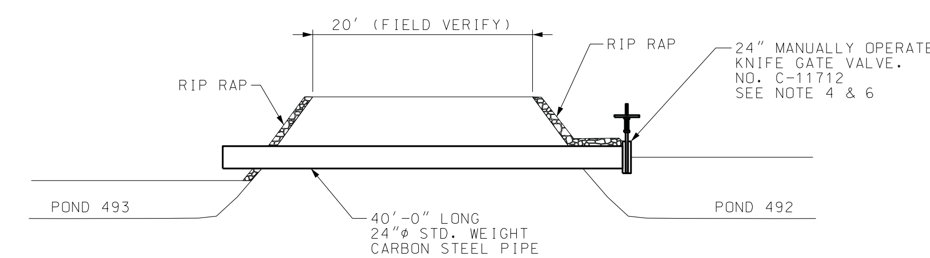
1) DEPRESSED SECTIONS OF POND #489 LEVEES SHALL FIRST BE RESTORED TO THEIR ORIGINAL TOP-OF-LEVEE ELEVATION 415', AS SHOWN IN SECTION A-A.
2) FLYASH SHALL BE RECLAIMED FROM POND #495 BY APPROPRIATE METHODS. FLYASH SHALL BE DRYED, PLACED AND COMPACTED IN POND #489, TO AN EL. OF 414'-6".
3) METHODS OF DRYING (IE. MOISTURE REDUCTION) SHALL BE RESTRICTED SUCH THAT ANY RESULTING RUNOFF BE KEPT WITHIN EXISTING ASH POND LIMITS AND BE ROUTED TO THE EXISTING PERMITTED DISCHARGE.
4) RECLAIMED FLYASH SHALL BE PLACED IN LOOSE LIFTS NOT TO EXCEED 8-12 INCHES, AND IMMEDIATELY COMPACTED AT OPTIMUM MOISTURE CONTENT BY MEANS OF A VIBRATORY ROLLER. SEE SPECIFICATION FOR COMPACTION REQUIREMENT. (SEE ALSO NOTE #9)
5) EARTHEN MATERIAL REQUIRED FOR EROSION PROTECTION AND CONTAINMENT SHALL CONFORM TO CL, CH, ML, OR MH SOIL CLASSIFICATIONS, AS GIVEN BY ASTM DESIGNATION D-2487. THIS MATERIAL SHALL BE COMPACTED WITH A SHEEPS-FOOT TYPE COMPACTOR. SEE SPECIFICATION FOR COMPACTION REQUIREMENT. (SEE ALSO NOTE #9)
6) SEE TOPOGRAPHIC MAP DRAWING 8020-W-122627 FOR EXISTING ELEVATIONS.
7) REBUILD ACCESS ROADS TO RENOVATED LEVEE TO PROVIDE SMOOTH TRANSITIONS FOR SMALL VEHICLES.
8) TWO NEW CULVERTS WILL BE INSTALLED AS SHOWN TO PROVIDE STORMWATER DRAINAGE FROM POND #489 INTO POND #495.
9) COMPACTION SPECIFICATIONS SHOULD YIELD PERMEABILITIES WITHIN THE REPAIRED LEVEE AS FOLLOWS:
   CLAY FILL – LESS THAN 10^{-7} CM/SEC.
   FLYASH – LESS THAN 10^{-6} CM/SEC.
10) SURVEY MONUMENT #2 SHALL BE RAISED TO ELEVATION 415'-0" ± 2". SEE DRAWING 8020-W-122627 FOR LOCATION.
11) S.B. #5/7 – SOIL BORINGS (SEE U.E. SPEC. EC-2392, APPENDIX E)
12) RENOVATED LEVEE SHOWN THUS
13) ALL WORK SHALL BE DONE IN ACCORDANCE WITH U.E. SPECIFICATION EC-2392



SECTION A-A
LEVEE RENOVATION



SECTION "B-B"
PIPE THROUGH LEVEE
N.T.S.



SECTION "C-C"
PIPE THROUGH LEVEE
N.T.S.

NOTES:

1. VERIFY INLET ELEVATION OF EXISTING CULVERT IN POND 492.
2. REMOVE THE EXISTING CORRUGATED CULVERT BETWEEN PONDS 492 & 493.
3. INSTALL NEW 24" DIA. STANDARD WEIGHT CARBON STEEL PIPE WITH KNIFE GATE VALVE. INLET OF NEW 24" PIPE SHALL BE PLACED AT SAME ELEVATION AS THE OLD CULVERT. NEW 24" PIPE SHALL HAVE 8" OF DROP BETWEEN INLET & OUTLET.
4. KNIFE GATE VALVE SHALL BE RED VALVE FLEXGATE SLURRY KNIFE GATE VALVE OR EQUIVALENT. VALVE SHALL HAVE TWO FULL PART EPDM CARTRIDGE SEAT HALVES THAT ARE SUPPORTED & COMPRESSED BETWEEN FLANGES. THE SEATS PROVIDE BY-DIRECTIONAL SEALING. THE GATE & STEM SHALL BE STAINLESS STEEL.
5. BACKFILL & RE-GRADE ROAD TO MATCH EXISTING ROADWAY AFTER INSTALLATION OF NEW 24" PIPE.
6. INTAKE INVERT ELEVATION AT SECTION "B-B" SHALL BE 12" LOWER THAN SECTION "C-C".

REFERENCE DRAWING:
TOPOGRAPHIC MAP----------------8020-W-122627

DRAWING RECORD									
REV.	DATE	PROJECT NO.	AMEREN SUPV ENGR	DRAFTING DRFTR	DRAFTING CHK'D	DRAFTING SUPV	ENGR APPROVAL AMEREN	ENGR APPROVAL OTHER	DESCRIPTION
001	05-08-13	J017N	–	DLF	RBM	KAJ	RBM	–	ADD PIPE THRU LEVEE, SECTION B-B, PER MR-2012-MDW-0011
002	03-31-14			MSB	MB	KAJ	HART		REVISED SECTION "B-B" & ADD SECTION "C-C" & NOTE-6 PER MR-2013-MDW-0025

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AS BUILT

MARK UP DRAWING NO.	REV.
SHEET NO. ---	

SCALE –	PROPERTY PLAN ASH RETENTION PONDS
UNIT NO. –	SITE: MERAMEC ENERGY CENTER
DWG. SIZE 24X36 / SUB CLASS 02010	Ameren MISSOURI — DRAWING NO. MR-8020-Y-122626 — REV. 002 — SHEET NO. 001

SCANNED HYBRID DRAWING

Figure 4

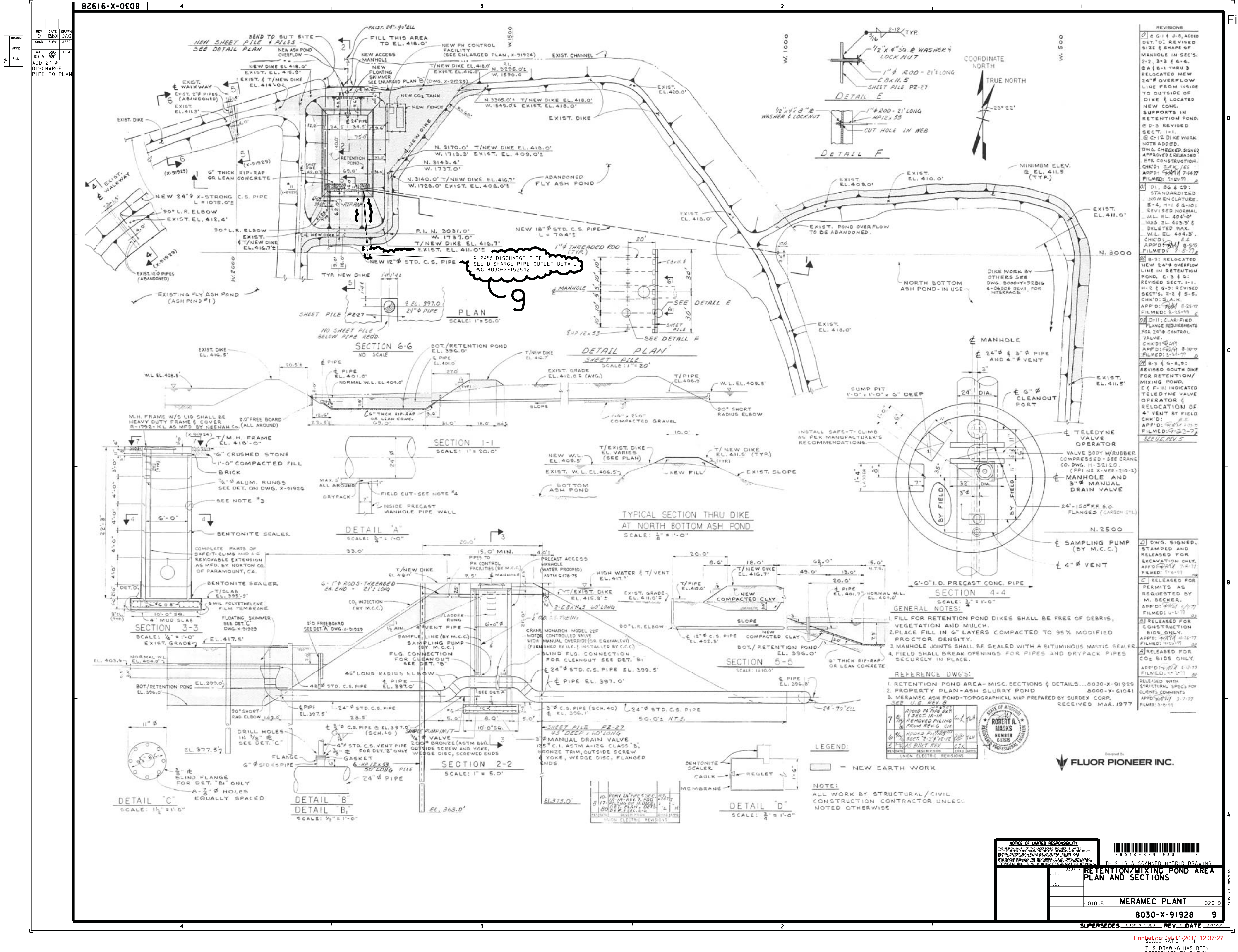

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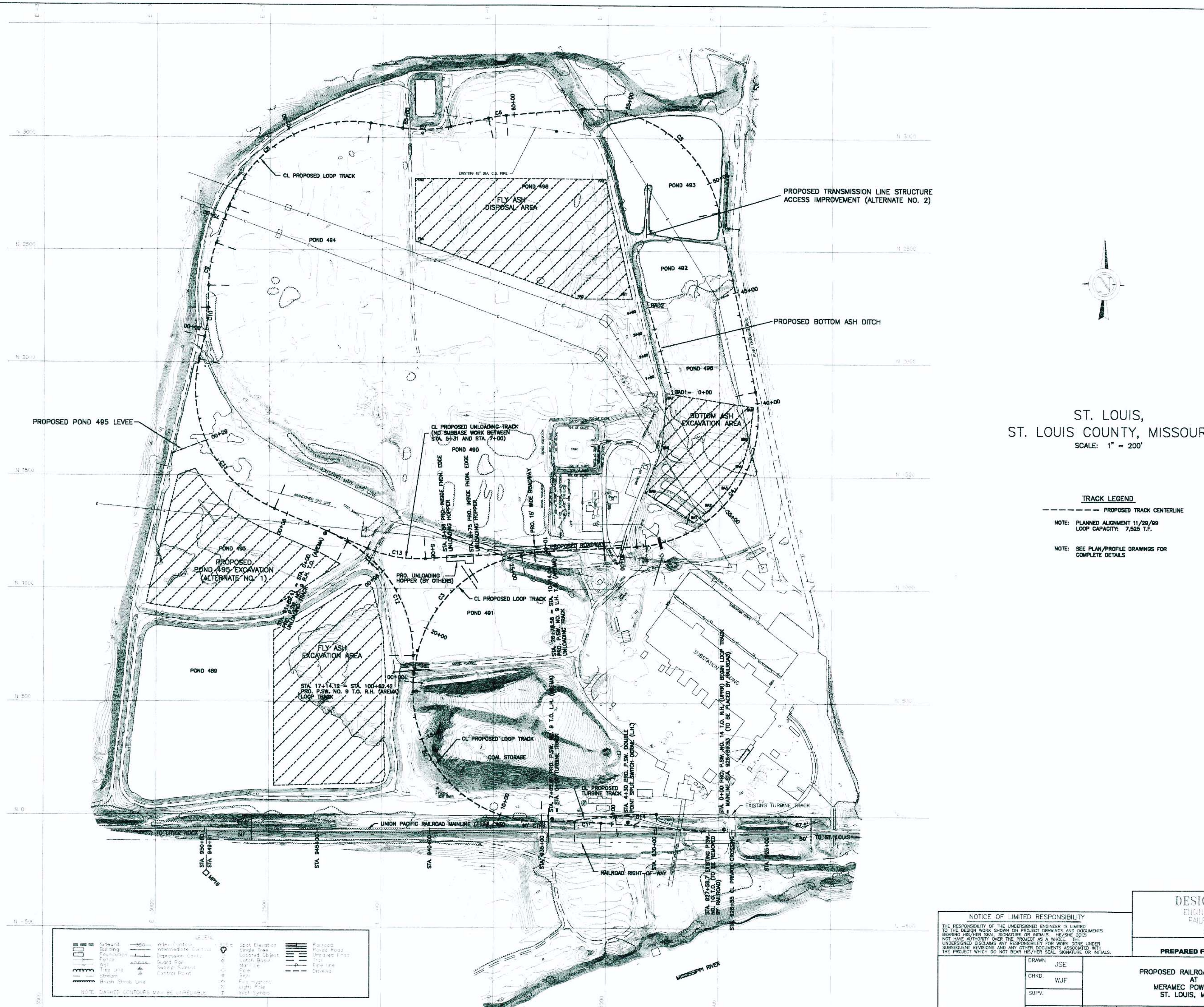
Figure 5

PRINT DIST.

REVISIONS	
REV.	W.O.

FIRST ISSUE 3/27/00



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DESIGN NINE, INC.
ENGINEERING SERVICES FOR RAILROADS AND INDUSTRY
ST. LOUIS, MO

PREPARED FOR AmerenUE

DRAWN	JSE
CHKD.	WJF
SUPV.	
APPD.	GTH

PROPOSED RAILROAD TRACKAGE AT MERAMEC POWER PLANT ST. LOUIS, MISSOURI

LOCATION	GENERAL PLAN	CLASS
001005		02010

ST. LOUIS, MISSOURI

DRAWING NO. 8030-Y-149103

REV. 0

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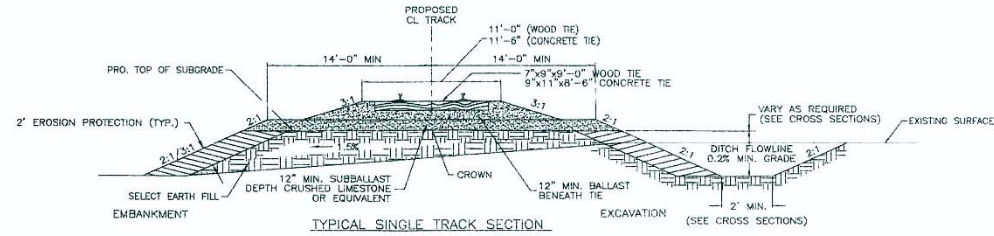
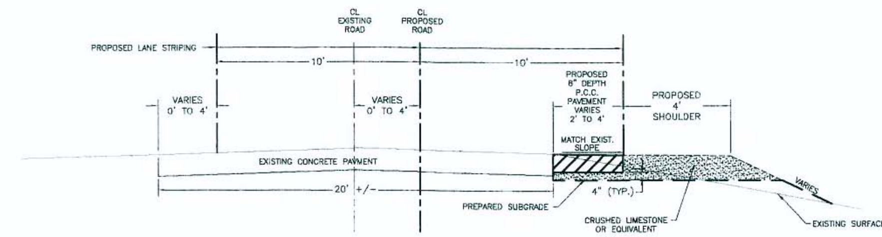
Figure 6

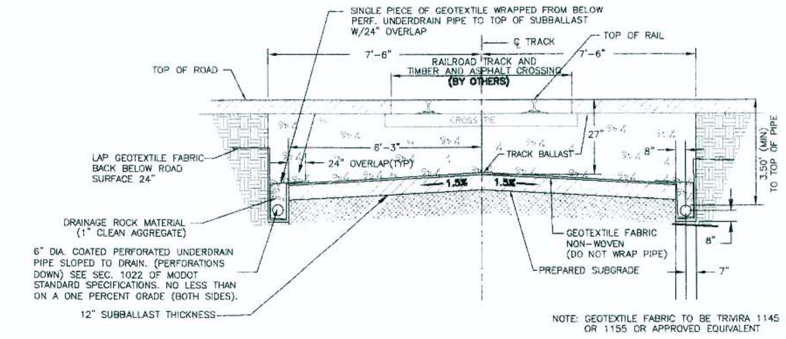
PRINT DIST.	
REVISIONS	
REV.	W.O.
FIRST ISSUE 3/27/00	



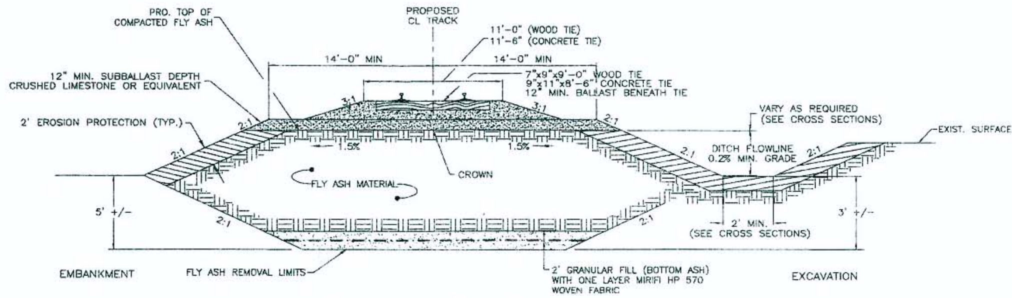
TYPICAL SINGLE TRACK SECTION
THROUGH NON ASH MATERIAL
(NOT TO SCALE)
NOTE: TRACK WORK BY OTHERS



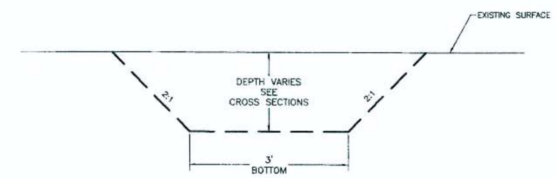
TYPICAL PLANT ENTRANCE ROAD SECTION
SECTION LOOKING NORTH
(NOT TO SCALE)



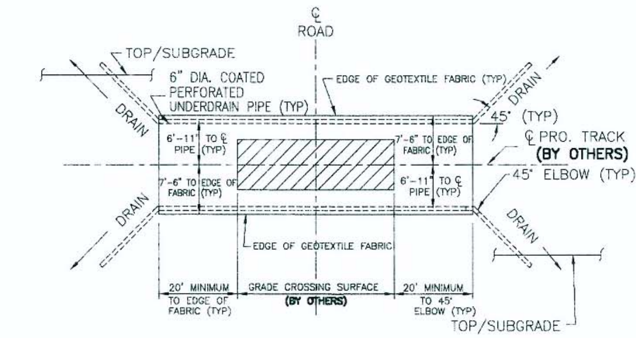
TYPICAL SECTION THROUGH ROADWAY CROSSINGS
(NOT TO SCALE)



TYPICAL SINGLE TRACK SECTION
THROUGH FLY ASH MATERIAL
(NOT TO SCALE)
NOTE: TRACK WORK BY OTHERS

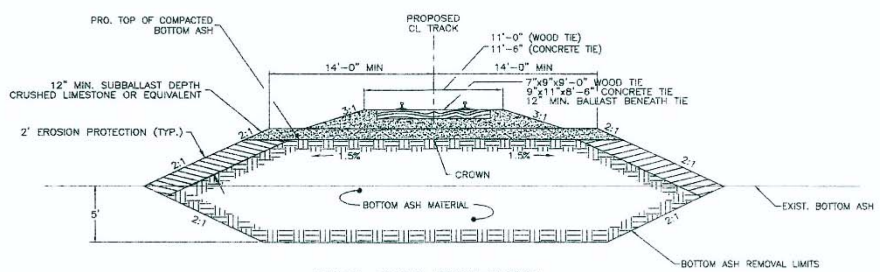


TYPICAL BOTTOM ASH DITCH SECTION
(NOT TO SCALE)

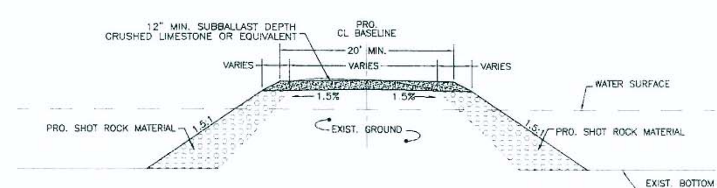


LAYOUTS FOR INSTALLATION OF GEOTEXTILE
FABRIC AND DRAINS AT ROADWAY CROSSINGS
(NOT TO SCALE)

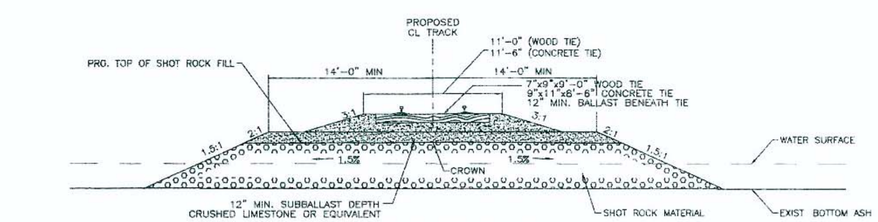
NOTE: UNDERDRAIN PIPES TO FLOW ON NO LESS THAN A ONE PERCENT GRADE. UNDERDRAIN PIPES TO EXTEND FROM 45° ELBOW TO A DAYLIGHT POINT AT SIDE SLOPES OF ROADBED.



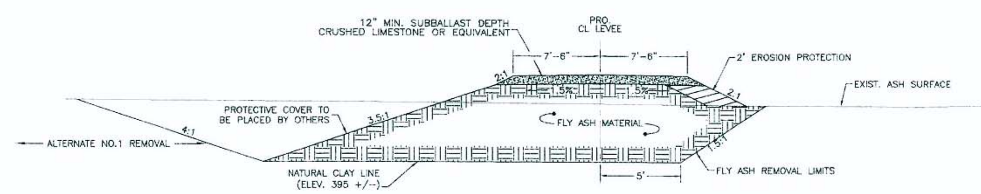
TYPICAL SINGLE TRACK SECTION
STA. 31+00 TO STA. 38+00
(NOT TO SCALE)
NOTE: TRACK WORK BY OTHERS



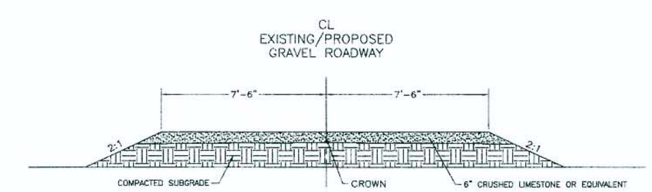
TYPICAL TRANSMISSION LINE STRUCTURE
ACCESS IMPROVEMENT SECTION
(ALTERNATE NO. 2)
(NOT TO SCALE)



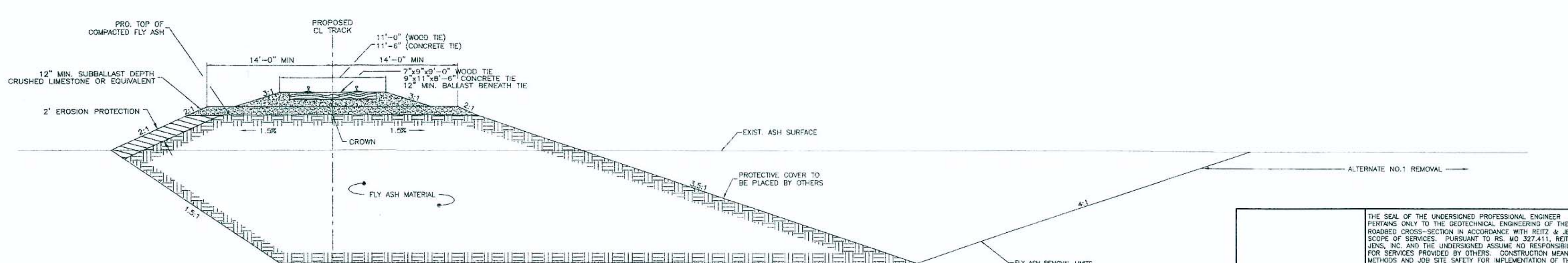
TYPICAL SINGLE TRACK SECTION
STA. 45+75 +/- TO STA. 54+80 +/-
(NOT TO SCALE)
NOTE: TRACK WORK BY OTHERS



TYPICAL POND 495 LEVEE SECTION
(NOT TO SCALE)



TYPICAL GRAVEL ROADWAY SECTION
(NOT TO SCALE)



TYPICAL SINGLE TRACK SECTION THROUGH FLY ASH MATERIAL
STA. 85+00 TO 93+75
(NOT TO SCALE)
NOTE: TRACK WORK BY OTHERS

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THE SEAL OF THE UNDERSIGNED PROFESSIONAL ENGINEER PERTAINS ONLY TO THE GEOTECHNICAL ENGINEERING OF THE ROADBED CROSS-SECTION IN ACCORDANCE WITH REITZ & JENS' SCOPE OF SERVICES. PURSUANT TO RS. MO 327.411, REITZ & JENS, INC. AND THE UNDERSIGNED ASSUME NO RESPONSIBILITY FOR SERVICES PROVIDED BY OTHERS. CONSTRUCTION MEANS AND METHODS AND JOB SITE SAFETY FOR IMPLEMENTATION OF THE PLANS SHALL BE THE SOLE RESPONSIBILITY OF THE CONTRACTOR.

JEFFREY L. FOUSE, P.E.
MISSOURI E-21043

REITZ & JENS, INC.
Consulting Engineers

DESIGN NINE, INC.
ENGINEERING SERVICES FOR RAILROADS AND INDUSTRY
ST. LOUIS, MO

PREPARED FOR AmerenUE

DRAWN	JSE	PROPOSED RAILROAD TRACKAGE AT MERAMEC POWER PLANT ST. LOUIS, MISSOURI
CHKD.	WJF	
SUPV.		
APPD.	GTH	
LOCATION	001005	TYPICAL SECTIONS AND ROAD CROSSING DETAILS
CLASS	02010	
ST. LOUIS, MISSOURI	DRAWING NO. 8030-Y-149107	REV. 0

Figure 7

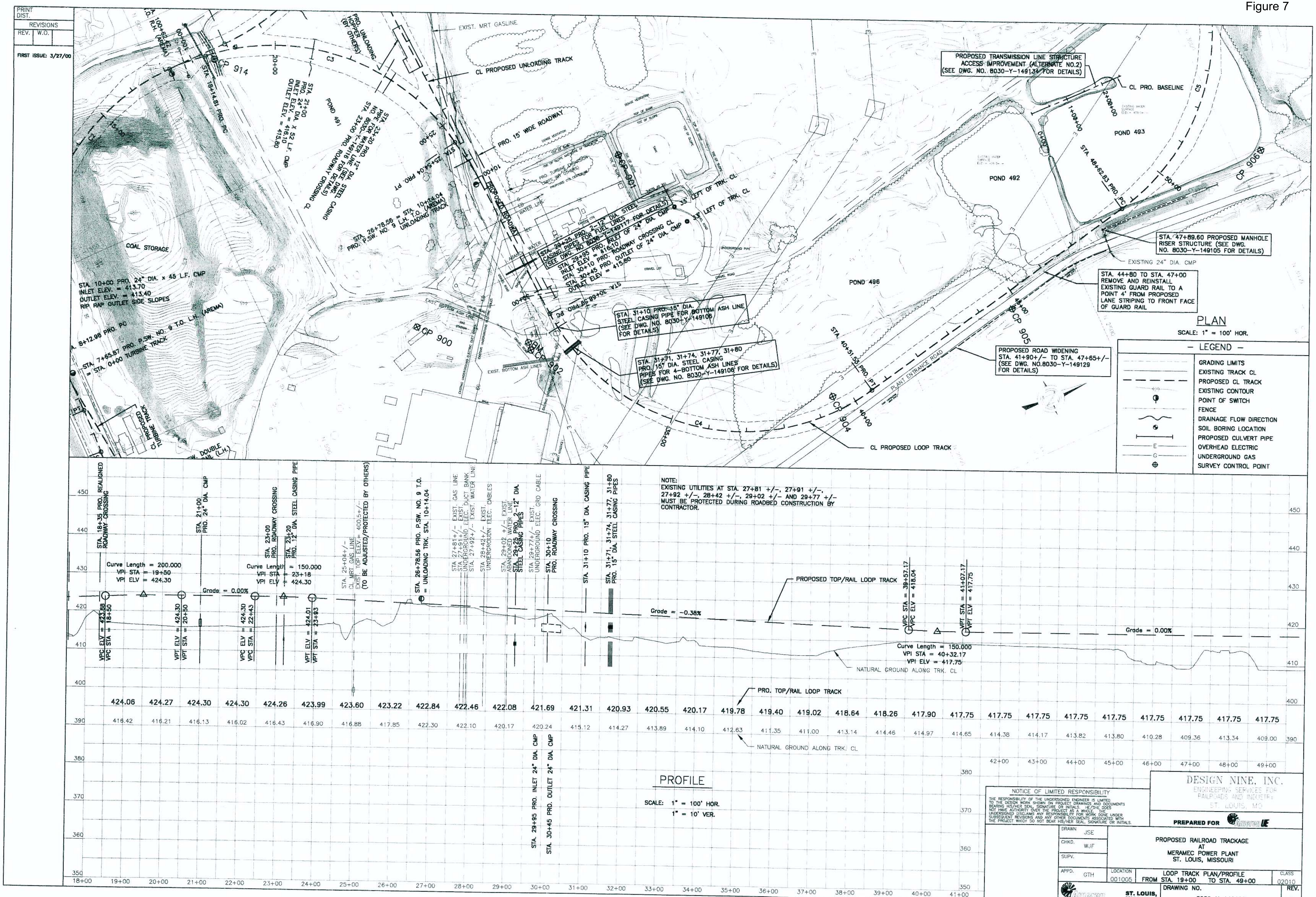

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Figure 8

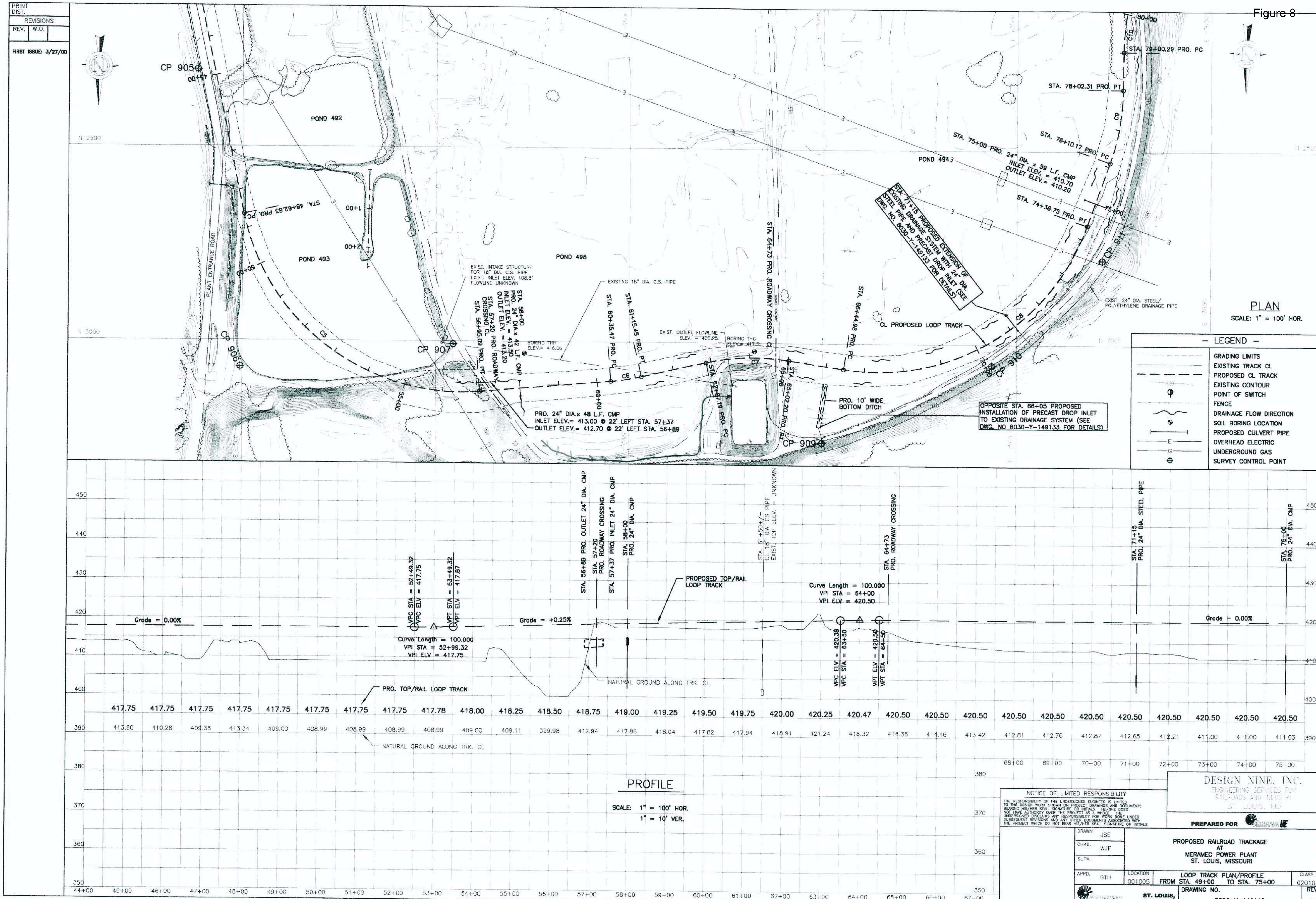
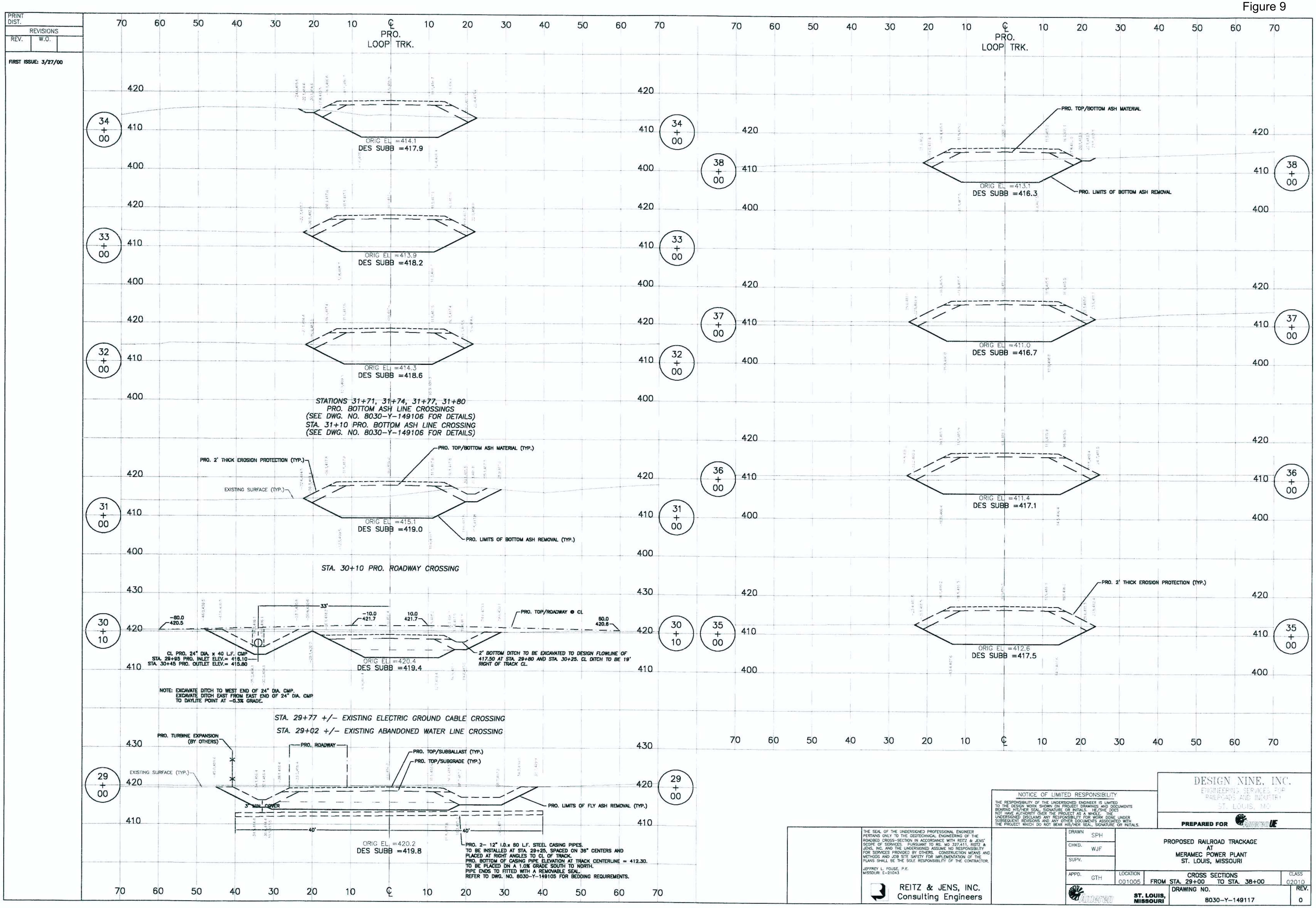
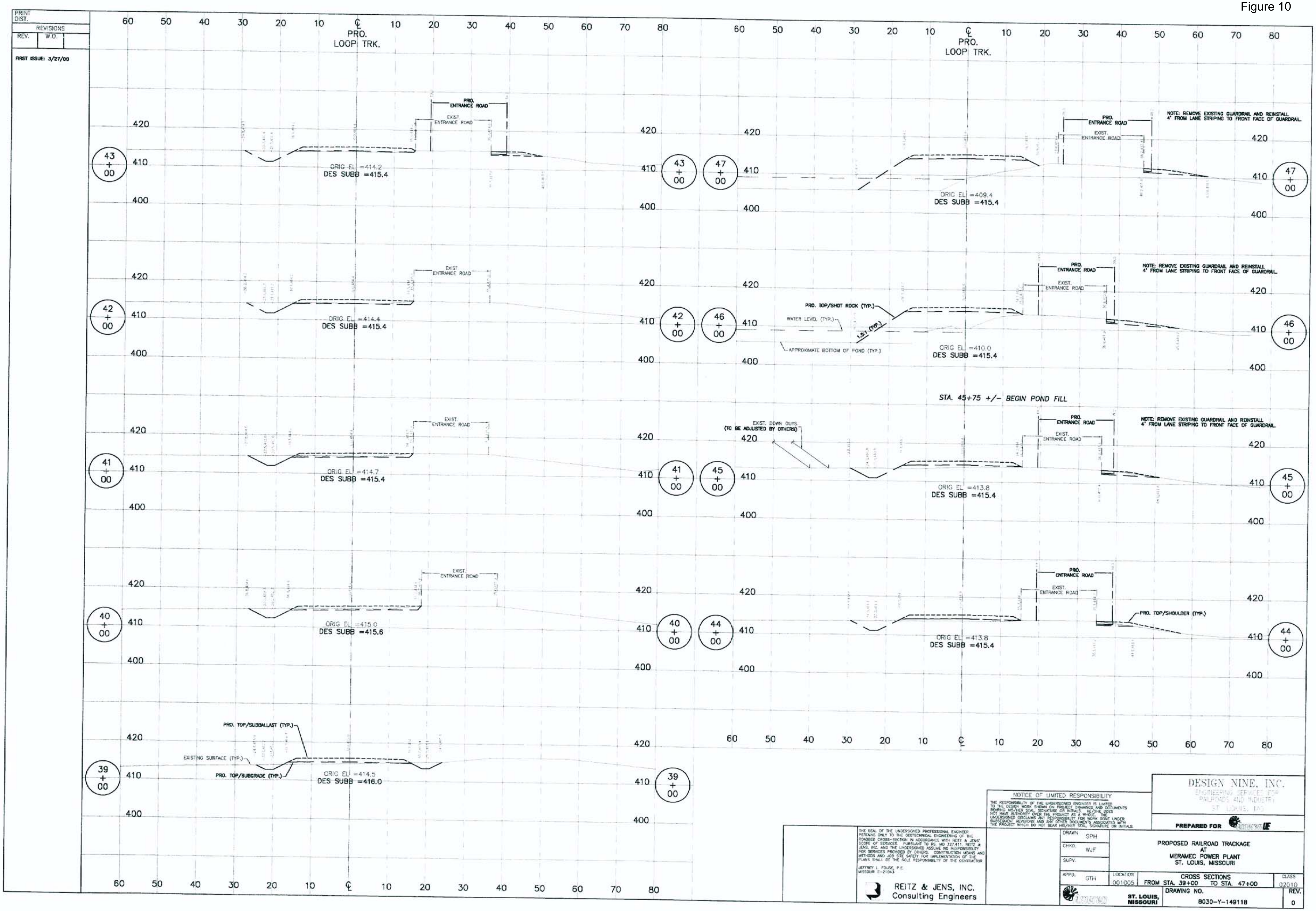

PRINT DIST.
REVISIONS
REV. W.O.
FIRST ISSUE: 3/27/00
CP 905
POND 492
POND 493
POND 494
POND 498
PLANT ENTRANCE ROAD
STA. 48+62.83 PRO. PC
CP 906
CP 907
CP 909
CP 910
CP 911
EXIST. INTAKE STRUCTURE FOR 18" DIA. C.S. PIPE
EXIST. INLET ELEV. 408.81
FLOWLINE UNKNOWN
EXISTING 18" DIA. C.S. PIPE
STA. 58+00
PRO. 24" DIA.x 42 L.F. CMP
INLET ELEV. = 413.50
OUTLET ELEV. = 413.20
STA. 57+20 PRO. ROADWAY CROSSING CL
STA. 56+95.09 PRO. PT
PRO. 24" DIA.x 48 L.F. CMP
INLET ELEV.= 413.00 @ 22' LEFT STA. 57+37
OUTLET ELEV.= 412.70 @ 22' LEFT STA. 56+89
STA. 60+35.47 PRO. PC
STA. 61+15.45 PRO. PT
EXIST. OUTLET FLOWLINE ELEV. = 400.25
STA. 64+73 PRO. ROADWAY CROSSING CL
STA. 62+57.19 PRO. PC
STA. 65+02.20 PRO. PT
STA. 66+44.98 PRO. PC
PRO. 10' WIDE BOTTOM DITCH
CL PROPOSED LOOP TRACK
STA. 71+15 PROPOSED EXTENSION OF EXISTING DRAINAGE SYSTEM WITH 24" DIA. STEEL PIPE AND PRECAST DROP INLET (SEE DWG. NO. 8030-Y-149133 FOR DETAILS)
OPPOSITE STA. 66+05 PROPOSED INSTALLATION OF PRECAST DROP INLET TO EXISTING DRAINAGE SYSTEM (SEE DWG. NO 8030-Y-149133 FOR DETAILS)
STA. 74+36.75 PRO. PT
STA. 75+00 PRO. 24" DIA. x 59 L.F. CMP
INLET ELEV. = 410.70
OUTLET ELEV.= 410.20
STA. 76+10.17 PRO. PC
STA. 78+02.31 PRO. PT
STA. 79+00.29 PRO. PC
EXIST. 24" DIA. STEEL/ POLYETHYLENE DRAINAGE PIPE
PLAN
SCALE: 1" = 100' HOR.
- LEGEND -
GRADING LIMITS
EXISTING TRACK CL
PROPOSED CL TRACK
EXISTING CONTOUR
POINT OF SWITCH
FENCE
DRAINAGE FLOW DIRECTION
SOIL BORING LOCATION
PROPOSED CULVERT PIPE
OVERHEAD ELECTRIC
UNDERGROUND GAS
SURVEY CONTROL POINT
Grade = 0.00%
VPC STA = 52+49.32
VPC ELV = 417.75
VPT STA = 53+49.32
VPT ELV = 417.87
Curve Length = 100.000
VPI STA = 52+99.32
VPI ELV = 417.75
Grade = +0.25%
STA. 56+89 PRO. OUTLET 24" DIA. CMP
STA. 57+20 PRO. ROADWAY CROSSING
STA. 57+37 PRO. INLET 24" DIA. CMP
STA. 58+00 PRO. 24" DIA. CMP
PROPOSED TOP/RAIL LOOP TRACK
STA. 61+50+/- CL 18" DIA. CS PIPE EXIST. TOP ELEV. = UNKNOWN
Curve Length = 100.000
VPI STA = 64+00
VPI ELV = 420.50
STA. 64+73 PRO. ROADWAY CROSSING
VPC ELV = 420.38
VPC STA = 63+50
VPT ELV = 420.50
VPT STA = 64+50
STA. 71+15 PRO. 24" DIA. STEEL PIPE
STA. 75+00 PRO. 24" DIA. CMP
Grade = 0.00%
NATURAL GROUND ALONG TRK. CL
PRO. TOP/RAIL LOOP TRACK
417.75 417.75 417.75 417.75 417.75 417.75 417.75 417.75 417.78 418.00 418.25 418.50 418.75 419.00 419.25 419.50 419.75 420.00 420.25 420.47 420.50 420.50 420.50 420.50 420.50 420.50 420.50 420.50 420.50 420.50 420.50
413.80 410.28 409.36 413.34 409.00 408.99 408.99 408.99 408.99 409.00 409.11 399.98 412.94 417.86 418.04 417.82 417.94 418.91 421.24 418.32 416.36 414.46 413.42 412.81 412.76 412.87 412.65 412.21 411.00 411.00 411.03
NATURAL GROUND ALONG TRK. CL
44+00 45+00 46+00 47+00 48+00 49+00 50+00 51+00 52+00 53+00 54+00 55+00 56+00 57+00 58+00 59+00 60+00 61+00 62+00 63+00 64+00 65+00 66+00 67+00
68+00 69+00 70+00 71+00 72+00 73+00 74+00 75+00
PROFILE
SCALE: 1" = 100' HOR.
1" = 10' VER.
NOTICE OF LIMITED RESPONSIBILITY
DESIGN NINE, INC.
ENGINEERING SERVICES FOR RAILROADS AND INDUSTRY
ST. LOUIS, MO
PREPARED FOR
DRAWN JSE
CHKD. WJF
SUPV.
APPD. GTH
PROPOSED RAILROAD TRACKAGE AT MERAMEC POWER PLANT ST. LOUIS, MISSOURI
LOCATION 001005
LOOP TRACK PLAN/PROFILE FROM STA. 49+00 TO STA. 75+00
CLASS 02010
ST. LOUIS, MISSOURI
DRAWING NO. 8030-Y-149110
REV. 0

Figure 9



I:\DATA\sgt98\ameren_ue\meramec\9926-5 Issue 03-27-00\For CD 8-14\99026-1X.dwg Thu Oct 12 09:17:14 2000 PLOT BY BPG

Figure 10


PRINT DIST.
REVISIONS
REV.
W.O.
FIRST ISSUE: 3/27/00
PRO. LOOP TRK.
PRO. ENTRANCE ROAD
EXIST. ENTRANCE ROAD
ORIG EL =414.2
DES SUBB =415.4
ORIG EL =409.4
DES SUBB =415.4
NOTE: REMOVE EXISTING GUARDRAIL AND REINSTALL 4' FROM LANE STRIPING TO FRONT FACE OF GUARDRAIL.
ORIG EL =414.4
DES SUBB =415.4
PRO. TOP/SHOT ROCK (TYP.)
WATER LEVEL (TYP.)
1.5:1 (TYP.)
APPROXIMATE BOTTOM OF POND (TYP.)
ORIG EL =410.0
DES SUBB =415.4
STA. 45+75 +/- BEGIN POND FILL
EXIST. DOWN GUYS (TO BE ADJUSTED BY OTHERS)
ORIG EL =414.7
DES SUBB =415.4
ORIG EL =413.8
DES SUBB =415.4
ORIG EL =415.0
DES SUBB =415.6
PRO. TOP/SHOULDER (TYP.)
ORIG EL =413.8
DES SUBB =415.4
PRO. TOP/SUBBALLAST (TYP.)
EXISTING SURFACE (TYP.)
PRO. TOP/SUBGRADE (TYP.)
ORIG EL =414.5
DES SUBB =416.0
43+00
42+00
41+00
40+00
39+00
47+00
46+00
45+00
44+00
NOTICE OF LIMITED RESPONSIBILITY
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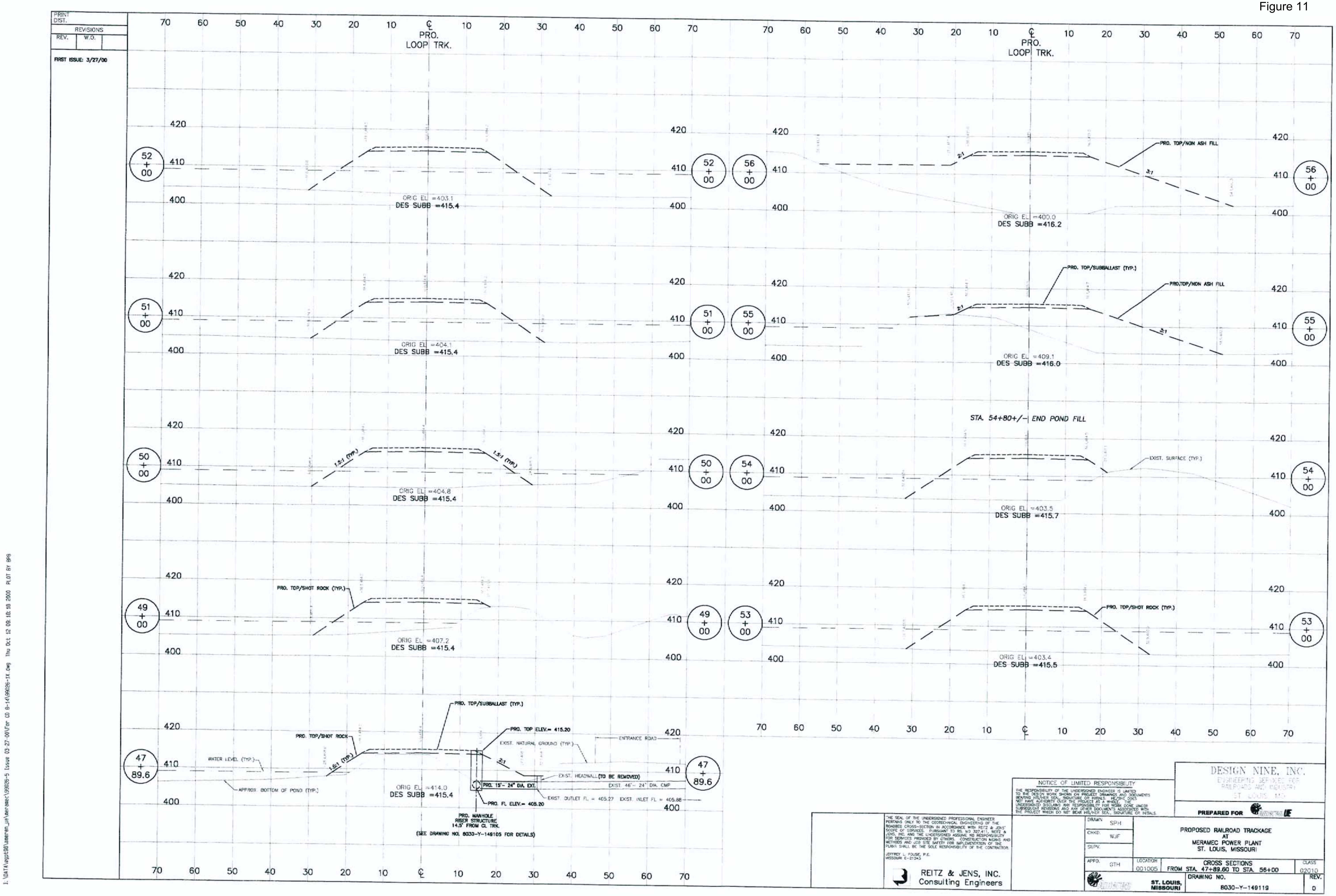
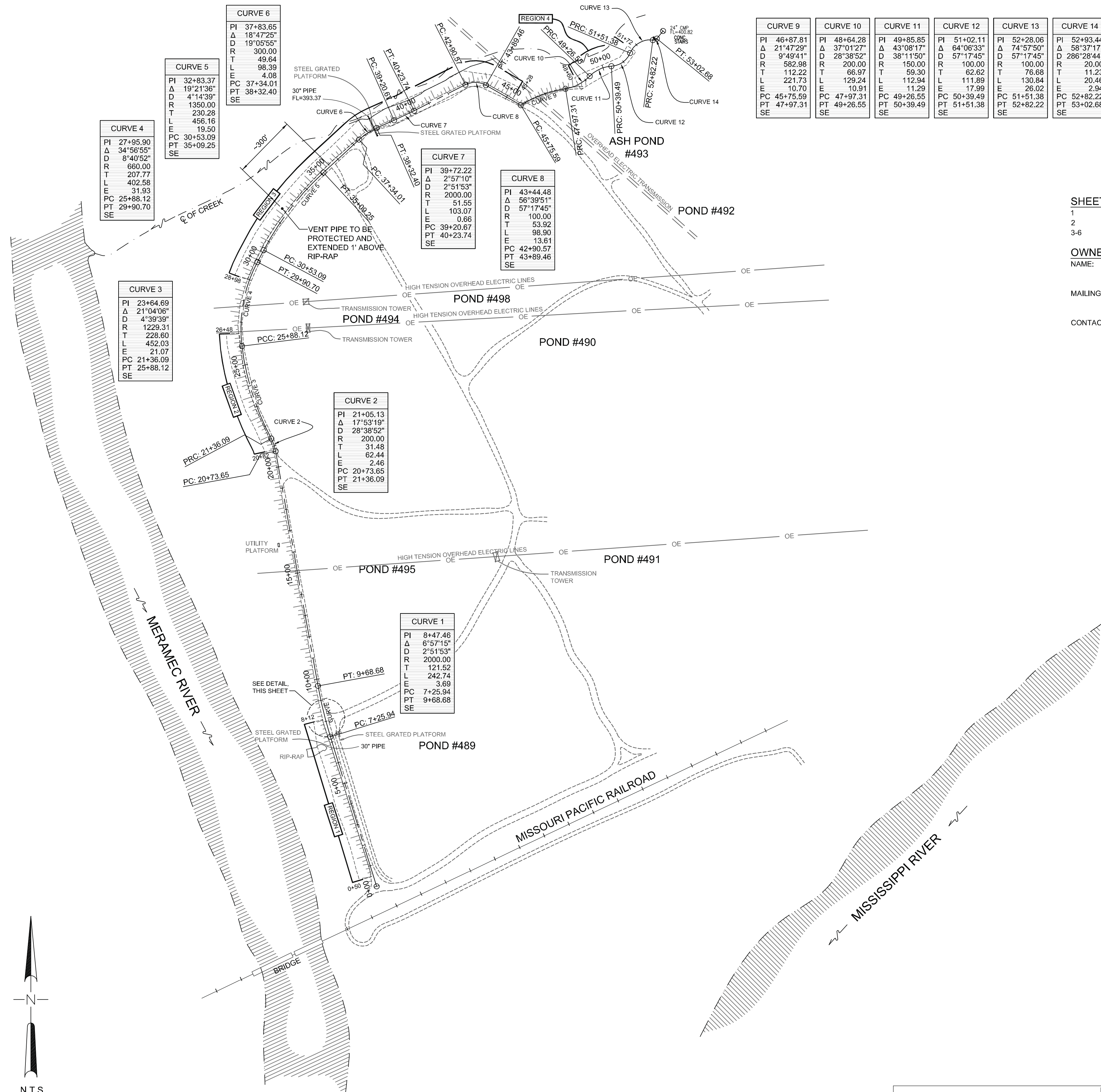
THE SEAL OF THE UNDERSIGNED PROFESSIONAL ENGINEER PERTAINS ONLY TO THE GEOTECHNICAL ENGINEERING OF THE ROADBED CROSS-SECTION IN ACCORDANCE WITH REITZ & JENS' SCOPE OF SERVICES. PURSUANT TO RS. MO 327.411, REITZ & JENS, INC. AND THE UNDERSIGNED ASSUME NO RESPONSIBILITY FOR SERVICES PROVIDED BY OTHERS. CONSTRUCTION MEANS AND METHODS AND JOB SITE SAFETY FOR IMPLEMENTATION OF THE PLANS SHALL BE THE SOLE RESPONSIBILITY OF THE CONTRACTOR.
JEFFREY L. FOUSE, P.E.
MISSOURI E-21043
REITZ & JENS, INC.
Consulting Engineers
DESIGN NINE, INC.
ENGINEERING SERVICES FOR RAILROADS AND INDUSTRY
ST. LOUIS, MO
PREPARED FOR
DRAWN SPH
CHKD. WJF
SUPV.
APPD. GTH
PROPOSED RAILROAD TRACKAGE
AT
MERAMEC POWER PLANT
ST. LOUIS, MISSOURI
LOCATION 001005
CROSS SECTIONS
FROM STA. 39+00 TO STA. 47+00
CLASS 02010
ST. LOUIS, MISSOURI
DRAWING NO.
8030-Y-149118
REV.
0

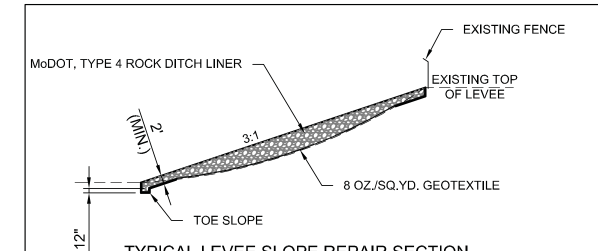
Figure 11


PRO. LOOP TRK.
ORIG EL =403.1
DES SUBB =415.4
ORIG EL =404.1
DES SUBB =415.4
ORIG EL =404.8
DES SUBB =415.4
ORIG EL =407.2
DES SUBB =415.4
ORIG EL =414.0
DES SUBB =415.4
ORIG EL =400.0
DES SUBB =416.2
ORIG EL =409.1
DES SUBB =416.0
ORIG EL =403.5
DES SUBB =415.7
ORIG EL =403.4
DES SUBB =415.5
STA. 54+80+/- END POND FILL
PRO. TOP/NON ASH FILL
PRO. TOP/SUBBALLAST (TYP.)
PRO. TOP/SHOT ROCK (TYP.)
EXIST. SURFACE (TYP.)
PRO. TOP ELEV.= 415.20
EXIST. NATURAL GROUND (TYP.)
ENTRANCE ROAD
WATER LEVEL (TYP.)
APPROX. BOTTOM OF POND (TYP.)
EXIST. HEADWALL (TO BE REMOVED)
PRO. FL ELEV.= 405.20
PRO. MANHOLE RISER STRUCTURE 14.5' FROM CL TRK.
(SEE DRAWING NO. 8030-Y-149105 FOR DETAILS)
FIRST ISSUE: 3/27/00
NOTICE OF LIMITED RESPONSIBILITY
REITZ & JENS, INC.
Consulting Engineers
DESIGN NINE, INC.
PREPARED FOR
PROPOSED RAILROAD TRACKAGE AT MERAMEC POWER PLANT ST. LOUIS, MISSOURI
CROSS SECTIONS FROM STA. 47+89.60 TO STA. 56+00
ST. LOUIS, MISSOURI
DRAWING NO. 8030-Y-149119



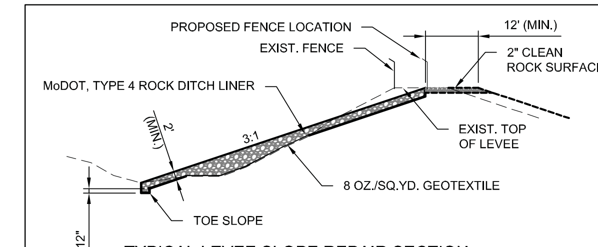
	CURVE 1	CURVE 2	CURVE 3	CURVE 4	CURVE 5	CURVE 6	CURVE 7
PI	8+47.46	21+05.13	23+64.69	27+95.90	32+83.37	37+83.65	39+72.22
Δ	6°57'15"	17°53'19"	21°04'06"	34°56'55"	19°21'36"	18°47'25"	2°57'10"
D	2°51'53"	28°38'52"	4°39'39"	8°40'52"	4°14'39"	19°05'55"	2°51'53"
R	2000.00	200.00	1229.31	660.00	1350.00	300.00	2000.00
T	121.52	31.48	228.60	207.77	230.28	49.64	51.55
L	242.74	62.44	452.03	402.58	456.16	98.39	103.07
E	3.69	2.46	21.07	31.93	19.50	4.08	0.66
PC	7+25.94	20+73.65	21+36.09	25+88.12	30+53.09	37+34.01	39+20.67
PT	9+68.68	21+36.09	25+88.12	29+90.70	35+09.25	38+32.40	40+23.74
SE							

	CURVE 8	CURVE 9	CURVE 10	CURVE 11	CURVE 12	CURVE 13	CURVE 14
PI	43+44.48	46+87.81	48+64.28	49+85.85	51+02.11	52+28.06	52+93.44
Δ	56°39'51"	21°47'29"	37°01'27"	43°08'17"	64°06'33"	74°57'50"	58°37'17"
D	57°17'45"	9°49'41"	28°38'52"	38°11'50"	57°17'45"	57°17'45"	286°28'44"
R	100.00	582.98	200.00	150.00	100.00	100.00	20.00
T	53.92	112.22	66.97	59.30	62.62	76.68	11.23
L	98.90	221.73	129.24	112.94	111.89	130.84	20.46
E	13.61	10.70	10.91	11.29	17.99	26.02	2.94
PC	42+90.57	45+75.59	47+97.31	49+26.55	50+39.49	51+51.38	52+82.22
PT	43+89.46	47+97.31	49+26.55	50+39.49	51+51.38	52+82.22	53+02.68
SE							



TYPICAL LEVEE SLOPE REPAIR SECTION

STA. 0+50.00 TO STA. 8+12.00
STA. 20+82.00 TO STA. 26+48.00
STA. 28+98 TO STA. 36+00.00



TYPICAL LEVEE SLOPE REPAIR SECTION

STA. 36+00.00 TO STA. 45+28.00
STA. 48+60.00 TO STA. 51+72.00

SHEET INDEX:

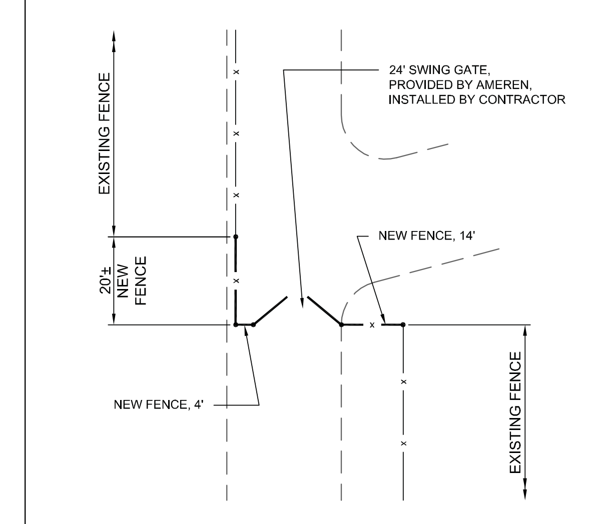
1	SITE PLAN
2	EXISTING TOPOGRAPHY
3-6	CROSS SECTIONS

OWNER:

NAME:
UNION ELECTRIC COMPANY
D/B/A AMEREN MISSOURI

MAILING ADDRESS:
3700 S. LINDBERGH BLVD, F-604
ST. LOUIS, MO. 63127

CONTACT:
MR. GENE CAMPBELL
(314) 304-6432



PLAN DETAIL @ 8+12±

TOP OF LEVEE

NOTE:
THE RECORD DRAWINGS HAVE BEEN PREPARED FROM AMEREN SUPPLIED REDLINES, KDG WAS NOT ON SITE DURING CONSTRUCTION AND HAS NOT SURVEYED THE SITE AFTER CONSTRUCTION

NOTICE OF LIMITED RESPONSIBILITY

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RECORD DRAWING

MARK UP DRAWING NO.	REV.
SHEET NO. 001	

REV.	DATE	PROJECT NO.	AMEREN SUPV ENGR	DRAFTING DRFTR	DRAFTING CHK'D	DRAFTING SUPV	ENGR APPROVAL AMEREN	ENGR APPROVAL OTHER	DESCRIPTION

DRAWING RECORD

KdG PROJECT NO. 110045-0002

SCALE N.T.S.

UNIT NO.

DWG. SIZE 24X36

SUB CLASS

SITE PLAN

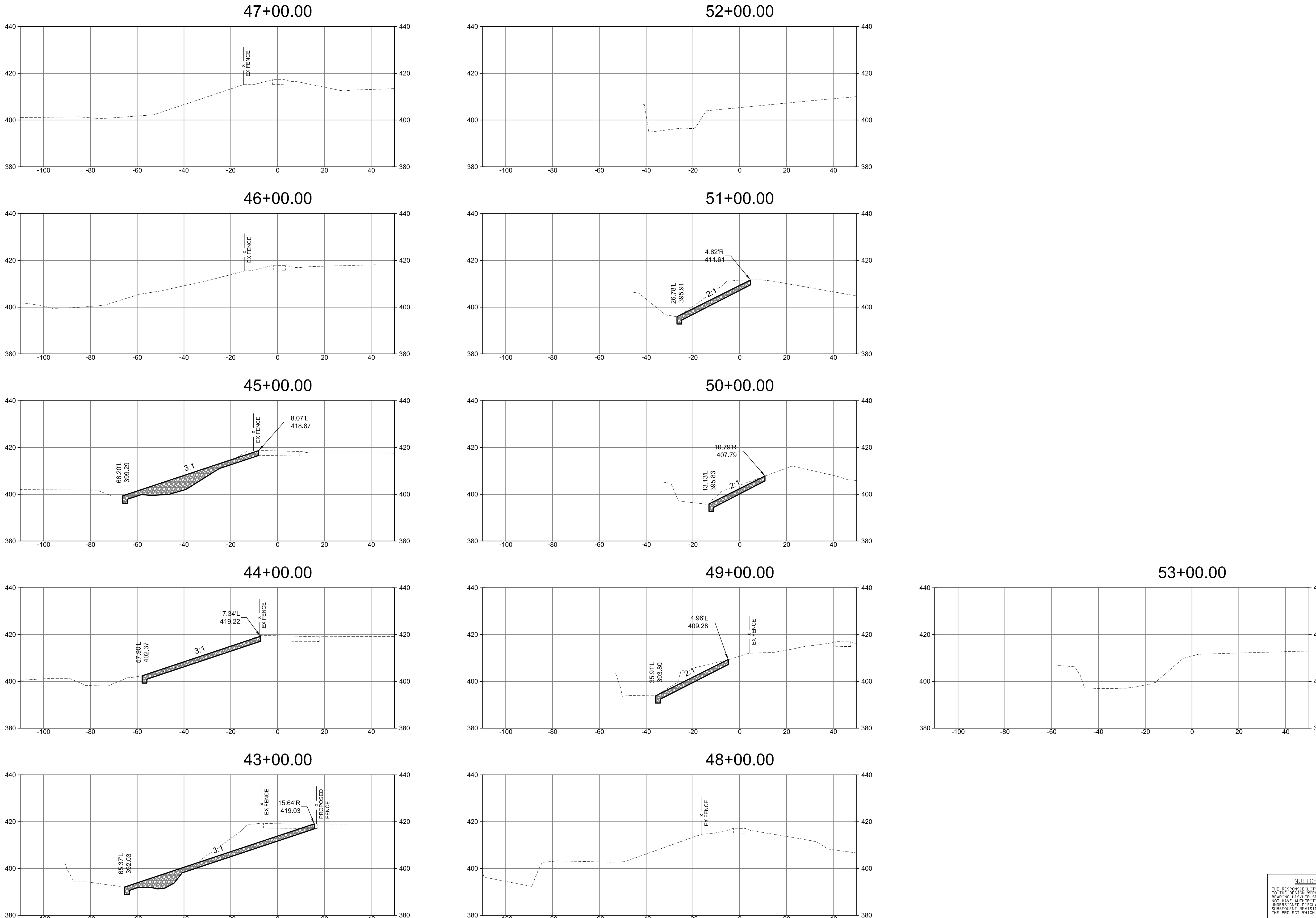
SITE: MERAMEC

Ameren MISSOURI

DRAWING NO.	REV.
MR-DWG-PROP-000001	
SHEET NO. 001	

DRAWING NO. REV.
MR-DWG-PROP-000001
SHEET NO. 001

Figure 13



NOTE:
THE RECORD DRAWINGS HAVE BEEN PREPARED FROM AMEREN SUPPLIED REDLINES, KDG WAS NOT ON SITE DURING CONSTRUCTION AND HAS NOT SURVEYED THE SITE AFTER CONSTRUCTION

NOTICE OF LIMITED RESPONSIBILITY

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RECORD DRAWING

MARK UP DRAWING NO. | REV.

SHEET NO. 006

DRAWING RECORD									
REV.	DATE	PROJECT NO.	AMEREN SUPV ENGR	DRAFTING DRFTR	DRAFTING CHK'D	DRAFTING SUPV	ENGR APPROVAL AMEREN	ENGR APPROVAL OTHER	DESCRIPTION

KdG PROJECT NO. 110045-0002

SCALE 1" = 20'

CROSS SECTIONS

UNIT NO.

SITE: MERAMEC

DWG. SIZE 24X36

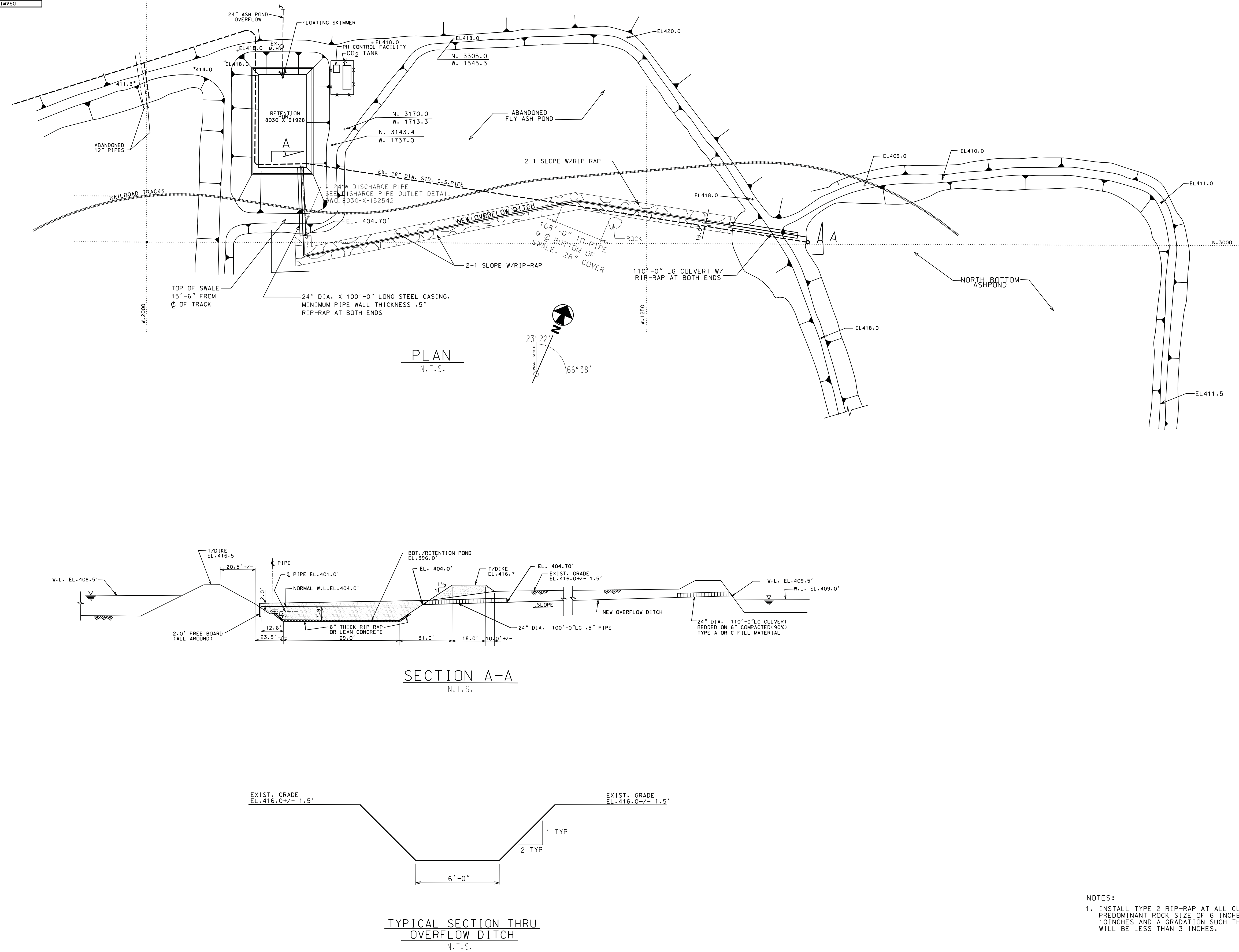
SUB CLASS

Ameren MISSOURI

DRAWING NO. MR-DWG-PROP-000001 | REV.

SHEET NO. 006

Figure 14



NOTES:

1. INSTALL TYPE 2 RIP-RAP AT ALL CULVERTS AND CASING ENDS. PREDOMINANT ROCK SIZE OF 6 INCHES. MAXIMUM ROCK SIZE OF 10INCHES AND A GRADATION SUCH THAT NO MORE THAN 15% WILL BE LESS THAN 3 INCHES.

NOTICE OF LIMITED RESPONSIBILITY

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AS BUILT

MARK UP DRAWING NO.	REV.
------------------	---
SHEET NO. ---	

DRAWING RECORD

REV.	DATE	PROJECT NO.	AMEREN SUPV ENGR	DRAFTING DRFTR	DRAFTING CHK'D	DRAFTING SUPV	ENGR APPROVAL AMEREN	ENGR APPROVAL OTHER	DESCRIPTION
000	08-28-12	J017N	–	MSB	MSB	KAJ	MRB	–	FIRST ISSUE PER MR-2012-MDM-0011 & JR109893
001	10-04-12	J017N		MSB	MSB	KAJ			REMOVED 24" PIPE/REPLACED WITH OVERFLOW DRAINAGE DITCH AND CULVERTS MR-2012-WO-DOCREQ-0033 JR109893
002	05-08-13	J017N		DLF	RBM	KAJ	RBM		AS BUILT PER JR109893; INSTALL NEW OVERFLOW DITCH

SCALE 1"=100'

UNIT NO. –

DWG. SIZE 34X44

SUB CLASS –

PIPING PLAN & DETAILS
ASH POND OVERFLOW DRAIN
TO RETENTION POND

SITE: MERAMEC ENERGY CENTER

Ameren MISSOURI

DRAWING NO.	REV.
MR-DWG-PIPE-000021	002
SHEET NO. 001	

Figure 15

Prepared for Ameren Missouri

Benchmark Information:
Vertical Datum: Meramec Plant Datum
Project Benchmark: Benchmark # 222
Description: Iron Pin Elevation: 417.95
See drawing AM15257 drawing01 submitted 9-2-2015 of "Meramec Engergy Center Retention Pond"

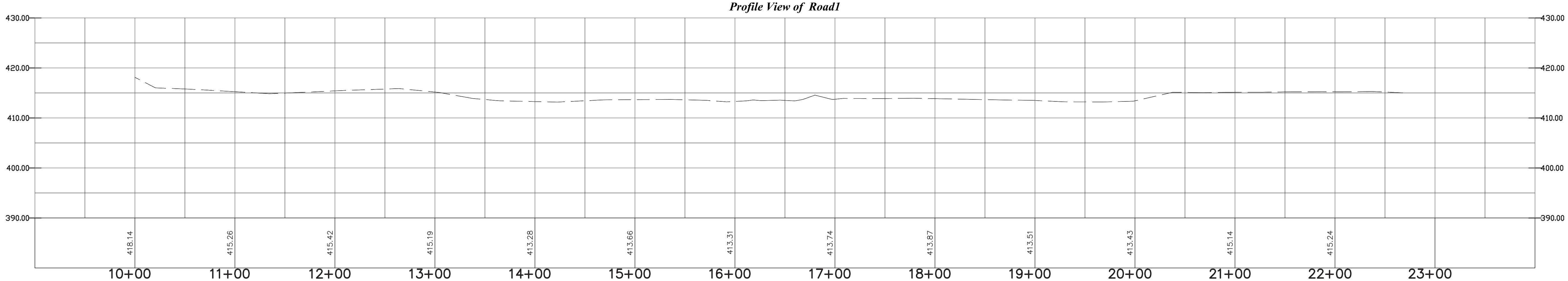
No single benchmark or elevation as shown hereon is intended for use independently without checking to or with other benchmarks or elevations. Please report any discrepancy to Zahner & Associates, Inc.

Grid North

50 0 50 100 150

GRAPHIC SCALE - FEET
SCALE: 1" = 50'

Profile View of Road1



HORIZONTAL SCALE: 1" = 50'
VERTICAL SCALE: 1' = 10'

Zahner & Associates, Inc.
Professional Land Surveyors
Michael D. Zahner, LS2294
200 Zahner Place
Perryville, MO 63775
(573) 547-1771
zahner@zahnerinc.com
Missouri Corporation Certificate of Authority No. 00355290

Date	By	Notes
09/29/2015	JW	Initial Release

Prepared for: Ameren Missouri
Being part of the Ameren Meramec Energy Center

Job No.: AM15257
File No.: AM15257 Ameren Meramec Energy Center Ret. Pond
Drawn By: JW
Reviewed By: MZ
Horiz. & Vert. Datum: Mo SPC E Modified to Plant system
Vert. Datum: Plant system

Ameren Missouri: Meramec Energy Center
POND 493
AREA-CAPACITY CURVE

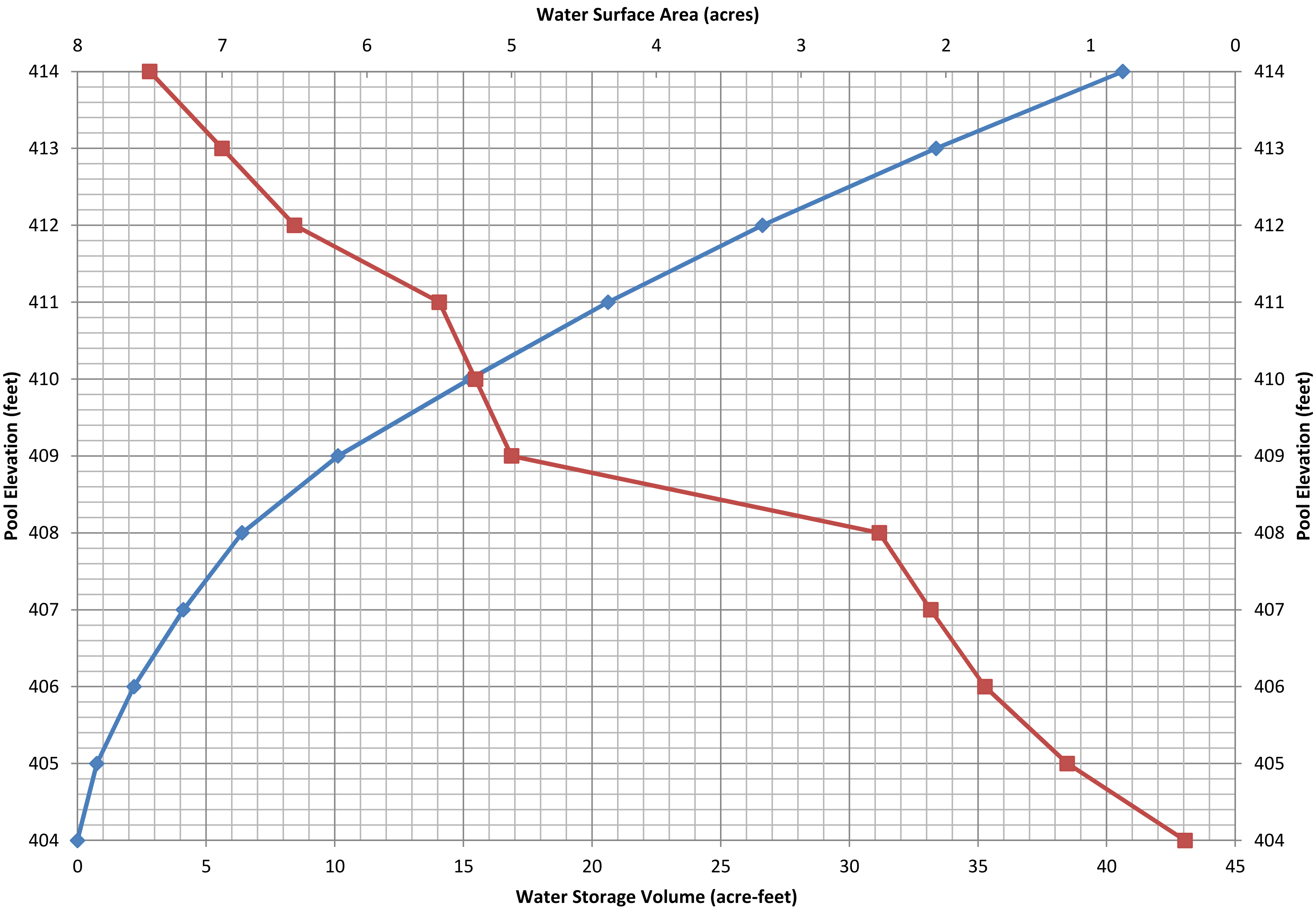


Figure 16

Ameren Missouri: Meramec Energy Center
POND 492 & 496
AREA-CAPACITY CURVE

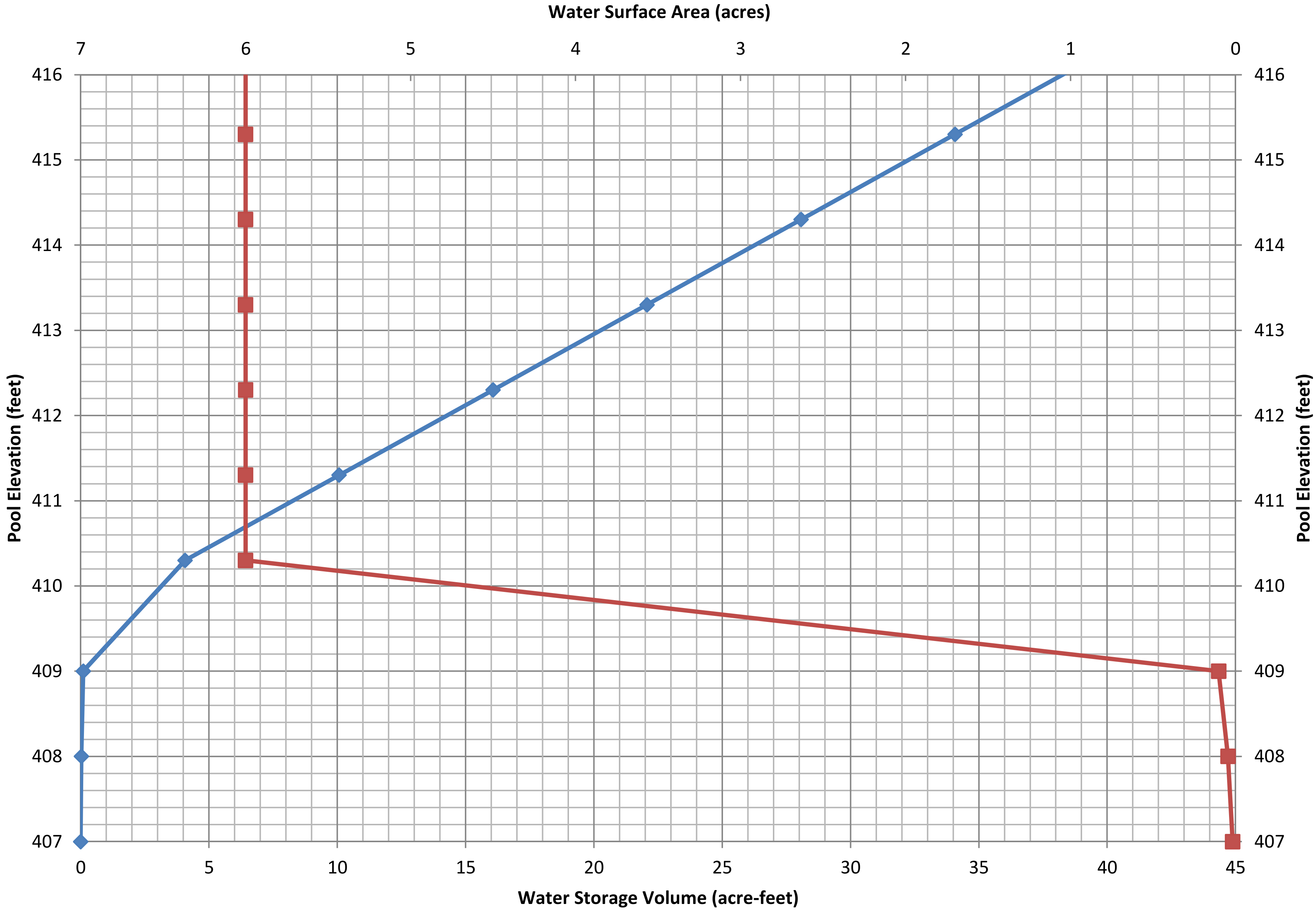
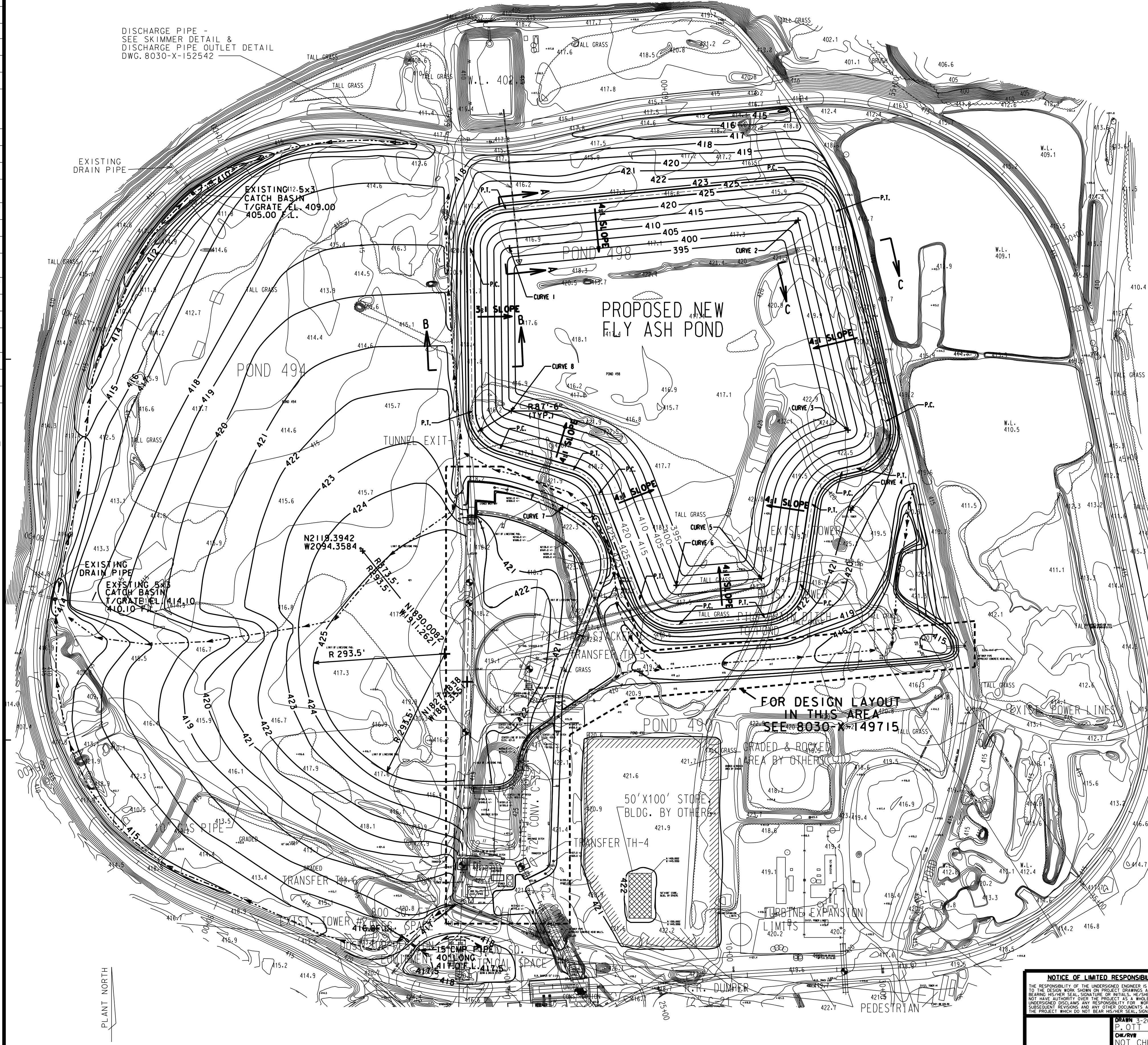


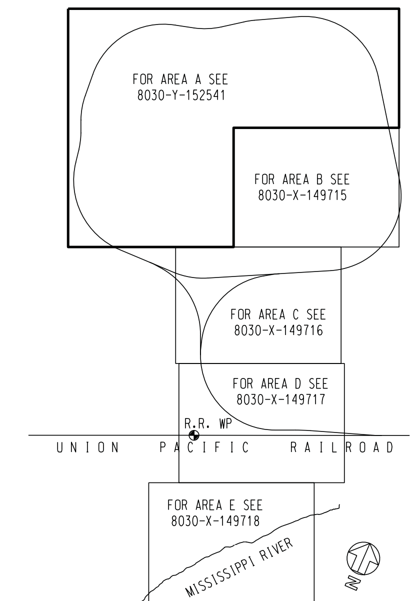
Figure 17

Figure 18

REVISIONS		
REV.	W.O.	
0	10775	
FIRST ISSUE		
REV 1	DATE 032001	DRAWN PDO
CHKD NOT	SUPV SAH	APPD
W.O. 10775		FILM
ADDED COORDINATES AND RADIUS FOR NEW COAL PILE; SHOWED EXISTING CATCH BASINS		
REV 2	DATE 040201	DRAWN MLE
CHKD NOT	SUPV SAH	APPD
W.O. 10775		FILM
REVISED CONTOURS PER ENGINEERING COMMENTS		
REV 3	DATE 041701	DRAWN MGL
CHKD NOT	SUPV SAH	APPD
W.O. 10775		FILM
REVISED CONTOURS PER ENGINEERING COMMENTS		
REV 4	DATE 042001	DRAWN MGL
CHKD NOT	SUPV SAH	APPD
W.O. 10775		FILM
REVISED CONTOURS PER ENGINEERING COMMENTS		
REV 5	DATE 051501	DRAWN DAG
CHKD	SUPV	APPD
W.O. 10775		FILM
REVISED CONTOURS PER ENGINEERING COMMENTS; ADD DISCHARGE PIPE FROM FLY ASH POND TO RETENTION BASIN & TABLE		



GRADING PLAN



AREA KEY PLAN

TOTAL CUT 220,000yd^3
TOTAL FILL 221,800yd^3

TABLE

CURVE NO.	RADIUS	CENTER	(P.C.) POINT OF CURVATURE	(P.T.) POINT OF TANGENCY
1	87'-6"	N2795.9654 W1766.7163	N2794.9985 W1854.2110	N2883.0642 W1775.0847
2	87'-6"	N2857.8626 W1122.4817	N2944.9616 W1130.8501	N2878.1002 W1037.3542
3	87'-6"	N2389.1821 W1011.0613	N2409.4196 W925.9338	N2303.9035 W991.4702
4	87'-6"	N2211.0398 W1004.8965	N2296.3184 W1024.4876	N2223.8795 W1091.4493
5	87'-6"	N2058.1369 W1204.4941	N2045.2973 W1117.9412	N1970.9244 W1197.4075
6	87'-6"	N2042.6838 W1394.6702	N1955.4713 W1387.5836	N2011.3974 W1476.3856
7	87'-6"	N2216.2748 W1648.5213	N2247.5612 W1566.8058	N2300.2443 W1623.9170
8	87'-6"	N2432.0871 W1762.6952	N2348.1176 W1787.2994	N2431.1202 W1850.1898

REFERENCE DRAWINGS:
FOR SECTION CUTS AND TYPICAL SECTIONS SEE 8030-Y-152542
FOR ADDITIONAL DESIGN LAYOUTS SEE 8030-X-149714 & 8030-X-149715

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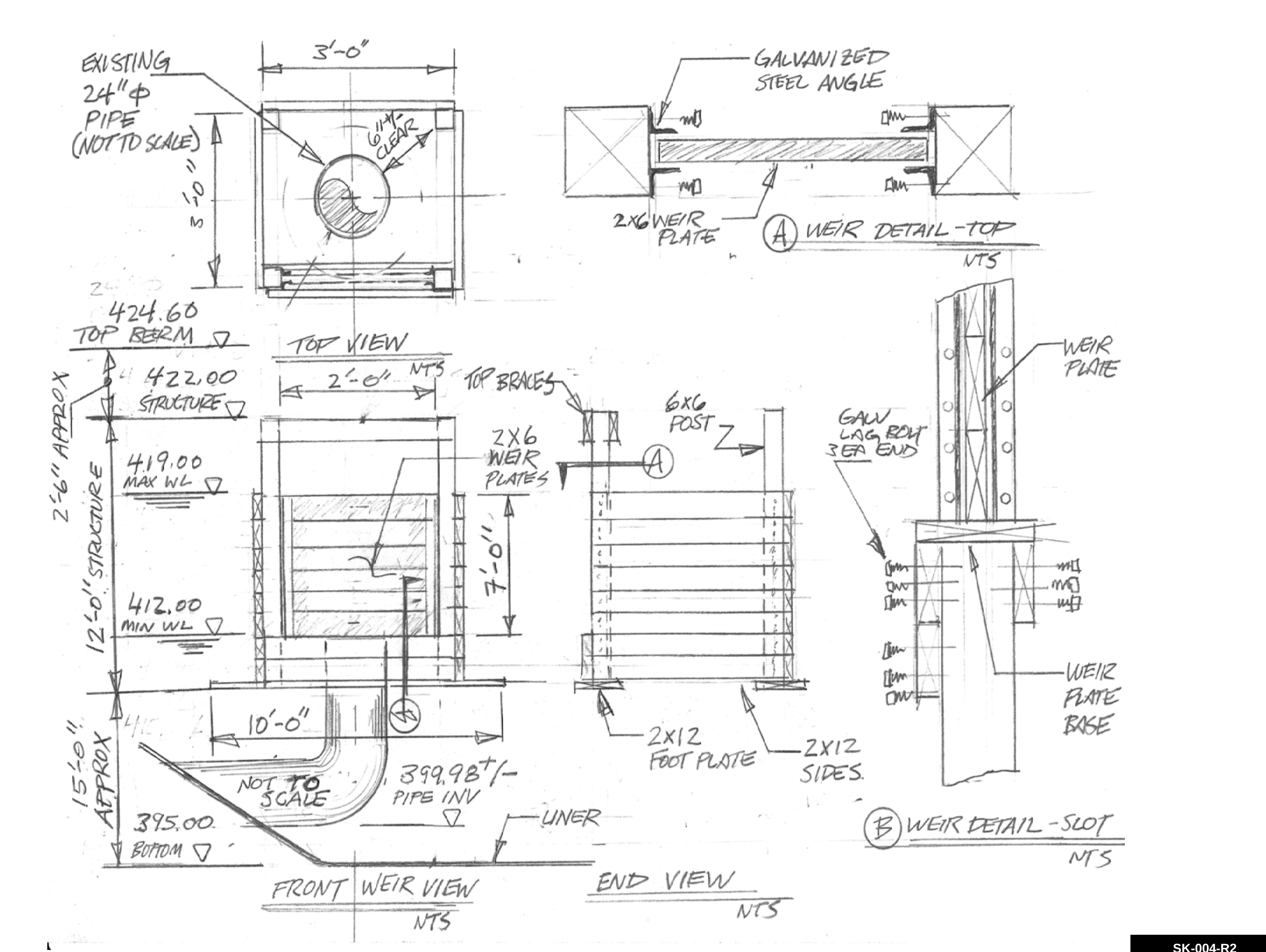
PREPARED FOR AmerenUE

DRAWN 3-20-01 P. OTT	PROPERTY - SITE PLAN AREA A NEW ASH POND AND GRADING OVER PONDS 490, 494 & 498
CHK/RVW NOT CHKD	
SUPV. 3-20-01 SAH	
APPD.	
LOCATION 001005	MERAMEC PLANT — CLASS 02010
Ameren — ST. LOUIS, MISSOURI	8030-Y-152541 — REV. 5

SCALE RATIO =100
THIS DRAWING HAS BEEN REFERENCED TO (FILES):
GHOST ALL BUT 100

04-11-2011 12:34:18

Figure 19



SK-004-R2

00	21-Oct-11	Release for AMS review
01	21-Oct-11	Release for Ameren review
02	07-Nov-11	Revised

Meramec Power Station
8200 Fine Road
St. Louis, Missouri 63129

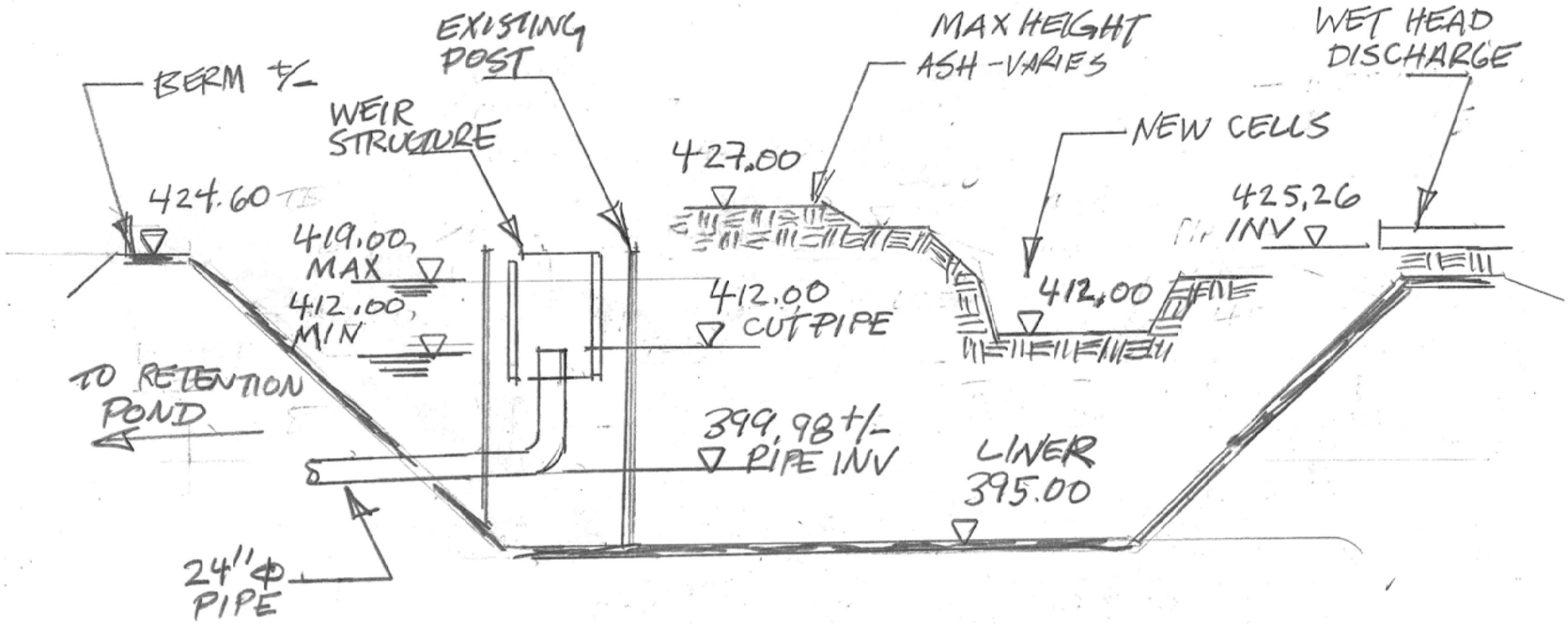
AMS
Ash Management Services

Pond No. 498
Outfall weir structure

SK-004-R2

Figure 19

Figure 20



00	21-Oct-11	Release for AMS review
01	21-Oct-11	Release for Ameren review
02	07-Nov-11	Revised

Meramec Power Station
8200 Fine Road
St. Louis, Missouri 63129

Ash Management Services

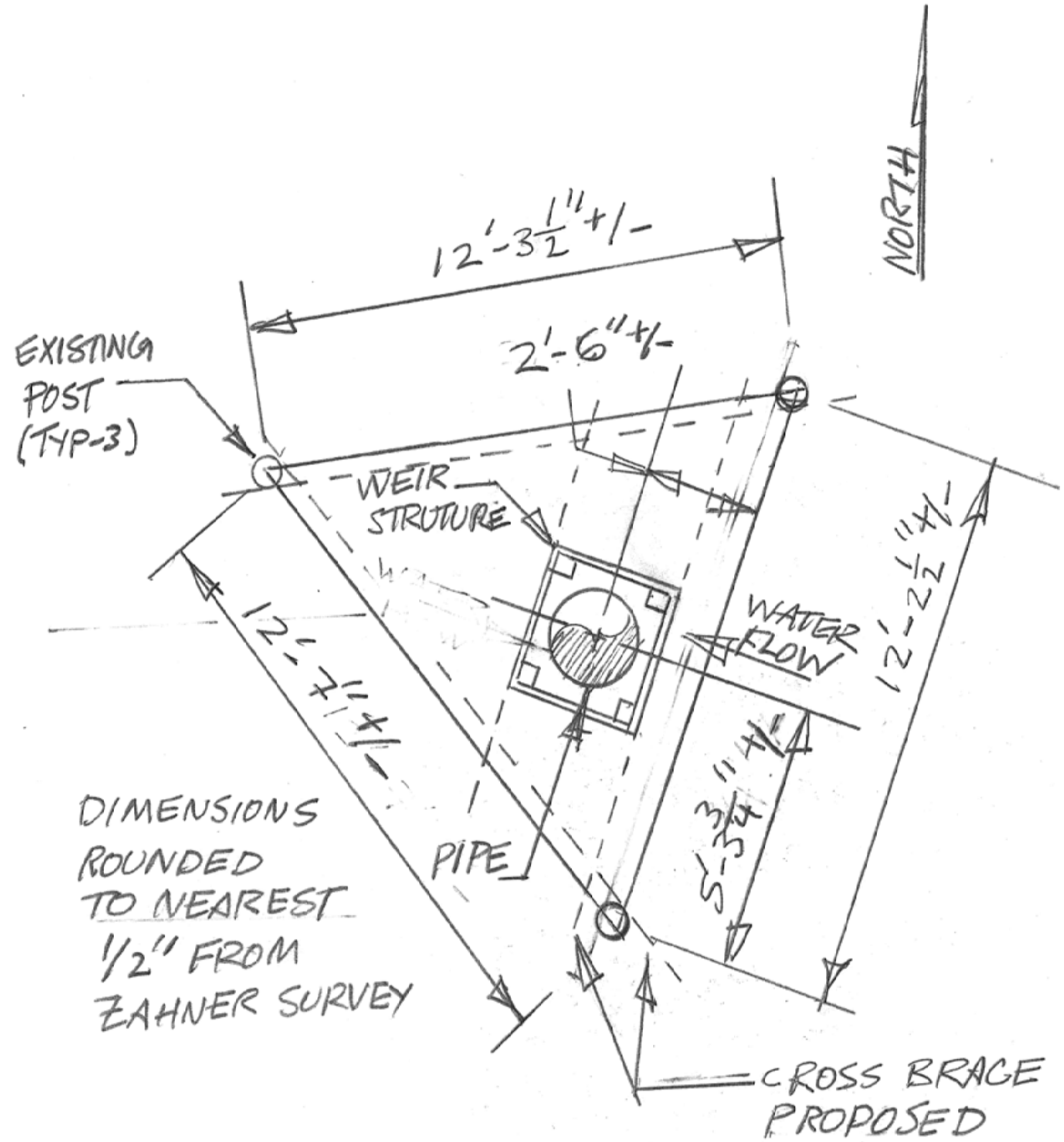
Ash Pond No. 498
Hydraulic profile

SK-005-R2

Figure 20

Figure 21

NOTES:



00 07-Nov-11 Release for AMS review

Meramec Power Station
8200 Fine Road
St. Louis, Missouri 63129

AMS
Ash Management Services

Ash Pond No. 498
Weir layout plan view

SK-006-R0

SK-006-R0

Figure 21

APPENDIX A

OPERATIONS AND MAINTENANCE MANUAL
POND 498 GEOTECHNICAL BORINGS
RAILROAD LOOP GEOTECHNICAL INVESTIGATION REPORT
BOTTOM ASH CLOSURE GEOTECHNICAL BORINGS

OPERATION AND MAINTENANCE MANUAL

MERAMEC ASH POND EMBANKMENT
ST LOUIS, MISSOURI
ST. LOUIS COUNTY

MAY 23, 2011

DAM SAFETY & HYDRO ENGINEERING
3700 S. LINDBERGH BLVD
ST. LOUIS, MO 63127

OPERATION AND MAINTENANCE PLAN
MERAMEC ASH POND EMBANKMENT
ST. LOUIS COUNTY, MO

TABLE OF CONTENTS

SECTION 1

GENERAL

This operation and maintenance plan, (hereafter referred to as the O&M Manual), outlines objectives, proposed policies, responsibilities, and procedures for Ameren personnel who are responsible for the management of the Meramec Ash Pond Embankment.

REASONS FOR DEVELOPMENT AND DISSEMINATION OF THE O&M MANUAL

As an ash pond embankment owner, Ameren is responsible for the safety of the public and for maintaining the structures within the Ameren's jurisdiction for both safety and economy. The overall public interest is served by providing a document to serve as a basis for the safe and economical operation and maintenance of the ash pond embankment during both emergency and day-to-day conditions.

GENERAL RESPONSIBILITIES CONCERNING ASH POND EMBANKMENTS

Shift Supervisor

Contacts local agencies when emergency conditions exist at the Meramec Ash Pond Embankment.

Plant Engineer

Ensures operation and maintenance program is being implemented as outlined in this document. Ensures performance of weekly inspections. Performs annual assessment of the Operation and Maintenance Manual.

Chief Dam Safety Engineer

Reviews all updates to the Operation and Maintenance Manual.

Dam Safety Group

Performs annual ash pond embankment inspection with Plant Engineer.

SECTION 2

DEFINITIONS

Abutment - That part of the valley side or concrete walls against which the dam is constructed. Right and left abutments are those on respective sides of an observer when viewed looking downstream.

Appurtenant Works - The structures or machinery auxiliary to dams that are built to operate and maintain dams; such as outlet works, spillways, gates, valves, channels, etc.

Auxiliary Spillway - A spillway that works in conjunction with the principal spillway to control flood flows and is constructed of non-erodible materials.

Boil - A stream of water discharging from the ground surface downstream of the dam carrying with it a volume of soil that is distributed around the hole formed by the discharging water.

Berm - A horizontal step or bench in the sloping profile of an embankment dam.

Breach - A break, gap, or opening (failure) in a dam that releases impoundment water.

Concrete Block - An erosion protection method using interlocking concrete blocks, usually with openings that are filled with soil and grass.

Core - A zone of material of low permeability in an earthen dam.

Dam - A barrier built for impounding or diverting the flow of water.

Dike (Levee) - An embankment or structure built alongside a river to prevent high water from flooding bordering land.

Drain, Layer or Blanket - A layer of pervious material in a dam to facilitate the drainage of the embankment, including such items as a toe drain, a weep hole, and a chimney drain.

Drawdown - The resultant lowering of water surface level due to the controlled release of water from the impoundment.

Embankment - Fill material, usually earth or rock, placed with sloping sides.

Emergency Spillway - A spillway designed to operate very infrequently, only during exceptionally large floods, usually constructed of materials expected to erode slowly.

Earthen Dam - Any dam constructed of excavated natural materials.

Emergency Action Plan - A predetermined plan of action to be taken to reduce the potential for property damage and loss of lives.

Failure - An incident resulting in the uncontrolled release of water from a dam.

Freeboard - The vertical distance between a stated water level and the top of a dam.

Gate or Valve - In general, a device in which a leaf or member is moved across the waterway to control or stop the flow.

Groin - The junction of the upstream or downstream face of the dam with the valley wall.

Maintenance - The upkeep, involving labor and materials, necessary for efficient operation of dams and their appurtenant works.

Operation - The administration, management, and performance needed to operate the dam and appurtenant works.

Operation and Maintenance Inspection - Inspections conducted by the Plant Engineer. These inspections are frequent visual inspections of the dam surface and appurtenant works.

Outlet - An opening through which water can freely discharge for a particular purpose from an impoundment.

Phreatic Surface - The upper surface of saturation in an embankment.

Piping - The progressive development of internal erosion by seepage, appearing downstream as a hole or seam, discharging water that contains soil particles.

Principal Spillway - The main spillway that controls both normal and flood flows and is constructed of non-erodible materials.

Riprap - A layer of large stones, broken rock or precast blocks placed in a random fashion, usually on the upstream slope of an embankment dam, on a reservoir shore, or on the sides of a channel as a protection against current, wave and ice action.

Silt/Sediment - Soil particles and debris in an impoundment.

Slump/Slide Area - A portion of earth embankment that moves downslope, sometimes suddenly, often with cracks developing.

Spillway System - A structure or structures over or through which flows are discharged. If the flow is controlled by gates, it is considered a controlled spillway. If the elevation of the spillway crest is the only control of the flows, it is considered an uncontrolled spillway.

Stilling Basin - A basin constructed to dissipate the energy of fast flowing water, such as from a spillway, and to protect the stream bed from erosion.

Toe of Embankment - The junction of the face of the dam with the ground surface in the floodplain upstream or downstream of the dam.

Trash Rack - A structure of metal or concrete bars located in the waterway at an intake to prevent the entry of floating or submerged debris.

SECTION 3

INFORMATION ABOUT THE ASH POND EMBANKMENT

LOCATION

The Meramec Power Plant (Meramec Energy Center) is located at the southern most point in St. Louis County, Missouri near the confluence of the Meramec and Mississippi Rivers. The plant is located south of the City of Oakville and east of the City of Arnold. The Meramec River is adjacent to the plant on the west. To the east is the Mississippi River. The confluence of these two rivers is directly south of the plant. To the north of the plant is a small creek, wooded uplands and Meramec River floodplain. The ash pond embankment is located adjacent to the Mississippi River in the southwest quarter of Section 3, Township 42 North, Range 6 East of the 5th Principal Meridian.

DESCRIPTION OF ASH POND EMBANKMENT AND APPURTENANCES

The Meramec Ash Pond Embankment is a single stage industrial ash pond embankment. The ash pond embankment impounds an area of approximately 138-acres for coal combustion ash sedimentation and water treatment purposes. The perimeter of the ash pond embankment has a length of approximately 6,400-lineal-feet (lf) and a maximum height of 24.7-ft. The ash pond embankment forms the perimeter of several smaller impoundments. These impoundments include the Retention Pond, Pond 489, Ponds 490-496, and Pond 498. Ponds 490, 491, 494, and 495 have been filled near capacity with coal combustion ash, and are now supporting plant equipment.

Pond 489

Pond 489 is located in the southwest corner of the plant, and is used for fly ash sedimentation, water treatment and chemical stabilization purposes. The upstream slopes are approximately 3 (H) to 1 (V) and the downstream slopes are approximately 1.9 (H) to 1 (V). The embankment height is approximately 24.5 feet. Pond 489 has an outfall to the Meramec River that consists of a drop inlet, two 36-in diameter butterfly valves and a 36-in diameter high-density polyethylene (HDPE) pipe. There are four 12-in diameter polyvinyl chloride (PVC) pipes that form an overflow in Pond 489 at elevation 417.5-ft that drains to Pond 495 and ultimately to the Retention Pond through a drainage channel that runs along the outside perimeter of the rail loop.

Retention Pond

The Retention Pond is along the north boundary of the plant and used for water clarification and chemical stabilization. The pond has a drop inlet outfall that discharges to the Meramec River through a 24-in diameter carbon steel pipe. One 24-in diameter butterfly valve is installed on this pipe. The embankment height in this section is approximately 24.7 feet.

Bottom Ash Pond

The Bottom Ash Pond (Pond 496, 492, and 493) is along the northeast boundary of the plant and is used for bottom ash sedimentation. The pond outfall discharges to the Retention Pond through a drop inlet and carbon steel pipe.

Pond 498

Pond 498 is also used for fly ash sedimentation. The pond is located just south of the Retention Pond and was built on top of Pond 498. The outfall for the Pond 498 is a drop inlet with a 24-in HDPE pipe that discharges to the Retention Pond.

HAZARD CLASSIFICATION

The Meramec Ash Pond Embankment is not currently subject to MDNR dam safety regulations. If regulations did apply, the Meramec Plant Ash Pond Embankment would be classified as a Class III, LOW HAZARD POTENTIAL, as defined by Missouri Department of Natural Resources (MDNR), because there are no dwellings downstream. In addition, there are no dams currently registered with MDNR directly influencing the Meramec Plant Ash Pond Embankment.

PURPOSE OF ASH POND EMBANKMENT

The perimeter ash pond embankment forms several individual ponds. The active reservoirs are used for coal combustion sedimentation storage.

PERTINENT DATA

Pertinent data about the ash pond embankment, appurtenant works, and reservoir is presented in Table 1.

TABLE 1
PROJECT DATA

Drainage Area	187-Acres
Ash Pond Embankment:	
Type	Earth Embankment
Elevation, Top of Embankment	Varies from 413.3 to 419.5
Height Above Streambed	Approximately 24.7 feet
Upstream Slope	Varies from 1.6 (H) to 3 (H) on 1 (V)
Downstream Slope	Varies from 1.7 (H) to 2.5 (H) on 1 (V)
Length	6,400 feet
Top Width	Varies
Minimum Freeboard Requirements	2.5 Feet

Pond 489:	
Elevation, Top of Embankment	419.5 feet
Elevation, Normal Pool	415.8 feet
Height Above Streambed	24.5 feet
Area, Normal Pool	17.6 acres
Freeboard, Normal Pool	3.7 feet
<u>*Outlet Works:*</u>	
Inlet Invert Elevation	406 feet
Outlet Invert Elevation	408.5 feet
<u>*Overflow:*</u>	
Type	Four polyvinyl Chloride (PVC) overflow pipes
Inlet Elevation	417.5 feet
Retention Pond:	
Elevation, Top of Embankment	414 feet
Elevation, Normal Pool	404 feet
Height Above Streambed	18 feet
Area, Normal Pool	0.7 acres
Freeboard, Normal Pool	10 feet
<u>*Outlet Works:*</u>	
Inlet Invert Elevation	403.6 feet
Outlet Invert Elevation	396.8 feet
Bottom Ash Pond	
Elevation, Top of Embankment	417.4
Elevation, Normal Pool	409.5 feet
Height Above Streambed	24.7 feet
Area, Normal Pool	14 acres
Freeboard, Normal Pool	7.9 feet
<u>*Outlet Works:*</u>	
Inlet Invert Elevation	412 feet (Estimated)
Pond 498:	
Elevation, Top of Embankment	423 feet
Elevation, Normal Pool	418 feet
Height Above Streambed	19.5 feet
Area, Normal Pool	13.5 acres
Freeboard, Normal Pool	5 feet
<u>*Outlet Works:*</u>	
Inlet Invert Elevation	420 feet

SECTION 4

OPERATION ACTIVITIES

NORMAL OPERATION

The Retention Pond receives indirect flow from pond 489 and discharge from the Bottom Ash Pond and Pond 498 outfalls. Indirect flow from Pond 489 flows through Pond 495 and portions of Pond 494 outside the rail loop in a channel which is inside of the west perimeter road and into the Retention Pond. The indirect flow from Pond 489 occurs when the pool elevation of Pond 489 exceeds 417.5-ft. Indirect flow from Pond 498 and Bottom Ash Pond is through a single orifice and occurs when the available storage in each pond is filled to capacity.

The Retention Pond outfall consists of one 24-in diameter Carbon Steel pipe which is upturned on the upstream end to an elevation of 403.6. The downstream invert elevation is 396.8-ft. One 24-in diameter motor operated butterfly valve is used to control flow through this pipe. The valve is programmed to operate in response to water quality measurements. The pH is constantly monitored. When the pH is within acceptable water quality tolerances the valve is opened and water is discharged. When the pH exceeds acceptable levels the valve is closed.

Pond 489 water level is regulated by an outfall that discharges into the Meramec River. The outfall is a drop inlet and consists of one 36-in diameter HDPE pipe which has an invert elevation of 406-ft into the upstream discharge structure. The discharge structure consists of a 10-ft diameter galvanized multi-plate corrugated metal pipe. On the downstream end, the 36-in diameter pipe is upturned to an elevation of 408.5-ft. Flow through the HDPE pipe is regulated by two 36-in diameter motor operated butterfly valves. The valve is programmed to operate in response to water quality measurements. The pH is constantly monitored. When the pH is within acceptable water quality tolerances the valve is opened and water is discharged. When the pH exceeds acceptable levels the valve is closed.

INSTRUMENTATION MONITORING DATA

There is a staff gage in the northwest portion of pond 489 to obtain pool elevations. The staff gage is checked weekly to ensure that the reservoir level is at or below the standard operating level of 415.8-feet.

TYPES OF ASH POND EMBANKMENT INSPECTIONS

Weekly visual inspections are conducted at the ash pond embankment by plant operations staff. The Ameren Missouri Dam Safety Group performs annual inspections with plant operations. In addition, the Ameren Missouri Dam Safety Group may conduct unannounced safety inspections. The following sections describe each type of inspection.

Pond water level elevations should be maintained in accordance with Table 1. At no time should the water levels be above the minimum required 2.5 foot freeboard.

Weekly Inspection:

Weekly inspections are conducted by plant staff or support staff familiar with the ponds/ ash pond embankment. The weekly inspection consists of visually inspecting the crest and slopes of the ash pond embankment to identify any new or changed conditions. Checklists are completed and are made available to the Dam Safety Group for review. A recommended inspection checklist for the weekly inspection is included in ***Appendix A.***

Annual Inspection:

These inspections are conducted annually by the plant staff and the Ameren Missouri Dam Safety Group staff. The annual inspection is a detailed visual inspection of the ash pond embankment crest, interior and exterior slopes, downstream toe area, inlet/outlet works, and appurtenant structures. A recommended inspection checklist for the annual inspection is included in ***Appendix A.***

Records: An inspection Report is to be prepared by the Ameren Missouri Dam Safety Group staff that includes a description of the observations of the visual inspection, photographs of the facilities taken during the inspection, and a written evaluation of the results. A record of activities occurring at the ash pond embankment is to be kept current by the Ameren Missouri Dam Safety Group.

Special Inspection:

These inspections are conducted when extreme events which may impact stability (seismic activity, severe flooding, etc.). Special inspections are similar to the annual inspection, but may be focused on a particular area. If conditions are discovered during a weekly or annual inspection which create concern for the plant or dam safety staff, a special inspection will be conducted. Responsibility for performance of special inspections will be evaluated based on severity of the event. A recommended inspection checklist for the special inspection is included in ***Appendix A.***

Unannounced Inspections:

The Ameren Missouri Chief Dam Safety Engineer (CDSE) may conduct unannounced inspections at the site as deemed appropriate. The inspection may include a visual inspection of the facility, a review of the inspection documentation, and interviews with plant personnel to review their understanding of the required inspection procedure.

The inspections checklists are to be completed and filed for each inspection. The checklists for each inspection are located in ***Appendix A.*** Condition codes are given to each item listed on the inspection checklist. The condition codes are defined below.

EC - Emergency Condition. A serious dam safety condition exists that needs immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work stoppage, plant stoppage.

Examples: Whirlpools, piping situation, embankment slough extending through half crest width, sinkhole in crest

IM - Item needing immediate maintenance to restore or ensure its safety or integrity. Remediation should be completed within 1 month.

Examples: Sinkhole on downstream slopes, gate of valve failure

MM - Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.

Examples: Crest rutting, rodent holes and animal burrows, tree growth on embankment slope, minor downstream embankment slough

OB - Condition requires regular observation to ensure that the condition does not become worse.

Examples: Minor seepage – No evidence of material movement

GC - Good Condition.

NE - No evidence of a problem.

NI - Not Inspected. Reason should be stated in comment.

SECTION 5

MAINTENANCE ACTIVITIES

Timely repairs are a must after problem areas have been identified. The Plant Engineer is to specify the work by generating a Job Request (JR) and provide direction to correct items noted in the operation and maintenance and engineering inspections. Prioritization of maintenance JR's should be reviewed with the Dam Safety Group to ensure proper emphasis has been placed on the JR. Such items include mowing, seeding, tree and brush removal, painting, replacing riprap, repairing fences and locks, clearing debris, etc. The maintenance activities specified in the following sections are minimum requirements. Maintenance activities should be documented. NOTE: NO alterations or repairs to structural elements should be made without the approval of the Chief Dam Safety Engineer.

Ash Pond Stacking: Ash may be temporarily stacked up to an elevation of 15 feet above the top levee elevation with the toe of the slope of the stacked ash 125 feet from the existing ash containment levee. The ash stack slope shall be a minimum 3 horizontal to 1 vertical. No perched water level above the crest of the perimeter embankment is permissible.

Debris: Remove all trash, logs and other debris that may obstruct flow from the outlet works.

Concrete Block and Rip Rap: Replace or level blocks and rip rap as needed to provide adequate protection against erosion.

Vegetation Control:

(1) A good grass cover on the embankment should be maintained by seeding, fertilizing and mulching areas that are refilled, barren, or thinly vegetated. Seeding mixtures used for maintenance reseeding shall result in cover compatible with adjacent cover.

(2) Grassed areas such as the embankment and areas beyond the embankment toe for a distance of approximately 20 feet should be mowed at least twice annually, where physically accessible.

(3) All eroded areas should be filled and compacted, reseeded, fertilized and mulched to establish a thick erosion resistant cover.

(4) All trees and brush on the ash pond embankment should be removed to prevent development of a root system that could provide seepage paths. Herbicides utilized for tree and brush control are discussed in ***Appendix B***.

(5) All brush and trees should be removed to a distance of approximately 20 feet beyond the toe of the ash pond embankment, where physically accessible.

Animal Damage: Rodent holes should be filled with compacted clay dirt and reseeded. If rodents become a nuisance, an effective rodent control program as approved by the Missouri Department of Natural Resources District Wildlife Biologist should be implemented.

Concrete: Spalled and cracked areas on concrete structures should be patched to guard against any further deterioration of the structure. Concrete construction joints should be filled with a suitable joint filler, such as a bituminous sealant, to protect against weathering.

Drains: All drains and weep holes should be kept open and functional by cleaning them of silt and debris.

Painting: All metal work, fencing, railing, etc. should be properly prepared and repainted as necessary to protect against rusting.

Signs: All warning signs and staff gages should be maintained (repaired, painted, or replaced) as needed.

Sedimentation: As sediment accumulates in the reservoir, less storage is available for the control of flood waters from the watershed. Efforts should be made to work with the U.S. Department of Agriculture, Natural Resources Conservation Service and the upstream land owners to minimize the sediment being transported to the reservoir. A location for the placement of the sediment removed from the reservoir (if upstream of the ash pond embankment, above the top of the ash pond embankment) should be determined.

SECTION 6

EMERGENCY CONDITIONS

If a condition arises where there is a possibility of ash pond embankment failure, the following plan will be put into effect (Refs. Meramec EIP MP-EIP-DAMINT-16 and MP-EIP-NOTIFY-17).

(1) The pond level will be lowered by the primary spillway, and closely monitoring the area for changes in conditions. If the primary spillway should become inoperable, supplemental pumps will be used to lower the level of the pond.

(2) The following agencies would be notified by Ameren concerning the status of the ash pond embankment. These agencies will inform the public as to what action would be taken. Ameren will do whatever possible to minimize damage at downstream locations.

A. St. Louis County Sheriff	314-889-2341
B. St. Louis County Emergency Management	314-628-5400
C. MDNR –Water Resources Center	573-751-2867
D. Army Corps of Engineers (St. Louis District)	314-331-8567
E. MDNR – Dam Safety	573-368-2175
F. Ameren Chief Dam Safety Engineer	314-210-4356

FIGURES

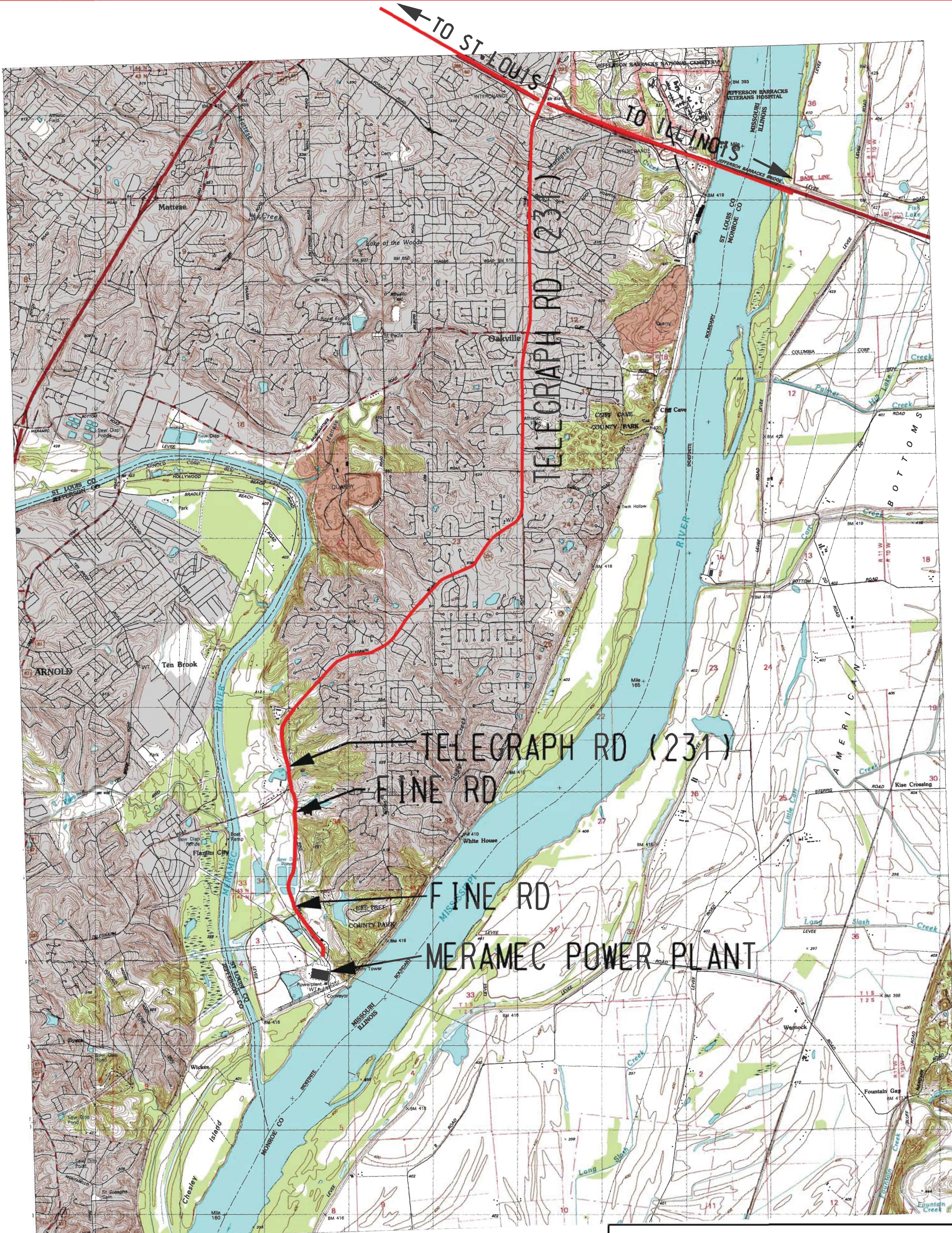


FIGURE-1
MERAMEC POWER PLANT
LOCATION MAP

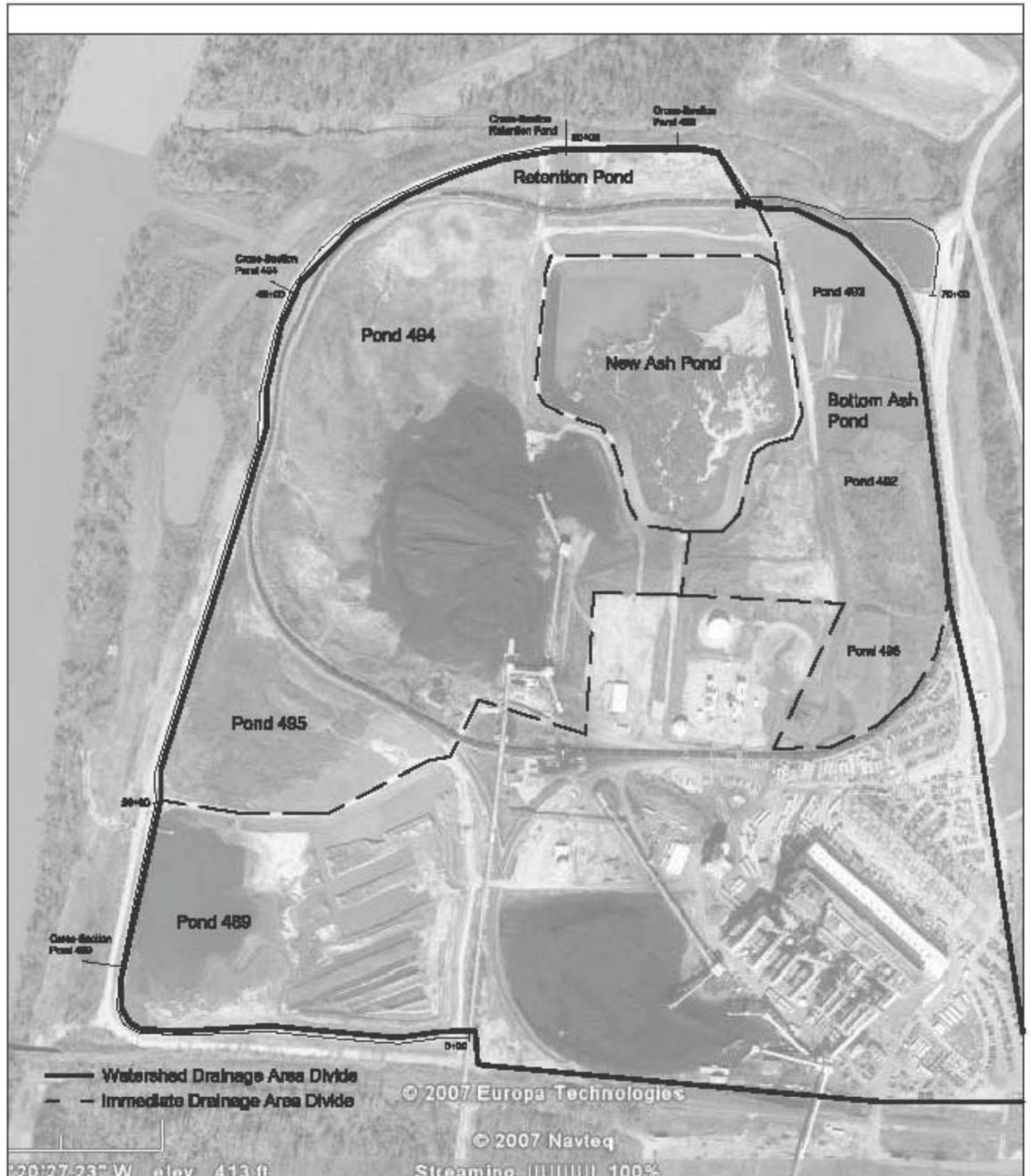


FIGURE 2
AERIAL PLAN
MERAMEC POWER PLANT

APPENDIX A

INSPECTION CHECKLISTS

Meramec Ash Impoundment

Weekly Inspection Checksheet

Date	
Inspector	
Lake Level	
Temperature	
Weather	

	Item	Condition Code *	Comments
Inlet / Outlet	Pond 489 Outfall Condition		
	Retention Pond Outfall Condition		
	Other		
Earth Embankment	Vertical & Horizontal Alignment of Crest		
	Seepage		
	Erosion		
	Vegetation		
	Unusual Movement or Cracking		
	New Fly Ash Pond Liner		
	Other		

Condition Codes

EC = Emergency Condition. A serious dam safety condition exists that needs immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work stoppage, plant stoppage.
IM = Item needing immediate maintenance to restore or ensure its safety or integrity. Remediation should be completed within 1 month.
MM = Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.
OB = Condition requires regular observation to ensure that the condition does not become worse.
GC = Good Codition.
NE = No evidence of a problem.
NI = Not Inspected. Reason should be stated in comment

New Fly Ash Pond
Annual Inspection Checksheet

Date	
Inspector	
Lake Level	
Temperature	
Weather	

	Item	Condition Code *	Comments
Inlet and Outlet	Obstruction		
	Inlet Piping Supports		
	Leakage		
	Outfall Pipe Condition		
	Outfall Valve		
	Other		
Earth Embankment	Vertical & Horizontal Alignment of Crest		
	Pond Liner		
	Seepage		
	Erosion		
	Fencing		
	Vegetation		
	Unusual Movement or Cracking At or Beyond Toe		
	Other		

Condition Codes

EC = Emergency Condition. A serious dam safety condition exists that needs immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work
IM = Item needing immediate maintenance to restore or ensure its safety or integrity. Remediation should be completed within 1 month.
MM = Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.
OB = Condition requires regular observation to ensure that the condition does not become worse.
GC = Good Codition.
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NI = Not Inspected. Reason should be stated in comment

Bottom Ash Ponds (492, 493, 496)
Annual Inspection Checksheet

Date	
Inspector	
Lake Level	
Temperature	
Weather	

	Item	Condition Code *	Comments
Inlet and Outlet	Obstruction		
	Inlet Piping Supports		
	Leakage		
	Outfall Pipe Condition		
	Outfall Valve		
	Other		
Earth Embankment	Vertical & Horizontal Alignment of Crest		
	Pond Liner		
	Seepage		
	Erosion		
	Fencing		
	Vegetation		
	Unusual Movement or Cracking At or Beyond Toe		
	Other		

Condition Codes

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IM = Item needing immediate maintenance to restore or ensure its safety or integrity. Remediation should
MM = Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is
OB = Condition requires regular observation to ensure that the condition does not become worse.
GC = Good Codition.
NE = No evidence of a problem.
NI = Not Inspected. Reason should be stated in comment

Pond 489

Annual Inspection Checksheet

Date	
Inspector	
Lake Level	
Temperature	
Weather	

	Item	Condition Code *	Comments
Inlet and Outlet	Obstruction		
	Inlet Piping Supports		
	Leakage		
	Outfall Pipe Condition		
	Outfall Valve		
	Other		
Earth Embankment	Vertical & Horizontal Alignment of Crest		
	Pond Liner		
	Seepage		
	Erosion		
	Fencing		
	Vegetation		
	Unusual Movement or Cracking At or Beyond Toe		
	Other		

Condition Codes

EC = Emergency Condition. A serious dam safety condition exists that needs immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work
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NE = No evidence of a problem.
NI = Not Inspected. Reason should be stated in comment

Retention Pond

Annual Inspection Checksheet

Date	
Inspector	
Lake Level	
Temperature	
Weather	

	Item	Condition Code *	Comments
Inlet and Outlet	Obstruction		
	Inlet Piping Supports		
	Leakage		
	Outfall Pipe Condition		
	Outfall Valve		
	Other		
Earth Embankment	Vertical & Horizontal Alignment of Crest		
	Pond Liner		
	Seepage		
	Erosion		
	Fencing		
	Vegetation		
	Unusual Movement or Cracking At or Beyond Toe		
	Other		

Condition Codes

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GC = Good Codition.
NE = No evidence of a problem.
NI = Not Inspected. Reason should be stated in comment

New Fly Ash Pond

Special Inspection Checksheet

Date	
Inspector	
Lake Level	
Temperature	
Weather	

	Item	Condition Code *	Comments
Inlet and Outlet	Obstruction		
	Inlet Piping Supports		
	Leakage		
	Outfall Pipe Condition		
	Outfall Valve		
	Other		
Earth Embankment	Vertical & Horizontal Alignment of Crest		
	Pond Liner		
	Seepage		
	Erosion		
	Fencing		
	Vegetation		
	Unusual Movement or Cracking At or Beyond Toe		
	Other		

Condition Codes

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IM = Item needing immediate maintenance to restore or ensure its safety or integrity. Remediation should be completed within 1 month.
MM = Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.
OB = Condition requires regular observation to ensure that the condition does not become worse.
GC = Good Codition.
NE = No evidence of a problem.
NI = Not Inspected. Reason should be stated in comment

Bottom Ash Ponds (492, 493, 496)
Special Inspection Checksheet

Date	
Inspector	
Lake Level	
Temperature	
Weather	

	Item	Condition Code *	Comments
Inlet and Outlet	Obstruction		
	Inlet Piping Supports		
	Leakage		
	Outfall Pipe Condition		
	Outfall Valve		
	Other		
Earth Embankment	Vertical & Horizontal Alignment of Crest		
	Pond Liner		
	Seepage		
	Erosion		
	Fencing		
	Vegetation		
	Unusual Movement or Cracking At or Beyond Toe		
	Other		

Condition Codes

EC = Emergency Condition. A serious dam safety condition exists that needs immediate action.
IM = Item needing immediate maintenance to restore or ensure its safety or integrity. Remediation should
MM = Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is
OB = Condition requires regular observation to ensure that the condition does not become worse.
GC = Good Codition.
NE = No evidence of a problem.
NI = Not Inspected. Reason should be stated in comment

Pond 489

Special Inspection Checksheet

Date	
Inspector	
Lake Level	
Temperature	
Weather	

	Item	Condition Code *	Comments
Inlet and Outlet	Obstruction		
	Inlet Piping Supports		
	Leakage		
	Outfall Pipe Condition		
	Outfall Valve		
	Other		
Earth Embankment	Vertical & Horizontal Alignment of Crest		
	Pond Liner		
	Seepage		
	Erosion		
	Fencing		
	Vegetation		
	Unusual Movement or Cracking At or Beyond Toe		
	Other		

Condition Codes

EC = Emergency Condition. A serious dam safety condition exists that needs immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work
IM = Item needing immediate maintenance to restore or ensure its safety or integrity. Remediation should be completed within 1 month.
MM = Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.
OB = Condition requires regular observation to ensure that the condition does not become worse.
GC = Good Codition.
NE = No evidence of a problem.
NI = Not Inspected. Reason should be stated in comment

Retention Pond

Special Inspection Checksheet

Date	
Inspector	
Lake Level	
Temperature	
Weather	

	Item	Condition Code *	Comments
Inlet and Outlet	Obstruction		
	Inlet Piping Supports		
	Leakage		
	Outfall Pipe Condition		
	Outfall Valve		
	Other		
Earth Embankment	Vertical & Horizontal Alignment of Crest		
	Pond Liner		
	Seepage		
	Erosion		
	Fencing		
	Vegetation		
	Unusual Movement or Cracking At or Beyond Toe		
	Other		

Condition Codes

EC = Emergency Condition. A serious dam safety condition exists that needs immediate action.
IM = Item needing immediate maintenance to restore or ensure its safety or integrity. Remediation should
MM = Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is
OB = Condition requires regular observation to ensure that the condition does not become worse.
GC = Good Codition.
NE = No evidence of a problem.
NI = Not Inspected. Reason should be stated in comment

APPENDIX B

HERBICIDES

HERBICIDES

Site personnel should check with the Missouri Department of Natural Resources, Regional Fisheries Biologist and the Regional Wildlife Biologist before using any herbicide. Read the product label prior to use and follow the use directions and precautions accordingly.

On March 1, 1979 the U.S. Environmental Protection Agency (U.S.E.P.A.) halted the use of the herbicide 2, 4, 5-T in parks and recreation areas. The use of silvex (2, 4, 5-TP) around water has also been banned.

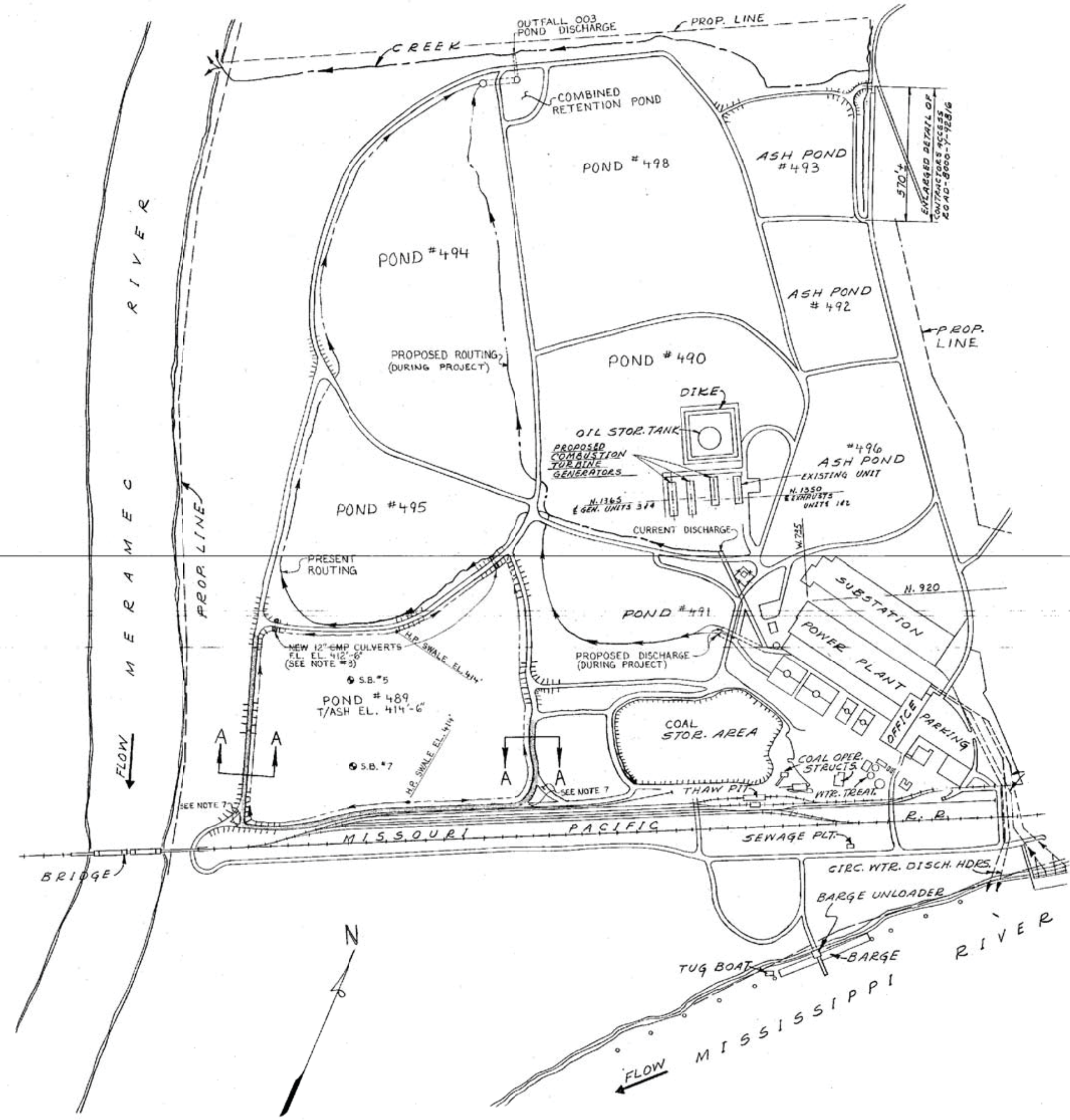
Some examples of approved herbicides are:

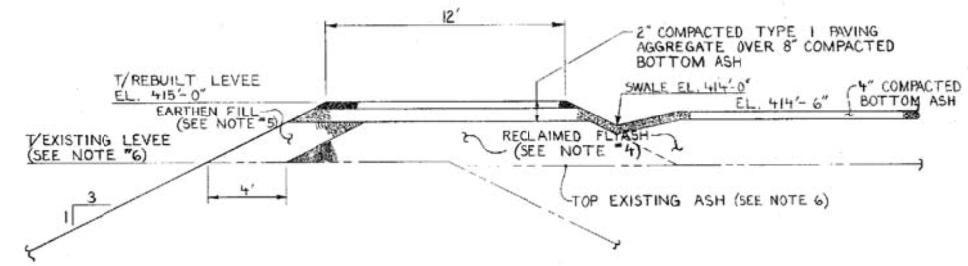
1)	Tordon RTU by DOW Chemical. (Can be obtained with blue dye.)
2)	WEEDONE 170 by Union Carbide
3)	WEEDONE, 2, 4-DP by Union Carbide
4)	A 1% to 2% solution of ROUNDUP
5)	Garlon by DOW Chemical
6)	Banvel by Sandoz

Your distributor may carry brand name herbicides other than those listed above. Be certain that the product does not contain the ingredients 2, 4, 5-T or 2, 4, 5-TP. An example of an unacceptable product is ESTERON 2, 4, 5 by DOW Chemical.

APPENDIX C

PROJECT DRAWINGS





SECTION A-A
LEVEE RENOVATION

NOTES:

1) DEPRESSED SECTIONS OF POND #489 LEVEES SHALL FIRST BE RESTORED TO THEIR ORIGINAL TOP-OF-LEVEE ELEVATION 415', AS SHOWN IN SECTION A-A.

2) FLYASH SHALL BE RECLAIMED FROM POND # 495 BY APPROPRIATE METHODS. FLYASH SHALL BE DRYED, PLACED AND COMPACTED IN POND #489, TO AN EL. OF 414'-6".

3) METHODS OF DRYING (I.E. MOISTURE REDUCTION) SHALL BE RESTRICTED SUCH THAT ANY RESULTING RUNOFF BE KEPT WITHIN EXISTING ASH POND LIMITS AND BE ROUTED TO THE EXISTING PERMITTED DISCHARGE.

4) RECLAIMED FLYASH SHALL BE PLACED IN LOOSE LIFTS NOT TO EXCEED 8-12 INCHES, AND IMMEDIATELY COMPACTED AT OPTIMUM MOISTURE CONTENT BY MEANS OF A VIBRATORY ROLLER. SEE SPECIFICATION FOR COMPACTION REQUIREMENT. (SEE ALSO NOTE #9)

5) EARTHEN MATERIAL REQUIRED FOR EROSION PROTECTION AND CONTAINMENT SHALL CONFORM TO CL, CH, ML, OR MH SOIL CLASSIFICATIONS, AS GIVEN BY ASTM DESIGNATION D-2487. THIS MATERIAL SHALL BE COMPACTED WITH A SHEEPS-FOOT TYPE COMPACTOR. SEE SPECIFICATION FOR COMPACTION REQUIREMENT. (SEE ALSO NOTE #9)

6) SEE TOPOGRAPHIC MAP DRAWING 8020-W-122627 FOR EXISTING ELEVATIONS.

7) REBUILD ACCESS ROADS TO RENOVATED LEVEE TO PROVIDE SMOOTH TRANSITIONS FOR SMALL VEHICLES.

8) TWO NEW CULVERTS WILL BE INSTALLED AS SHOWN TO PROVIDE STORMWATER DRAINAGE FROM POND #489 INTO POND #495.

9) COMPACTION SPECIFICATIONS SHOULD YIELD PERMEABILITIES WITHIN THE REPAIRED LEVEE AS FOLLOWS:
CLAY FILL – LESS THAN 10^{-7} CM/SEC.
FLYASH – LESS THAN 10^{-6} CM/SEC.

10) SURVEY MONUMENT #2 SHALL BE RAISED TO ELEVATION 415'-0"±2". SEE DRAWING 8020-W-122627 FOR LOCATION.

11) S.B. #5/7 – SOIL BORINGS (SEE U.E. SPEC. EC-2392, APPENDIX E)

12) RENOVATED LEVEE SHOWN THUS

13) ALL WORK SHALL BE DONE IN ACCORDANCE WITH U.E. SPECIFICATION EC-2392.

REFERENCE DRAWING:
TOPOGRAPHIC MAP ______________ 8020-W-122627

8020-Y-122626

NOTICE OF LIMITED RESPONSIBILITY
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STATE OF MISSOURI
THOMAS LEE HOLLENKAMP
NUMBER E-18247
REGISTERED PROFESSIONAL ENGINEER

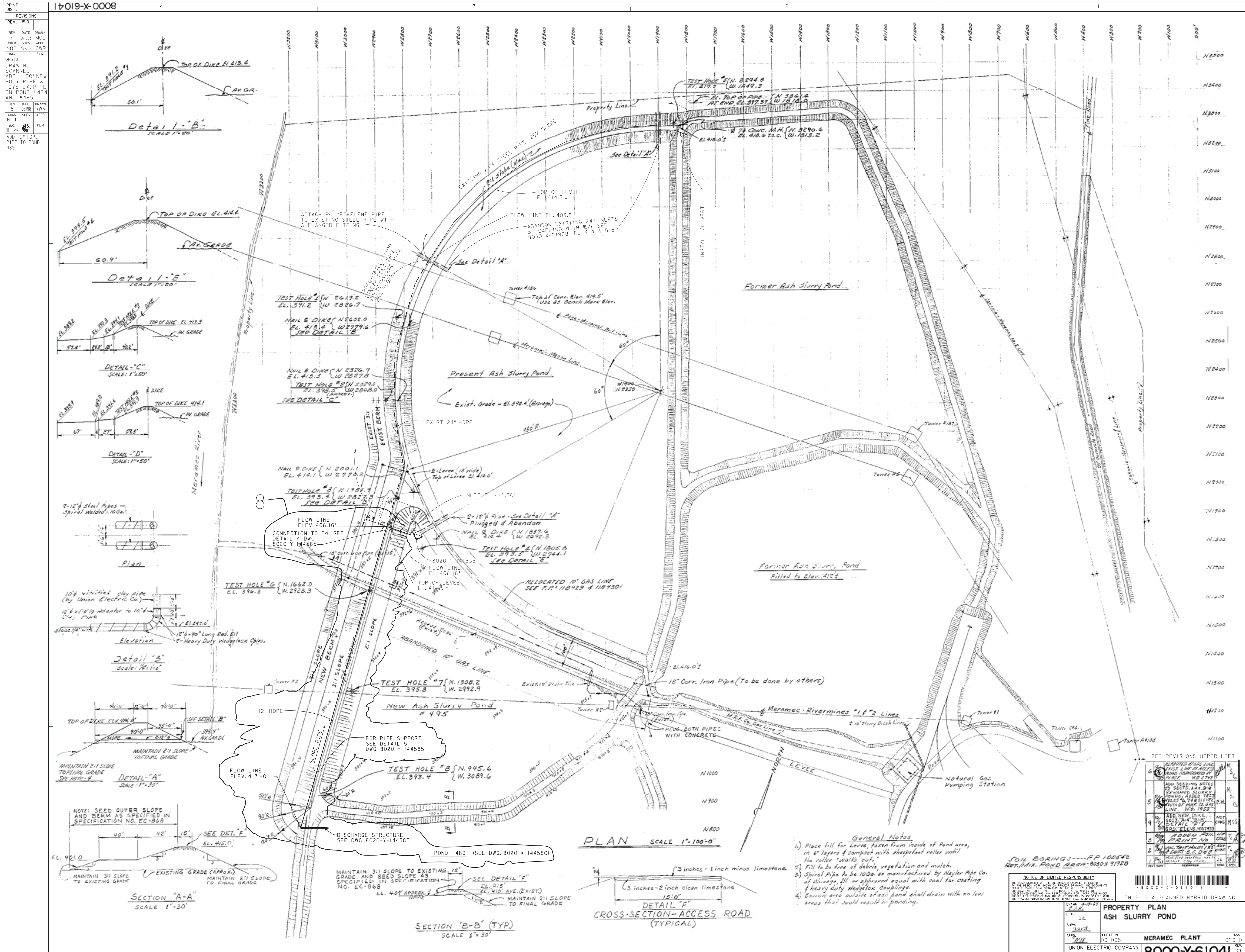
DRAWN 5/6/91 SCOTT HELD	**PROPERTY PLAN ASH RETENTION PONDS**		
CHKD. P.O.			
SUPV. 5-7-91			
APPD. 5-7-91 R. KINPER	LOCATION 001005	**MERAMEC PLANT**	CLASS 02010
UNION ELECTRIC COMPANY ST. LOUIS, MO.		**8020-Y-122626**	REV. 0

REVISIONS
REV	W O
0	E296

FIRST ISSUE

8020-Y-122626

SCANNED HYBRID DRAWING



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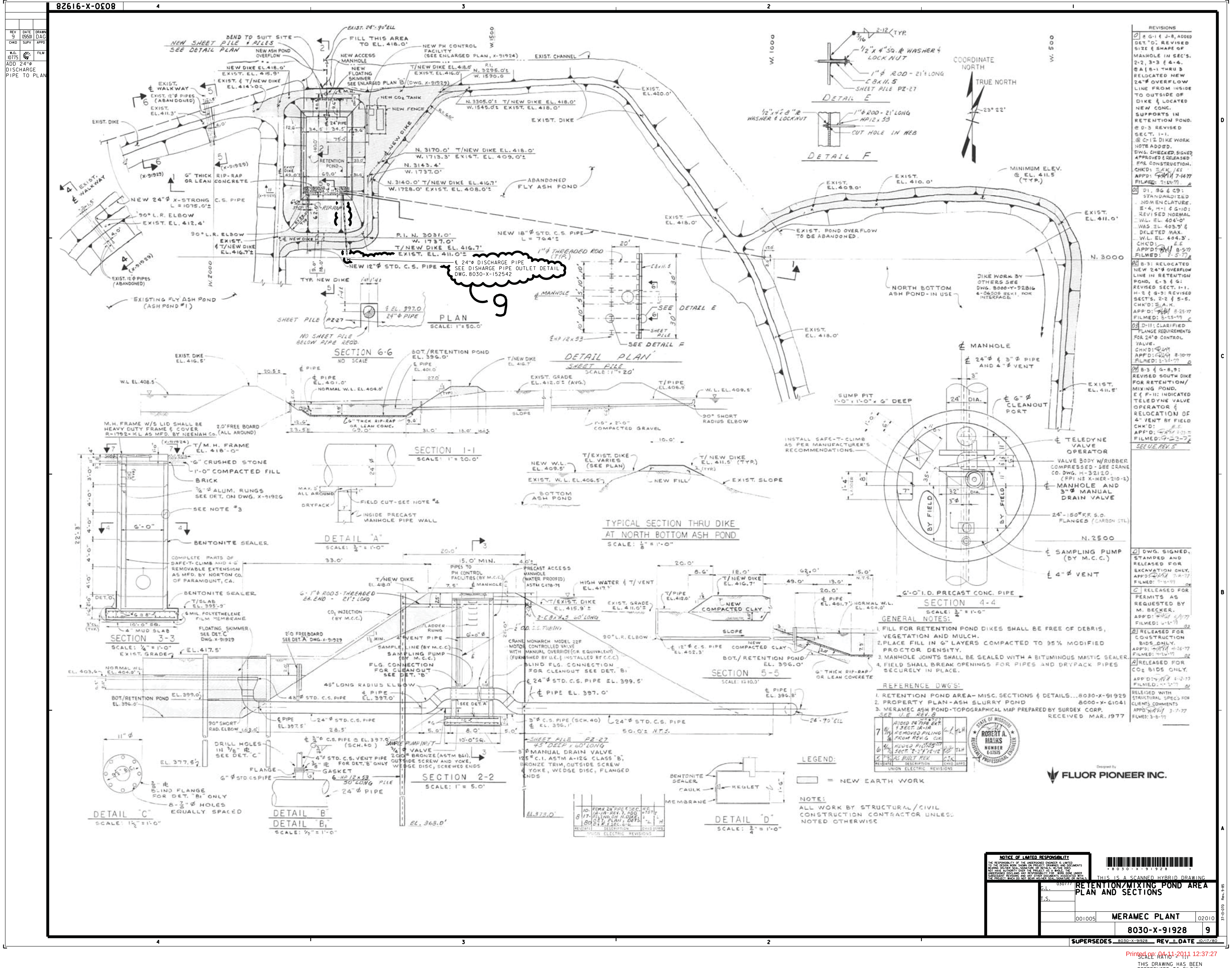

8030-X-91928
ADD 24"Ø DISCHARGE PIPE TO PLAN
NEW SHEET PILE & PILES SEE DETAIL PLAN
FILL THIS AREA TO EL. 418.0'
NEW PH CONTROL FACILITY (SEE ENLARGED PLAN, X-91924)
EXIST. CHANNEL
NEW ACCESS MANHOLE
NEW FLOATING SKIMMER SEE ENLARGED PLAN 'B' (DWG. X-91929)
NEW CO2 TANK
NEW FENCE
RETENTION POND
ABANDONED FLY ASH POND
EXIST. DIKE
NEW 24"Ø X-STRONG C.S. PIPE L = 1075.0'±
NEW 18"Ø STD. C.S. PIPE L = 764'±
NEW 12"Ø STD. C.S. PIPE
℄ 24"Ø DISCHARGE PIPE SEE DISHARGE PIPE OUTLET DETAIL DWG. 8030-X-152542
EXISTING FLY ASH POND (ASH POND #1)
EXIST. POND OVERFLOW TO BE ABANDONED
NORTH BOTTOM ASH POND - IN USE
DIKE WORK BY OTHERS SEE DWG. 8000-Y-92816 & 06508 REV.1 FOR INTERFACE.
MINIMUM ELEV. @ EL. 411.5 (TYP.)
COORDINATE NORTH
TRUE NORTH
DETAIL E
DETAIL F
PLAN SCALE: 1"=50.0'
SECTION 6-6 NO SCALE
DETAIL PLAN SHEET PILE SCALE: 1"=20'
SECTION 1-1 SCALE: 1"=20.0'
DETAIL "A" SCALE: 3/4"=1'-0"
TYPICAL SECTION THRU DIKE AT NORTH BOTTOM ASH POND SCALE: 1/8"=1'-0"
SECTION 3-3 SCALE: 1/4"=1'-0"
SECTION 2-2 SCALE: 1"=5.0'
SECTION 5-5 SCALE: 1"=10.0'
SECTION 4-4 SCALE: 3/4"=1'-0"
DETAIL "C" SCALE: 1 1/2"=1'-0"
DETAIL "B" DETAIL "B1" SCALE: 1/2"=1'-0"
DETAIL "D" SCALE: 3/4"=1'-0"
GENERAL NOTES:
1. FILL FOR RETENTION POND DIKES SHALL BE FREE OF DEBRIS, VEGETATION AND MULCH.
2. PLACE FILL IN 6" LAYERS COMPACTED TO 95% MODIFIED PROCTOR DENSITY.
3. MANHOLE JOINTS SHALL BE SEALED WITH A BITUMINOUS MASTIC SEALER.
4. FIELD SHALL BREAK OPENINGS FOR PIPES AND DRYPACK PIPES SECURELY IN PLACE.
REFERENCE DWG'S:
1. RETENTION POND AREA - MISC. SECTIONS & DETAILS ... 8030-X-91929
2. PROPERTY PLAN - ASH SLURRY POND ... 8000-X-61041
3. MERAMEC ASH POND - TOPOGRAPHICAL MAP PREPARED BY SURDEX CORP. RECEIVED MAR. 1977
LEGEND:
= NEW EARTH WORK
NOTE:
ALL WORK BY STRUCTURAL/CIVIL CONSTRUCTION CONTRACTOR UNLESS NOTED OTHERWISE
REVISIONS
FLUOR PIONEER INC.
ROBERT A. MARKS NUMBER E-22525 STATE OF MISSOURI REGISTERED PROFESSIONAL ENGINEER
UNION ELECTRIC REVISIONS
NOTICE OF LIMITED RESPONSIBILITY
THIS IS A SCANNED HYBRID DRAWING
RETENTION/MIXING POND AREA PLAN AND SECTIONS
MERAMEC PLANT
8030-X-91928
9
SUPERSEDES 8030-X-91928
REV. & DATE
Printed on: 04-11-2011 12:37:27
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0	E124

FIRST ISSUE

8020-X-135356

SHEET 1 OF 2
JULY 13, 1995

MRF
PHR
PHR

LEGEND

Symbol	Description	Symbol	Description
====	Sidewalk	× 325.6	Spot Elevation
	Building		Single Tree
	Foundation		Located Object
	Fence		Catch Basin
	Wall		Manhole
	Tree Line		Pole
	Stream		Sign
320	Index Contour		Railroad
	Intermediate Contour		Paved Road
	Depression Contour		Unpaved Road
	Approximate Contour		Trail
	Guard Rail		Pipe line
	Swamp Symbol		Fire Hydrant
	Control Point		Light Pole

NOTE: Elevations shown in ponds 490, 491, 494 & 498 are approximate top of HDPE liner. An additional 1.0 ft. thick soil layer shall be placed on top of liner per typical cross sections.

EXISTING TOPOGRAPHY FROM PHOTOGRAMMETRIC DIGITAL DATA. PHOTOS FLOWN BY WALKER & ASSOCIATES APRIL 20, 1994.

• ASH PONDS HAVE NOT BEEN MODIFIED TO THIS DESIGN

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8020-X-135356

PREPARED FOR AmerenUE

DRAWN 040398 M. ENGLUND	FLYASH PONDS 489 AND 495 RECLAMATION		
CHK/RVW			
SUPV.			
APPD.	LOCATION 001005	MERAMEC POWER PLANT	CLASS 02010
Ameren ST. LOUIS, MISSOURI	8020-X-135356		REV. 0

37-13-070 Rev. 9-85

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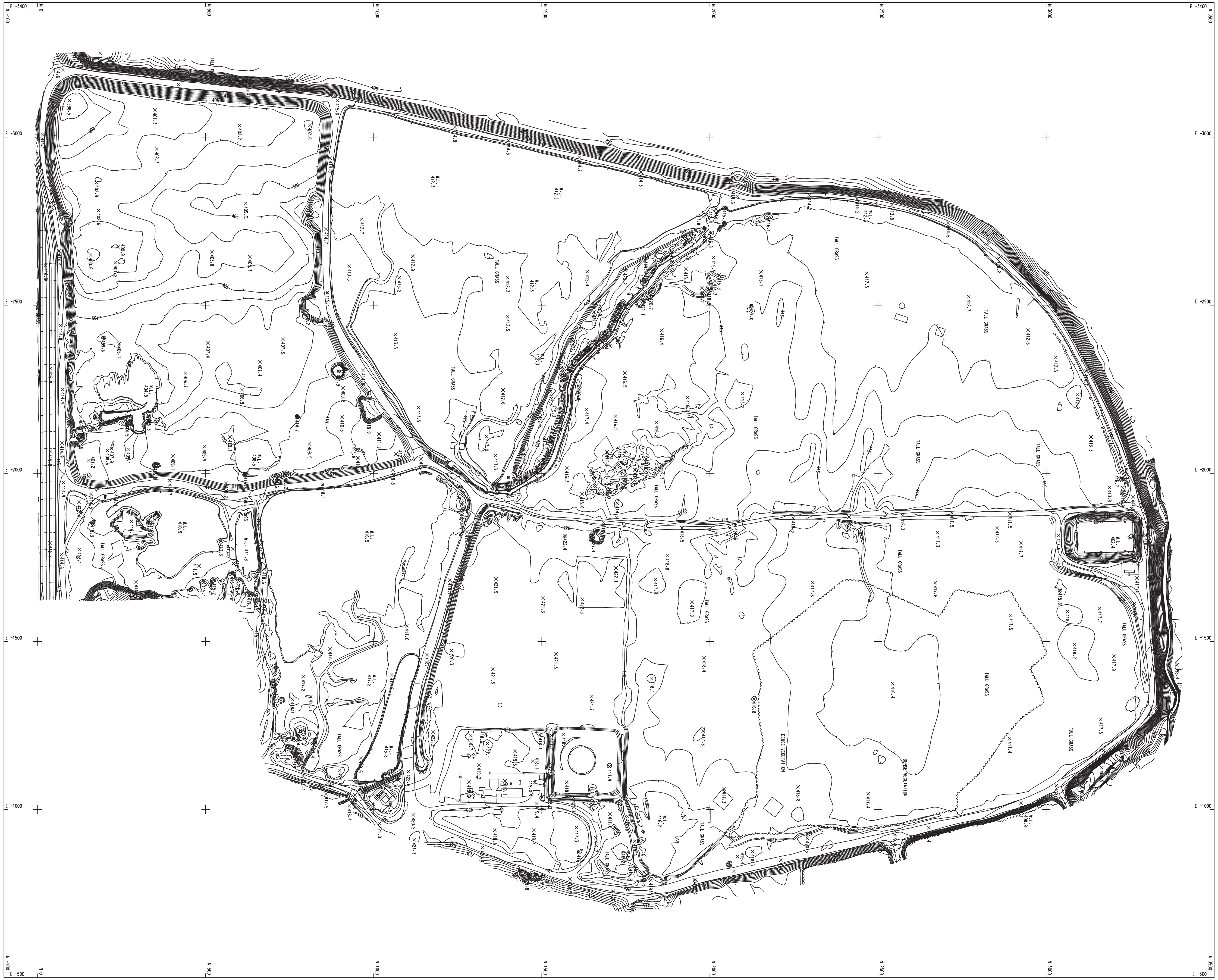
REV.	W.O.
0	E124
FIRST ISSUE	

8020-X-144271



NOTE:
SEE AMEREN DRAWING NUMBER 8020-X-144288 FOR ASH POND 489 MODIFICATIONS

SCALE: 1"=100'
CONTOUR INTERVAL: 1'

LEGEND

Sidewalk	Index Contour	Spot Elevation
Building	Intermediate Contour	Single Tree
Foundation	Depression Contour	Located Object
Fence	Guard Rail	Catch Basin
Wall	Swamp Symbol	Manhole
Tree Line	Control Point	Pole
Stream		Sign
Brush/Shrub Line		Fire Hydrant
		Light Pole

Railroad
Paved Road
Unpaved Road
Trail
Pipe line
Driveway

NOTE: DASHED CONTOURS MAY BE UNRELIABLE.

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8020-X-144271

PREPARED FOR AmerenUE

DRAWN 040298 M. ENGLUND	PROPERTY TOPO MAP ASH PONDS	
CHK/RVW		
SUPV.		
APPD.	LOCATION 001005	MERAMEC PLANT
Ameren ST. LOUIS, MISSOURI	8020-X-144271	CLASS 02010 REV. 0

37-13-070 Rev. 9-85

PRINT DIST.		
REVISIONS		
REV. 0	W.O. 0EI24	
FIRST ISSUE		

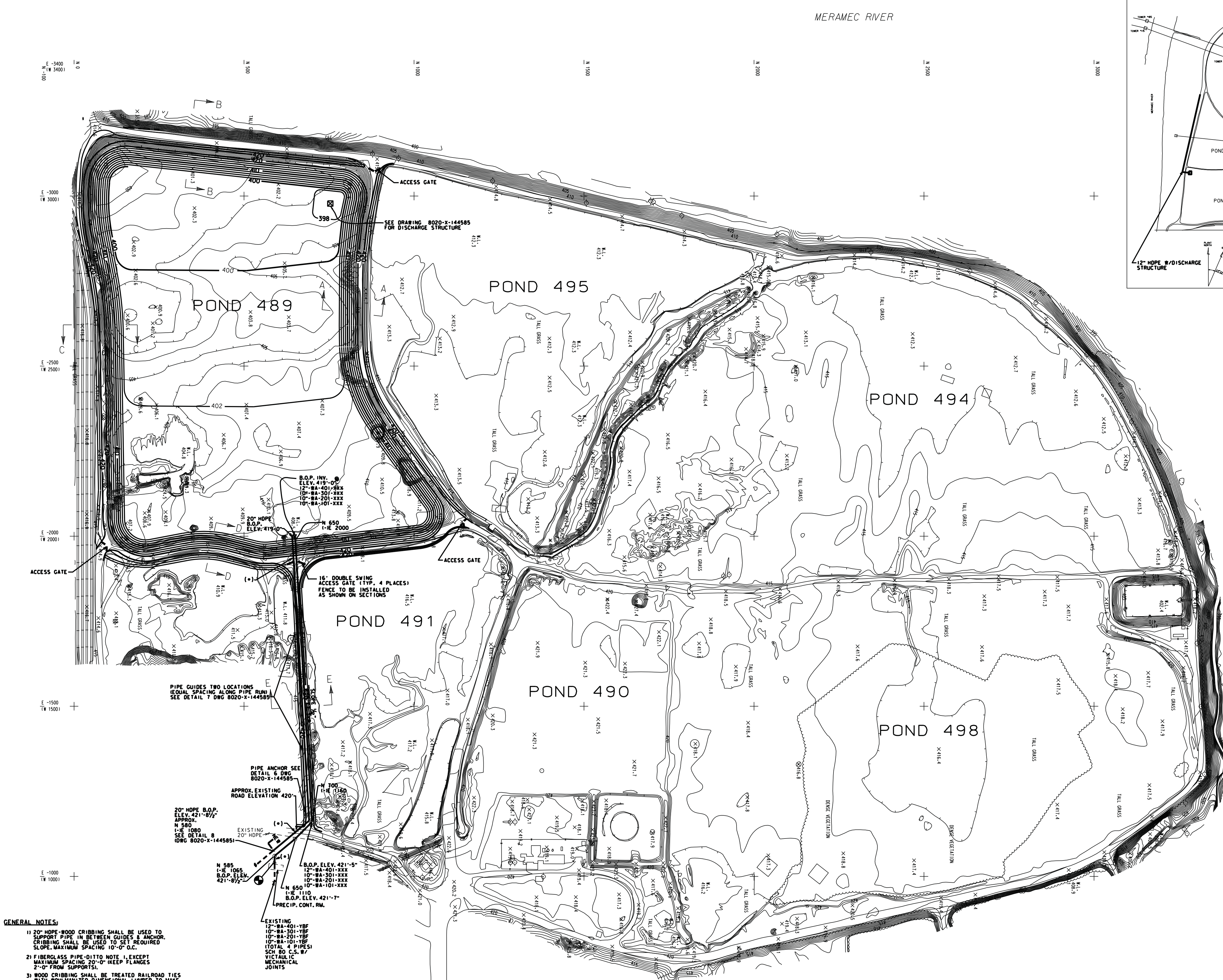
UPDATED CONTOURS POND 489

REV	DATE	DRAWN
2	060198	RWV
CHKD NOT	SUPV	APPD
W.O. 0EI24		FILM

ADDED VICINITY MAP, NOTES, MERAEC RIVER NEW FLOODWAY, SILTATION FENCE, LOCATION OF MERAMEC RIVER & CO. ADDRESS

REV	DATE	DRAWN
CHK/RVW	SUPV	APPD
W.O.		FILM

8020-X-144580



GENERAL NOTES:

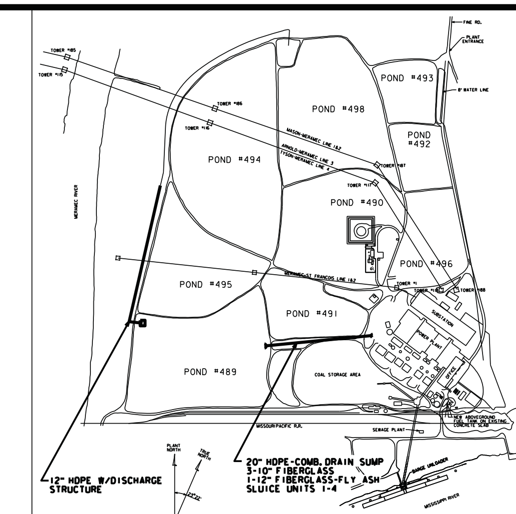
1) 20" HDPE-WOOD CRIBBING SHALL BE USED TO SUPPORT PIPE IN BETWEEN GUIDES & ANCHOR. CRIBBING SHALL BE USED TO SET REQUIRED SLOPE. MAXIMUM SPACING 10'-0" O.C.

2) FIBERGLASS PIPE-DITTO NOTE 1, EXCEPT MAXIMUM SPACING 20'-0" (KEEP FLANGES 2'-0" FROM SUPPORTS).

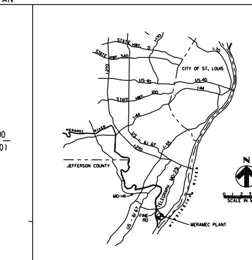
3) WOOD CRIBBING SHALL BE TREATED RAILROAD TIES WITH WOHLMANIZED DIMENSIONAL LUMBER TO MAKE FINAL ELEVATION ADJUSTMENT.

4) DO NOT INSTALL FLANGES INSIDE SLEEVES

(•) INSTALL PIPING INSIDE SCH. 40 C.S. SLEEVE COVER WITH 1" GRANULAR FILL (1'-0" ABOVE TOP OF SLEEVE) AND SLOPE 5% ON EITHER SIDE (SEE DETAIL 3 ON DWG 8020-X-96121).



KEY PLAN



VICINITY MAP

SEE REFRENCE DWGS

8020-X-144585
8030-X-91925
8020-X-91921
8020-X-96120
8000-X-61041

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•0010050502O•

•8020-X-144580•

PREPARED FOR AmerenUE

SCALE: 1"=100'

LEGEND

Sidewalk, Building, Foundation, Fence, Wall, Tree Line, Stream, Brush/Shrub Line, Index Contour (320), Intermediate Contour, Depression Contour, Guard Rail, Swamp Symbol, Control Point, Spot Elevation (×325.6), Single Tree, Located Object, Catch Basin, Manhole, Pole, Sign, Fire Hydrant, Light Pole, Railroad, Paved Road, Unpaved Road, Trail, Pipe line, Driveway

NOTE: DASHED CONTOURS MAY BE UNRELIABLE.

DRAWN 5-18-98 R. VANCE	PIPING-PLAN DRAINS TO ASH POND 489 1998 MODIFICATIONS	
CHK/RVW		
SUPV.		
APPD.	LOCATION 001005 — MERAMEC PLANT	CLASS 05020
Ameren — ST. LOUIS, MISSOURI	8020-X-144580	REV. 0

37-13-070 Rev. 9-85

SCALE RATIO =
THIS DRAWING HAS BEEN REFERENCED TO FILE(S):

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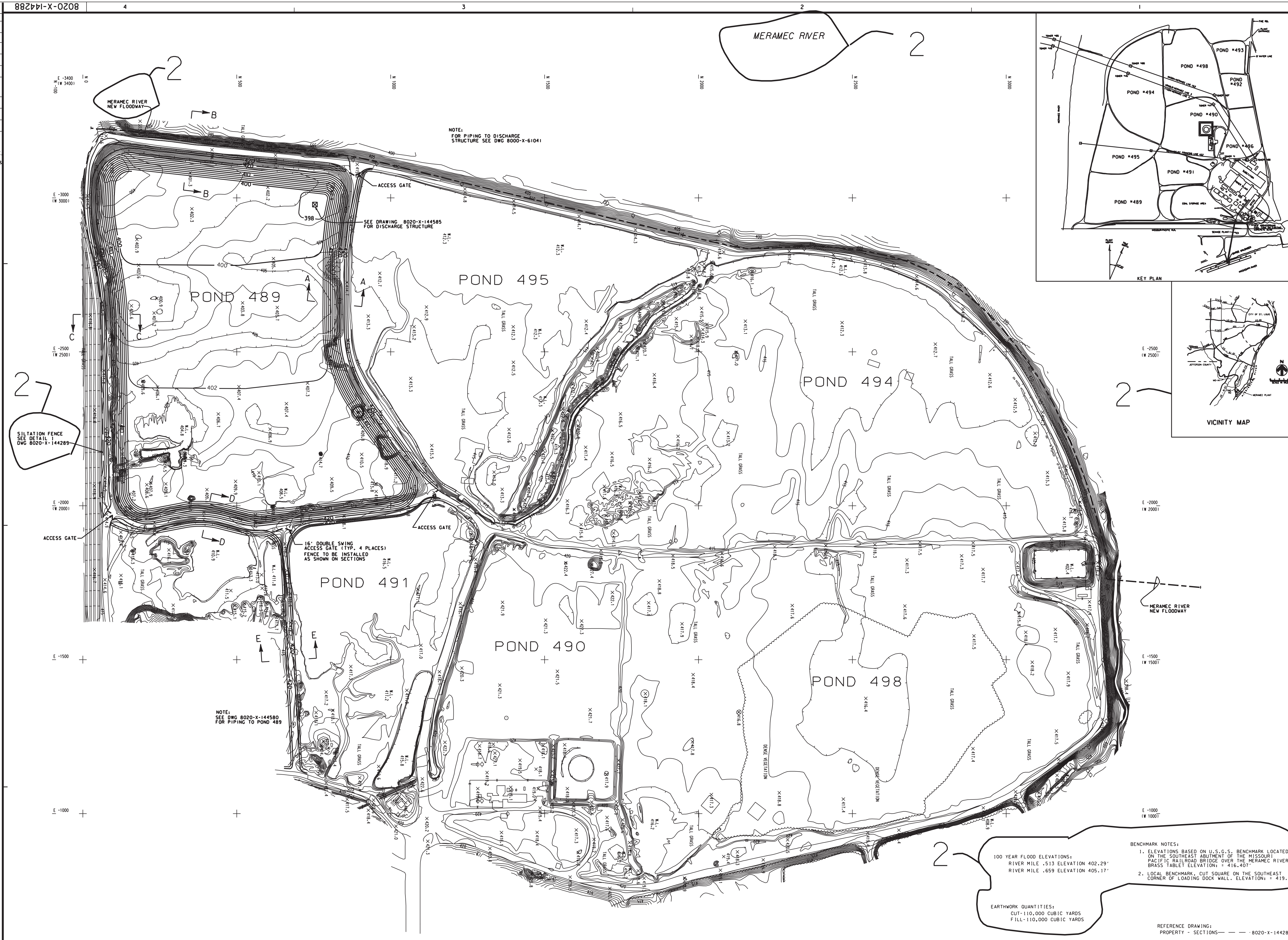
REVISIONS		
REV. 0	W.O. E124	
FIRST ISSUE		
REV 1	DATE 050798	DRAWN RWV
CHKD NOT	SUPV RACH	APPD CWR
W.O. 0E124		FILM
UPDATED CONTOURS POND 489		
REV 2	DATE 060198	DRAWN RWV
CHKD NOT	SUPV	APPD
W.O. 0E124		FILM
ADDED VICINITY MAP, NOTES, MERAEC RIVER NEW FLOODWAY, SILTATION FENCE, LOCATION OF MERAMEC RIVER & CO. ADDRESS		



100 YEAR FLOOD ELEVATIONS:
RIVER MILE .513 ELEVATION 402.29'
RIVER MILE .659 ELEVATION 405.17'

BENCHMARK NOTES:
1. ELEVATIONS BASED ON U.S.G.S. BENCHMARK LOCATED ON THE SOUTHEAST ABUTMENT OF THE MISSOURI PACIFIC RAILROAD BRIDGE OVER THE MERAMEC RIVER. BRASS TABLET ELEVATION: = 416.407'
2. LOCAL BENCHMARK, CUT SQUARE ON THE SOUTHEAST CORNER OF LOADING DOCK WALL. ELEVATION: = 419.00'

EARTHWORK QUANTITIES:
CUT-110,000 CUBIC YARDS
FILL-110,000 CUBIC YARDS

REFERENCE DRAWING:
PROPERTY - SECTIONS— — — ·8020-X-144289

COMPANY ADDRESS
AMEREN UE
ONE AMEREN PLAZA
1901 CHOUTEAU AVE.
ST. LOUIS, MO 63103

COMPANY MAILING ADDRESS
AMEREN UE
P.O. BOX 66149
ST. LOUIS, MO 63166-6149

PLANT ADDRESS
AMEREN UE
MERAMEC PLANT
8200 FINE ROAD
ST. LOUIS COUNTY, MO 63129

LEGEND
Sidewalk, Building, Foundation, Fence, Wall, Tree Line, Stream, Brush/Shrub Line, Index Contour, Intermediate Contour, Depression Contour, Guard Rail, Swamp Symbol, ControlPoint, Spot Elevation, Single Tree, Located Object, Catch Basin, Manhole, Pole, Sign, Fire Hydrant, Light Pole, Railroad, Paved Road, Unpaved Road, Trail, Pipe line, Driveway

NOTE: DASHED CONTOURS MAY BE UNRELIABLE.

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·8020-X-144288·

PREPARED FOR AmerenUE

DRAWN 033198 M. ENGLUND	PROPERTY - PLAN FLYASH POND 489 RECLAMATION AND NEW LINER	
CHK/RVW NOT CHK'D		
SUPV. 4-3-98 RACH		
APPD. 4-6-98 C.W. REZSONYA	LOCATION 001005 — MERAMEC PLANT	CLASS 02010
Ameren ST. LOUIS, MISSOURI	8020-X-144288	REV. 2

37-13-070 Rev. 9-85

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REV.	W.O.	
0	10775	

FIRST ISSUE

REV	DATE	DRAWN
1	032001	PDO
CHKD	SUPV	APPD
NOT	SAH	
W.O.		FILM
10775		

ADDED COORDINATES AND RADIUS FOR NEW COAL PILE: SHOWED EXISTING CATCH BASINS

REV	DATE	DRAWN
2	040201	MLE
CHKD	SUPV	APPD
NOT	SAH	
W.O.		FILM
10775		

REVISED CONTOURS PER ENGINEERING COMMENTS

REV	DATE	DRAWN
3	041701	MGL
CHKD	SUPV	APPD
NOT	SAH	
W.O.		FILM
10775		

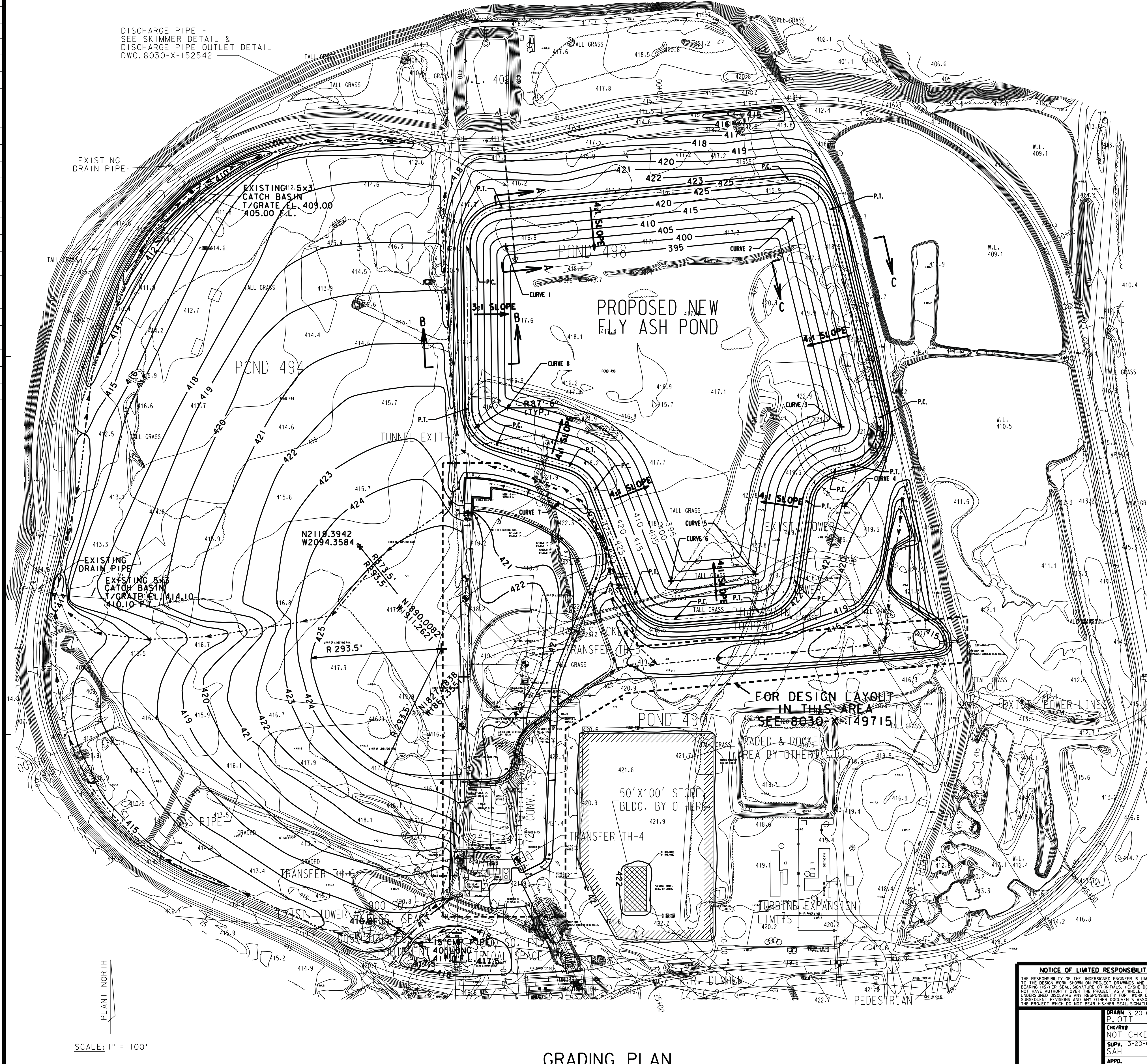
REVISED CONTOURS PER ENGINEERING COMMENTS

REV	DATE	DRAWN
4	042001	MGL
CHKD	SUPV	APPD
NOT	SAH	
W.O.		FILM
10775		

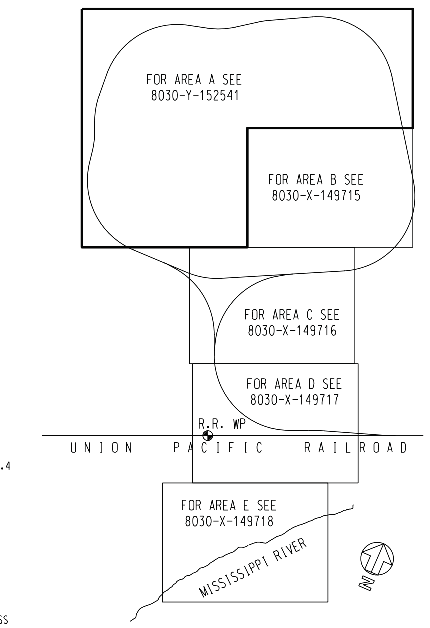
REVISED CONTOURS PER ENGINEERING COMMENTS

REV	DATE	DRAWN
5	051501	DAG
CHKD	SUPV	APPD
W.O.		FILM
10775		

REVISED CONTOURS PER ENGINEERING COMMENTS; ADD DISCHARGE PIPE FROM FLY ASH POND TO RETENTION BASIN & TABLE



GRADING PLAN



AREA KEY PLAN

TOTAL CUT 220,000yd^3
TOTAL FILL 221,800yd^3

TABLE

CURVE NO.	RADIUS	CENTER	(P.C.) POINT OF CURVATURE	(P.T.) POINT OF TANGENCY
1	87'-6"	N2795.9654 W1766.7163	N2794.9985 W1854.2110	N2883.0642 W1775.0847
2	87'-6"	N2857.8626 W1122.4817	N2944.9616 W1130.8501	N2878.1002 W1037.3542
3	87'-6"	N2389.1821 W1011.0613	N2409.4196 W925.9338	N2303.9035 W991.4702
4	87'-6"	N2211.0398 W1004.8965	N2296.3184 W1024.4876	N2223.8795 W1091.4493
5	87'-6"	N2058.1369 W1204.4941	N2045.2973 W1117.9412	N1970.9244 W1197.4075
6	87'-6"	N2042.6838 W1394.6702	N1955.4713 W1387.5836	N2011.3974 W1476.3856
7	87'-6"	N2216.2748 W1648.5213	N2247.5612 W1566.8058	N2300.2443 W1623.9170
8	87'-6"	N2432.0871 W1762.6952	N2348.1176 W1787.2994	N2431.1202 W1850.1898

REFERENCE DRAWINGS:

FOR SECTION CUTS AND TYPICAL SECTIONS SEE 8030-Y-152542

FOR ADDITIONAL DESIGN LAYOUTS SEE 8030-X-149714 & 8030-X-149715

NOTICE OF LIMITED RESPONSIBILITY

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8030-Y-152541

PREPARED FOR AmerenUE

DRAWN 3-20-01 P. OTT	PROPERTY - SITE PLAN AREA A NEW ASH POND AND GRADING OVER PONDS 490, 494 & 498
CHK/RVW NOT CHKD	
SUPV. 3-20-01 SAH	
APPD.	LOCATION 001005 — MERAMEC PLANT — CLASS 02010
Ameren ST. LOUIS, MISSOURI	8030-Y-152541 — REV. 5

37-13-118 Rev. 9-85

SCALE RATIO =100

THIS DRAWING HAS BEEN REFERENCED TO PREFS.

GHOST ALL BUT 100

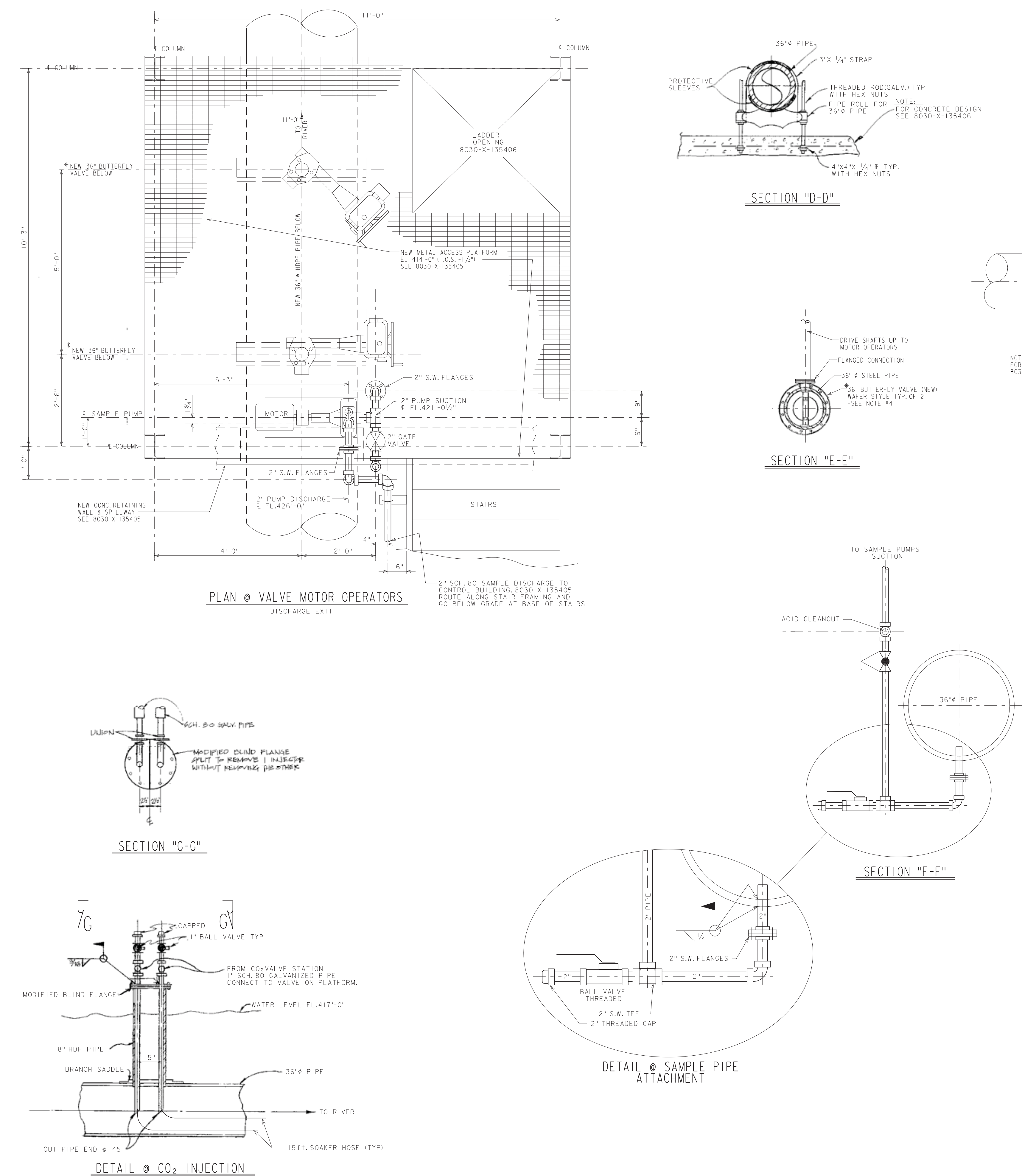
PRINT DIST.

REVISIONS

REV.	W.O.
0	0018

FIRST ISSUE

AS-BUILT



PLAN @ VALVE MOTOR OPERATORS

DISCHARGE EXIT

SECTION "D-D"

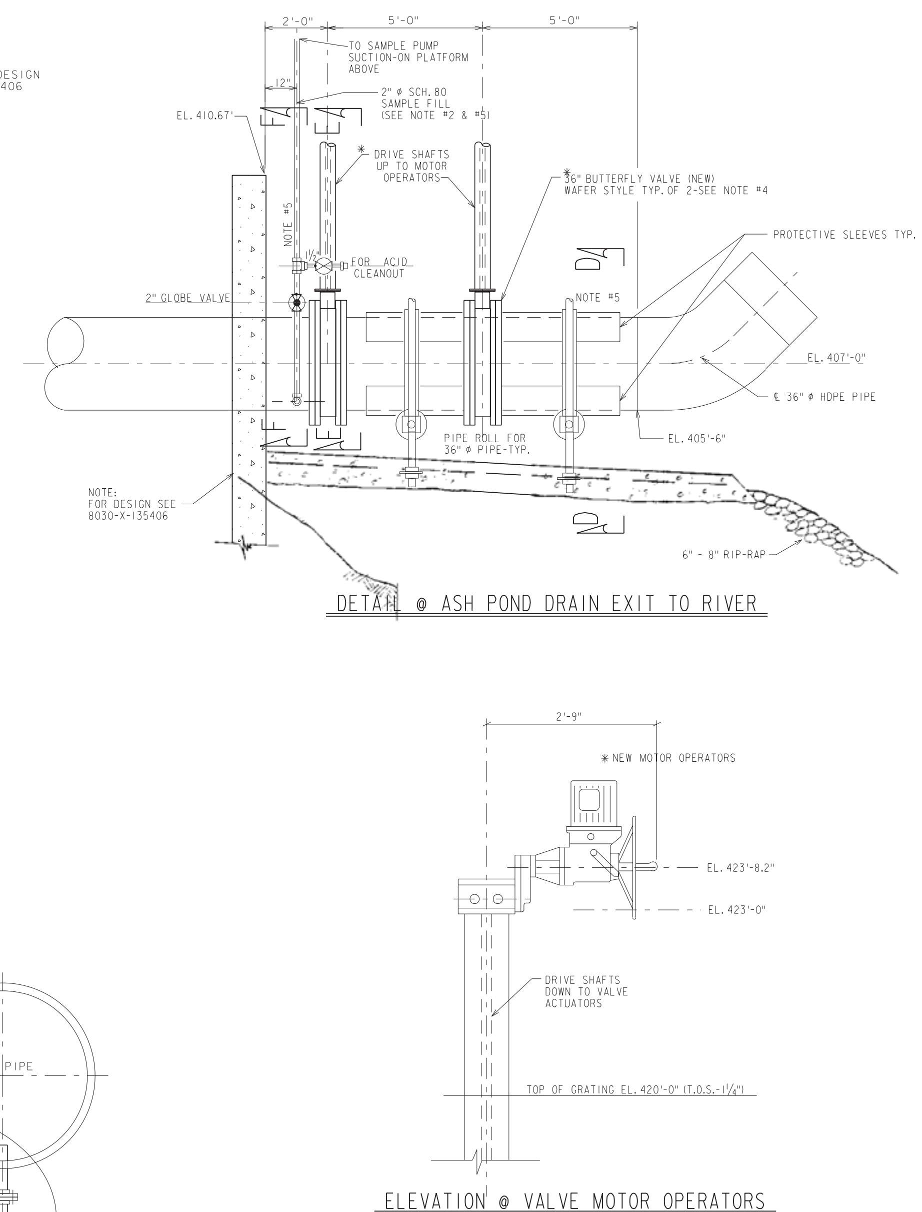
SECTION "E-E"

SECTION "G-G"

DETAIL @ CO₂ INJECTION

SECTION "F-F"

DETAIL @ SAMPLE PIPE ATTACHMENT



DETAIL @ ASH POND DRAIN EXIT TO RIVER

ELEVATION @ VALVE MOTOR OPERATORS

NOTES

1. THIS WORK TO BE DONE IN ACCORDANCE WITH U.E. SPEC. NO. EC-4022
2. ALL 2" SCH. 80 PIPE ABOVE GROUND IS TO BE GALVANIZED. ALL 2" SCH. 80 PIPING BELOW GROUND SHALL BE COMMON CARBON STEEL.
3. ALL PIPING 2" & SMALLER TO BE SCHEDULE 80.
4. CONTRACTOR TO REAM PIPE FLANGES TO PERMIT FREE OPERATION OF 36" BUTTERFLY VALVES. ALSO TRIM OR REROUTE 2" SAMPLE LINE PER SAME CRITERIA.
5. INSTALL ⅜" INSULATION AND HEAT TRACE ON 36" PIPE FROM CONCRETE WALL TO LAST PIPE ROLL. INSULATE 2" SAMPLE PUMP SUCTION FROM 36" PIPE TO PUMP & 2" SAMPLE TO CONTROL HOUSE FROM PUMP TO GROUND.
6. ALL HDPE PIPE CONNECTIONS SHALL BE FUSION WELDED.
7. * SUPPLIED BY AMEREN UE AND INSTALLED BY CONTRACTOR.

REFERENCE DRAWINGS:

PROPERTY-PLAN------------------------------------8030-X-135405

DRAWING HAS NO SCALE

1993 FLOOD LEVEL - 419.6

NOTICE OF LIMITED RESPONSIBILITY

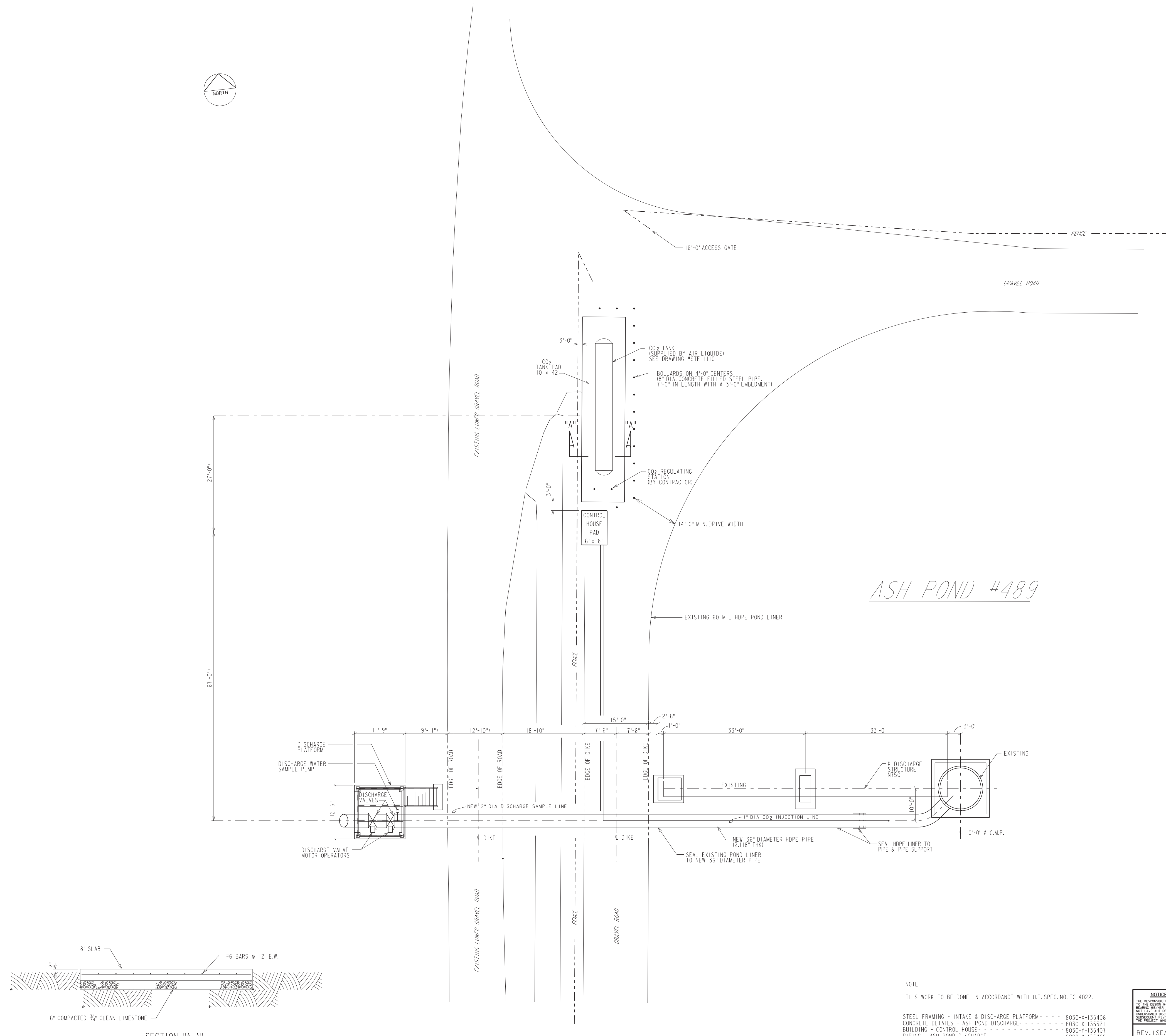
PREPARED FOR AmerenUE

DRAWN 051399 M. ENGLUND	PIPING-INSTALLATION & DETAILS ASH POND DISCHARGE ASH POND #489
CHK/RVW MSB	
SUPV. 112999 SAH	
APPD. 121699 C.W. REZSONYA	LOCATION 001005 — MERAMEC PLANT — CLASS 05030
Ameren ST. LOUIS, MISSOURI	8030-X-135408 — REV. 1

SCANNED HYBRID DRAWING

PRINT DIST.

REVISIONS		
REV. 0	W.O. 10788	
FIRST ISSUE		
REV 1	DATE 121599	DRAWN MLE
CHKD NOT	SUPV SAH	APPD CWR
W.O.		FILM F
REVISED CONTROL HOUSE PAD AND 36" DIA. PIPE LOCATION		
REV 2	DATE 082900	DRAWN MLE
CHKD NOT	SUPV	APPD
W.O.		FILM
AS-BUILT		



NOTE

THIS WORK TO BE DONE IN ACCORDANCE WITH U.E. SPEC. NO. EC-4022.

STEEL FRAMING - INTAKE & DISCHARGE PLATFORM	8030-X-135406
CONCRETE DETAILS - ASH POND DISCHARGE	8030-X-135521
BUILDING - CONTROL HOUSE	8030-Y-135407
PIPING - ASH POND DISCHARGE	8080-X-135408
PIPING - CO2 REGULATING STATION	8030-X-135409

1993 FLOOD LEVEL - 419.6

0010050201 0

8030-X-135405

REV. 1 SEALED BY

STATE OF MISSOURI CARL W. REZSONYA NUMBER E-18282 REGISTERED PROFESSIONAL ENGINEER

DRAWN 5/12/99 M. ENGLUND	PROPERTY- SITE PLAN NEW ASH POND 489 DISCHARGE STRUCTURE	
CHKD. NOT		
SUPV. 11/29/99 SAH		
APPD. 12/16/99 C.W. REZSOYA	LOCATION 001005 MERAMEC PLANT	CLASS 02010
UNION ELECTRIC COMPANY ST. LOUIS, MO.	8030-X-135405	REV. 2

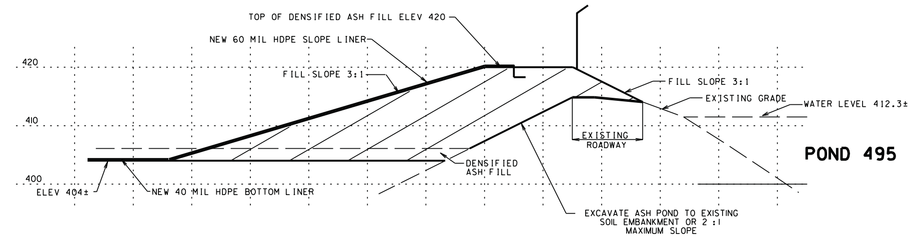
37-13-070 Rev. 9-85

...\135405.DGN 04/11/2011 1:48:21 PM

8020-X-144289

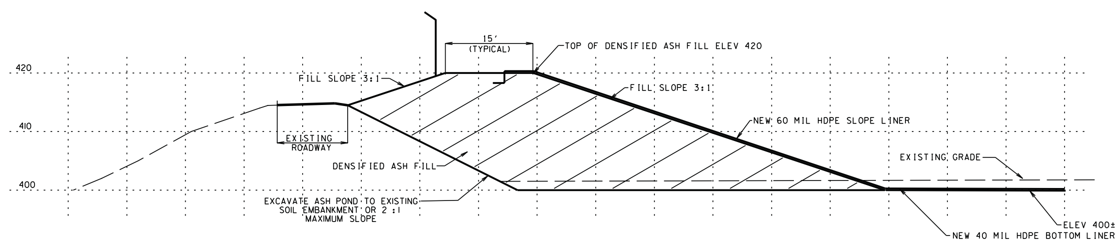
PRINT DIST.		
REVISIONS		
REV. 0	W.O. E124	F
FIRST ISSUE		
REV 1	DATE 051898	DRAWN RWV
CHKD NOT	SUPV RACH	APPD CWR
W.O. 0E124		FILM
ADDED SECTION E		
REV 2	DATE 060198	DRAWN RWV
CHKD NOT	SUPV	APPD
W.O. 0E124		FILM
ADDED SILTATION FENCE DETAIL		

REV	DATE	DRAWN
CHK/RVW	SUPV	APPD
W.O.		FILM



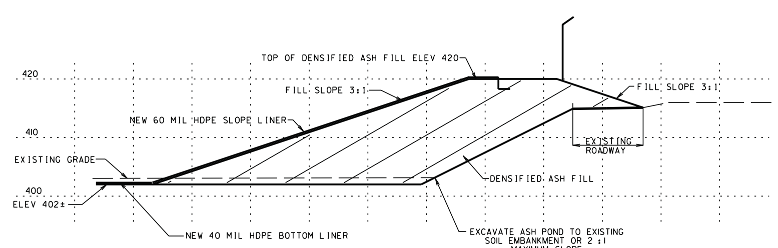
POND 495

A-A

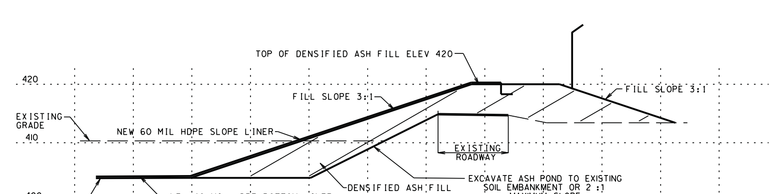


B-B

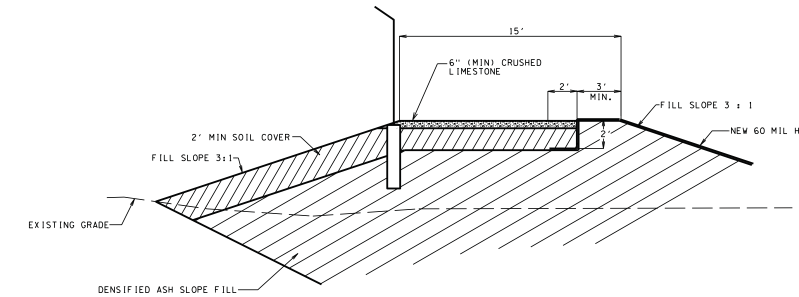
TYPICAL SECTIONS
SCALE 1" = 10'H
1" = 10'V



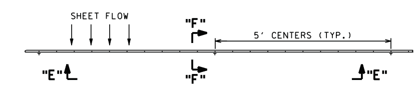
C-C



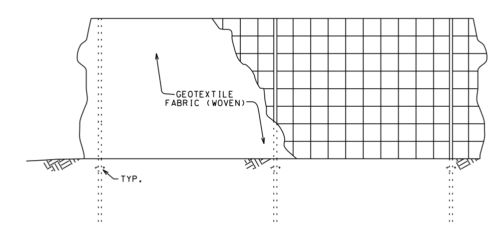
D-D



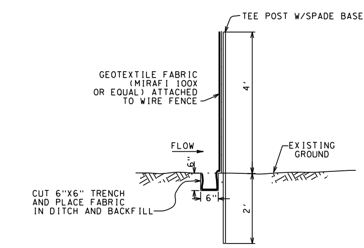
TYPICAL LEVEE CAP AT POND 489
SCALE 1/4" = 1'



PLAN

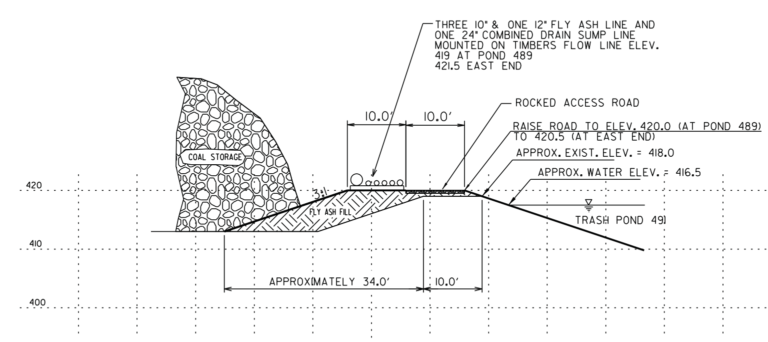


SECTION E-E



SECTION F-F

DETAIL 1
SILTATION FENCE
N.T.S.



E-E
SECTION LOOKING WEST THRU LEVEE
BETWEEN POND 491 & COAL PILE

NOTICE OF LIMITED RESPONSIBILITY
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•0010050201O•
•8020-X-144289

PREPARED FOR AmerenUE

DRAWN 032698I P. OTT	PROPERTY - SECTIONS FLYASH POND 489 RECLAMATION AND NEW LINER	
CHK/RVW NOT CHKD		
SUPV. 4-3-98 RACH		
APPD. 4-3-98 REZSONYA	LOCATION 001005	MERAMEC PLANT	CLASS 02010
Ameren ST. LOUIS, MISSOURI	8020-X-144289	REV. 2

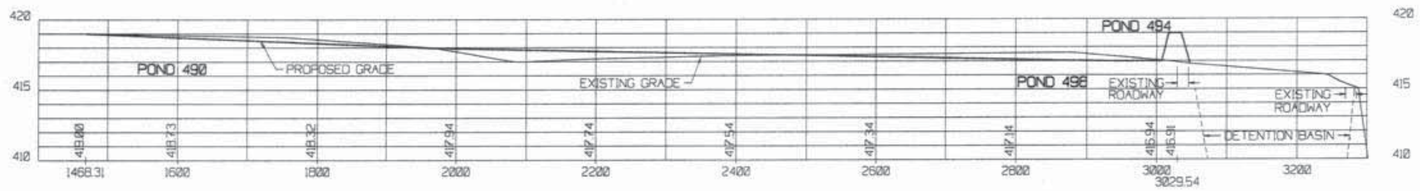
37-13-070 Rev. 9-85

SCALE RATIO = 10
THIS DRAWING HAS BEEN REFERENCED TO FILE(S):

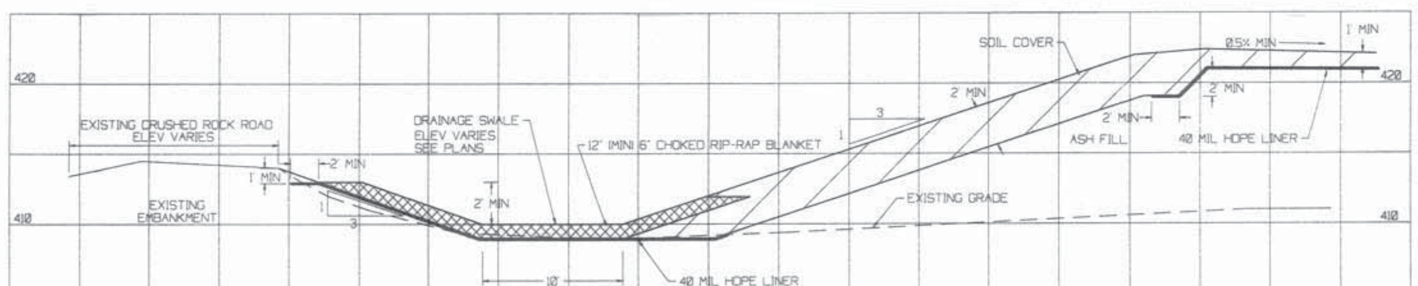
PRINT DIST. 9/15/94

REVISIONS

REV. NO.

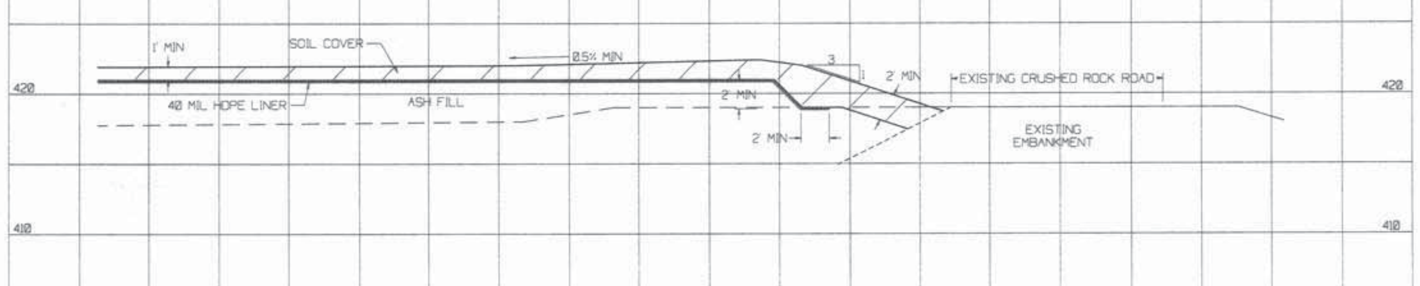


SECTION E-E (ROAD PROFILE)
SCALE 1" = 100'H
1" = 5'V



SECTION F-F
(TYPICAL)
SCALE: 1" = 5'H
1" = 5'V

SECTION G-G
(TYPICAL)
SCALE: 1" = 5'H
1" = 5'V



SECTION H-H
(TYPICAL AT PERIMETER ROAD)
SCALE: 1" = 5'H
1" = 5'V

NOTICE OF LIMITED RESPONSIBILITY

SEPTEMBER 14, 1994

DRAWN MRF
CHKD. PHR
SUPV.
APPD.

FLYASH POND 489
RECLAMATION

LOCATION 001005

MERAMEC POWER PLANT

CLASS 02010

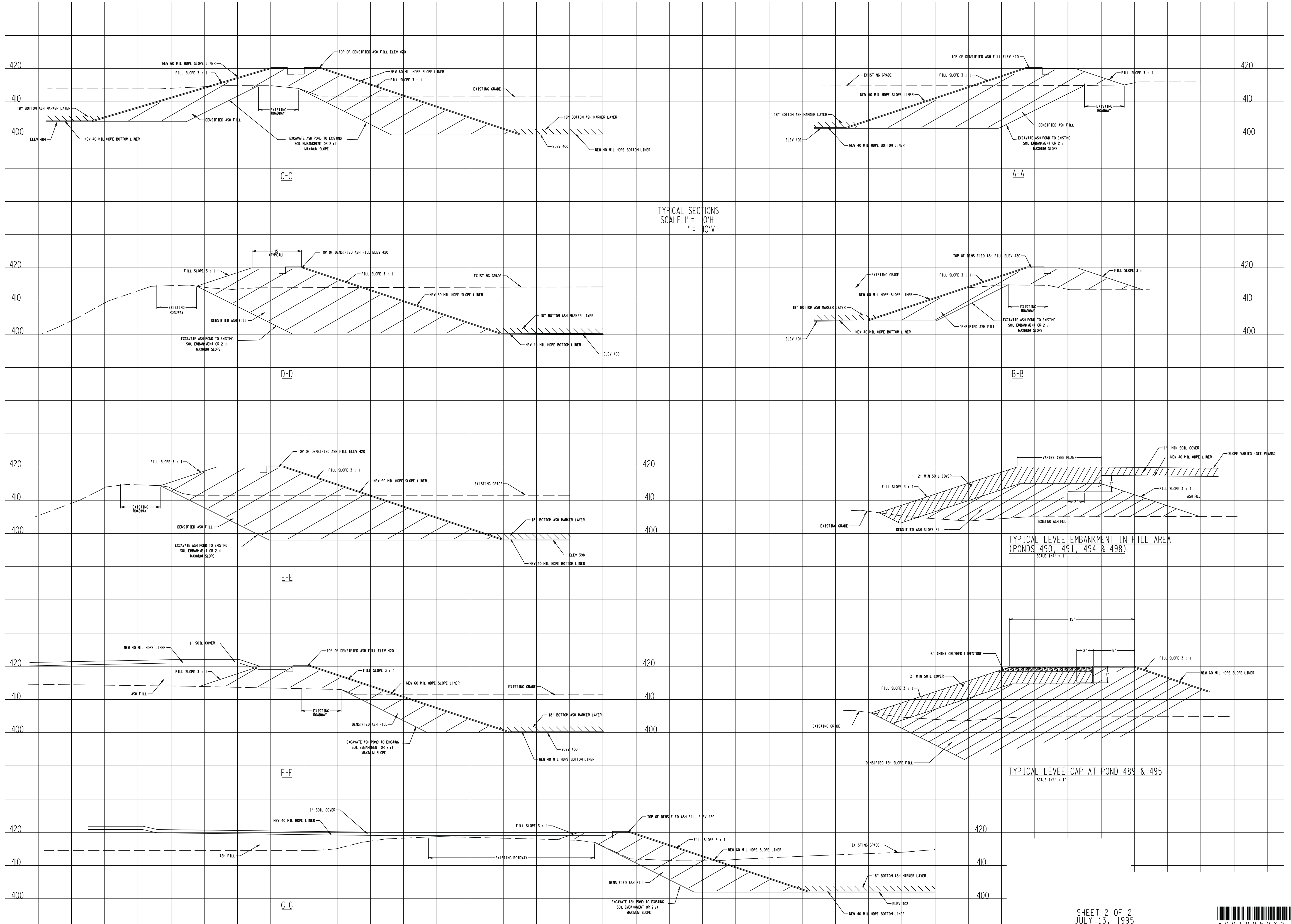
UNION ELECTRIC COMPANY
ST. LOUIS, MO.

8020-X-135358

REV. 0

SHEET 3 OF 3

PRINT DIST.	
REVISIONS	
REV.	W.O.
0	E124
FIRST ISSUE	



SHEET 2 OF 2
JULY 13, 1995

* ASH PONDS HAVE NOT BEEN MODIFIED TO THIS DESIGN

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0010050201 0
8020-X-135357

PREPARED FOR AmerenUE

DRAWN 040298 M. ENGLUND	FLYASH PONDS 489 AND 495 RECLAMATION	
CHK/RVW		
SUPV.		
APPD.	LOCATION 001005 — MERAMEC POWER PLANT	CLASS 02010
Ameren ST. LOUIS, MISSOURI	8020-X-135357	REV. 0

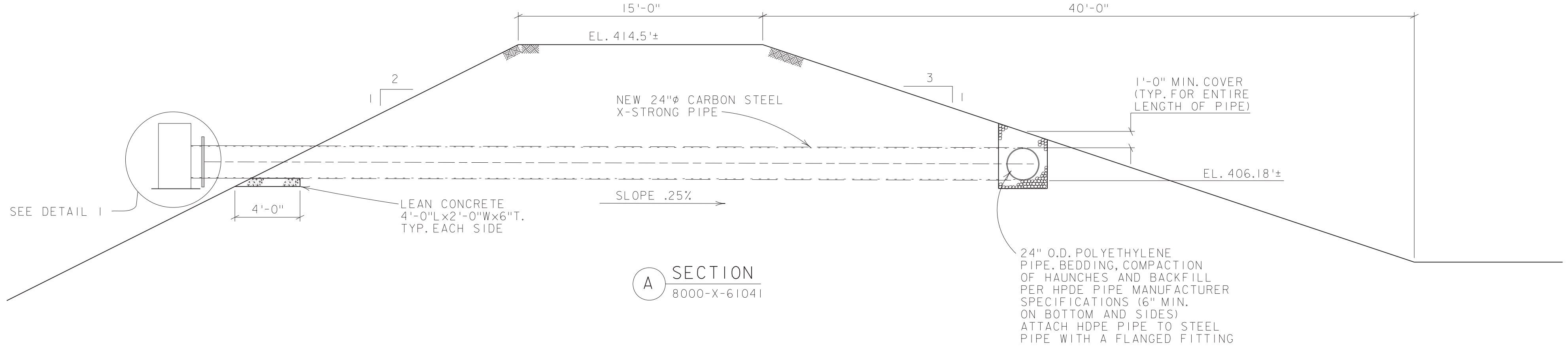
37-13-070 Rev. 9-85

SCALE RATIO = 10
THIS DRAWING HAS BEEN REFERENCED TO FILE(S):

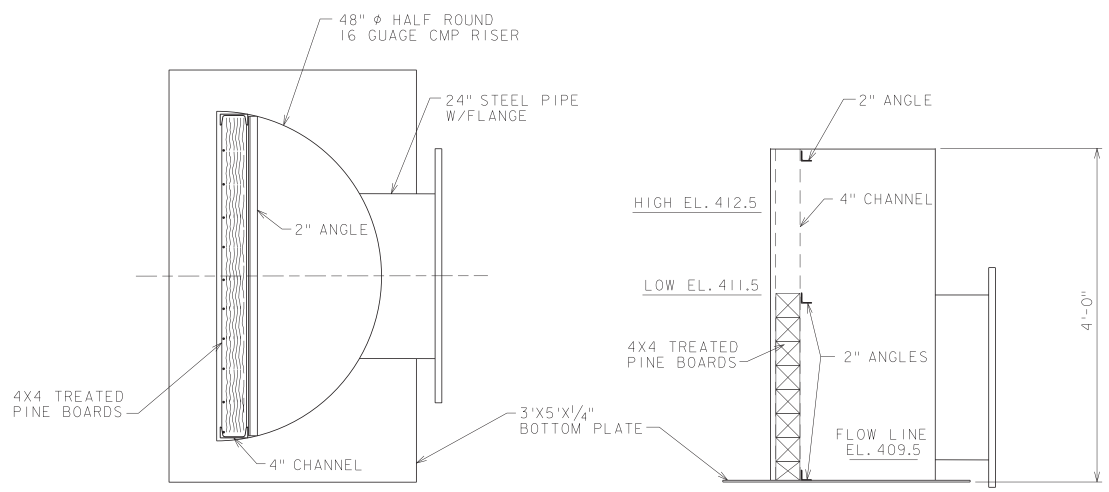
REVISIONS		
REV. 0	W.O.	
FIRST ISSUE		
REV 1	DATE 052298	DRAWN RWV
CHKD DAG	SUPV	APPD
W.O.		FILM

ADDED DECANT STRUCTURE

8020-Y-141535



A SECTION
8000-X-61041



PLAN

ELEVATION

DETAIL 1

ENLARGED VIEW OF DECANT STRUCTURE

NOTES:

1. THIS WORK TO BE DONE IN ACCORDANCE WITH U.E. SPEC. NO. EC-3572

REFERENCE DRAWINGS:
8000-X-61041-----SITE PLAN
8030-X-91928-----PARTIAL PLAN & SECTIONS
8030-X-91929-----MISC. DETAILS

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0010050503 0

*8020-Y-141535 *

REV. 0 SEALED BY

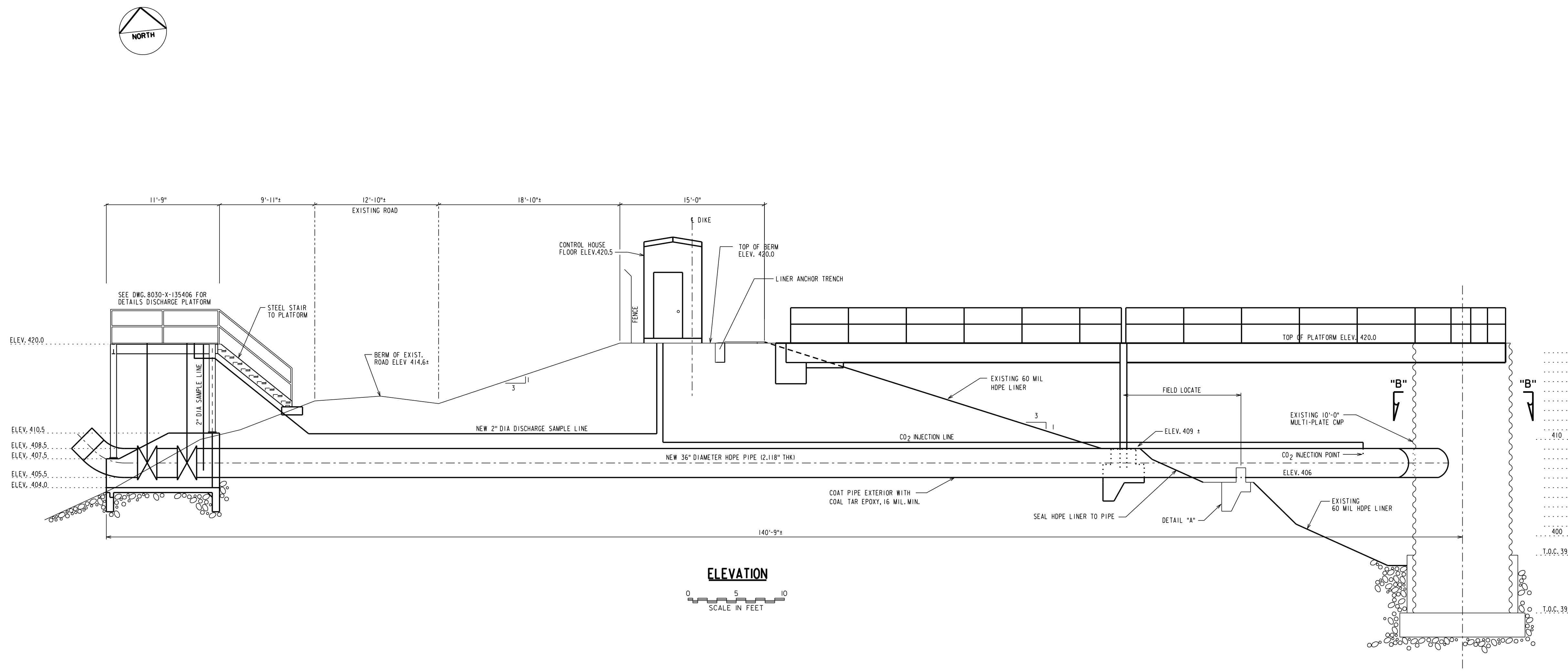
STATE OF MISSOURI CARL W. REZSONYA NUMBER E-18282 REGISTERED PROFESSIONAL ENGINEER

DRAWN 071896 MIKE LOWRY	PIPING-ASH POND DISCHARGE POND #494 & #495 1996 ADDITION	
CHKD. NOT CHKD.		
SUPV. STEVE OTT		
APPD. 7-25-96 C.W. REZSONYA	LOCATION 001005 MERAMEC PLANT	CLASS 05030
UNION ELECTRIC COMPANY ST. LOUIS, MO.	8020-Y-141535	REV. 1

37-13-118 Rev. 9-85

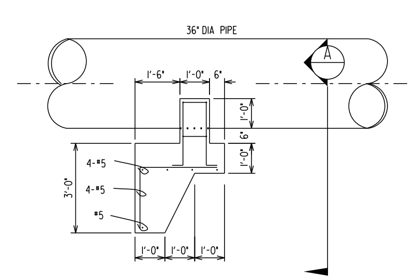
PRINT DIST.		
REVISIONS		
REV. 0	W.O. 10788	F
FIRST ISSUE		
REV 1	DATE 082900	DRAWN MLE
CHKD NOT	SUPV	APPD
W.O.		FILM
AS-BUILT		

8030-X-147376

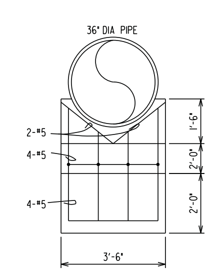


ELEVATION

0 5 10
SCALE IN FEET



DETAIL "A"



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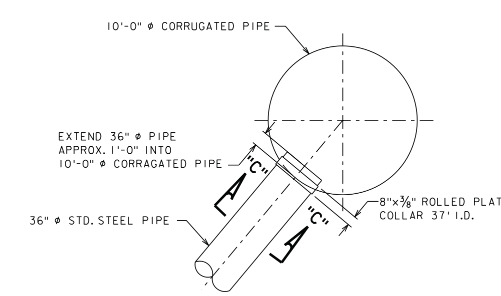
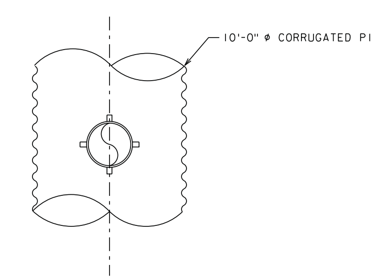


SECTION "B"



SECTION "C"

NOTE

THIS WORK TO BE DONE IN ACCORDANCE WITH U.E. SPEC. NO. EC-4022.

STEEL FRAMING - INTAKE & DISCHARGE PLATFORM 8030-X-135406
CONCRETE DETAILS - ASH POND DISCHARGE 8030-X-135521
BUILDING - CONTROL HOUSE 8030-Y-135407
PIPING - ASH POND DISCHARGE 8080-X-135408
PIPING - CO2 REGULATING STATION 8030-X-135409

1993 FLOOD LEVEL - 419.6

NOTICE OF LIMITED RESPONSIBILITY

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•0010050201O•

•8030-X-147376•

PREPARED FOR AmerenUE

REV. 0 SEALED BY

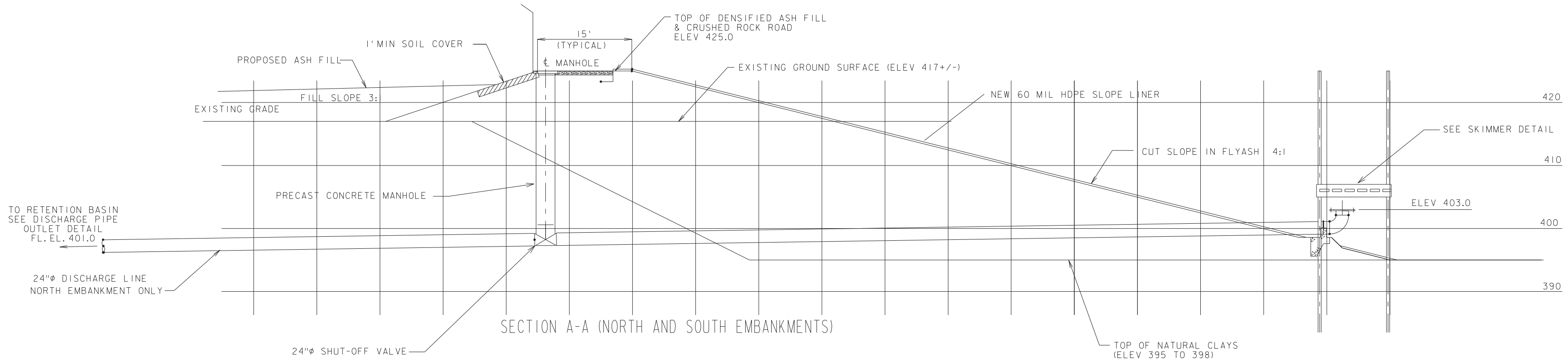
STATE OF MISSOURI CARL W. REZSONYA NUMBER E-18282 REGISTERED PROFESSIONAL ENGINEER

DRAWN 072699 M.ENGLUND	PROPERTY - ELEVATION NEW ASH POND DISCHARGE STRUCTURE
CHK/RVW NOT	
SUPV. 112999 SAH	
APPD. 072699 C.W. REZSONYA	LOCATION 001005 / MERAMEC PLANT / CLASS 02010
Ameren ST. LOUIS, MISSOURI	8030-X-147376 / REV. 1

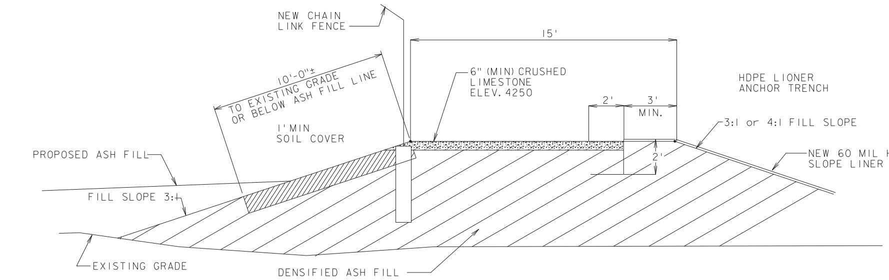
37-13-070 Rev. 9-85

SCALE RATIO = 4
THIS DRAWING HAS BEEN REFERENCED TO FILE(S):

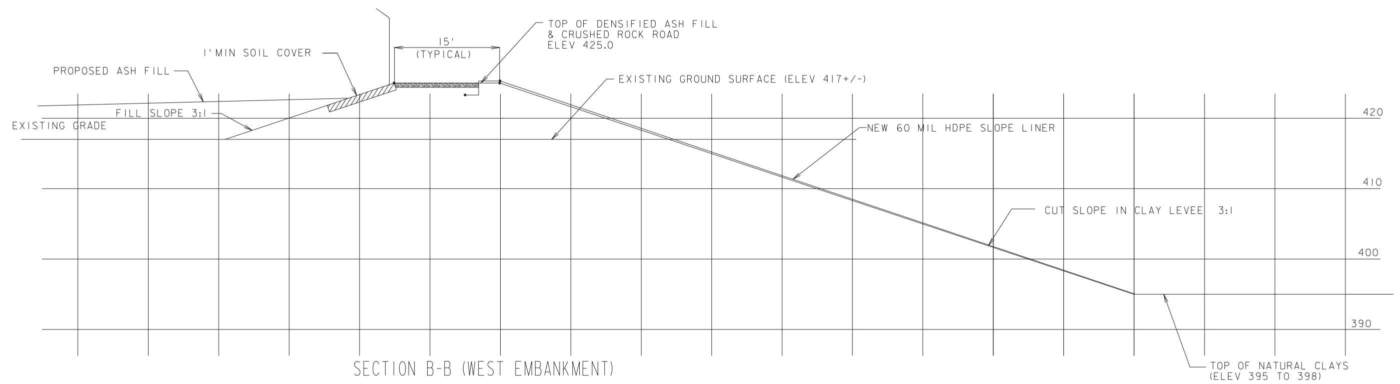
PRINT DIST.		
REVISIONS		
REV. 0	W.O.	
FIRST ISSUE		
REV 1	DATE 041801	DRAWN MGL
CHKD NOT	SUPV	APPD
W.O. 10775		FILM
BOTTOM OF LINER WAS EL. 405.0'		
REV 2	DATE 051501	DRAWN DAG
CHKD	SUPV	APPD
W.O. 10775		FILM
REV. DWG. PER ENGINEER'S COMMENTS; REV. DWG. SIZE		



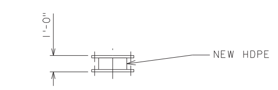
SECTION A-A (NORTH AND SOUTH EMBANKMENTS)



TYPICAL SECTION AT TOP OF LEVEE

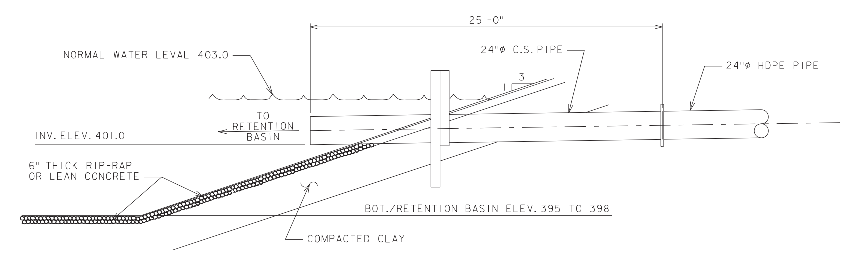


SECTION B-B (WEST EMBANKMENT)

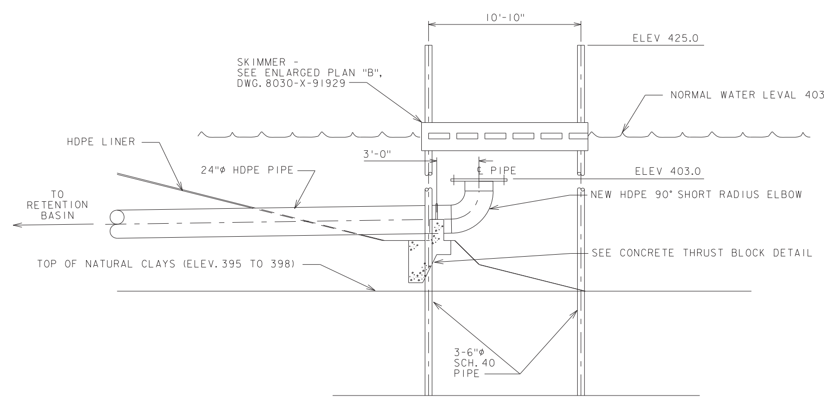


SKIMMER EXTENSION SECTION DETAIL

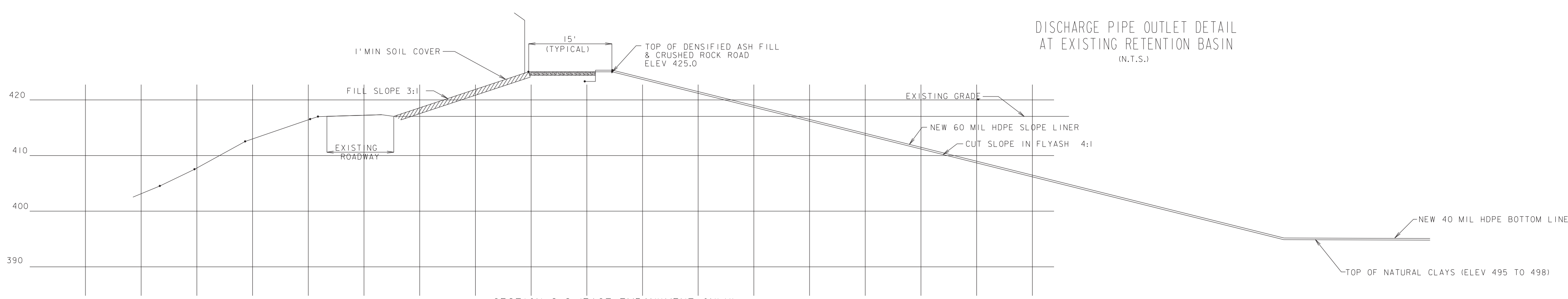
10 SECTIONS WITH BOLTS REQUIRED FOR FUTURE USE
TO BE BOLTED TOGETHER IN ONE 10'-0" EXTENSION FOR DELIVERY



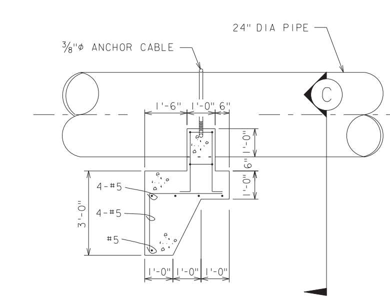
DISCHARGE PIPE OUTLET DETAIL
AT EXISTING RETENTION BASIN
(N.T.S.)



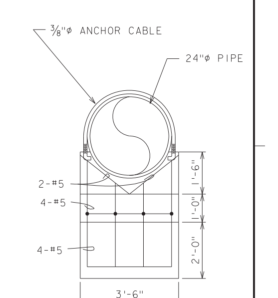
SKIMMER DETAIL
AT NORTH EMBANKMENT ONLY
(N.T.S.)



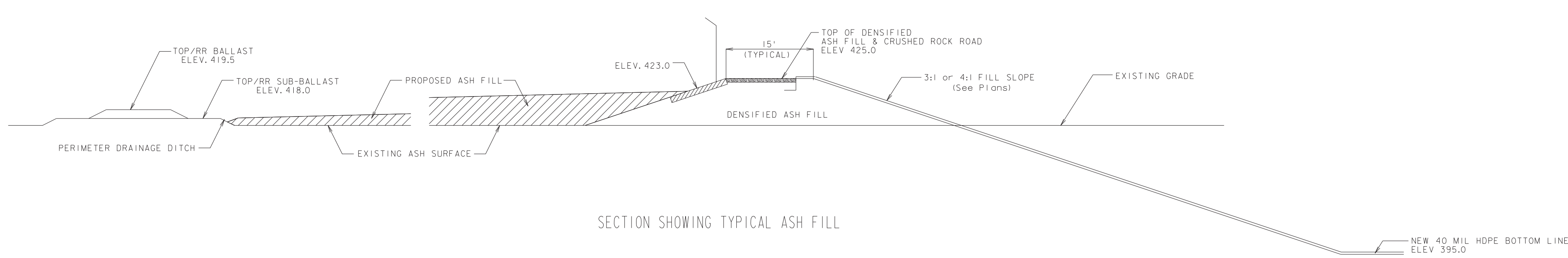
SECTION C-C (EAST EMBANKMENT ONLY)



CONCRETE THRUST BLOCK DETAIL



SECTION "C"



SECTION SHOWING TYPICAL ASH FILL

REFERENCE DRAWINGS:
ASH POND AND FILL AREA _ _ _ _ _ _ _ _ 8030-Y-154541

NOTICE OF LIMITED RESPONSIBILITY

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8030-X-152542

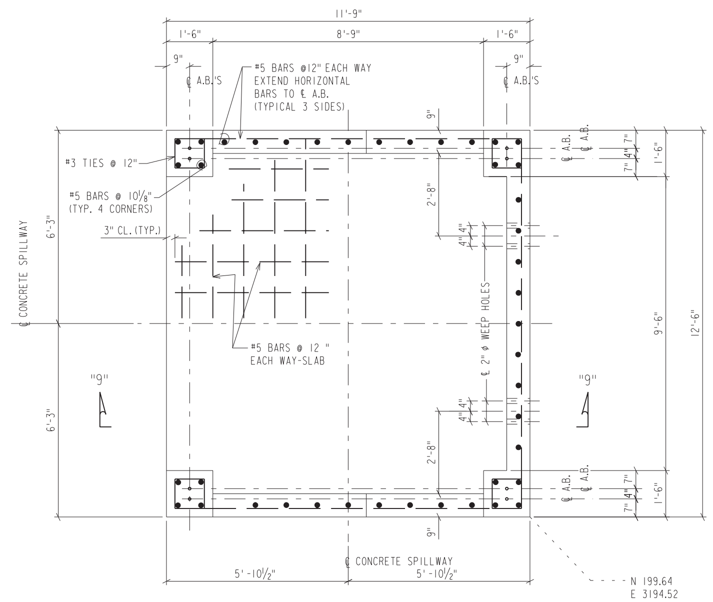
PREPARED FOR AmerenUE

DRAWN 032101 P. OTT	PROPERTY - SECTIONS NEW ASH POND AND GRADING OVER PONDS 490, 494 & 498	
CHK/RVW NOT CHKD		
SUPV. 032101 SAH		
APPD.	LOCATION 001005 — MERAMEC PLANT	CLASS 02010
Ameren ST. LOUIS, MISSOURI	8030-X-152542	REV. 2

$UPERSEDES 8030-Y-152542 REV 1 DATE 4/18/01

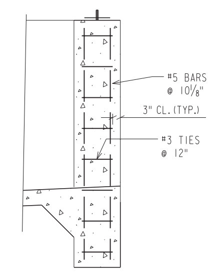
37-13-070 Rev. 9-85

8030-X-135521



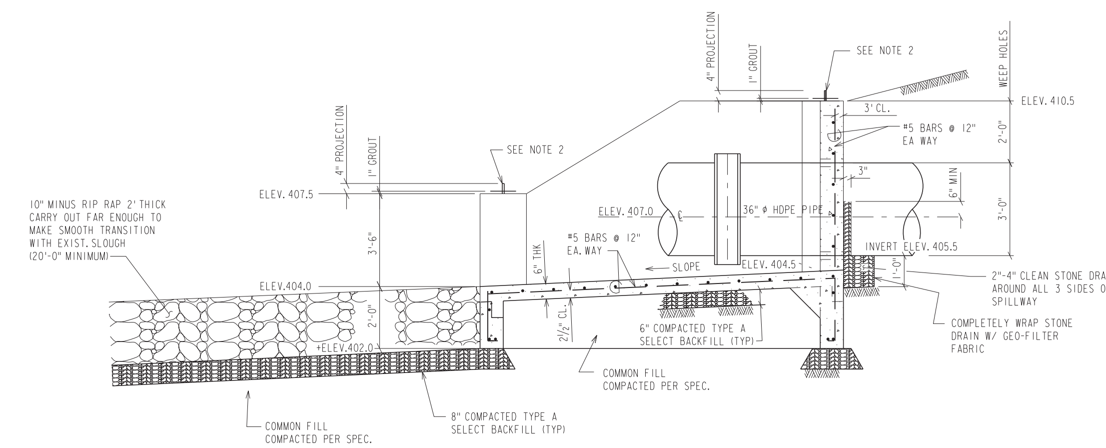
PLAN

CONCRETE SPILLWAY



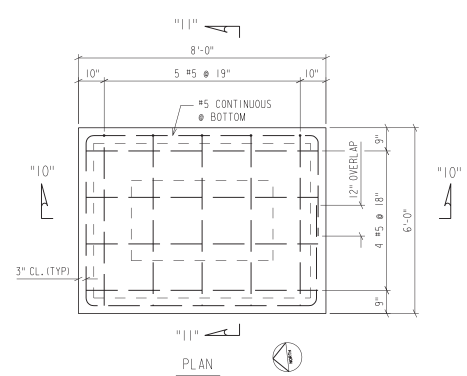
DETAIL

TYPICAL COLUMN SECTION



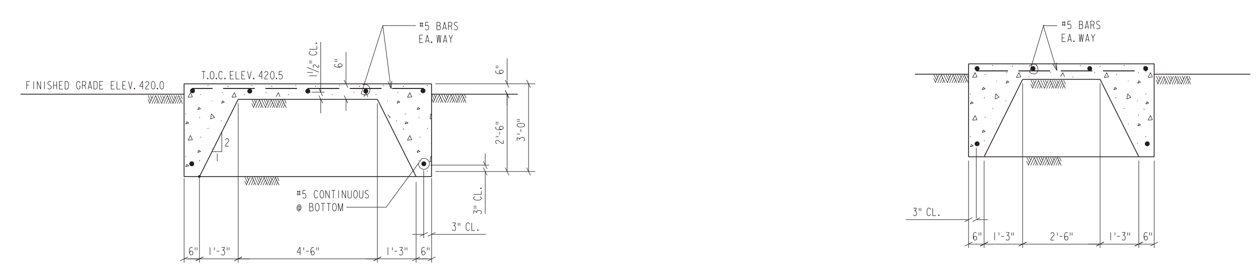
SECTION "9-9"

CONCRETE SPILLWAY



PLAN

CONTROL HOUSE FOUNDATION



SECTION "10-10"

SECTION "11-11"

SITE PLAN NEW ASH POND DISCHARGE. — 8030-X-135405
STRUCTURE - STEEL FRAMING- INTAKE & DISCHARGE STRUCT. — 8030-X-135406

NOTES

1. THIS WORK TO BE DONE IN ACCORDANCE WITH U.E. SPEC. NO. 4022.
2. ALL ANCHOR BOLTS TO BE 3/4" ϕ x1'-6" LG (U.N.O.) VERTICLE LENGTH WITH 3" HOOK, GALVANIZE.
3. CONCRETE TO HAVE A MINIMUM COMPRESSIVE STRENGTH OF 4000 P.S.I. @ 28 DAYS

1993 FLOOD LEVEL - 419.6

NOTICE OF LIMITED RESPONSIBILITY

THE RESPONSIBILITY OF THE UNDERSIGNED ENGINEER IS LIMITED TO THE DESIGN WORK SHOWN ON PROJECT DRAWINGS AND DOCUMENTS BEARING HIS/HER SEAL, SIGNATURE OR INITIALS. HE/SHE DOES NOT HAVE AUTHORITY OVER THE PROJECT AS A WHOLE. THE UNDERSIGNED DISCLAIMS ANY RESPONSIBILITY FOR WORK DONE UNDER SUBSEQUENT REVISIONS AND ANY OTHER DOCUMENTS ASSOCIATED WITH THE PROJECT WHICH DO NOT BEAR HIS/HER SEAL, SIGNATURE OR INITIALS.

0010050405 0
8030-X-135521

REV. 0 SEALED BY
STATE OF MISSOURI
CARL W. REZSONYA
NUMBER E-18282
REGISTERED PROFESSIONAL ENGINEER

DRAWN 5/13/99 M. ENGLUND	STRUCTURE - CONCRETE ASH POND - DISCHARGE STRUCT.	
CHKD. NOT		
SUPV. 11/29/99 SAH		
APPD. 12/16/99 C.W. REZSONYA	LOCATION 001005	MERAMEC PLANT — CLASS 04050
UNION ELECTRIC COMPANY ST. LOUIS, MO.	8030-X-135521	REV. 1

37-13-070 Rev. 9-85

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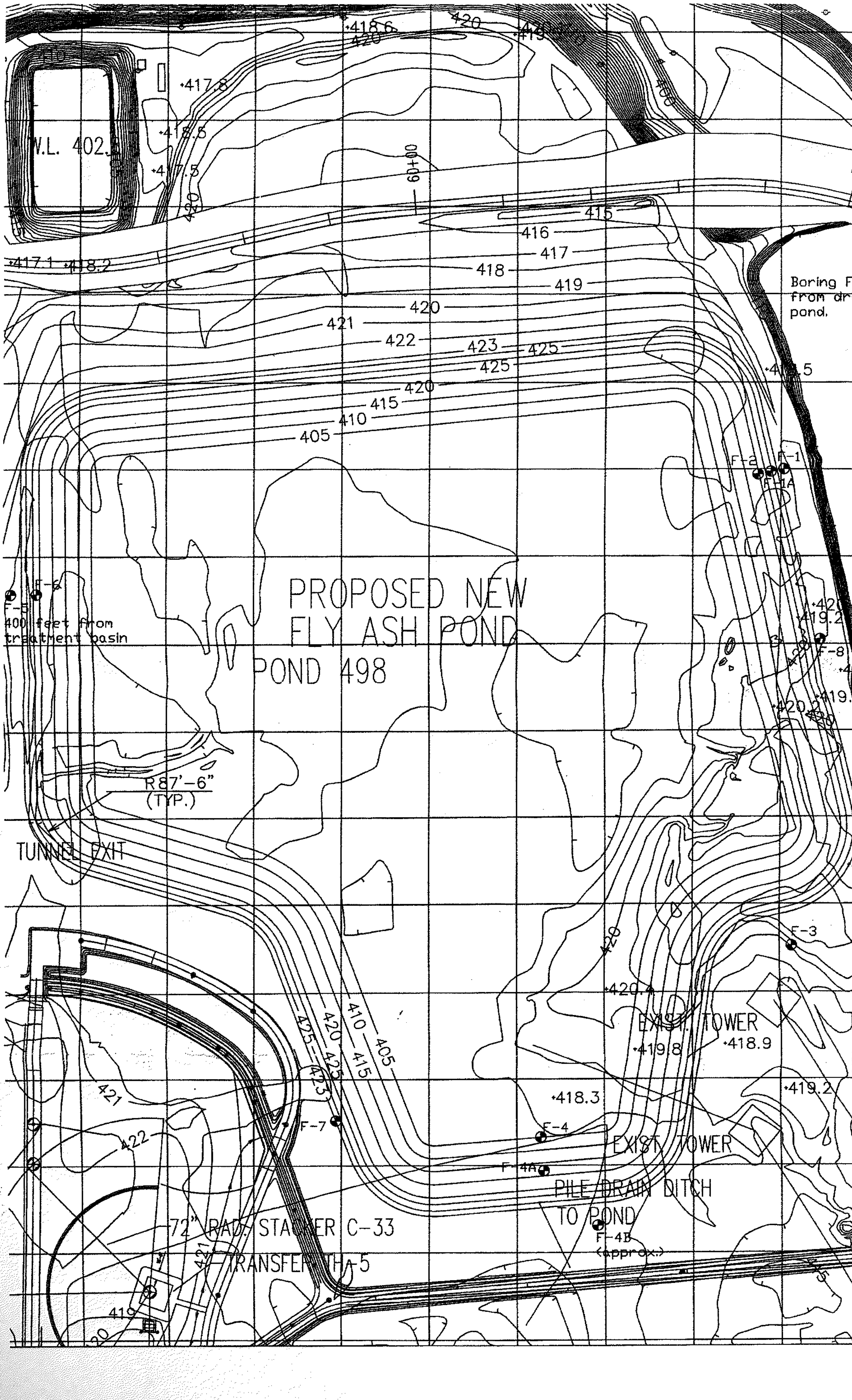

PROPOSED NEW
FLY ASH POND
POND 498
W.L. 402.
Boring F
from dr
pond.
400 feet from
treatment basin
R87'-6"
(TYP.)
TUNNEL EXIT
EXIST. TOWER
EXIST. TOWER
PILE DRAIN DITCH
TO POND
F-4B
(approx.)
72" RAD. STACKER C-33
TRANSFER TH-5
F-1
F-1A
F-2
F-3
F-4
F-4A
F-5
F-6
F-7
F-8
60+00

REITZ & JENS, INC.
CONSULTING ENGINEERS
1055 CORPORATE SQUARE DRIVE
ST. LOUIS MISSOURI 63132
(314) 993-4132

Boring No. F-1

SUBSURFACE EXPLORATION LOG

Sheet 1 of 1

Job No. ________ Job Title UE-Meramec - New Ash Pond Date 3-21-01

Depth (Elev) ft	Blows/6" (REC %) [RQD]	SYM	DESCRIPTION OF MATERIAL	Sample No.	Sample Typ	Sample Depth From	Sample Depth To	Casing Size	Casing Bl/12"	Remarks
5	8" 0-0-1		Fly Ash	1	SS	5'	6½'			
										7'
	8" 0-0-1		Brown silty clay	2	SS	7½'	9'			
										9½'
10	6" 0-1-2		Dark grey silty clay	3	SS	10'	11½'			
			Stopped Boring 11½'							
15										
20										

Boring No. ________

0-0-1
0-1-2

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SUBSURFACE EXPLORATION LOG

Boring No. F-2

Sheet 1 of 1

Job No. ________ Job Title UE - Meramec - New Ash Pond Date 3-21-01

Depth (Elev) ft	Blows/6" (REC %) [RQD]	SYM	DESCRIPTION OF MATERIAL	Sample No.	Sample Typ	Sample Depth From	Sample Depth To	Casing Size	Casing Bl/12"	Remarks
5	18" 0-0-1		Fly Ash	1	SS	5'	6½'			
10	Rec 19"		Fly Ash (Firm at Bottom)	2	ST	10'	12'			
15	18" 0-1-1		Fly Ash	3	SS	15'	16½'			
	18" 1-1-1		Fly Ash	4	SS	17½'	19'			
20	Rec. 24"		Fly Ash	5	ST	20'	22'			
	18" 0-2-2		Grey silty Clay 23' Brown silty clay 23½'	6	SS	22½'	24'			
25	18" 0-1-2		Brown silty clay	7	SS	25'	26½'			
			Stopped at 26½'							

Hit Water while drilling at 22'
Water Level after Drilling = 12.2'
Set Screen 20' to 25'
Sand 15' to 25'
12' to 15' = Bentonite chips

cut off 16" off 30' total
44" above Ground

Boring No. ________

REITZ & JENS, INC.
CONSULTING ENGINEERS
1055 CORPORATE SQUARE DRIVE
ST. LOUIS MISSOURI 63132
(314) 993-4132

15' – 15'

Between F-1 & F-2

Boring No. ______

SUBSURFACE EXPLORATION LOG

Sheet ______ of ______

Job No. ______ Job Title UE – Meramec – New Ash Pond Date 3-21-01

Depth (Elev) ft	Blows/6" (REC %) [RQD]	PP	DESCRIPTION OF MATERIAL	Sample No.	Sample Typ	Sample Depth From	Sample Depth To	Casing Size	Casing Bl/12"	Remarks
5										
10	10" 0-1-1		Fly Ash	1	SS	10'	11½			
	18" 1-2-2		Fly Ash	2	SS	13'	14½'			
15	18" 0-1-1		Fly ash cinders 15½' to 16' Dark gray silty clay at 16' to 16½'	3	SS	15'	16½'			
	18" 1-1-1		Fly Ash & Soil Mixed 18½' to 19' Silty Clay	4	SS	17½'	19'			
20	24" Rec	1.25	Grey & Brown silty Clay	5	ST	20'	22'			
			Stopped Boring @ 22'							

Boring No. ______

Brotcke Drilling
636-343-3029
Don Houston - Driller

REITZ & JENS, INC.
CONSULTING ENGINEERS
1055 CORPORATE SQUARE DRIVE
ST. LOUIS MISSOURI 63132
(314) 993-4132

SUBSURFACE EXPLORATION LOG

Boring No. F-3
Sheet 1 of 1
Job No. ________ Job Title UE - Meramec - New Ash Pond Date 3-21-01

Depth (Elev) ft	Blows/6" (REC %) [RQD]	~~OVM~~ PP	DESCRIPTION OF MATERIAL	Sample No.	Sample Typ	Sample Depth From	Sample Depth To	Casing Size	Casing Bl/12"	Remarks
5	13" 1-3-7		Fly Ash	1	SS	5'	6½'			5
	15" 1-4-5		Fly Ash	2	SS	7½'	10'			
10	15" 0-1-2		Fly Ash	3	SS	10'	11½'			10
	21" Rec		Fly Ash - Hit rock at end - Bent tip of Tube	4	ST	12½	14½'			
15										15
	17" Rec	1.0	Dark grey clay at end of tube	5	ST	17½'	19½'			
20			Hole Dry while Drilling							20
			Total Depth 19½'							
										25

Boring No. ________

1-2-5

REITZ & JENS, INC.
CONSULTING ENGINEERS
1055 CORPORATE SQUARE DRIVE
ST. LOUIS MISSOURI 63132
(314) 993-4132

SUBSURFACE EXPLORATION LOG

Boring No. F-4

Sheet ____ of ____

Job No. ____ Job Title UE-Meramec - New Ash Pond Date 3-23-01

Depth (Elev) ft	Blows/6" (REC %) [RQD]	PP	DESCRIPTION OF MATERIAL	Sample No.	Sample Typ	Sample Depth From	Sample Depth To	Casing Size	Casing Bl/12"	Remarks
	13" 1-2-5	4.5*	Fly Ash	1	SS	2½'	4'			
5	18" 1-0-1	0	Fly Ash	2	SS	5'	6½'			
	18" 2-2-2	0 to 2.5	Fly Ash	3	SS	7½'	10'			
10	18" 0-0-1	0	Fly Ash	4	SS	10'	11½'			
			Total Depth = 11½'							
15			This is ? old Levee Road,							
20										
25										

Dry while Drilling & After

Boring No. ____

1-3-2

REITZ & JENS, INC.
CONSULTING ENGINEERS
1055 CORPORATE SQUARE DRIVE
ST. LOUIS MISSOURI 63132
(314) 993-4132

SUBSURFACE EXPLORATION LOG

Boring No. E-4-A

Sheet ______ of ______

Job No.________ Job Title UE - Meramec - New Ash Pond Date 3-23-01

Depth (Elev) ft	Blows/6" (REC %) [RQD]	~~SMI~~ PP	DESCRIPTION OF MATERIAL	Sample No.	Typ	Depth From	Depth To	Casing Size	Bl/12"	Remarks
	18" 1-3-2		Fly Ash	1	SS	2½'	4'			
5	18" 1-1-1		Fly Ash	2	SS	5'	6½'			
	18" Rod wt. 0-0-0		Fly Ash	3	SS	7½'	10'			
10	Rec. 19"	0	Fly Ash	4	ST	10'	12'			
	18" 0-0-2		Fly Ash	5	SS	12½'	14'			
15	Rec. 24"	0	Fly Ash - Sample almost Liquid -	6	ST	15'	17'			
	18" 0-1-1		Fly Ash	7	SS	17½'	19'			
20	Rec. 18"	0.5	Grey w/ some Brown HP Clay.	8	ST	20'	22'			
	1-3-4	1.75	Grey &/ Brown HP Clay	9	SS	22½'	24'			
25			Total Depth: 24'							
			Proposed End of Pond							

Hole Dry while Drilling

Boring No. __________

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ST. LOUIS MISSOURI 63132
(314) 993-4132

other old levee Rd. ?

Boring No. F-4-B

SUBSURFACE EXPLORATION LOG

Sheet ______ of ______

Job No.________ Job Title UE - Meramec - New Ash Pond Date 3-23-01

Depth (Elev) ft	Blows/6" (REC %) [RQD]	SYM	DESCRIPTION OF MATERIAL	Sample No.	Sample Typ	Sample Depth From	Sample Depth To	Casing Size	Casing Bl/12"	Remarks
5	18" 1-1-1		Fly Ash	1	SS	5'	6½'			
10	18" 0-1-1		Fly Ash	2	SS	10'	11½'			
			Stopped at 10' Hole Dry while Drilling							
15										
20										

Boring No. ________

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SUBSURFACE EXPLORATION LOG

Boring No. F-5

Sheet ____ of ____

Job No. ________ Job Title UE - Meramec - New Ash Pond Date 3-21-01

Depth (Elev) ft	Blows/6" (REC %) (RQD)	SYM	DESCRIPTION OF MATERIAL	Sample No.	Sample Typ	Sample Depth From	Sample Depth To	Casing Size	Casing Bl/12"	Remarks
5	11" 1-1-2		5" Fly Ash 6" Brown silty Clay	1	SS	5'	6½'			
	14" 0-2-2		Grey clay & Brown silty clay w/ Vegetation	2	SS	7½'	9'			
10										
15	23" Rec		Brown silty clay	3	ST	15'	17'			
			Stopped Boring at 17'							
20										

Dry while Drilling
Dry after Drilling

Boring No. ________

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1055 CORPORATE SQUARE DRIVE
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SUBSURFACE EXPLORATION LOG

Boring No. E-6

Sheet ____ of ____

Job No. ________ Job Title UE - Meramec - New Ash Pond Date 3-21-01

Depth (Elev) ft	Blows/6" (REC %) [RQD]	PP	DESCRIPTION OF MATERIAL	Sample No.	Sample Typ	Sample Depth From	Sample Depth To	Casing Size	Casing Bl/12"	Remarks
5	3" 0-0-0		Grey silty clay & Fly Ash	1	SS	5'	6½'			
	18" 1-1-1		Fly Ash	2	SS	7½'	9'			
10	0-0-0		Fly Ash	3	SS	10'	11½'			
15	13" Rec		Fly Ash	4	ST	15'	17'			
	24" Rec	0.5	Grey Clay	5	ST	17½'	19½'			
20	0-2-2		Grey clay w/ Some Veg.	6	SS	20'	21½'			
			Stopped at 21½'							

Dry while Drilling - Piez. - ~~2~~ 25' - 11" cut off

Boring No. ________

4.5' from top to ground Surface

5' Screen

10' Filter Sand

3' Bent. chips

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CONSULTING ENGINEERS
1055 CORPORATE SQUARE DRIVE
ST. LOUIS MISSOURI 63132
(314) 993-4132

SUBSURFACE EXPLORATION LOG

Boring No. F-7

Sheet ______ of ______

Job No. ______ Job Title UE - Meramec - New Ash Pond Date 3-23-01

Depth (Elev) ft	Blows/6" (REC %) [RQD]	~~SWR~~ PP	DESCRIPTION OF MATERIAL	Sample No.	Typ	Depth From	To	Casing Size	Bl/12"	Remarks
	18" 0-0-1		Fly Ash	1	SS	2½'	4'			
5										
	2-1-1		Fly Ash	2	SS	7½'	9'			
10										
	Rec. 24"		Fly Ash	3	ST	10'	12			
	18" 0-2-6		Fly Ash S-4 = Bottom 4"	4	SS	12½'	14'			
			S-4A = Top =	4						
15										
	Rec. 20"		Fly Ash	5	ST	15'	17'			
	1-1-4		Fly Ash	6	SS	17½'	19'			
20										
	Rec. 24"		Fly Ash	7	ST	20'	22'			
	Rec 18" 0-1-1		Fly Ash	8	SS	22½	24'			
25										
	Rec. 24"	0.75	Brown & grey Clay	9	ST	25'	27'			
			Stopped at 27'							

Hit Water while drilling at 15.0'
Water at 15.0' at end

Boring No. ______

200' South of F-1

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1055 CORPORATE SQUARE DRIVE
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(314) 993-4132

Boring No. F-8

SUBSURFACE EXPLORATION LOG

Sheet ______ of ______

Job No. ________ Job Title UE-Meramec - New Ash Pond Date 3-23-01

Depth (Elev) ft	Blows/6" (REC %) [RQD]	PP	DESCRIPTION OF MATERIAL	Sample No.	Typ	Depth From	Depth To	Casing Size	Bl/12"	Remarks
										Location 200' South of F-1
5	18" 1-0-1		Fly Ash	1	SS	5'	6½'			
	18" 0-0-1		Fly Ash	2	SS	7½'	9'			
10	5" 0-0-1	0.0	PP on soil = 0 Brown silty clay at 11' to 11½' - Soft	3	SS	10'	11½'			
		0.5	Brown & Grey HP clay	4	ST	12'	14'			
15	Rec 14"	2.25	Brown & grey HP Clay	5	ST	15'	17'			
20	Rec 22"	1.75	Brown w/some grey HP Clay	6	ST	20'	22'			
			Stopped at 22'							
25										

No Water while Drilling or at end
Back filled w/C-Ash

Boring No. ________

REPORT

PHASE I
GEOTECHNICAL INVESTIGATION FOR
MERAMEC POWER PLANT RAIL LOOP
ST. LOUIS, MISSOURI

Prepared for

AMEREN SERVICES
St. Louis, Missouri

Prepared by

REITZ & JENS, Inc.
Consulting Engineers
St. Louis, Missouri

STATE OF MISSOURI
JEFFREY
FOUSE
NUMBER
E-21043
12/8/99
REGISTERED PROFESSIONAL ENGINEER

December 8, 1999

The Professional, whose signature and personal seal appear hereon, assumes responsibility only for what appears in the attached report and disclaims (pursuant to Section 327.411 RSMo) any responsibility for all other plans, specifications, estimates, reports, or other documents or instruments not sealed by the undersigned Professional relating to or intended to be used for any part or parts of the project to which this report refers.

REITZ & JENS, Inc. · 1055 Corporate Square Drive · St. Louis, Missouri 63132 · 314 993-4132
CONSULTING ENGINEERS FAX · 314 993-4177

December 8, 1999

Ameren Services
One Ameren Plaza
1901 Chouteau Avenue
P.O. Box 66149, MC 402
St. Louis, Missouri 63166-6149

Attention: Mr. Thomas Hollenkamp, P.E.
Supervising Engineer, Engineering & Construction

Re: Report of Phase I Geotechnical Investigation for
Meramec Power Plant Rail Loop
St. Louis, Missouri

Gentlemen:

This report presents our findings and recommendations for Phase I of the geotechnical investigation for the proposed rail loop at the Meramec Power Plant. The purpose of this investigation was to further study the feasibility of alternative methods for improving the capabilities of the flyash in the various ponds at the Meramec Plant to support the new rail loop. Phase I included four borings and three cone penetrometer soundings to obtain characteristics of the subsurface materials. However, the number and locations of the borings were restricted due to lack of access into the flyash ponds that still have surface water. Only Ponds 491 and 498 could actually be investigated. We relied primarily on borings that Reitz & Jens and others have done for previous studies at the Meramec Power Plant dating back to 1937.

Where the proposed railroad embankment will be constructed on the flyash ponds, we propose removing the existing flyash to a depth of five feet, and drying and compacting the flyash on top of a 2-foot thick blanket of compacted granular backfill. This provides a densified base "mat" on which the embankment may then be constructed. This report also contains recommendations pertaining to the coal car hopper, the stability of the existing Meramec River levee, miscellaneous foundations, and other pertinent issues, plus recommendations for Phase II.

We look forward to working with Ameren Services and Design Nine during the design and construction phases. Thank you for selecting Reitz & Jens.

Sincerely,
REITZ & JENS, INC.

Jeffrey L. Fouse

Jeffrey L. Fouse, P.E.
Senior Project Engineer

Executive Summary

This is the report of our geotechnical investigation for the proposed rail loop for coal trains at the Meramec Power Plant. The study was done in general accordance with our proposal dated July 21, 1999. The purpose of this investigation was to further study the feasibility of alternative methods for improving the capabilities of the flyash in the various ponds at the Meramec Plant to support the new rail loop. Some alternatives and preliminary construction cost estimates were presented in our design memorandum, dated April 9, 1999. The alternatives considered included: 1) complete removal of the flyash, drying, and backfilling; or 2) *in situ* densification of the flyash by vibro-replacement stone columns.

The recommendations in our previous design memorandum were based upon: 1) a requirement to limit settlement of the sub-ballast to 1 inch, and 2) the depth of the flyash equal to about 35 feet. We understand from further discussion with Design Nine that settlements of several inches may be tolerated by the track structure. Differential settlement adjacent to the deep hopper pit should be limited to 1 inch, however. Also, further research of previous borings along the track alignment, and new borings made for this investigation, indicate that the average depth of the flyash is about 25 feet. Therefore, our new recommendation is a partial removal-and-replacement of the flyash.

Where the railroad loop embankment will cross the flyash ponds, we recommend removing the flyash to a depth of 5 feet. The bottom of this overdig will vary between about el. 406 and el. 411, which should be above the maximum Mississippi River stage in most years. The flyash that is removed may be dried for use as fill. A 2-foot thick of compacted granular fill should be placed in the bottom of the overdig, with a woven geofabric such as Mirafi HP570 at about the center of the granular fill. This blanket will provide a base upon which to place and compact the flyash to build the embankment. Where the embankment will cross the bottom ash ponds, we recommend constructing the embankment using coarse "shot rock" fill. The bottom ash is coarser than the flyash, so it should not be necessary to overexcavate the bottom ash to create a base.

The lower floor of the proposed coal car hopper will be at el. 365.63. Deep dewatering wells will not be used, to avoid creating a hydraulic connection between the flyash pond and the deep sands and gravels. Therefore, we recommend driving a rectangular sheetpile cofferdam, and excavating within the cofferdam without dewatering to 5 to 10 feet below the proposed bottom of the floor slab, and then using a tremie to pour a 5- to 10-foot thick concrete "mud mat." The mud mat is to provide a seal and a stable bottom so that the cofferdam may be unwatered. Interior wales and struts will be required to support the sheetpile cofferdam until the excavation is backfilled.

The proposed railroad loop will be about 75 feet from the interior of the Waste Water Treatment Pond (WWTP); therefore, the additional load should not affect the retaining wall of the WWTP. The stability of the existing Meramec River Levee at the closest points of the proposed railroad embankment is adequate for static load conditions. However, the minimum factor of safety against a deep slope failure is less than 1 for seismic loads. This is discussed further in this report.

Table of Contents

LIST OF FIGURES

Table of Contents (cont.)

FIGURES (cont.)

APPENDICES

Phase I Geotechnical Investigation
Meramec Power Plant Rail Loop
St. Louis, Missouri

INTRODUCTION

A railroad loop is planned for the Ameren/U.E. Meramec Power Plant in south St. Louis County, for unloading coal trains. The railroad loop will cross existing flyash and bottom ash ponds. The purpose of this investigation was to further study the feasibility of alternative methods for improving the capabilities of the flyash and bottom ash in the various ponds to support the new railroad track and embankment. This report summarizes our findings and recommendations for Phase I of this investigation, which included four borings and three cone penetrometer soundings to obtain characteristics of the subsurface materials. Because of the limited amount of field exploration under Phase I, our findings and recommendations are primarily based upon borings that Reitz & Jens and others have done for previous studies at the Meramec Power Plant dating back to 1937. The goals of Phase I were:

- develop a cross-section for the railroad track embankment where it will cross the flyash and bottom ash ponds to provide a stable subbase and to limit settlements to less than 2 inches over the first several years,
- provide foundation recommendations for the coal car hopper,
- provide recommendations for miscellaneous shallow foundations,
- provide lateral earth pressures for the design of the coal car hopper,
- check the stability of the existing Meramec River levee under the imposed load of the new railroad loop,
- check the stability of the Waste Water Treatment Pond under the imposed load of the new railroad loop, and
- provide recommendations for Phase II of the investigation.

Because the scope of services and level of effort are specific to the needs of this project, the contents of this report may not address items critical to other projects. Therefore, this report is not to be used for other projects or by third parties without Reitz and Jens' written authorization.

PROJECT DESCRIPTION

The proposed railroad loop is shown in Figure 1. Partial plans are shown in Figures 2 through 7, with the profile of the top of rail. The proposed loop is 9,263 feet long, with a connecting wye or spur track, 978 feet long, where the coal car hopper and car heaters will be located. The proposed top of rail is at about el. 419 where it will connect to the U.P.R.R. tracks (at Sta. 0+00) and rises to about el. 425 to cross the pipes that feed Ash Pond 489. The top of rail varies between about el. 417 to el. 424 around the loop. The top of rail at the coal car hopper is el. 424.38.

The typical embankment proposed by Design Nine, Inc. will be 24 feet wide, with a minimum of 12 inches of subballast. The subballast will be crushed limestone, sand and gravel, with a gradation in accordance with Missouri Department of Transportation (MoDOT) Type 2 Aggregate (100 percent passing a 1-inch sieve, 15 to 35 percent passing a No. 40 sieve, and less than 5 to 12 percent passing a No. 200 sieve). The track section will have a minimum of 10 inches of ballast below the ties.

A plan and sections of the proposed coal car hopper are shown in Figure 8. The overall interior dimensions of the hopper are 119 feet by 25 feet wide. The upper floor of the hopper is 33 feet below the top of rail. The lower floor of the hopper is 58.75 feet below the top of rail, or at el. 365.63. A permanent dewatering system will not be used. Therefore, the walls of the hopper must be designed for hydrostatic pressure and the floor slabs must be designed for the uplift pressure. The total soil bearing pressure of the coal car hopper will be 6000 psf.

Other features of the project include a "bad order" track and coal car heaters located adjacent to the hopper. Also, the railroad loop will cross an existing high-pressure natural gas pipeline at two or three locations. The depth of the gas pipeline is not known.

The existing waste water treatment pond (WWTP) located at the north end of the railroad loop has about 3 feet of water. The bottom of the pond is at el. 396. The top of the retention system is about 2.5 feet above the water level. The retention system consists of double channels with 3-inch lagging boards. The slope above the retention system is about 1.5(h) to 1(v). The approximate ground surface surrounding the WWTP is at el. 417. The centerline of the proposed railroad loop is about 75 feet from the interior wall of the pond. No additional height of embankment is planned in the vicinity of the WWTP, except for the minimum subballast and ballast.

Our findings and recommendations are based in part upon our understanding of this project, as described above. Changes or discrepancies in loads, geometry, location, or the scope of the project from the above description should be considered to invalidate our findings and recommendations until we have reviewed the differences and, if necessary, modified our findings and recommendations accordingly.

SITE DESCRIPTION

The Ameren/U.E. Meramec Power Plant is located adjacent to the confluence of the Meramec and the Mississippi Rivers, in the southern corner of St. Louis County. The site is underlain by floodplain deposits of the two rivers. The Meramec River is a relatively steeply-graded river, and carries a greater percentage of sand and gravel sediments than the Mississippi River. The deposits from the Mississippi River consist more of fine sand, silts and clays. Because of the location of the site, the deposits will be very heterogeneous, both vertically and horizontally. Deposits of soft, high plastic clay tend to occur in lenses or long channels, where temporary backwater situations were created by the relative stages of the two rivers.

The readings from piezometers previously installed at the Meramec Power Plant indicate that the general groundwater levels follow closely with the stage of the adjacent Mississippi River. Historic records of the Mississippi River stages, between 1990 and 1997, indicate that the stage varies between about el. 369 and el. 406.5, except in 1993 and 1995 when the high water stage reached about el. 416.5 and el. 412, respectively.

From Sta. 0+00 to about 4+30, the proposed railroad loop will cross the existing railroad tracks. From Sta. 4+30 to about Sta. 11+20, the loop will cross the area of the coal storage pile and the surface pipelines that carry flyash from the plant to Ash Pond 489. The wye of the loop and the coal car hopper will be located within the limits of Flyash Pond 491, also referred to as the "trash pond." This pond is inactive. The surface is at about el. 416.5 to 417.5. Therefore, up to 6 feet of fill will be required in this area. A thin crust of dry flyash provides some support. However, the all-terrain vehicle (ATV) drill rig broke through the crust several times.

From about Sta. 16+30 to Sta. 45+30, the railroad loop will cross Flyash Ponds 495 and 494. These ponds are not receiving flyash, but are used to convey excess water from Ash Pond 489 to the WWTP. So, most of the site of the proposed embankment is currently under water. Up to about 9 feet of fill will be required in Flyash Pond 495, and up to about 9 feet in 494. The centerline of the railroad loop will be about 56 feet from the top of the existing levee at Sta. 29+00 and again at Sta. 30+50.

From about Sta. 45+30, in the vicinity of the WWTP, the railroad loop will run along an existing levee, and then cross Flyash Pond 498 from Sta. 47+00 to Sta. 53+00. This pond is inactive and is dry. The surface elevation is at about 417.5. The height of the embankment will be limited to the minimum thicknesses of subballast and ballast.

From about Sta. 53+00 to Sta. 61+00, the railroad loop will cross Bottom Ash Pond 493. This pond is currently flooded. The water level was at el. 408.9 on the date of the topographic survey (September 21, 1999). The current depth of the pond and the thickness of the bottom ash are not known. From Sta. 61+00 to about Sta. 80+00, the loop will run along the edges of Bottom Ash Ponds 492 and 496, and then cross Pond 496. These ponds are either currently flooded or heavily over-grown with brush and trees. A boring was planned for this Phase I investigation in Pond 496, but we could not gain access because of the surface water. Beyond Sta. 80+00, the railroad loop will cross the existing levee and road, and join the wye to be located in Flyash Pond 491.

PREVIOUS INVESTIGATIONS

For this Phase I investigation, we reviewed subsurface information which we have in our files for projects dating back to 1937 (the original borings for the plant). The approximate locations of those historic borings pertinent to the railroad loop are shown in Figures 1 through 7.

Reitz & Jens performed an investigation for the proposed Union Colliery plant that was to be located in Bottom Ash Pond 496. Fourteen borings were made in 1975. Several of these borings, labeled "UC-" are shown in Figures 1 through 7. Consolidation tests were performed on 12 samples of the underlying low plastic and high plastic clays. These data were used in the settlement analyses for this Phase I study.

Reitz & Jens, Union Electric and an earthwork contractor experimented with methods of densifying and excavating the flyash in 1975. In general, the surface of the flyash was made trafficable by densifying with vibratory compactors and by providing a means to collect and remove the water displaced by the densification. The initial densification was done with light-weight equipment. Subsequently, heavier compactors and equipment could be used as the surface density was increased. The dry unit weight of the flyash was increased from about 60 lbs/ft^3 to between 78 and 88 lbs/ft^3. This indicates a possible shrinkage of about 20 percent.

Reitz & Jens investigated a number of slides in the Meramec River levee between 1978 and 1987. Fourteen borings were made in Flyash Ponds 490 and 498 in 1988 for a study for the transfer of flyash between ponds. The data from these borings indicated that there is a relatively "weak clay layer" throughout the site between about el. 350 and el. 370.

Design Memorandum of Geotechnical Considerations/Cost Estimate

As directed by Ameren Services on March 19,1999, we have reviewed our internal records and the existing site conditions to develop the following preliminary recommendations for constructing the railroad loop. No more than 1 inch of differential settlement in the subballast was to be considered at that time. Two options are available for reworking the bottom ash: 1) complete removal and replacement of the flyash, and 2) in-situ densification.

Using previous records of the material properties of the flyash in the ponds, we estimated the temporary and permanent slopes and cross-sections required to construct and support the anticipated railroad loads. The existing data suggested a temporary excavation up to 35 feet deep would require approximately 4.5:1 side slopes to be stable without dewatering the ponds. Based on these slopes, we estimated that a total of 1,400,000 c.y. of flyash would be excavated and temporarily stockpiled. Approximately 390,000 c.y. of this material would be dried and recompacted to create the 1:1 slopes. We assumed that the remaining 1,000,000 c.y. of flyash would be pushed back into the excavation to confine the new slope. Approximately 16,600 c.y. (29,000 tons) of MODOT Type 2 aggregate would be needed to cap the flyash fill above the existing ground surface and to construct the subballast. An additional 10,000 c.y. (15,500 tons) of shot rock would be required to create the desired cross-section across the existing bottom ash pond.

The total estimated cost to create an adequate railroad subgrade using the remove and replace method was $ 7.3 million.

An alternative to the complete removal and replacement that was considered was to densify the existing flyash fills in place. We contacted Hayward Baker, Inc. to discuss alternative methods for densifying the existing flyash fills in this manner. They advised they had recently completed a similar project in a flyash pond for Pekin Energy in Pekin, Illinois. Hayward Baker 's preliminary recommendations for the Meramec railroad loop were to densify the existing flyash beneath the new embankment using vibro-replacement stone columns. Their preliminary estimate would require 3-ft. diameter stone columns to the underlying natural soils on an 8-foot by 8-foot grid. Their preliminary cost estimate for densifying an area of flyash 44 feet wide by 35 feet deep and 6500 feet long was $4.2 million. The cost for building the fills in the bottom ash ponds, raising the tracks above the existing ponds, and importing the necessary MODOT Type 2 aggregate for the subballast added approximately $ 700,000.

On the basis of these preliminary construction cost estimates, we proceeded with this Phase I investigation. Initially, deep soil mixing was also considered to improve the characteristics of the flyash in-situ. Some laboratory tests using the flyash and several admixtures were performed. From further discussions with Design Nine, we understand that settlements of several inches may be tolerated by the track structure. Differential settlement adjacent to the deep hopper pit should be limited to 1 inch, however.

SUBSURFACE INVESTIGATION

The field work for this investigation consisted of four test holes and four cone penetrometer soundings, the approximate locations of which are shown in Figures 1 through 7. Test holes were located by Reitz & Jens using existing features. The elevation of the existing ground surface at each boring was estimated from the contour lines on the topographic survey dated September 21, 1999. The test holes were drilled between August 26 and September 1, 1999, by Brotcke Well and Pump, Inc., using a CME 750 drilling rig mounted on an all-terrain vehicle (ATV). The test holes were advanced using 4-¼ in. I.D. hollow-stem augers. Borings TH-H and TH-N were drilled to auger or sampler refusal on bedrock, about 108 feet and 106.5 feet deep, respectively. Borings TH-A and TH-L were drilled into through the flyash and into the underlying natural clay. The field investigation was done under the direction of a Reitz & Jens ' Senior Soils Technician, who determined the sampling intervals and the termination depths, and logged the borings. Detailed boring logs included in Appendix A. Graphic representations of the major soil strata encountered in the borings are shown in Figures 2 through 7.

Samples of subsurface materials were obtained at about 2.5-foot intervals for the first 10 feet, and at 5-foot intervals below 10 feet. Two types of samplers were used: 1) a hydraulically pushed, 3-in. O.D., thin-walled "Shelby tube" sampler (ASTM D-1587); and 2) a 2-in. O.D., split-spoon sampler driven by a 140-lb. hammer in conjunction with a Standard Penetration Test (ASTM D-1586). The blow counts from these tests are shown on the boring logs. The disturbed split-spoon samples obtained were visually classified in the field and sealed in glass jars to prevent loss of moisture, for later testing in the laboratory. The relatively undisturbed Shelby tube samples were sealed in the tubes for testing in the laboratory. Borings were logged in the field based upon recovered samples, cuttings, and drilling characteristics. Boring logs were subsequently modified as appropriate based on laboratory test results.

In addition to the borings, cone penetrometer sounds through the flyash were made at TH-G, and adjacent to Borings TH-H and TH-L. This was done to develop correlations between the results of the cone penetrometer and the borings, which may be used in Phase II of this investigation. The results of the cone penetrometer readings are included in Appendix C.

LABORATORY TESTING PROGRAM

All recovered samples were visually described in general accordance with the Unified Soil Classification System and the Standard Test Method for Classification, Description, and Identification of Soils (ASTM D-2487 and D-2488). Index tests performed included: water content and dry unit weight (ASTM D-2216), liquid and plastic limits (ASTM D-4318), unconfined compressive strength (ASTM D-2166). The results of these index tests appear on the detailed borings logs. A consolidated and undrained triaxial shear strength test with pore pressure readings was performed on a flyash sample from Boring TH-N. Eight consolidation tests were performed on samples of the flyash and the underlying clays. The number of triaxial and consolidation tests were limited because of the difficulty in obtaining and preparing relatively undisturbed samples of the flyash. The results of the triaxial and consolidation tests are presented in Appendix B.

Testing of Admixtures to Flyash

As stated previously, deep soil mixing was considered to improve the properties of the flyash in place. Deep soil mixing involves the mixing of an additive, such as cement, lime or flyash, to the soil by use of rotating "paddles" arranged in a row. We simulated the in-situ mixing of the flyash with a blender, using dough-hooks and a limited mixing time of 1 minute, as suggested by Hayward-Baker. We mixed combinations of flyash and cement, flyash and Type "C" flyash, flyash and hydrated lime, and part cement and part Type "C" flyash. We formed miniature cylinders, which were moist cured and tested for unconfined compressive shear strength at 3, 7 and 14 days. We had numerous difficulties in preparing and forming the cylinders. Our initial results indicated that adding the Type "C" flyash had little benefit compared to the disturbance by the mixing itself. Substantial gains in strength were achieved using cement or hydrated lime, but this significantly increases the costs of the deep soil mixing. We stopped further testing when it was decided that a partial remove-and-replacement scheme would be effective.

SUMMARY OF SUBSURFACE CONDITIONS ENCOUNTERED

Generalized subsurface profiles are shown along the railroad loop in Figures 2 through 7. The depths of the flyash in the existing ponds ranged from about 11 to 30 feet deep, and averaged about 25 feet deep. Underlying the flyash are strata of low plastic silty clays, silts, and high plastic clays, with various intermediate strata of sands and gravels. The stratification is very variable due to the alluvial origin of the deposits, as discussed earlier. Generally, the clay strata contained layers and seams of fine sand and silty sand. Also, the clay strata are generally near normally-consolidated, that is the strata have not previously been subjected to higher overburden pressures than exist at present.

Where present, the top of the underlying sand and gravel stratum varied between el. 325 and about el. 368. A few deep borings encountered high plastic clays all the way to the top of the underlying limestone bedrock. The top of the limestone ranged between el. 304 and el. 310, and generally sloped slightly toward the Mississippi River.

EVALUATION AND RECOMMENDATIONS

Railroad Track

Flyash Ponds

Where the railroad loop embankment will cross the flyash ponds, we recommend removing the flyash to a depth of 5 feet. The typical track section is shown in Figure 9. The bottom of this overdig will vary between about el. 406 and el. 411, which should be above the maximum Mississippi River stage in most years. The flyash that is removed may be dried for use as fill. A 2-foot thick of compacted granular fill should be placed in the bottom of the overdig, with a woven geofabric such as Mirafi HP570 at about the center of the granular fill. This blanket will provide a base upon which to place and compact the flyash to build the embankment. The fill should be compacted as recommended under "Fill Materials and Placement."

With a confining pressure from the surrounding ash, the design criteria can be adequately met with dried and recompacted flyash at a 1(v) to 1(h) slope. Where there is no confining pressure, 1(v)-to-3(h) slopes should be used for compacted flyash fills greater than 10 feet high, and 1(v)-to-2(h) slopes for fills under 10 feet high. Any flyash fills exposed to surface runoff should be covered with 2 feet of non-erodible material, such as the MoDOT Type 2 aggregate used to build the track subballast.

Using this section, we anticipate that the total settlement in the flyash ponds below the embankments will vary from about 3 to 14 inches. However, this settlement should occur during the construction of the embankment itself, due to the rapid consolidation of the flyash. The lower clays are subject to less change in stress, and the numerous horizontal sand seam and layers will promote more rapid settlement than may be estimated based upon laboratory test data. Secondary consolidation will take place following the construction of the embankment. The estimated rate of secondary settlement is about 4 inches over the first two years.

Bottom Ash Ponds

Where the embankment will cross the bottom ash ponds, we recommend constructing the embankment using coarse "shot rock" fill. The bottom ash is coarser than the flyash, so it should not be necessary to overexcavate the bottom ash to create a base. A typical track section is shown in Figure 9.

Meramec River Levee

The proposed railroad loop will require fill to achieve grade, and will approach close to the existing levee near Sta. 29+00. The stability of the existing levee with the added fill and train load was analyzed using data obtained from previous investigations of the slides in the levee.

The maximum top of rail elevation is assumed to be 422. The rail centerline is about 21 feet from the top of levee centerline. This area adjacent to station 29+00 is in the vicinity of previous landslides along the outer and inner face of the levee. Inner face slides occurred during construction in 1980. The outer face slides occurred about 1988. The outer face slides were repaired with the addition of a stability berm at the outside toe of the levee. The following table shows the calculated factors of safety for different loading conditions.

Calculated Factors of Safety Station 29+00

LOAD CONDITION	Static Condition	Seismic Event a = 0.15g
Existing Embankment	1.98	0.88
Track Embankment Added	1.60	0.82
Loaded Train on Track	1.53	0.81

An example of the stability analyses at Sta. 29+00 is shown in Figure 10. The calculated factors of safety indicate that the static condition should be stable. The factors of safety less than 1.0 for the seismic event required calculation of the required shear strengths needed for the soft clays at depth to provide a factor of safety equal to 1.0, and inversely what seismic acceleration can be tolerated for the existing strength of the soils. The soft clay soils need to have a shear strength of about 610 psf, versus the indicated strength of 450 psf. The present soils can resist a seismic acceleration of about 0.096g.

The track embankment construction will require about 8.5 feet of embankment fill. The calculated factors of safety are greater than 2.0 for all load conditions on the inside side of the proposed track loop.

Opposite Station 30+50 the track alignment is about the same distance from the top of existing levee, but the levee section does not have the stabilizing berm at the outside toe. The following table shows some of the calculated factors of safety at this station.

Calculated Factors of Safety Station 30+50

LOAD CONDITION	Static Condition	Seismic Event a = 0.15g
Existing Embankment	1.837	0.870
Track Embankment Added	1.473	NOT CALC.
Loaded Train on Track	1.409	0.795

The above analysis utilized the soil strengths measured in clays that were not loaded from an embankment. The location opposite Sta. 30+50 is at the location of an older levee section and ash disposal pond. It is thought that the soils have gained strength from a longer period of consolidation, and that these slightly lower calculated factors of safety for the static conditions are acceptable, based on the probable presence of soils stronger than the analyzed strengths.

The soil strengths should be sampled and tested to obtain a better understanding of the seismic resistance, if the owner wishes to have protection for an event with an acceleration greater than 0.09g.

Waste Water Treatment Pond

The proposed top of rail in the vicinity of the WWTP is about el. 420, or 24 feet above the bottom of the pond. The centerline of the track is about 75 feet from the near face of the pond. Therefore, the WWTP should be stable without any corrective measures.

Coal Car Hopper

The excavation for the coal car hopper will be largely influenced by the stage of the Mississippi River. Historic river stages from 1990 through 1997 are shown in Figure 11. Based upon this data, it appears that a normal high water to be used in the design of the temporary excavation shoring is about el. 406.5, which generally occur during April through June. The design of the permanent walls and floor slabs should be based upon maximum possible water level before the hopper would become flooded. The 100-year flood level is el. 418.

The lower floor of the proposed coal car hopper will be at el. 365.63. Deep dewatering wells will not be used, to avoid creating a hydraulic connection between the flyash pond and the deep sands and gravels. Therefore, we recommend driving a rectangular sheetpile cofferdam, and excavating within the cofferdam without dewatering to 5 to 10 feet below the proposed bottom of the floor slab, and then using a tremie to pour a 5- to 10-foot thick concrete "mud mat." The mud mat is to provide a seal and a stable bottom so that the cofferdam may be unwatered. Interior wales and struts will be required to support the sheetpile cofferdam until the excavation is backfilled. The thickness of the mud mat will have to be designed to resist the upward water pressure.

Recommended lateral earth pressures for various design conditions are shown in Figure 12. The design of the temporary sheetpile cofferdam should be based upon the total of the lateral earth pressure and the hydrostatic water pressure for a water level at el. 406.5. The total is about 4000 psf at the base of the excavation. If PZ-27 sheetpiles with a yield strength of 50 ksi are used, then the cofferdam will require horizontal wales and struts at about 14 feet on centers vertically.

The permanent reinforce concrete walls should be designed for two lateral earth pressures - short-term and long-term, as shown in Figure 12. The short-term distribution of lateral earth pressures will govern the design of the upper part of the wall. Over time, the lateral earth pressures will redistribute as shown for the long-term pressures in Figure 12. Therefore, the lower part of the wall should be designed to resist the higher long-term lateral earth pressures. The total design pressure on the wall is the total of the lateral earth pressures, either short-term or long-term, and the hydrostatic pressure for a water level at el. 424.38 (the top of rail).

The short interior cross-wall should be designed to resist the lateral surcharge pressure due to the upper floor (with an assumed soil bearing pressure of 6000 psf), and the lateral earth pressure of the granular fill, as shown in Figure 12.

The coal car hopper must also be designed to resist the uplift hydrostatic pressure, or buoyancy. If the dead load of the hopper and equipment is less than the uplift pressure (3978 psf), then additional vertical resistance may be obtained by using rock bolts grouted into the underlying limestone.

Some differential settlement should be expected between the hopper and the adjacent railroad embankment. This may be reduced by using reinforced concrete approach slabs on either end of the hopper.

Miscellaneous Foundations

Shallow footings bearing on the compacted flyash section may be designed for bearing pressures of 1500 psf for continuous or wall footings, and 1800 psf for isolated square footings that are on level ground (that is, where the horizontal distance from the near edge of a footing to the face of a slope is more than three times the footing width). These values may be increased by 33 percent for temporary or transient loads, such as wind loads.

Resistance to lateral loads may be based on a design base shear of 500 psf between cast-in-place concrete and the compacted fill. The passive lateral resistance of the soil against vertical faces between 3 and 7 feet deep may be based on an "equivalent fluid pressure" using an equivalent unit weight of 300 lb/ft^3. These values are for footings on level ground, as defined above, and are for "ultimate" soil resistance; a minimum factor of safety of 1.5 should be used for design.

Exterior footings, or interior footings that may be subjected to the same temperature extremes as exterior footings, should be founded below the potential for heave due to frost penetration or dessication. This is generally accepted to be 2.5 feet in the St. Louis area.

Continuous footings should be a minimum of 18 inches wide. Square or rectangular footings should have a minimum dimension of 30 inches.

Crossing Gas Pipeline

The railroad loop will cross the existing high pressure gas line in 2 or 3 locations. A reinforce concrete slab will probably be required to reduce the vertical stress on the pipeline. The design of the slab will depend upon the depth of the pipeline, which is not known at this time, and the adjacent soil properties. Recommendations may be presented in Phase II of this study, if needed.

General Recommendations

Site Preparation

Prior to fill placement or paving construction, vegetation and soil containing significant amounts of organics be stripped and wasted or used in landscaped areas. Where fill is to be placed on an existing slope that is steeper than 4(h) to 1(v), the existing slope should be notched or benched to tie each lift of fill into the existing soil, to prevent the formation of a weak sliding plane.

Site Excavations and Slopes

Temporary cut slopes should be no steeper than 1(h) to 1(v). OSHA guidelines should be followed for all excavations or trenches greater than 4 feet deep. Permanent slopes in fills less than 10 feet high should be no steeper than 2(h) to 1(v), and 3(h) to 1(v) over 10 feet high.

Fill Materials and Placement

Imported fill materials should consist of uncontaminated, inert, non-expansive soils classified as silty clay (CL), clayey silt (ML), sand (SP, SM, SW, SC) or gravel (GP, GW, GC). The liquid limit of clayey soils should be less than 50 percent, and the plasticity index should be at least 10 percent. Imported fill material should not contain roots or other similar organic matter, trash, frozen material, chemical contamination, or rock or concrete fragments larger than 6 inches in the maximum dimension.

Fill materials should be placed in uniform, horizontal lifts, and compacted in systematic coverages of the entire lift. The thickness of the loose lift (prior to compaction) should not exceed 12 inches where large, self-propelled compaction equipment can be used. In confined areas or immediately adjacent to retaining walls, where manual compactors are required, the lift thickness should not exceed 6 inches prior to compaction.

The compaction characteristics of fine-grain soils, such as clays or clayey silts or the flyash, are dependent upon water content. For these materials, the water content should be adjusted prior to compaction, either by sprinkling additional water, or by scarifying, discing and drying to lower the water content. Normally, materials on site will have to be dried prior to compaction.

Fill should be compacted to a dry unit weight equal to at least 92 percent of the maximum dry unit weight determined by the modified Proctor method (ASTM D-1557). Fill in other areas may be compacted to 85 percent of the maximum dry unit weight.

The compaction of granular materials is based on the minimum and maximum densities determined by laboratory tests (ASTM D-4253 and D-4254). Granular fill should be compacted to a relative density of 75 percent. Granular fill behind retaining walls where potential surface settlement is not a problem may be compacted to a minimum relative density of 70 percent.

Seismic Considerations

St. Louis is situated near one of the more currently active seismic regions in the central and eastern United States. Slightly more than 100 miles to the south, three of the largest earthquakes ever to occur in the interior of a tectonic plate rocked the New Madrid region during the winter of 1811-1812. Although the New Madrid zone is the most seismically active region in the vicinity of St. Louis, potentially damaging earthquakes have also occurred outside of the New Madrid zone in Missouri and southern Illinois.

The following recommendations are based on the 1996 BOCA requirements. The minimum seismic forces are based in part on the effective peak velocity-related acceleration (A_v), the effective peak acceleration (A_a), and the site coefficient (S). The values of A_v and A_a would vary slightly across the St. Louis region. Therefore, St. Louis County has adopted values of $A_v = 0.13$ and $A_a = 0.12$ for use throughout the County. The site coefficient (S) = 2.0, which corresponds to a soil profile type S_4.

Two effects of a seismic event that may affect this project are slope failures and liquefaction. The problems associated with slope failure are discussed under "Meramec River Levee." Liquefaction rarely occurs in sands and silts that have more than 35 percent of "fines" (that is passing the No. 200 sieve.) Based upon previous test data, it appears that the flyash has a minimum of 60 percent of fines. Therefore, liquefaction should not be a problem.

RECOMMENDATIONS FOR FURTHER INVESTIGATION

Borings and Cone Penetrometer Soundings

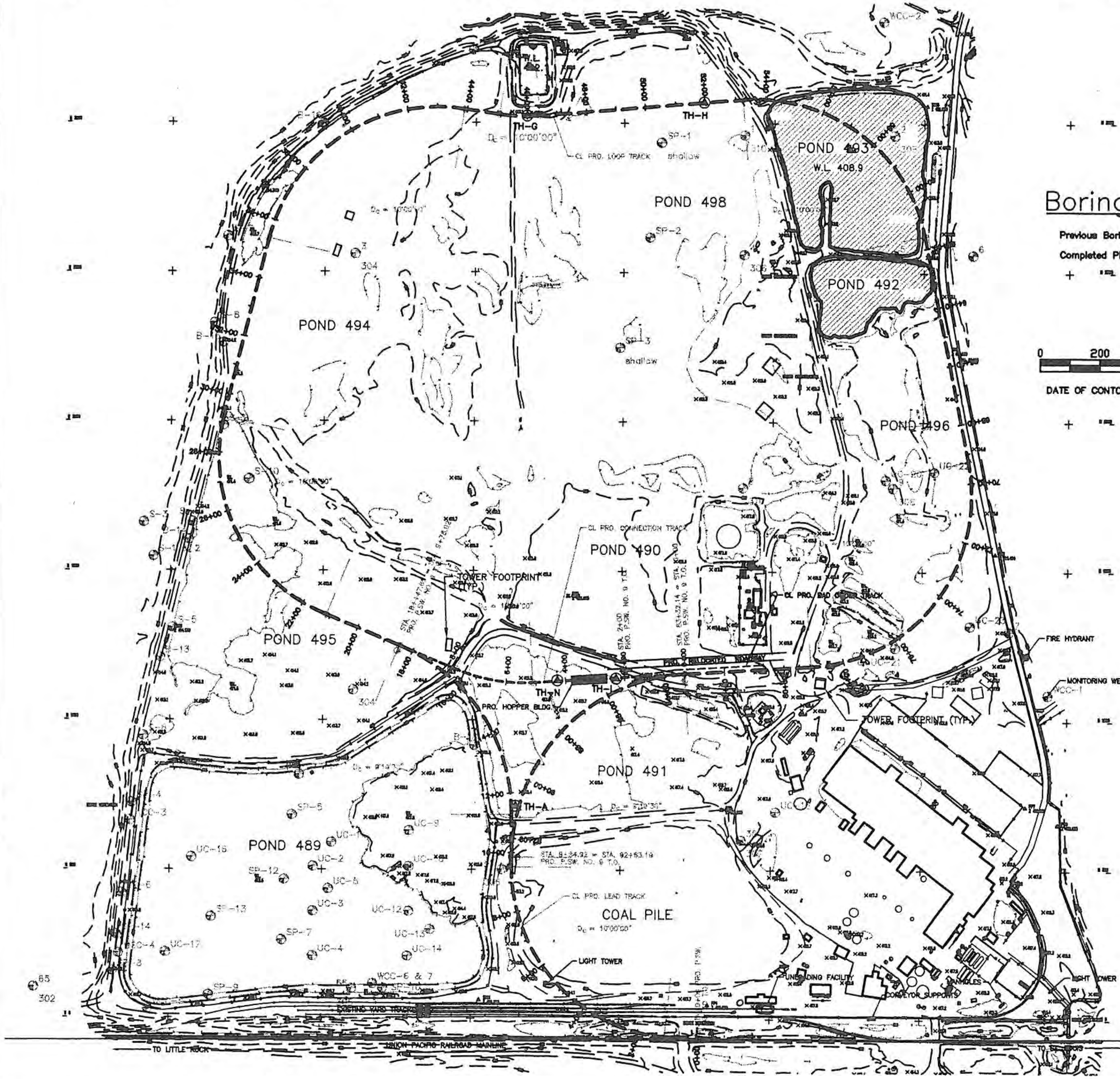
The original proposal for this investigation included borings along the centerline of the railroad loop in the flyash ponds where there are no previous borings. The primary purpose of these borings is to determine the thickness of the flyash. Using the data from the cone penetrometer soundings and borings for Phase I, cone penetrometer soundings may be used in lieu of borings. However, site access is still a problem because the flyash ponds are being used to convey waste water to the WWTP. Depending upon the final design, some additional sounding should be done, particularly in the vicinity of Sta. 29+00 to 30+50 where the railroad loop is close to the Meramec River levee.

Construction of Test Section

We recommend constructing a test section in Flyash Pond 495. This will provide information on the constructability of the proposed track section, the ability to drain the existing flyash in the temporary excavation, and settlement. Also, we recommend performing deflection tests on the constructed subballast using a fully-loaded dump truck or scraper, to provide data on the modulus of the subballast.

LIMITATIONS

The boring logs depict subsurface conditions for specific locations and dates. The recommendations and observations presented in the report assume that significant variations do not occur. Non-uniform conditions, however, often cannot be determined by the procedures described. Where present, such conditions may necessitate additional expenditures to obtain a properly constructed project. We recommend that a contingency fund be budgeted to accommodate such possible variations.



Boring Legend

Previous Boring
Completed Phase 1 Boring TH-A

0 200 400

DATE OF CONTOURS 9/21/99

KEY TO SOIL SYMBOLS

- FLYASH
- Silty GRAVEL (GM)
- Low plastic Silty CLAY/ Clayey SILT (CL-ML)
- Silty SAND or Sandy SILT (SM)
- High plastic CLAY (CH)
- Inorganic, non-plastic SILT (ML)
- Clayey SAND or Sandy CLAY (SC)

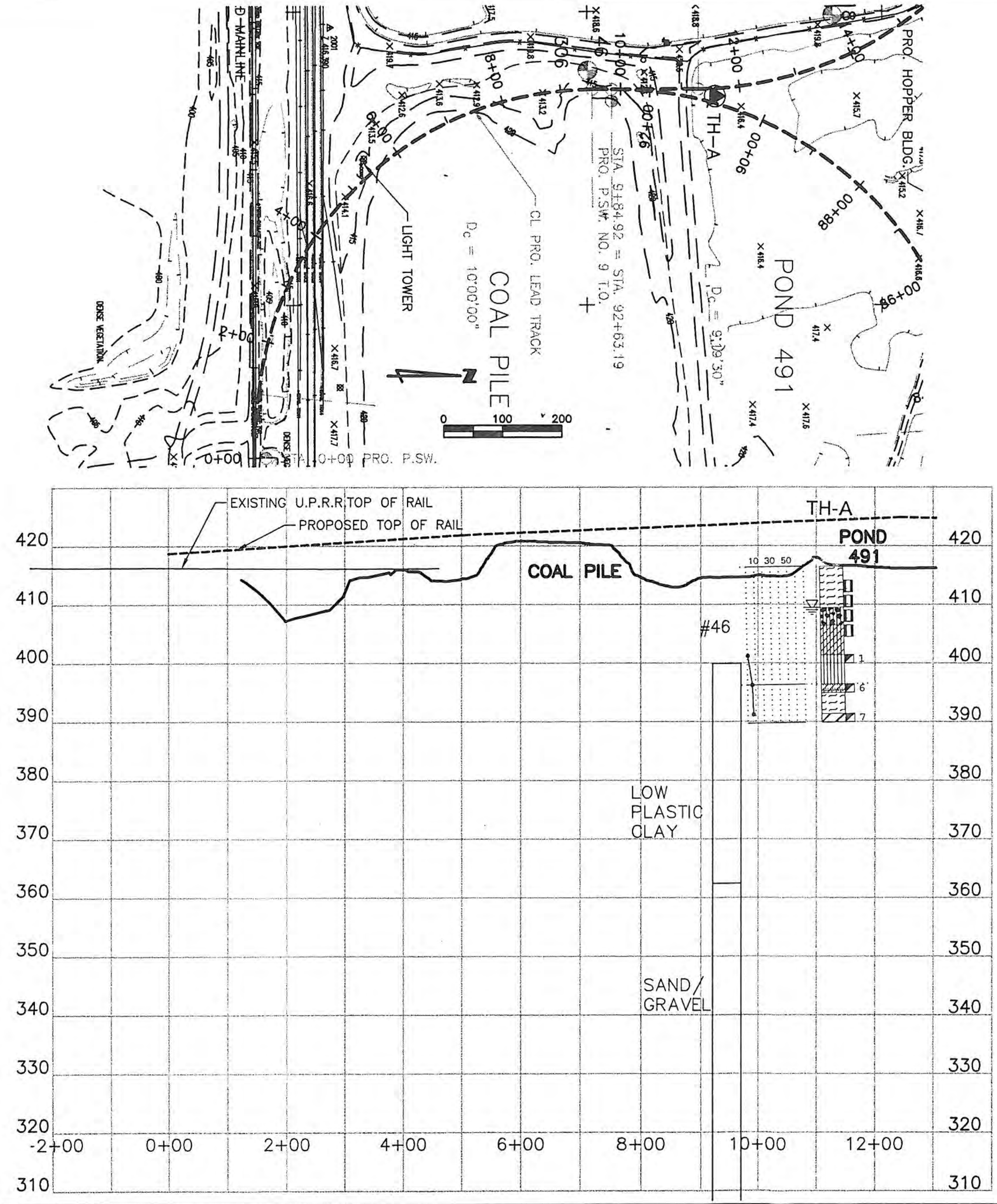
SCALE: HORZ 1"= 400'

RAIL LOOP
BORING LOCATION

REITZ & JENS, INC.
Consulting Engineers

FIGURE 1

92199TOPO.DWG 10/19/99



12/8/99

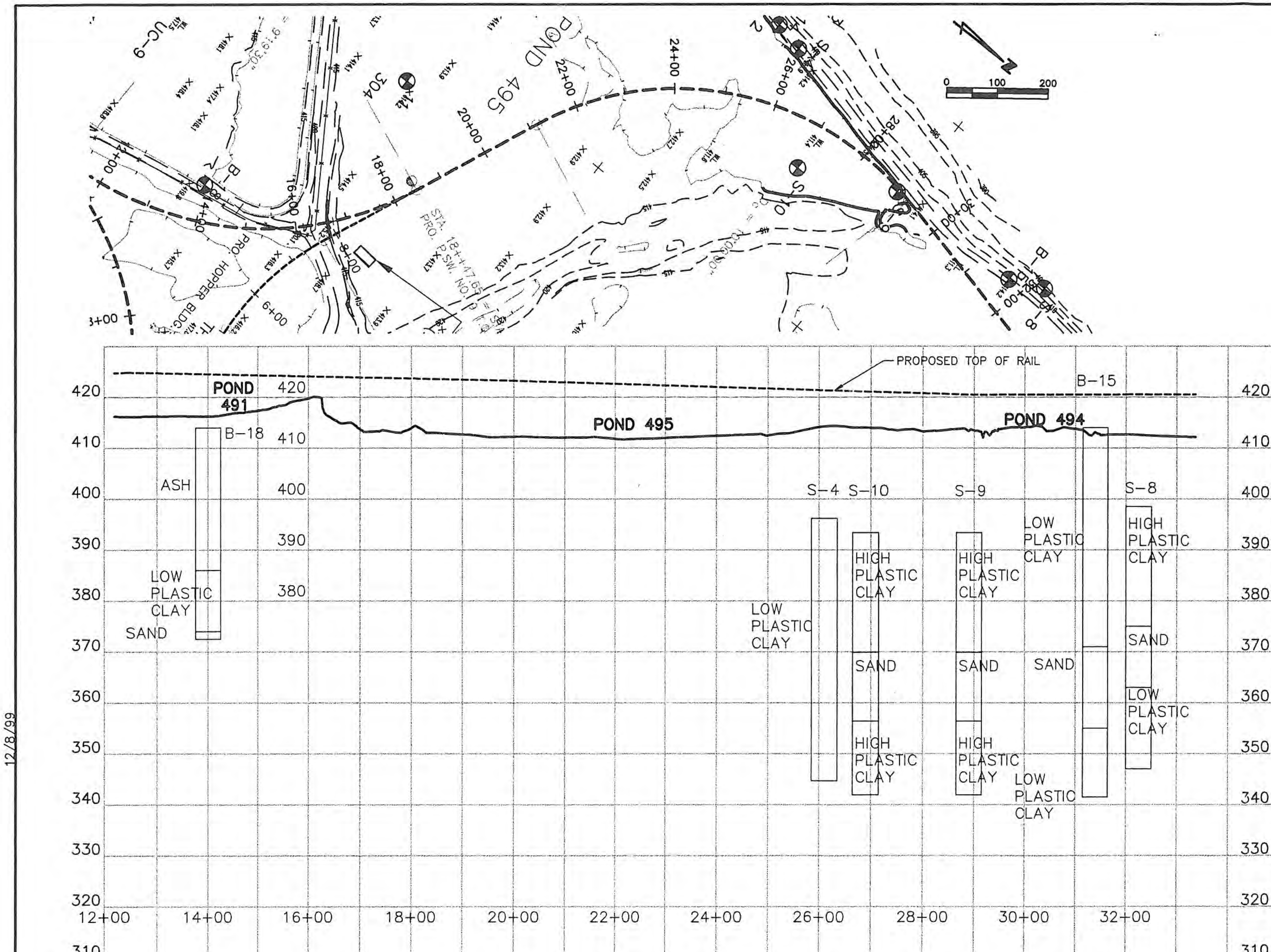
RLP1.DWG

SCALE: HORZ 1"= 200'
VERT. 1"= 20'

RAIL LOOP 0+00 TO 12+00
PLAN & PROFILE

REITZ & JENS, INC.
Consulting Engineers

FIGURE
2



SCALE: HORZ 1"= 200'
VERT. 1"= 20'

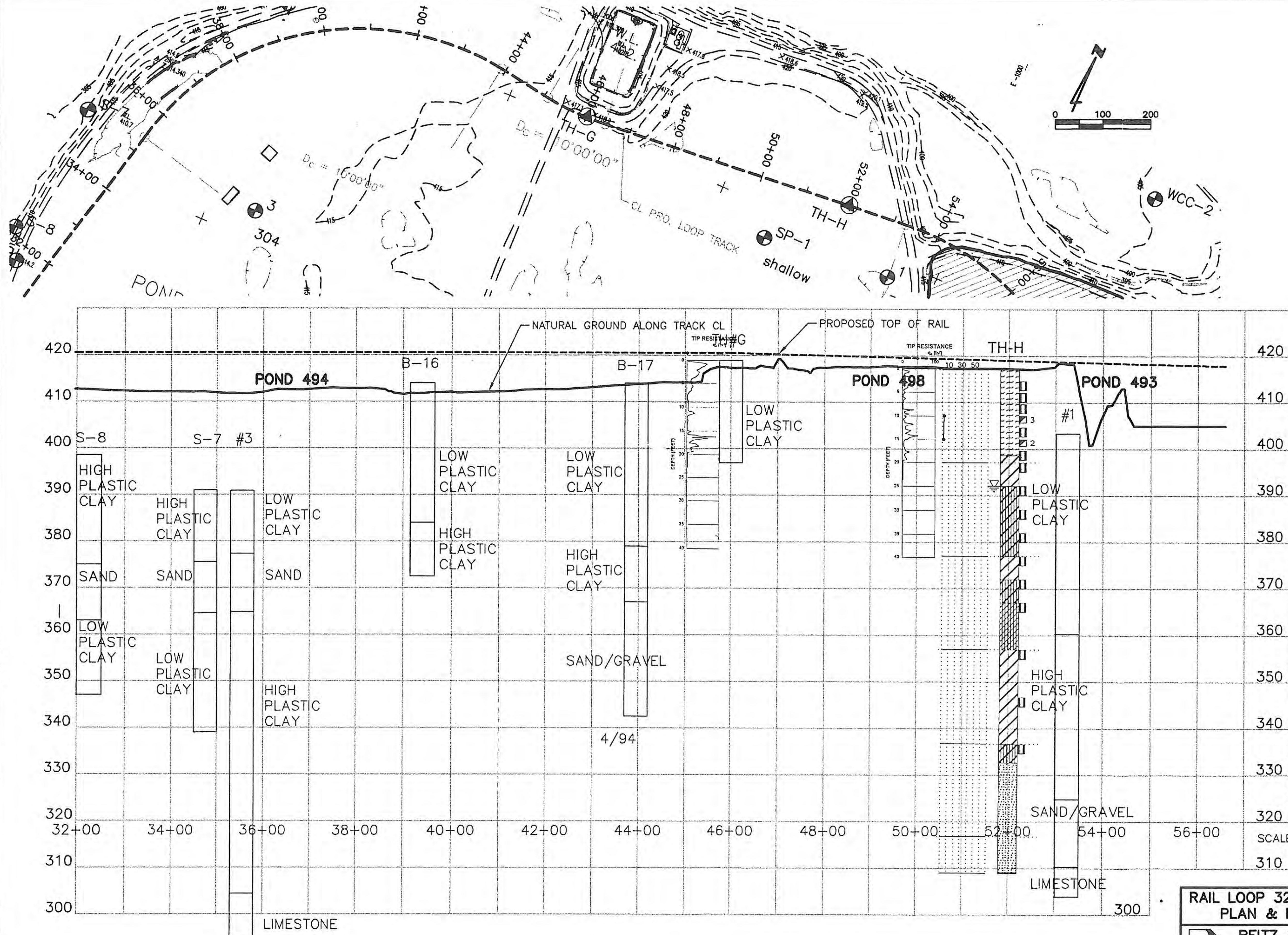
RAIL LOOP 12+00 TO 32+00
PLAN & PROFILE

REITZ & JENS, INC.
Consulting Engineers

FIGURE 3

12/8/99

RLP2.DWG



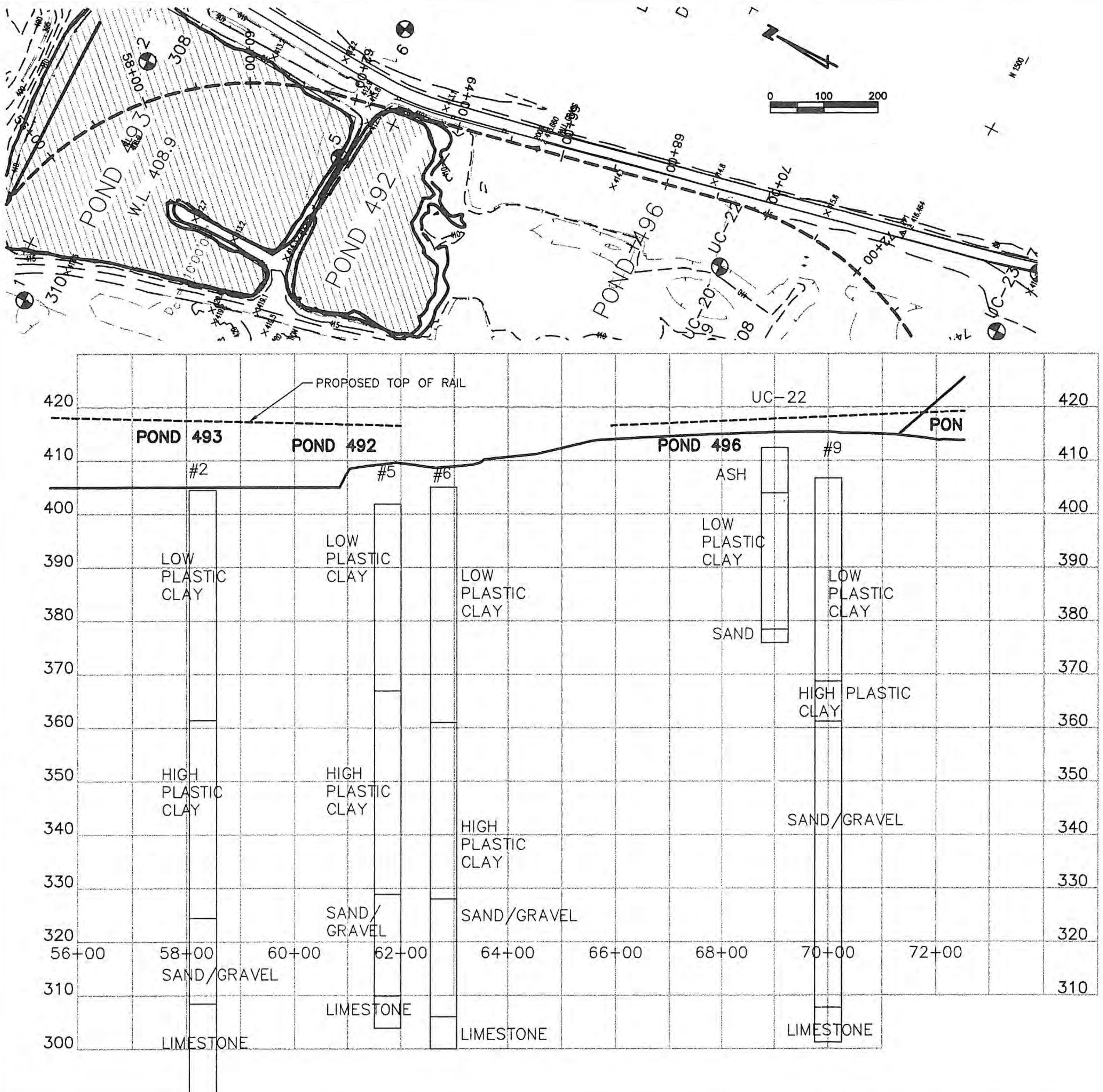
12/8/99

RLP3.DWG

RAIL LOOP 32+00 TO 56+00
PLAN & PROFILE

REITZ & JENS, INC.
Consulting Engineers

FIGURE 4



SCALE: HORZ 1"= 200'
VERT. 1"= 20'

RAIL LOOP 56+00 TO 72+00
PLAN & PROFILE

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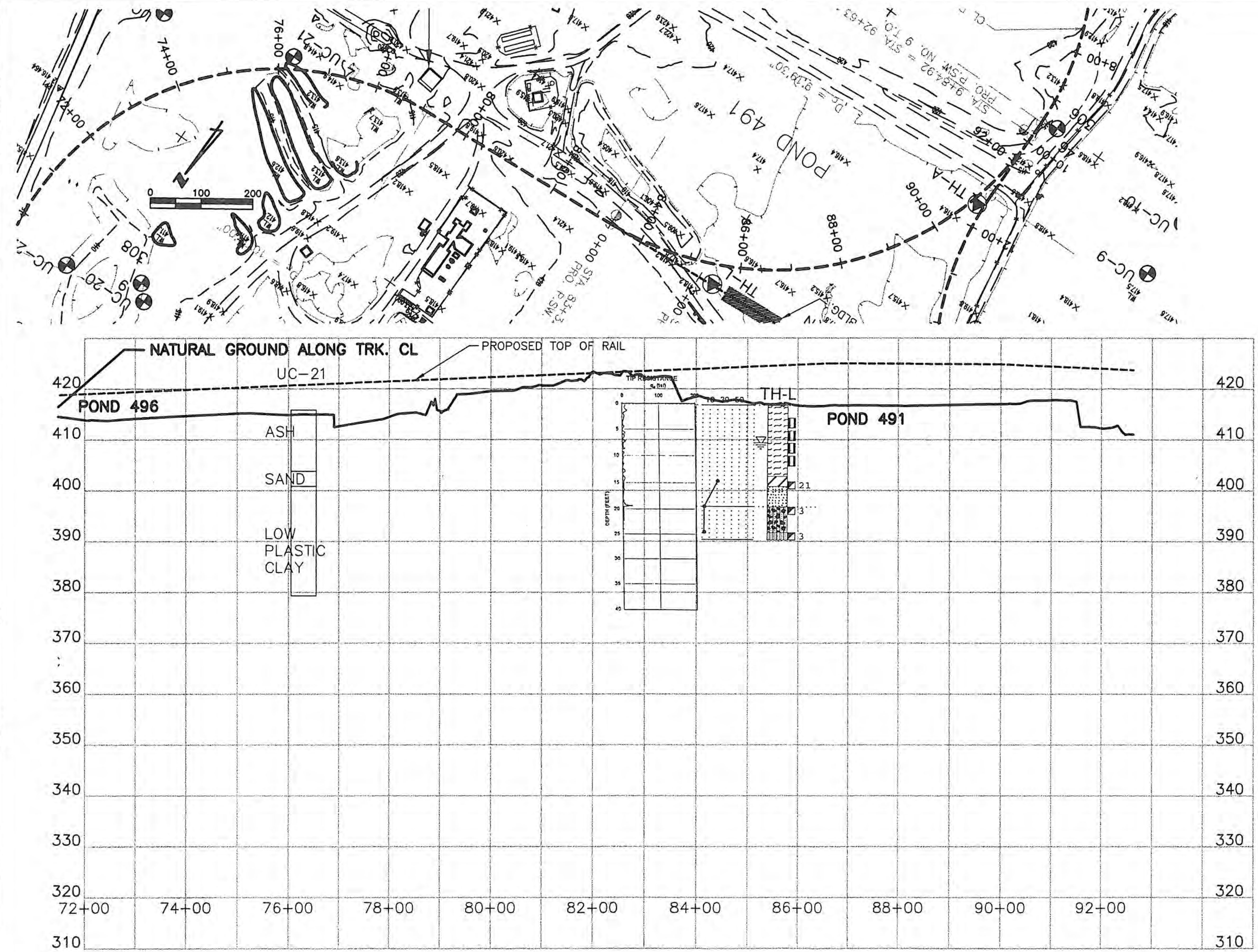
FIGURE 5

12/8/99

RLP4.DWG



SCALE: HORZ 1"= 200'
VERT. 1"= 20'

RAIL LOOP 72+00 TO 92+00
PALN & PROFILE

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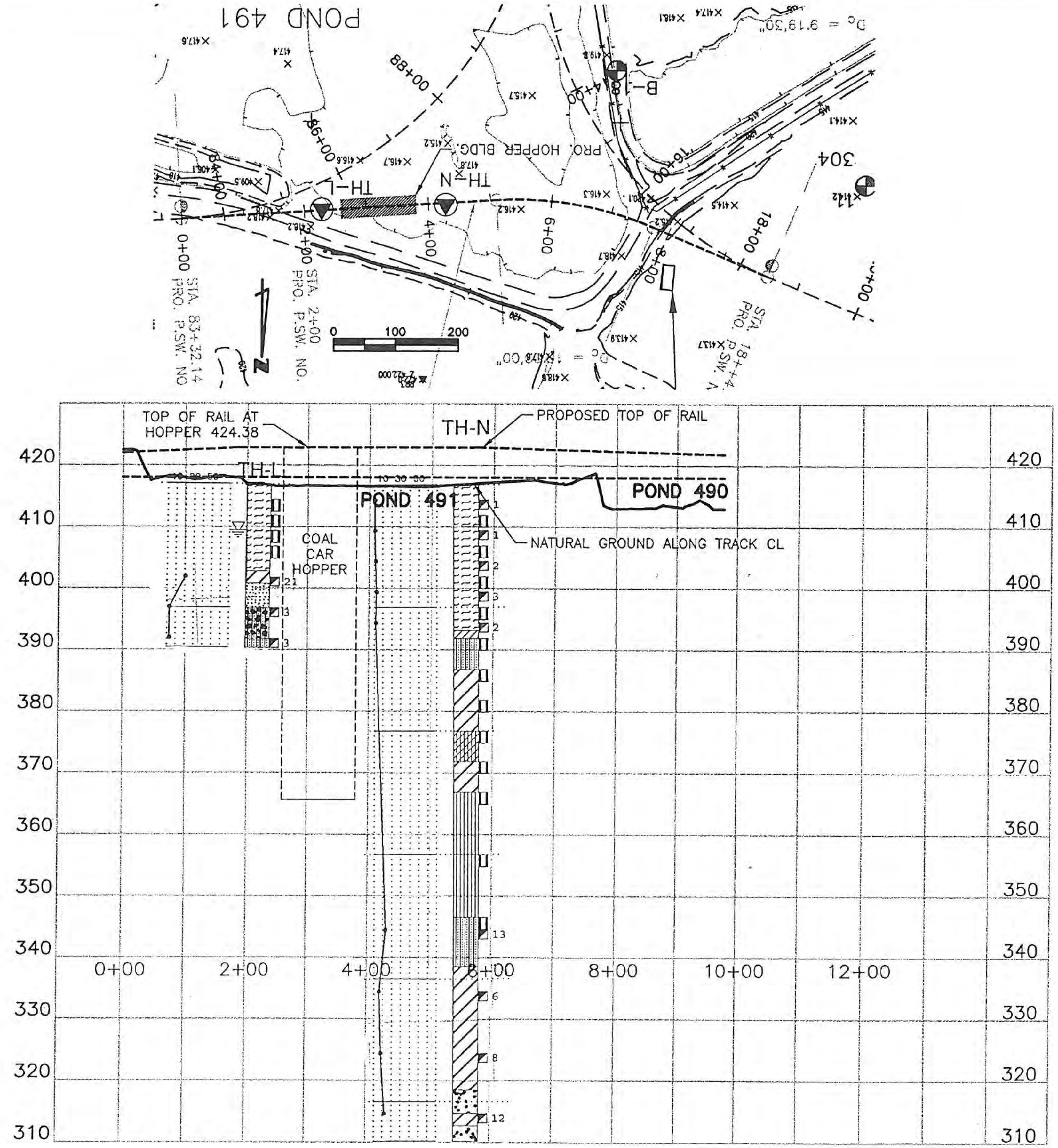
Consulting Engineers

FIGURE 6

12/8/99

RLP5.DWG



SCALE: HORZ 1"= 200'
VERT. 1"= 20'

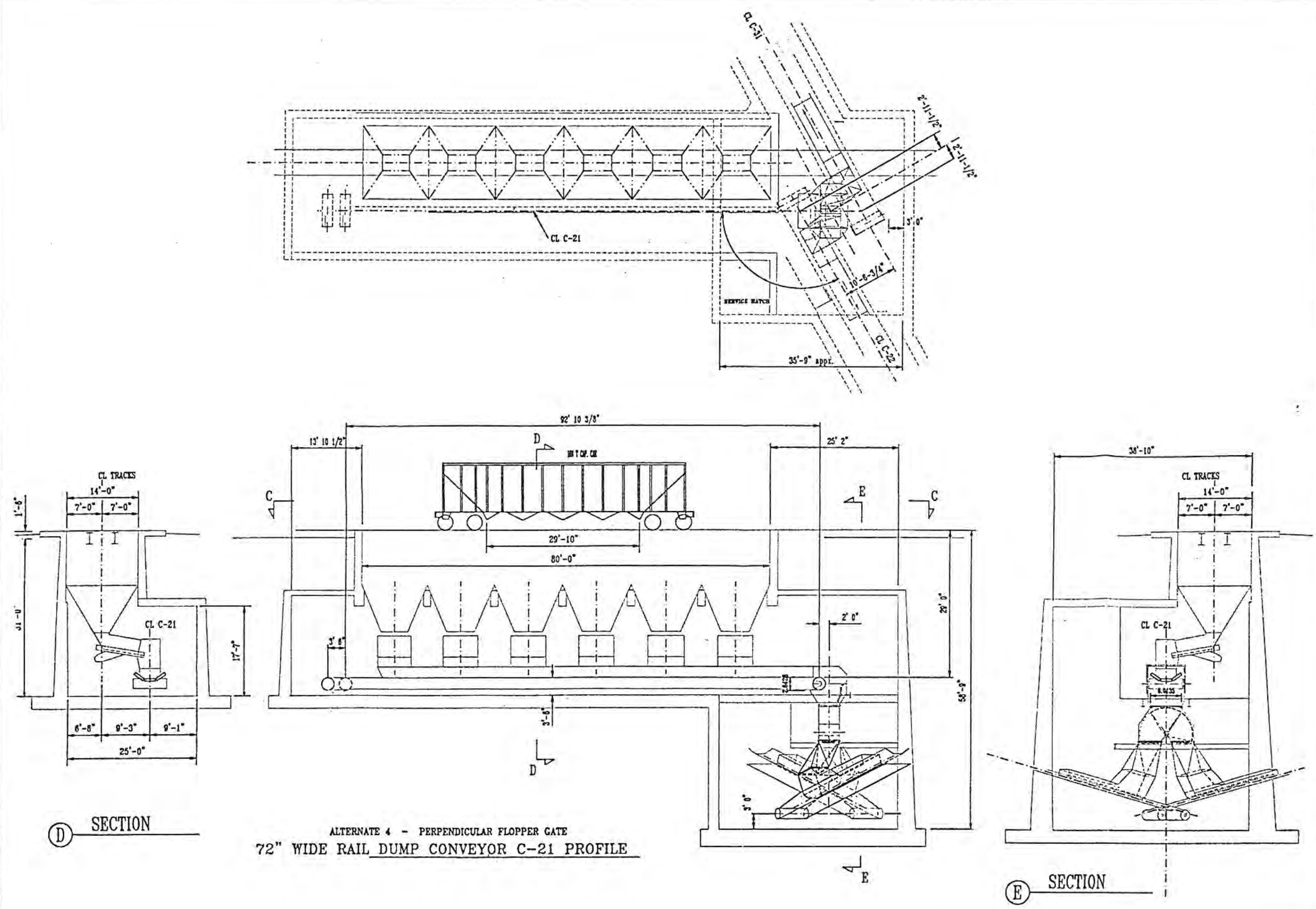
HOPPER SPUR 0+00 TO 12+00
PLAN & PROFILE

REITZ & JENS, INC.
Consulting Engineers

FIGURE 7

12/8/99

RLP6.DWG



PROPOSED COAL CAR HOPPER

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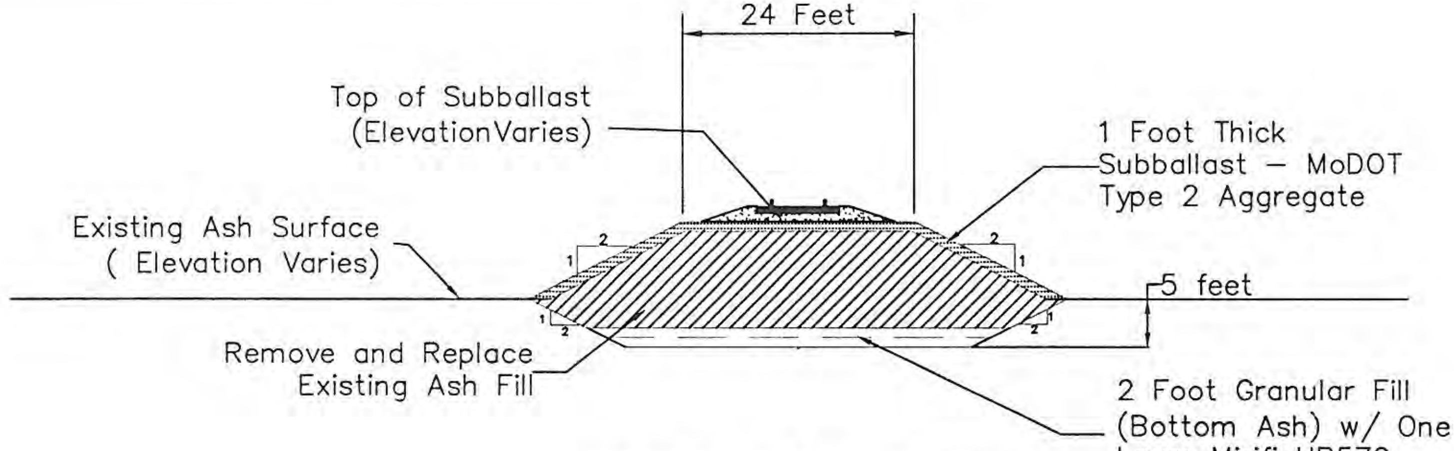
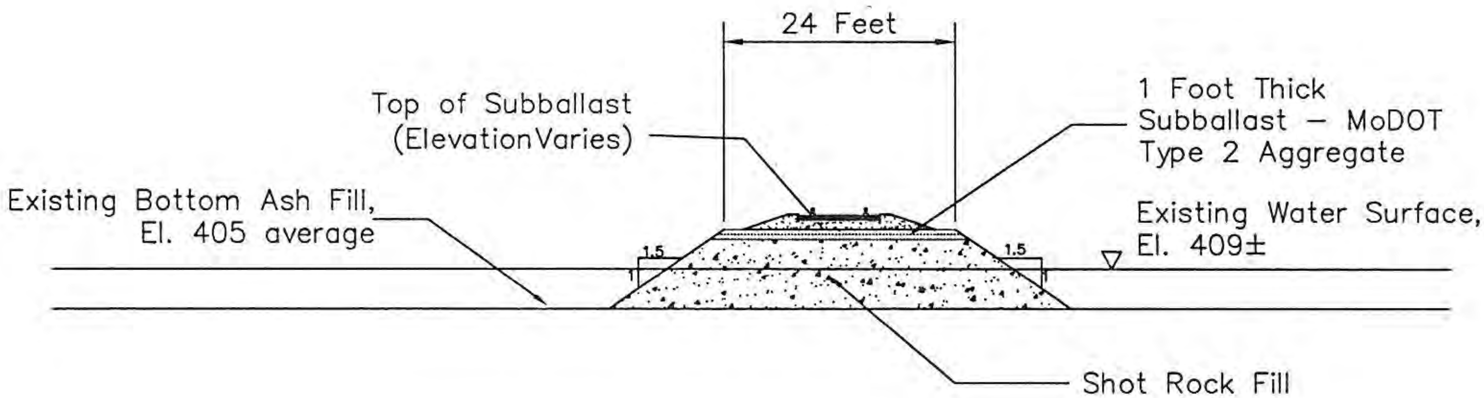
FIGURE 8



TYPICAL TRACK SECTION

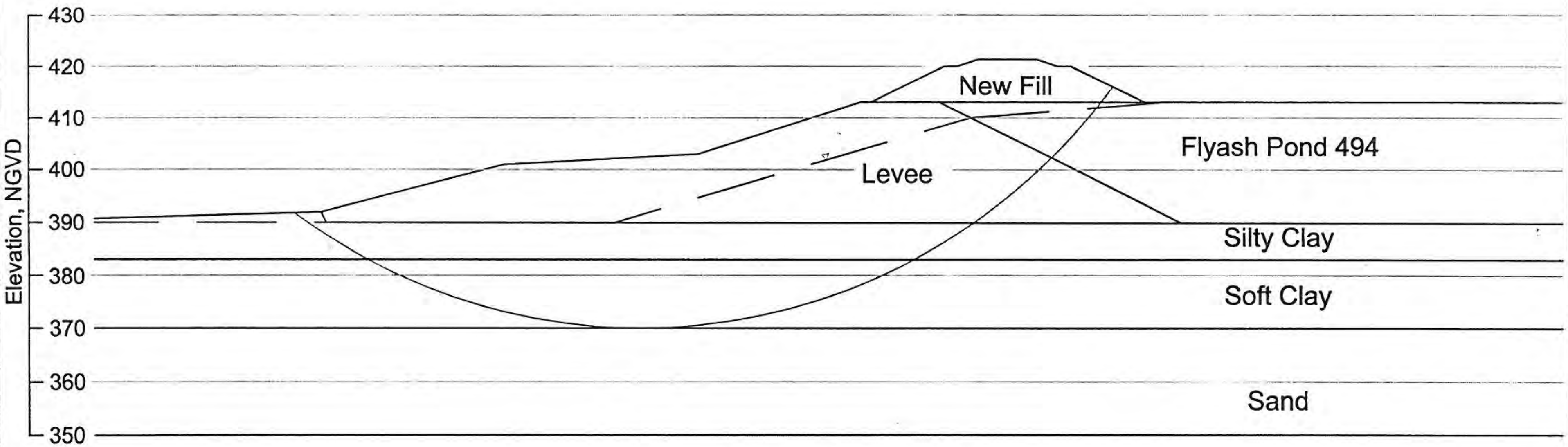
SCALE: 1" = 20 feet



TRACK SECTION FROM STA 53+00 TO 61+00

SCALE: 1" = 20 feet

TYPICAL TRACK SECTION	
REITZ & JENS, INC. Consulting Engineers	FIGURE 9



Section at Sta. 29+00
Minimum Factor of Safety = 1.53 (without seismic)
Minimum Factor of Safety = 0.81 (with a=0.15g)

STABILITY ANALYSES OF LEVEE AND RAILROAD EMBANKMENT

REITZ & JENS, INC.
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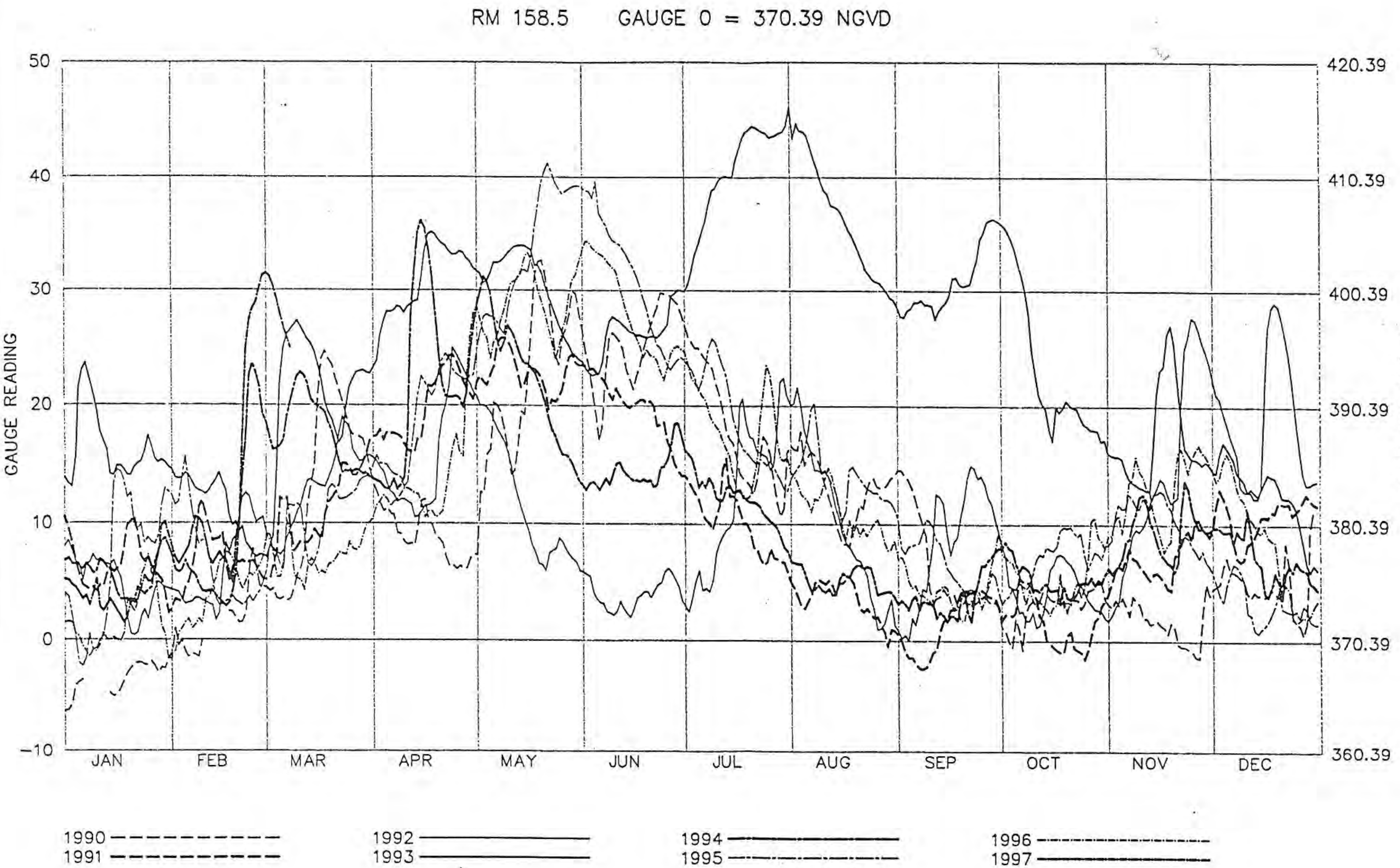
FIGURE 10



Note: Water's Point Gauge is about 1.5 river miles from Meramec Plant.

MISSISSIPPI RIVER STAGES AT WATER'S POINT GAGE

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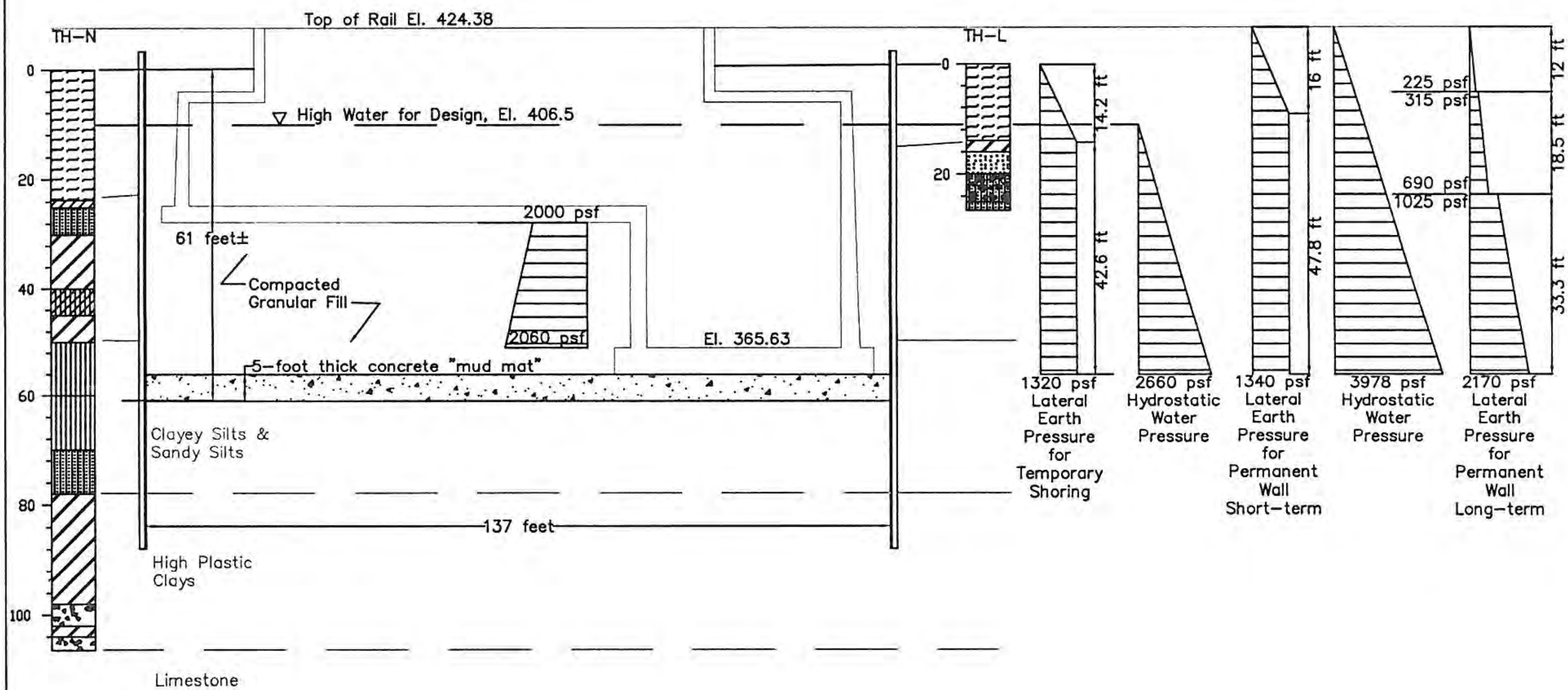
FIGURE 11



COAL CAR HOPPER
LATERAL EARTH PRESSURES

REITZ & JENS, INC.
Consulting Engineers

FIGURE 12

APPENDIX A

INDIVIDUAL BORING LOGS

KEY TO SYMBOLS

Symbol	Description
KEY TO SOIL SYMBOLS	
	FLYASH
	Silty GRAVEL (GM)
	Low plastic Silty CLAY/ Clayey SILT (CL-ML)
	Inorganic, non-plastic SILT (ML)
	Clayey SAND or Sandy CLAY (SC)
	Silty SAND or Sandy SILT (SM)
	High plastic CLAY (CH)
	Low plastic Silty CLAY (CL)
	Poorly-graded SAND with no fines (SP)
	LIMESTONE
	Mixed Silty SAND & GRAVEL (GM)
	Low plastic CLAY (CL)
	Poorly-graded GRAVEL (GP)

Symbol	Description
MISCELLANEOUS SYMBOLS	
□	Shear strength from from Shear Vane (tsf)
△	Shear strength from Unconfined Compression Test, ASTM D-2166 (tsf)
■	Shear strength from Pocket Penetrometer (tsf)
—	Range Plastic Limit (PL) to Liquid Limit (LL), ASTM D-4318
●	Moisture content (%)
▲	N-value from Standard Penetration Test, ASTM D-1586 (blows/ft)
	Boring continues
SOIL SAMPLERS	
	3-in. O.D. Shelby Tube
	2-in. O.D. Split-Spoon

Notes:

1. Borings made using CME-75 drill rig mounted on all-terrain vehicle (ATV) owned and operated by Brotcke Well and Pump, between August 26 and September 1, 1999. Borings advanced using 4.5-in. I.D. hollow-stem augers (HSA), or using rotary drilling with drilling mud, as noted.

2. Borings were logged in the field based upon recovered samples, cuttings, and drilling characteristics. The field logs were modified as appropriate based upon the results of laboratory testing.

3. Stratification lines on the boring logs represent approximate boundaries of changes in soil or rock classification; actual changes in strata may be gradual.

Figure A-1

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BORING LOG

Meramec Power Plant Rail Loop	**BORING NO:** TH-A
Ameren Services	**LOCATION:** Ash Pond 491
	ELEVATION: 416.8 **DATUM:** ft, NGVD
DATE MADE: 9/1/99	**FIGURE:** A-2 **SHEET** 1 **OF** 1

SHEAR STRENGTH, tsf: △ QU/2 ■ PP □ SV (1, 2, 3)
STANDARD PENETRATION TEST ▲ N-VALUE (BLOWS PER LAST FOOT)
MOISTURE CONTENT, %: PL ├──●──┤ LL (20, 40, 60)

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) / BLOWS PER 6 INCHES	MOISTURE CONTENT PERCENT BY WEIGHT
0	416.8		Loose, gray, dry FLYASH		
		38		53.2	59.0
5		100	Becoming moist		
		0	Very loose, saturated, Silty GRAVEL (coal or bottom ash) Note: no recovery with Shelby tube; split-spoon sampler sank under own weight.		
10		0	Soft, brown, wet, Silty CLAY/Clayey SILT Note: split-spoon sampler sank under own weight.		
15		100	Very loose, black, very fine Coal and Silt mixture, with fine Sand	0-0-1	
20		100	Soft, gray, Sandy CLAY	1-2-4	30.0
			Very loose, very fine SAND		
			Loose, FLYASH; with very fine Sand, very fine Coal particles, oily		
25		94	Firm, brown and gray, high plastic CLAY	1-3-4	35.9
			Bottom of boring @ 26.5 feet		

Depth scale: 0, 5, 10, 15, 20, 25, 30. Elevation scale: 415, 410, 405, 400, 395, 390.

THE STRATIFICATION LINES REPRESENT APPROXIMATE SOIL BOUNDARIES: ACTUAL STRATIFICATION MAY BE GRADUAL.

DRILLER: Brotcke Well
METHOD: Hollow-stem augers
LOGGED BY: J. Fouse

WATER LEVELS: DURING DRILLING 7.0 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT ____ FEET

File: UERAIL Date Printed: November 28, 1999

Reitz & Jens, Inc.
Consulting Engineers

BORING LOG

Meramec Power Plant Rail Loop
Ameren Services

DATE MADE: 8/26/99

BORING NO: TH-H
LOCATION: Ash Pond 498
ELEVATION: 417.5 **DATUM:** ft, NGVD
FIGURE: A-3 **SHEET** 1 **OF** 4

SHEAR STRENGTH, tsf: △ QU/2 ■ PP □ SV (1, 2, 3)
STANDARD PENETRATION TEST ▲ N-VALUE (BLOWS PER LAST FOOT)
MOISTURE CONTENT, %: PL —●— LL (20, 40, 60)

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) / BLOWS PER 6 INCHES	MOISTURE CONTENT PERCENT BY WEIGHT
0	417.5		Loose, gray, dry, FLYASH		
	415	50			
5		58		72.7	34.7
	410	0			
10		100		1-2-1	
	405	21			
15		100		0-1-1	
	400	96	Firm to stiff, brown and gray, high plastic CLAY	99.7	27.3
20		83		99.9	24.9
	395				
25		100	Soft to firm, tannish brown and gray, low plastic, Silty CLAY; with lignite & limonite	94.6	28.1
	390				
30					

THE STRATIFICATION LINES REPRESENT APPROXIMATE SOIL BOUNDARIES: ACTUAL STRATIFICATION MAY BE GRADUAL.

DRILLER: Brotcke Well
METHOD: HSA & rotary w/mud
LOGGED BY: Deryl Calvert

WATER LEVELS: DURING DRILLING 25 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ______ FEET AFTER ______ HOURS
AT ______ FEET AFTER ______ HOURS
PIEZOMETER: INSTALLED AT ______ FEET

File: UERAIL Date Printed: November 28, 1999

Reitz & Jens, Inc.
Consulting Engineers

BORING LOG

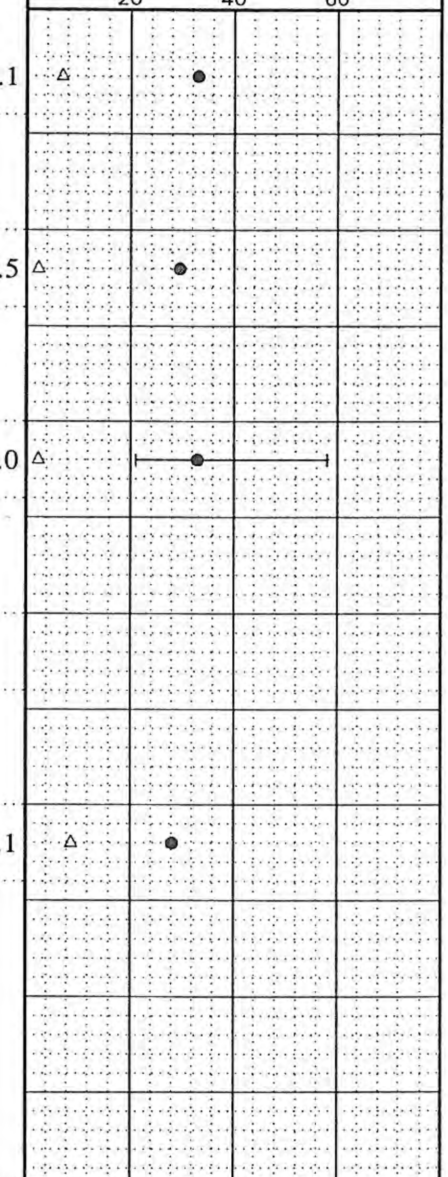
Meramec Power Plant Rail Loop
Ameren Services

DATE MADE: 8/26/99

BORING NO: TH-H
LOCATION: Ash Pond 498
ELEVATION: 417.5 **DATUM:** ft, NGVD
FIGURE: A-3 **SHEET** 2 **OF** 4

DEPTH (FEET)	ELEVATION	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES	MOISTURE CONTENT PERCENT BY WEIGHT
				100	Same: soft to firm, tannish brown and gray, low plastic, Silty CLAY; with lignite & limonite	89.1	33.1
	385						
35				100	Becoming gray	92.5	29.5
	380						
40				100	Soft, gray, high plastic CLAY; with fine Sandy Silt and very fine horizontal Sand seams	79.7	33.0
	375						
45				100	Gray Silty CLAY		
	370						
50				100	Firm, gray, Clayey SILT; with some Sand	96.6	28.1
	365						
55							
	360						
60							

SHEAR STRENGTH, tsf: △ QU/2 ■ PP □ SV (1, 2, 3)
STANDARD PENETRATION TEST ▲ N-VALUE (BLOWS PER LAST FOOT)
MOISTURE CONTENT, %: PL ├──●──┤ LL (20, 40, 60)



THE STRATIFICATION LINES REPRESENT APPROXIMATE SOIL BOUNDARIES: ACTUAL STRATIFICATION MAY BE GRADUAL.

DRILLER: Brotcke Well
METHOD: HSA & rotary w/mud
LOGGED BY: Deryl Calvert

WATER LEVELS: DURING DRILLING 25 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT ____ FEET

File: UERAIL Date Printed: November 28, 1999

Reitz & Jens, Inc.
Consulting Engineers

BORING LOG

Meramec Power Plant Rail Loop
Ameren Services

DATE MADE: 8/26/99

BORING NO: TH-H
LOCATION: Ash Pond 498
ELEVATION: 417.5 **DATUM:** ft, NGVD
FIGURE: A-3 **SHEET** 3 **OF** 4

SHEAR STRENGTH, tsf: △ QU/2 ■ PP □ SV (1, 2, 3)
STANDARD PENETRATION TEST ▲ N-VALUE (BLOWS PER LAST FOOT)
MOISTURE CONTENT, %: PL ├──●──┤ LL (20, 40, 60)

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) / BLOWS PER 6 INCHES	MOISTURE CONTENT PERCENT BY WEIGHT
65, 70, 75	355, 350, 345, 340	100	Firm, gray, high plastic CLAY; with some Clayey Silt and light gray fine Sand seams	62.8	63.1
		100			
80	335	100	Stiff, gray, Silty CLAY; with Clayey Silt	92.4	29.8
85, 90	330		SAND		

95

THE STRATIFICATION LINES REPRESENT APPROXIMATE SOIL BOUNDARIES: ACTUAL STRATIFICATION MAY BE GRADUAL.

DRILLER: Brotcke Well
METHOD: HSA & rotary w/mud
LOGGED BY: Deryl Calvert

WATER LEVELS: DURING DRILLING 25 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ____ FEET

File: UERAIL Date Printed: November 28, 1999

Reitz & Jens, Inc.
Consulting Engineers

BORING LOG

Meramec Power Plant Rail Loop
Ameren Services

DATE MADE: 8/26/99

BORING NO: TH-H
LOCATION: Ash Pond 498
ELEVATION: 417.5 **DATUM:** ft, NGVD
FIGURE: A-3 **SHEET** 4 **OF** 4

DEPTH (FEET)	ELEVATION	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES	MOISTURE CONTENT PERCENT BY WEIGHT	SHEAR STRENGTH, tsf (△ QU/2 ■ PP □ SV; 1 2 3) / STANDARD PENETRATION TEST ▲ N-VALUE (BLOWS PER LAST FOOT) / MOISTURE CONTENT, % (PL ● LL; 20 40 60)
	325				Note: Sand blowing up into hollow-stem augers; switch to rotary with drilling mud. Lost 600 gal. of drilling mud. Could not hold hole open to get samples.			
95	320							
100	315							
105	310				LIMESTONE			
					Bottom of boring @ 108 feet			
110	305							
115	300							
120								

THE STRATIFICATION LINES REPRESENT APPROXIMATE SOIL BOUNDARIES: ACTUAL STRATIFICATION MAY BE GRADUAL.

DRILLER: Brotcke Well
METHOD: HSA & rotary w/mud
LOGGED BY: Deryl Calvert

WATER LEVELS: DURING DRILLING 25 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT ____ FEET

File: UERAIL Date Printed: November 28, 1999

Reitz & Jens, Inc.
Consulting Engineers

BORING LOG

Meramec Power Plant Rail Loop
Ameren Services

DATE MADE: 9/1/99

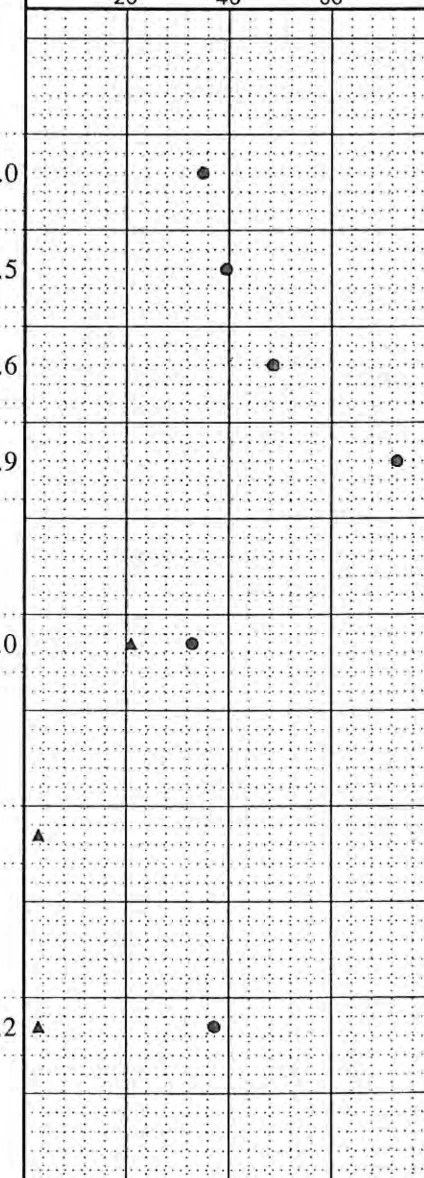
BORING NO: TH-L
LOCATION: Ash Pond 491
ELEVATION: 417.5 **DATUM:** ft, NGVD
FIGURE: A-4 **SHEET** 1 **OF** 1

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) / BLOWS PER 6 INCHES	MOISTURE CONTENT PERCENT BY WEIGHT
0	417.5		Loose, gray, moist, FLYASH		
	415	50		53.0	35.0
5		12			39.5
	410	8	Becoming wet		48.6
10		15			72.9
	405				
15		100	Stiff, brown and gray, high plastic CLAY; with Coal fragments	1-10-11	33.0
	400		Medium-dense, medium-grained, brown with black SAND		
20		83	Loose, coarse Coal fragments	2-1-2	
	395				
25		100	Loose, brown and gray, saturated Sandy SILT; with iron stains	1-1-2	37.2
	390		Bottom of Boring @ 26.5 feet		
30					

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)

MOISTURE CONTENT, %
PL ⊢——●——⊣ LL
20 40 60



THE STRATIFICATION LINES REPRESENT APPROXIMATE SOIL BOUNDARIES: ACTUAL STRATIFICATION MAY BE GRADUAL.

DRILLER: Brotcke Well
METHOD: Hollow-stem augers
LOGGED BY: J. Fouse

WATER LEVELS: DURING DRILLING 7.5 FEET
____ BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT ____ FEET

File: UERAIL Date Printed: November 28, 1999

Reitz & Jens, Inc.
Consulting Engineers

BORING LOG

Meramec Power Plant Rail Loop
Ameren Services

DATE MADE: 8/31/99

BORING NO: TH-N
LOCATION: Ash Pond 491
ELEVATION: 416.5 **DATUM:** ft, NGVD
FIGURE: A-5 **SHEET** 1 **OF** 4

SHEAR STRENGTH, tsf: △ QU/2 ■ PP □ SV (1, 2, 3)
STANDARD PENETRATION TEST ▲ N-VALUE (BLOWS PER LAST FOOT)
MOISTURE CONTENT, % PL ├──●──┤ LL (20, 40, 60)

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES	MOISTURE CONTENT PERCENT BY WEIGHT
0	415		Loose, dry, FLYASH		
		33		1-0-1	41.3
5	410	58		60.5	53.3
		50		1-0-1	53.4
10	405	0			48.8
		100		0-1-1	62.4
15	400	75			52.1
		56		1-1-2	28.3
20	395	100		62.6	55.9
		100		0-1-1	38.9
			Soft, gray, CLAY		
25	390	100	Loose, gray and brown Sandy SILT; with Clay, strong organic odor		35.2
30					

THE STRATIFICATION LINES REPRESENT APPROXIMATE SOIL BOUNDARIES: ACTUAL STRATIFICATION MAY BE GRADUAL.

DRILLER: Brotcke Well
METHOD: HSA & rotary w/mud
LOGGED BY: Deryl Calvert

WATER LEVELS: DURING DRILLING ______ FEET
______ BORING DRY AT COMPLETION OF DRILLING
AT ______ FEET AFTER ______ HOURS
AT ______ FEET AFTER ______ HOURS

PIEZOMETER: INSTALLED AT ______ FEET

File: UERAIL Date Printed: November 28, 1999

Reitz & Jens, Inc.
Consulting Engineers

BORING LOG

Meramec Power Plant Rail Loop
Ameren Services

DATE MADE: 8/31/99

BORING NO: TH-N
LOCATION: Ash Pond 491
ELEVATION: 416.5 **DATUM:** ft, NGVD
FIGURE: A-5 **SHEET** 2 **OF** 4

SHEAR STRENGTH, tsf: △ QU/2 ■ PP □ SV (1, 2, 3)
STANDARD PENETRATION TEST ▲ N-VALUE (BLOWS PER LAST FOOT)
MOISTURE CONTENT, %: PL ⊢—●—⊣ LL (20, 40, 60)

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES	MOISTURE CONTENT PERCENT BY WEIGHT
	385	96	Firm, light gray, high plastic CLAY; with light gray Sand seams, traces of lignite	81.3	37.0
35	380	100		74.6	38.7
40	375	100	Firm, gray, Clayey SILT	84.3	34.7
45	370	100	Firm, gray, high plastic CLAY	57.5	69.0
50	365	100	Medium-dense, gray, slightly Clayey, Sandy SILT Note: lost lead hollow-stem auger in hole; moved hole over 10 feet and augered to 60 feet to continue boring.	89.6	32.0
55	360				
60					

THE STRATIFICATION LINES REPRESENT APPROXIMATE SOIL BOUNDARIES. ACTUAL STRATIFICATION MAY BE GRADUAL.

DRILLER: Brotcke Well
METHOD: HSA & rotary w/mud
LOGGED BY: Deryl Calvert

WATER LEVELS: DURING DRILLING ______ FEET
______ BORING DRY AT COMPLETION OF DRILLING
AT ______ FEET AFTER ______ HOURS
AT ______ FEET AFTER ______ HOURS

PIEZOMETER: INSTALLED AT ______ FEET

Reitz & Jens, Inc.
Consulting Engineers

BORING LOG

Meramec Power Plant Rail Loop	**BORING NO:** TH-N
Ameren Services	**LOCATION:** Ash Pond 491
	ELEVATION: 416.5 **DATUM:** ft, NGVD
DATE MADE: 8/31/99	**FIGURE:** A-5 **SHEET** 3 **OF** 4

SHEAR STRENGTH, tsf: △ QU/2 ■ PP □ SV (1, 2, 3)
STANDARD PENETRATION TEST: ▲ N-VALUE (BLOWS PER LAST FOOT)
MOISTURE CONTENT, %: PL ●—— LL (20, 40, 60)

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) / BLOWS PER 6 INCHES	MOISTURE CONTENT PERCENT BY WEIGHT
	355	100	Same: medium-dense, gray, slightly Clayey, Sandy SILT; with strong organic odor	84.2	34.9
65	350				
70	345	0	Loose, gray, fine SAND; with some Silt and trace Gravel Note: sand came up in HSA. Resumed hole 9/1/99 using rotary drilling. Hole collapsed up to 47 feet overnight. Drilled back down to 72 feet.		
		83		5-6-7	33.3
75	340				
			Soft, gray, high plastic CLAY		
80	335	100		2-3-3	33.7
85	330				
90					

THE STRATIFICATION LINES REPRESENT APPROXIMATE SOIL BOUNDARIES: ACTUAL STRATIFICATION MAY BE GRADUAL.

DRILLER: Brotcke Well

METHOD: HSA & rotary w/mud

LOGGED BY: Deryl Calvert

WATER LEVELS: DURING DRILLING ______ FEET
______ BORING DRY AT COMPLETION OF DRILLING
AT ______ FEET AFTER ______ HOURS
AT ______ FEET AFTER ______ HOURS

PIEZOMETER: INSTALLED AT ______ FEET

Reitz & Jens, Inc.
Consulting Engineers

BORING LOG

Meramec Power Plant Rail Loop
Ameren Services

DATE MADE: 8/31/99

BORING NO: TH-N
LOCATION: Ash Pond 491
ELEVATION: 416.5 **DATUM:** ft, NGVD
FIGURE: A-5 **SHEET** 4 **OF** 4

SHEAR STRENGTH, tsf: △ QU/2 ■ PP □ SV (1, 2, 3)
STANDARD PENETRATION TEST ▲ N-VALUE (BLOWS PER LAST FOOT)
MOISTURE CONTENT, %: PL ├──●──┤ LL (20, 40, 60)

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) / BLOWS PER 6 INCHES	MOISTURE CONTENT PERCENT BY WEIGHT
			Same: soft, gray, high plastic CLAY		
		100		2-3-5	
			Medium-dense, fine to medium GRAVEL		
		100	Stiff, gray, high plastic CLAY	5-6-6	29.3
			Medium-dense, fine to medium GRAVEL		
			Refusal on Limestone @ 106.5 feet		

Depth scale: 95, 100, 105, 110, 115, 120
Elevation scale: 325, 320, 315, 310, 305, 300

THE STRATIFICATION LINES REPRESENT APPROXIMATE SOIL BOUNDARIES: ACTUAL STRATIFICATION MAY BE GRADUAL.

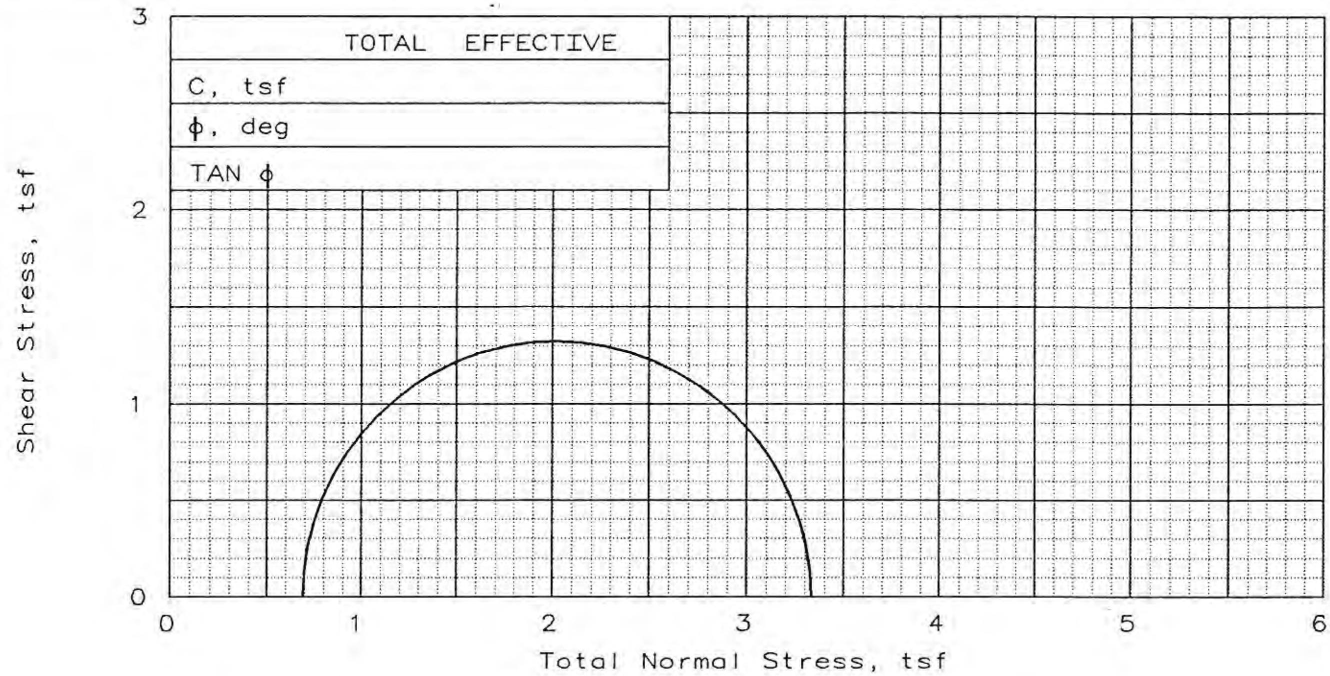
DRILLER: Brotcke Well
METHOD: HSA & rotary w/mud
LOGGED BY: Deryl Calvert

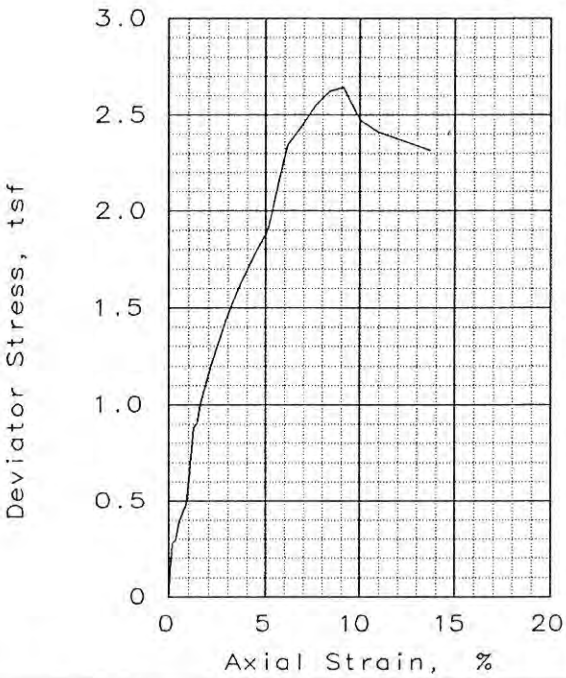
WATER LEVELS: DURING DRILLING ____ FEET
____ BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT ____ FEET

APPENDIX B

RESULTS OF LABORATORY TESTS





Sample No.:		1
INITIAL	WATER CONTENT, %	53.3
	DRY DENSITY, pcf	60.5
	SATURATION, %	86.7
	VOID RATIO	1.476
	DIAMETER, in	2.85
	HEIGHT, in	5.60
AT TEST	WATER CONTENT, %	55.0
	DRY DENSITY, pcf	64.6
	SATURATION, %	100.0
	VOID RATIO	1.319
	DIAMETER, in	2.79
	HEIGHT, in	5.48

Strain rate, %/min	1.00
EFF CELL PRESSURE, tsf	0.69
FAIL. STRESS, tsf	2.64
TOTAL PORE PR., tsf	5.79
STRAIN, %	9.1
ULT. STRESS, tsf	2.64
TOTAL PORE PR., tsf	5.79
STRAIN, %	9.1
$\bar{\sigma}_1$ FAILURE, tsf	3.34
$\bar{\sigma}_3$ FAILURE, tsf	0.69

TYPE OF TEST:
CU with Pore Pressures

SAMPLE TYPE: Shelby tube

DESCRIPTION: Flyash

SPECIFIC GRAVITY= 2.4

REMARKS:

CLIENT: Ameren U.E.

PROJECT: Meramec Rail Loop

SAMPLE LOCATION: TH-N, Depth 5.0 - 7.0 ft

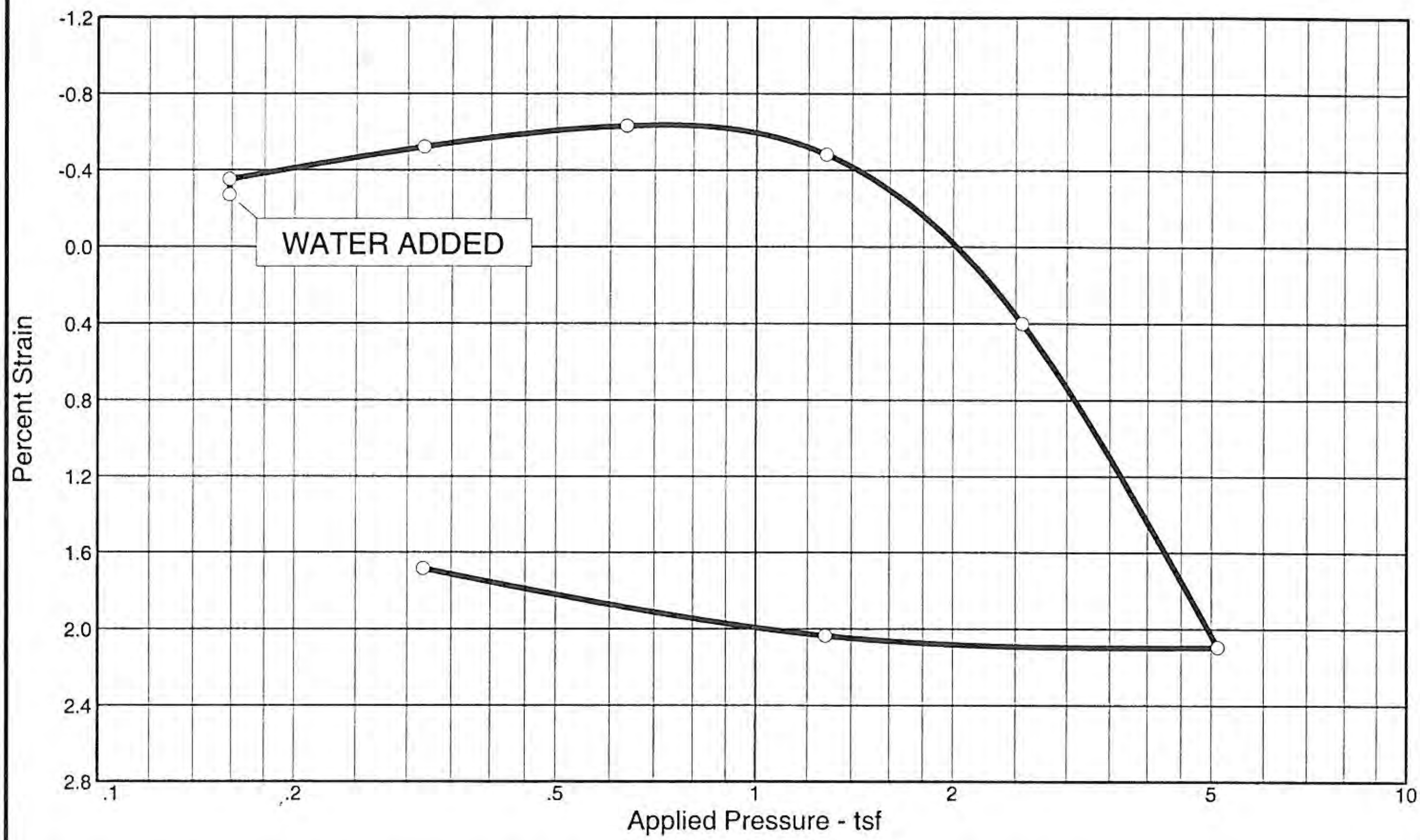
PROJ. NO.: 1999012402 DATE: 9/17/99

TRIAXIAL SHEAR TEST REPORT

REITZ & JENS, Inc.

Fig. No.: B-1

CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation											
No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α
2	0.16	0.02									
3	0.32	0.32	0.000								
4	0.63	0.20	0.000								
5	1.28	0.04	0.000								
6	2.56	0.64	0.001								
7	5.12	0.77	0.000								
8	1.28	0.78	0.000								
9	0.32	0.20	0.000								

Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
74.7 %	59.0 %	53.2			2.6	0.12	1.96	0.18	0.01	2.052

MATERIAL DESCRIPTION	USCS	AASHTO
Flyash		

Project No. 1999012402 **Client:** Ameren U.E.

Project: Meramec Rail Loop

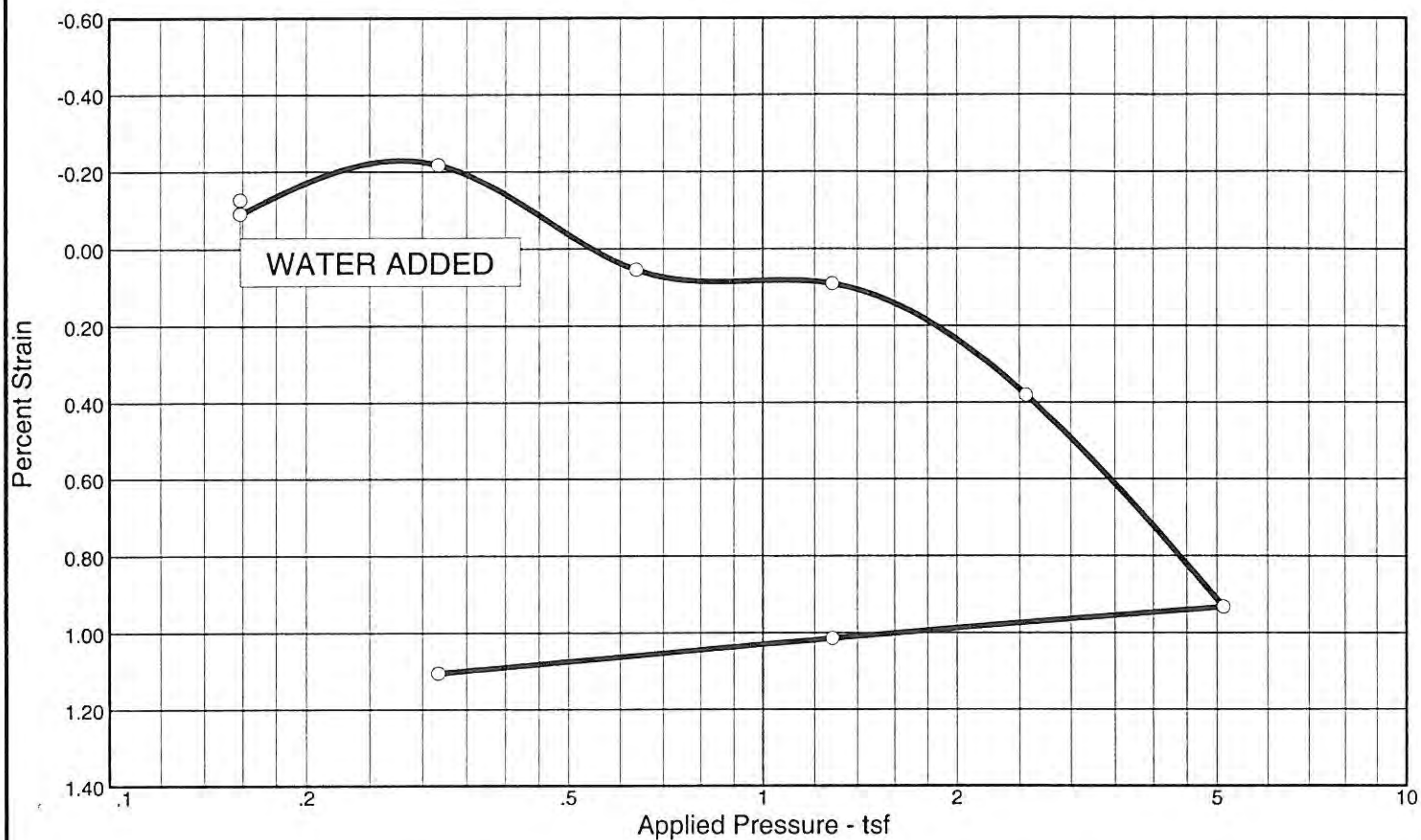
Source: TH-A **Sample No.:** ST-1 **Elev./Depth:** 2.5 to 4.5 feet

Reitz & Jens, Inc.
Consulting Engineers

Remarks:

Figure B-2

CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation											
No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α
1	0.16	0.63	0.001								
3	0.32	1.86	0.000								
4	0.63	0.54	0.000								
5	1.28	0.04	0.000								
6	2.56	1.57	0.001								
7	5.12	3.96	0.001								
8	1.28	0.08	0.000								
9	0.32	0.18									

Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
71.1 %	34.7 %	72.7			2.7	0.30	1.32	0.04	0.00	1.318

MATERIAL DESCRIPTION	USCS	AASHTO
Flyash		

Project No. 1999012402 **Client:** Ameren U.E.

Project: Meramec Rail Loop

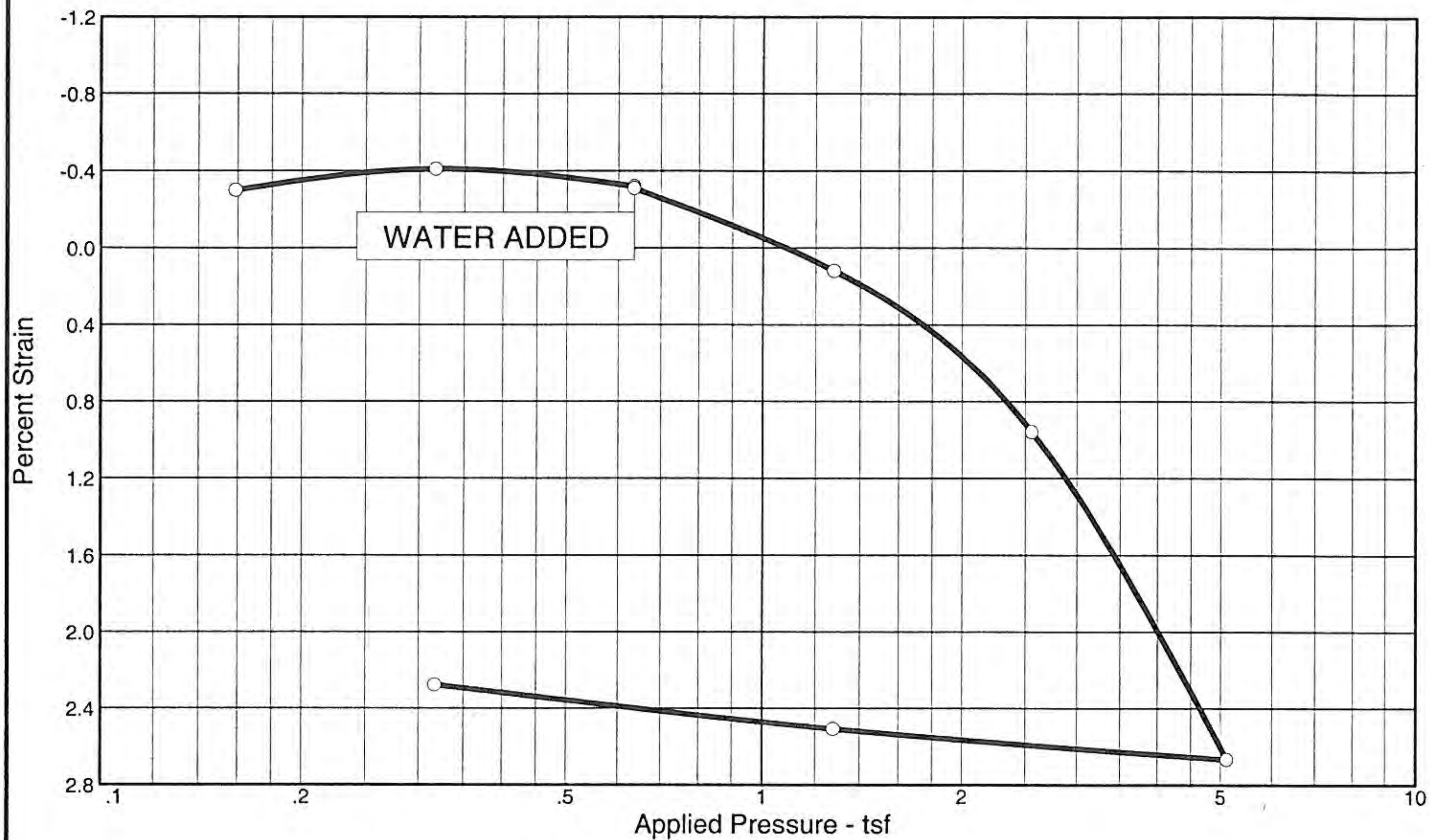
Source: TH-H **Sample No.:** ST-2 **Elev./Depth:** 5 to 7 feet

Remarks:

Reitz & Jens, Inc.
Consulting Engineers

Figure B-3

CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation											
No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α
2	0.32	0.06	0.000								
3	0.63	0.02	0.001								
4	0.63	0.02	0.000								
5	1.28	1.32	0.001								
6	2.56	4.25	0.001								
7	5.12	0.87	0.003								
8	1.28	0.59	0.000								
9	0.32	0.03	0.000								

Natural Saturation	Natural Moisture	Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
97.8 %	29.0 %	93.6	40	20	2.7	1.02	1.55	0.11	0.00	0.801

MATERIAL DESCRIPTION	USCS	AASHTO
Tannish brown with gray, Silty CLAY with large lignite deposits	CL	

Project No. 1999012402 **Client:** Ameren U.E.

Project: Meramec Rail Loop

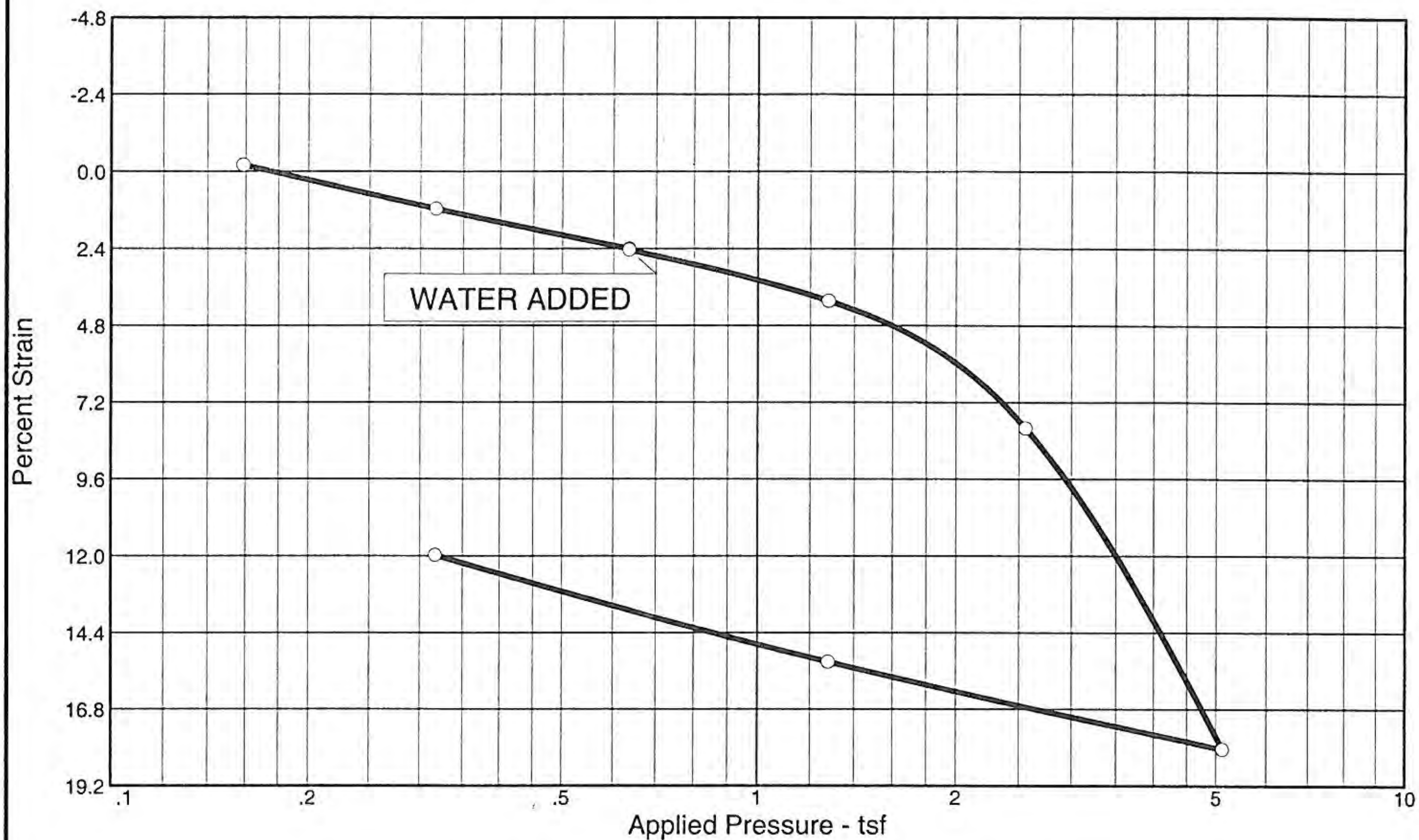
Source: TH-H **Sample No.:** ST-9 **Elev./Depth:** 25 to 27 feet

Reitz & Jens, Inc.
Consulting Engineers

Remarks:

Figure B-4

CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation											
No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α
1	0.16	0.70	0.000								
2	0.32	0.07	0.002								
3	0.63	0.05	0.001								
5	1.28	0.04	0.002								
6	2.56	0.03	0.008								
7	5.12	0.01	0.016								
8	1.28	0.01									
9	0.32	0.01									

Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
100.0 %	63.1 %	62.8	95	67	2.76	2.25	2.38	0.95	0.14	1.742

MATERIAL DESCRIPTION	USCS	AASHTO
Dark gray with traces of blackish gray, high plastic CLAY; with light gray fine Sand seams	CH	

Project No. 1999012402 **Client:** Ameren U.E.

Project: Meramec Rail Loop

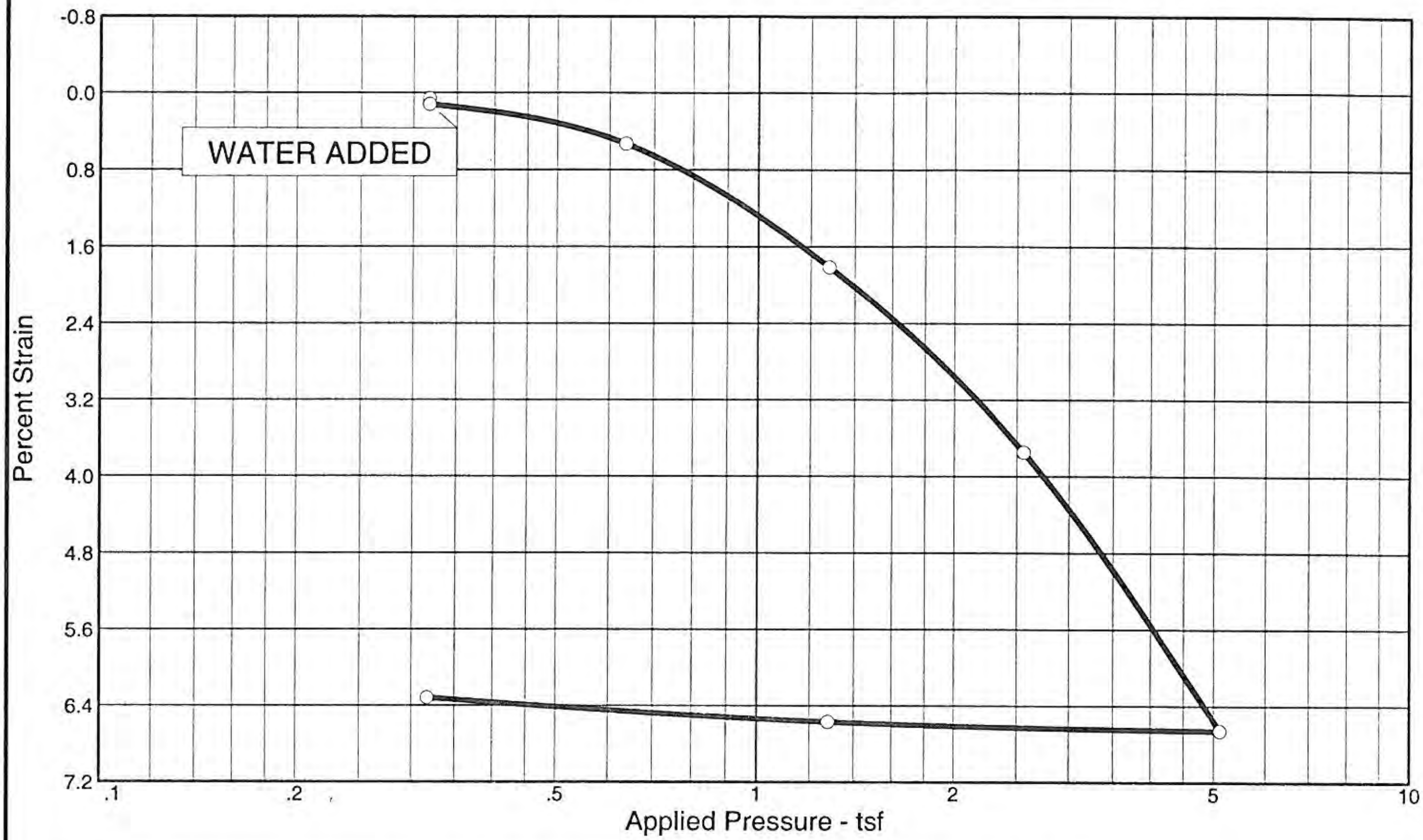
Source: TH-H **Sample No.:** ST-15 **Elev./Depth:** 60 to 62 feet

Remarks:

Reitz & Jens, Inc.
Consulting Engineers

Figure B-6

CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation											
No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α
1	0.32	0.35	0.001								
2	0.32	0.02	0.000								
3	0.63	3.91	0.001								
6	5.12	2.24	0.002								
8	0.32	1.07									

Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
90.2 %	55.9 %	62.6			2.65	0.92	1.38	0.26	0.01	1.642

MATERIAL DESCRIPTION	USCS	AASHTO
Flyash		

Project No. 1999012402 **Client:** Ameren U.E.

Project: Meramec Rail Loop

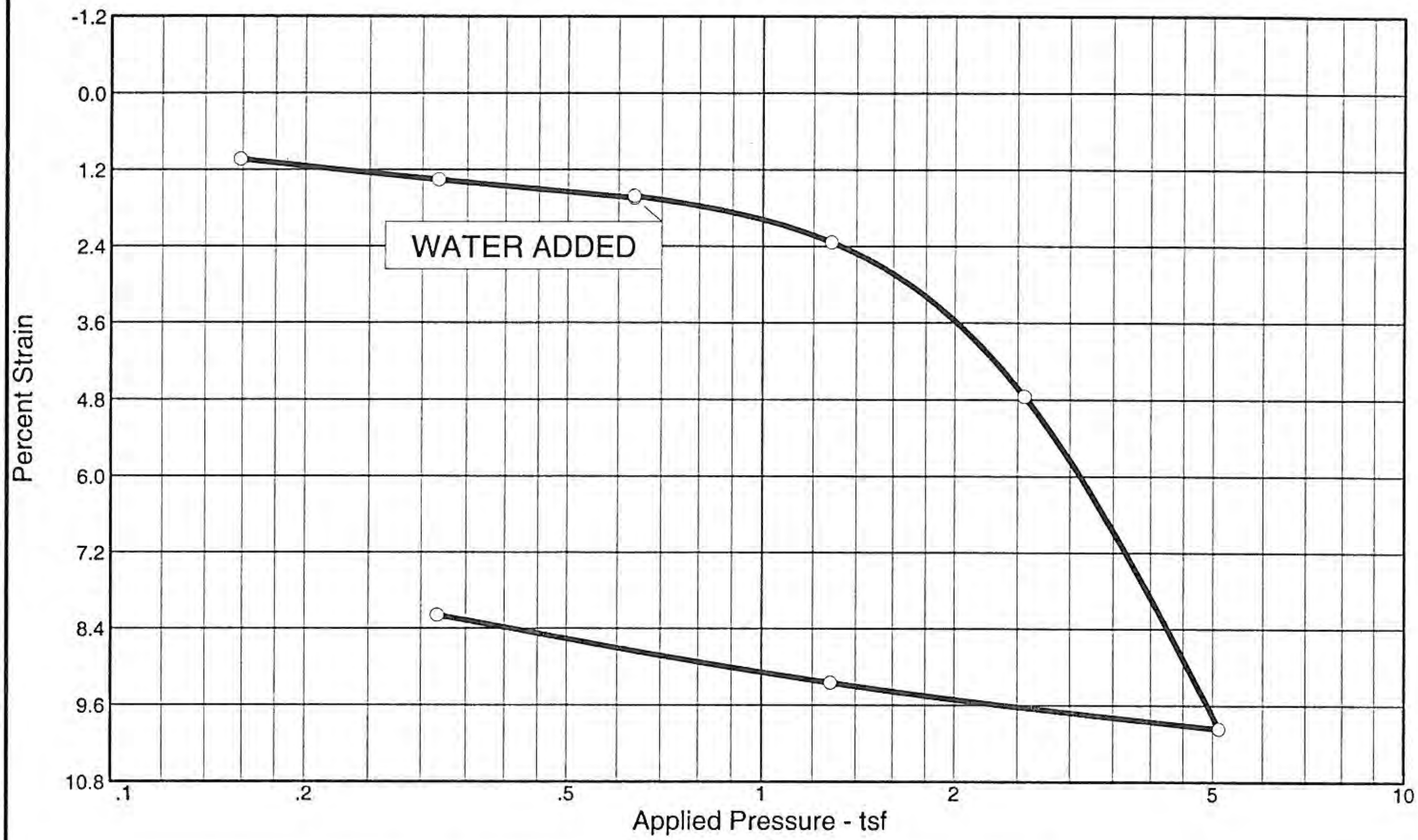
Source: TH-N **Sample No.:** ST-8 **Elev./Depth:** 20 to 22 feet

Remarks:

Reitz & Jens, Inc.
Consulting Engineers

Figure B-7

CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation											
No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α
1	0.16	0.42	0.001								
2	0.32	0.06	0.002								
3	0.63	0.04	0.001								
4	0.63	1.13	0.000								
5	1.28	0.22	0.002								
6	2.56	0.16	0.004								
7	5.12	0.06	0.007								
8	1.28	0.12									
9	0.32	0.04									

Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
100.0 %	38.7 %	83.9	53	28	2.8	1.43	2.19	0.37	0.03	1.083

MATERIAL DESCRIPTION	USCS	AASHTO
Medium-dark gray, high plastic CLAY; with light gray Sand seams, traces of lignite	CH	

Project No. 1999012402 **Client:** Ameren U.E.

Project: Meramec Rail Loop

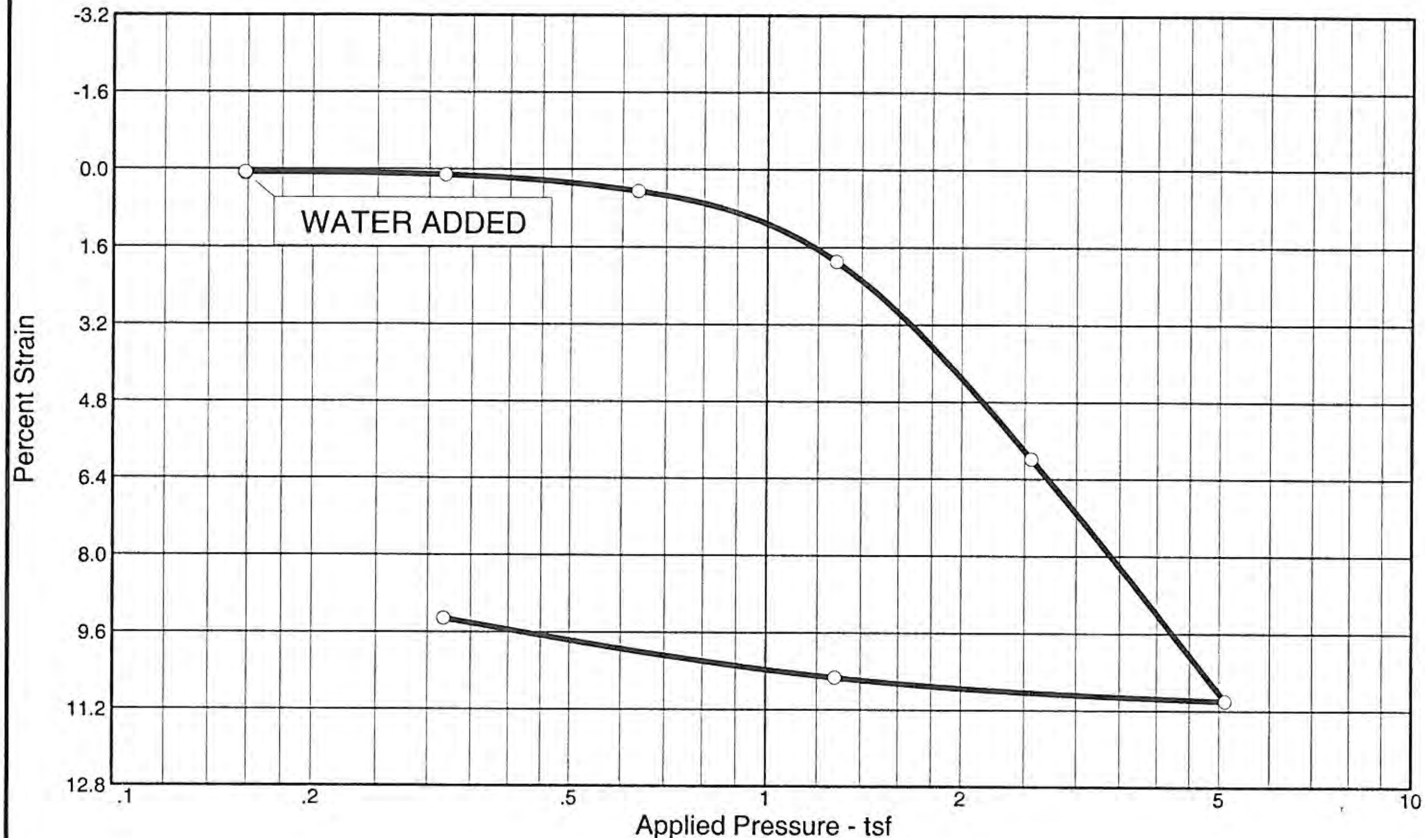
Source: TH-N **Sample No.:** ST-12 **Elev./Depth:** 35 to 37 feet

Reitz & Jens, Inc.
Consulting Engineers

Remarks:

Figure B-8

CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation											
No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α
1	0.16	2.97	0.000								
3	0.32	0.26	0.000								
4	0.63	0.09	0.000								
5	1.28	0.11	0.001								
6	2.56	3.85	0.002								
7	5.12	0.83	0.003								
8	1.28	1.32									
9	0.32	0.07									

Natural Saturation	Natural Moisture	Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
43.7 %	35.0 %	53.0			2.65	0.13	1.41	0.52	0.04	2.121

MATERIAL DESCRIPTION	USCS	AASHTO
Flyash		

Project No. 1999012402 **Client:** Ameren U.E.
Project: Meramec Rail Loop

Source: TH-L **Sample No.:** ST-1 **Elev./Depth:** 2.5 to 4.5 feet

Reitz & Jens, Inc.
Consulting Engineers

Remarks:

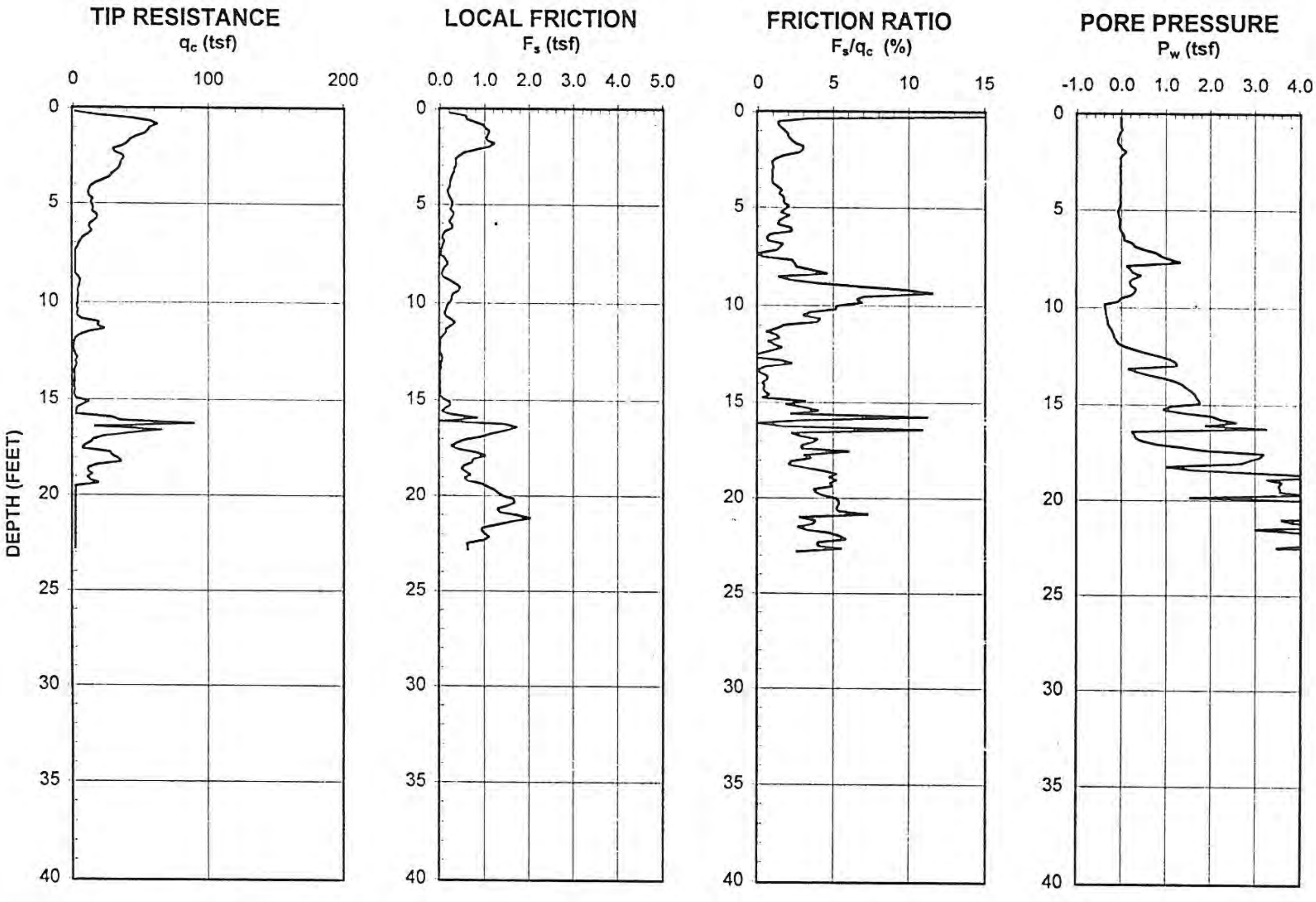
Figure B-9

APPENDIX C

RESULTS OF PIEZOMETRIC CONE PENETRATION TESTS

URS GREINER WOODWARD CLYDE
TH-G

Operator:	A. Bredikhin	CPT Date:	8/26/99
Page:	1 of 1	Location:	AmerenUE
Cone Used:	243	Job Number:	23-99000035



URS GREINER WOODWARD CLYDE
TH-G

Operator:	A. Bredikhin		
Cone Used:	243	Location:	AmerenUE
CPT Date:	8/26/99	Job Number:	23-99000035
Total Unit Weight (ave.):	120 pcf	Water Table:	6 ft

Depth (meters)	Depth (feet)	q_c (ave) (tsf)	F_s (ave) (tsf)	R_f (ave) (%)	σ'_v (tsf)	Soil Behavior Type	Eq - D_r (%)	ϕ' (deg)	SPT N-value	s_u (tsf)	$(q_{c1})_{cs}$ (tsf)	CRR M=7.5
0.175	0.6	39.7	0.69	4.76	-0.01	sand to silty sand	88	44	7	undefined	218.5	0.93
0.475	1.6	45.8	1.10	2.46	-0.02	sand to silty sand	78	42	8	undefined	155.5	0.39
0.775	2.5	34.3	0.48	1.44	-0.01	sand to silty sand	63	40	6	undefined	91.8	0.14
1.075	3.5	27.2	0.28	1.04	-0.02	sand to silty sand	51	37	5	undefined	64.8	0.10
1.375	4.5	13.0	0.22	1.72	-0.03	silty sand to sandy silt	27	33	3	undefined	53.0	0.09
1.675	5.5	16.1	0.26	1.65	-0.05	silty sand to sandy silt	30	33	4	undefined	54.9	0.09
1.975	6.5	10.8	0.15	1.37	0.11	silty sand to sandy silt	17	31	3	undefined	53.5	0.09
2.275	7.5	3.6	0.06	1.28	0.78	clay	undefined	undefined	1	0.19	undefined	undefined
2.575	8.4	4.0	0.11	3.03	0.26	clay	undefined	undefined	1	0.21	undefined	undefined
2.875	9.4	4.2	0.34	8.17	0.06	clay	undefined	undefined	2	0.22	undefined	undefined
3.175	10.4	3.9	0.16	4.16	-0.34	clay	undefined	undefined	1	0.20	undefined	undefined
3.475	11.4	13.3	0.15	1.15	-0.17	silty sand to sandy silt	18	31	3	undefined	55.1	0.09
3.775	12.4	1.5	0.01	0.78	0.69	organic soil	undefined	undefined	1	0.06	undefined	undefined
4.075	13.4	1.8	0.01	0.70	0.76	clay	undefined	undefined	1	0.07	undefined	undefined
4.375	14.4	1.4	0.01	0.44	1.58	organic soil	undefined	undefined	1	0.05	undefined	undefined
4.675	15.3	5.0	0.17	4.27	1.58	clay	undefined	undefined	2	0.26	undefined	undefined
4.975	16.3	46.3	1.12	3.43	1.44	silty sand to sandy silt	50	37	10	undefined	84.2	0.13
5.275	17.3	15.9	0.57	3.77	1.81	clayey silt to silty clay	undefined	undefined	4	0.89	undefined	undefined
5.575	18.3	23.1	0.69	3.42	2.68	clayey silt to silty clay	undefined	undefined	6	1.32	undefined	undefined
5.875	19.3	19.7	0.85	4.54	3.61	clayey silt to silty clay	undefined	undefined	5	1.11	undefined	undefined
6.175	20.3	28.9	1.48	5.14	4.92	clayey silt to silty clay	undefined	undefined	8	1.65	undefined	undefined
6.475	21.2	42.6	1.50	3.93	4.35	silty sand to sandy silt	45	36	10	undefined	87.7	0.14
6.775	22.2	18.2	0.88	4.93	5.74	clayey silt to silty clay	undefined	undefined	5	1.02	undefined	undefined

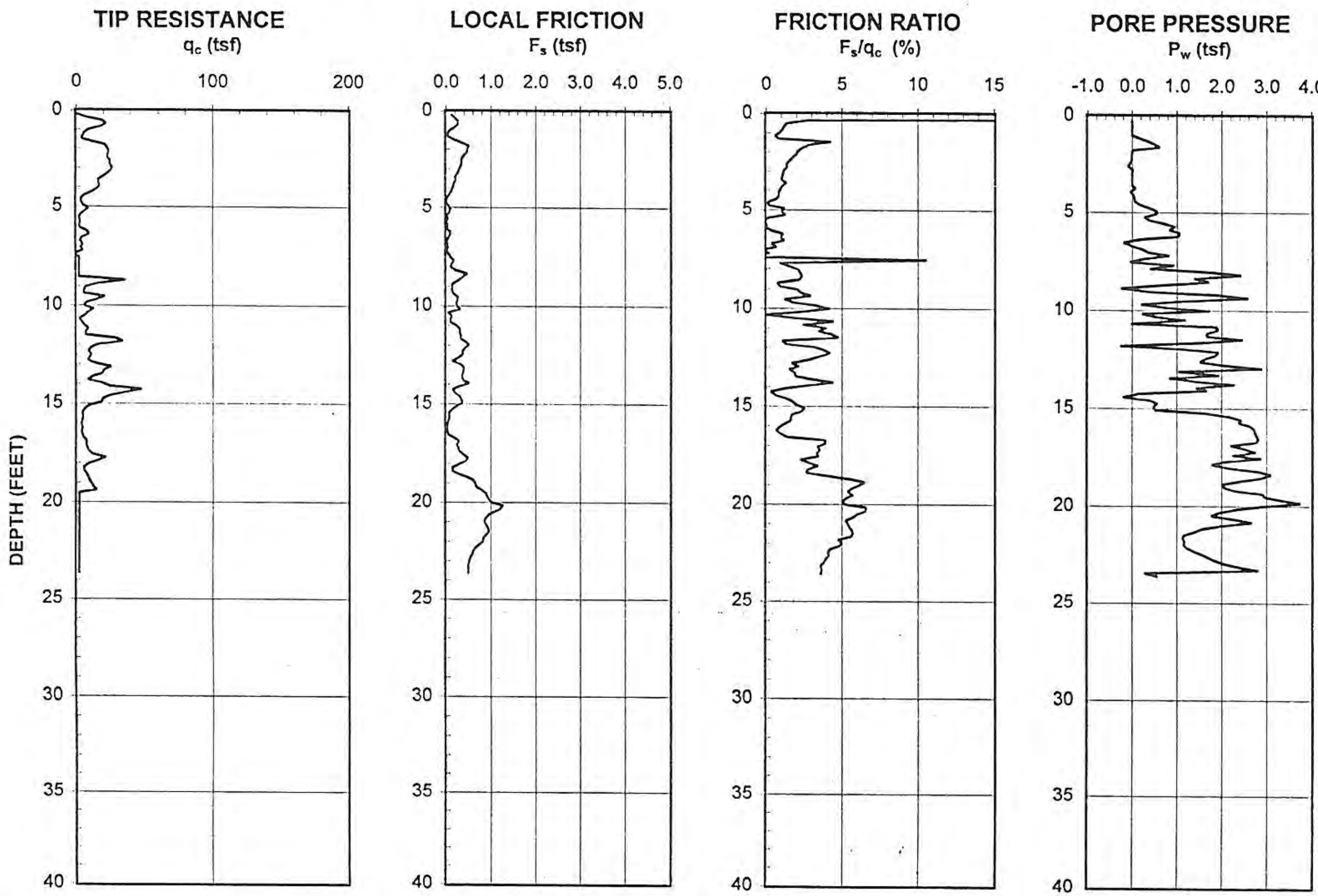
D_r - All sands (Jamiolkowski et al. 1985) ϕ' - Terzaghi, Peck, and Mesri (1996)

s_u: N_k = 17 CRR: M = 7.5 Robertson and Fear (1996)

** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPT-INT

URS GREINER WOODWARD CLYDE
TH-H

Operator:	A. Bredikhin	CPT Date:	8/26/99
Page:	1 of 1	Location:	AmerenUE
Cone Used:	243	Job Number:	23-99000035



URS GREINER WOODWARD CLYDE
TH-H

Operator:	A. Bredikhin		
Cone Used:	243	Location:	AmerenUE
CPT Date:	8/26/99	Job Number:	23-99000035
Total Unit Weight (ave.):	120 pcf	Water Table:	4 ft

Depth (meters)	(feet)	q_c (ave) (tsf)	F_s (ave) (tsf)	R_f (ave) (%)	σ'_v (tsf)	Soil Behavior Type	Eq - D_r (%)	ϕ' (deg)	SPT N-value	s_u (tsf)	$(q_{c1})_{cs}$ (tsf)	CRR M=7.5
0.175	0.6	39.7	0.69	4.76	-0.01	sand to silty sand	55	38	2	undefined	68.6	0.11
0.475	1.6	45.8	1.10	2.46	-0.02	silty sand to sandy silt	39	35	2	undefined	54.1	0.09
0.775	2.5	34.3	0.48	1.44	-0.01	sand to silty sand	53	38	5	undefined	69.9	0.11
1.075	3.5	27.2	0.28	1.04	-0.02	sand to silty sand	42	36	4	undefined	53.2	0.09
1.375	4.5	13.0	0.22	1.72	-0.03	silty sand to sandy silt	11	30	2	undefined	42.0	0.09
1.675	5.5	16.1	0.26	1.65	-0.05	silty sand to sandy silt	-8	26	1	undefined	53.1	0.09
1.975	6.5	10.8	0.15	1.37	0.11	silty sand to sandy silt	-1	28	1	undefined	53.4	0.09
2.275	7.5	3.6	0.06	1.28	0.78	clayey silt to silty clay	undefined	undefined	1	0.31	undefined	undefined
2.575	8.4	4.0	0.11	3.03	0.26	silty sand to sandy silt	30	33	4	undefined	55.1	0.09
2.875	9.4	4.2	0.34	8.17	0.06	silty sand to sandy silt	14	30	2	undefined	61.7	0.10
3.175	10.4	3.9	0.16	4.16	-0.34	clayey silt to silty clay	undefined	undefined	2	0.37	undefined	undefined
3.475	11.4	13.3	0.15	1.15	-0.17	silty sand to sandy silt	24	32	4	undefined	62.5	0.10
3.775	12.4	1.5	0.01	0.78	0.69	clayey silt to silty clay	undefined	undefined	3	0.61	undefined	undefined
4.075	13.4	1.8	0.01	0.70	0.76	silty sand to sandy silt	25	32	4	undefined	65.0	0.10
4.375	14.4	1.4	0.01	0.44	1.58	silty sand to sandy silt	39	35	6	undefined	58.3	0.10
4.675	15.3	5.0	0.17	4.27	1.58	clayey silt to silty clay	undefined	undefined	2	0.44	undefined	undefined
4.975	16.3	46.3	1.12	3.43	1.44	clay	undefined	undefined	1	0.21	undefined	undefined
5.275	17.3	15.9	0.57	3.77	1.81	clayey silt to silty clay	undefined	undefined	3	0.59	undefined	undefined
5.575	18.3	23.1	0.69	3.42	2.68	clay	undefined	undefined	3	0.46	undefined	undefined
5.875	19.3	19.7	0.85	4.54	3.61	clay	undefined	undefined	4	0.75	undefined	undefined
6.175	20.3	28.9	1.48	5.14	4.92	clayey silt to silty clay	undefined	undefined	5	1.04	undefined	undefined
6.475	21.2	42.6	1.50	3.93	4.35	clayey silt to silty clay	undefined	undefined	5	0.92	undefined	undefined
6.775	22.2	18.2	0.88	4.93	5.74	clayey silt to silty clay	undefined	undefined	5	0.88	undefined	undefined
7.275	23.9	4.1	0.11	0.43	1.21	clayey silt to silty clay	undefined	undefined	0	0.76	undefined	undefined

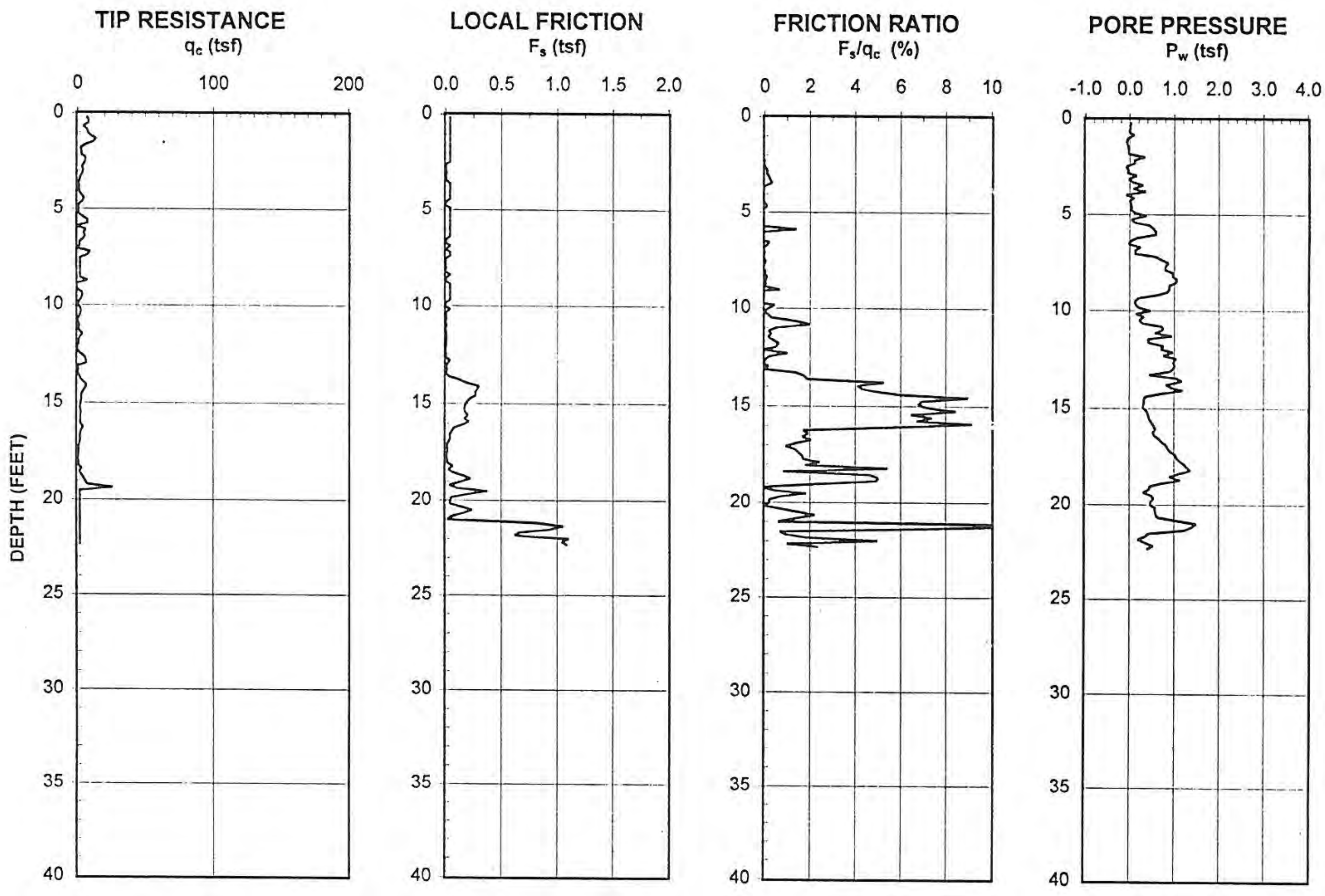
D_r - All sands (Jamiolkowski et al. 1985) ϕ' - Terzaghi, Peck, and Mesri (1996)

s_u: N_k = 17 CRR: M = 7.5 Robertson and Fear (1996)

** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPT-INT

WOODWARD-CLYDE CONSULTANTS
TH-L

Operator:	A. Bredikhin	CPT Date:	8/26/99
Page:	1 of 1	Location:	AmerenUE
Cone Used:	243	Job Number:	23-99000035



URS Greiner Woodward Clyde
TH-L

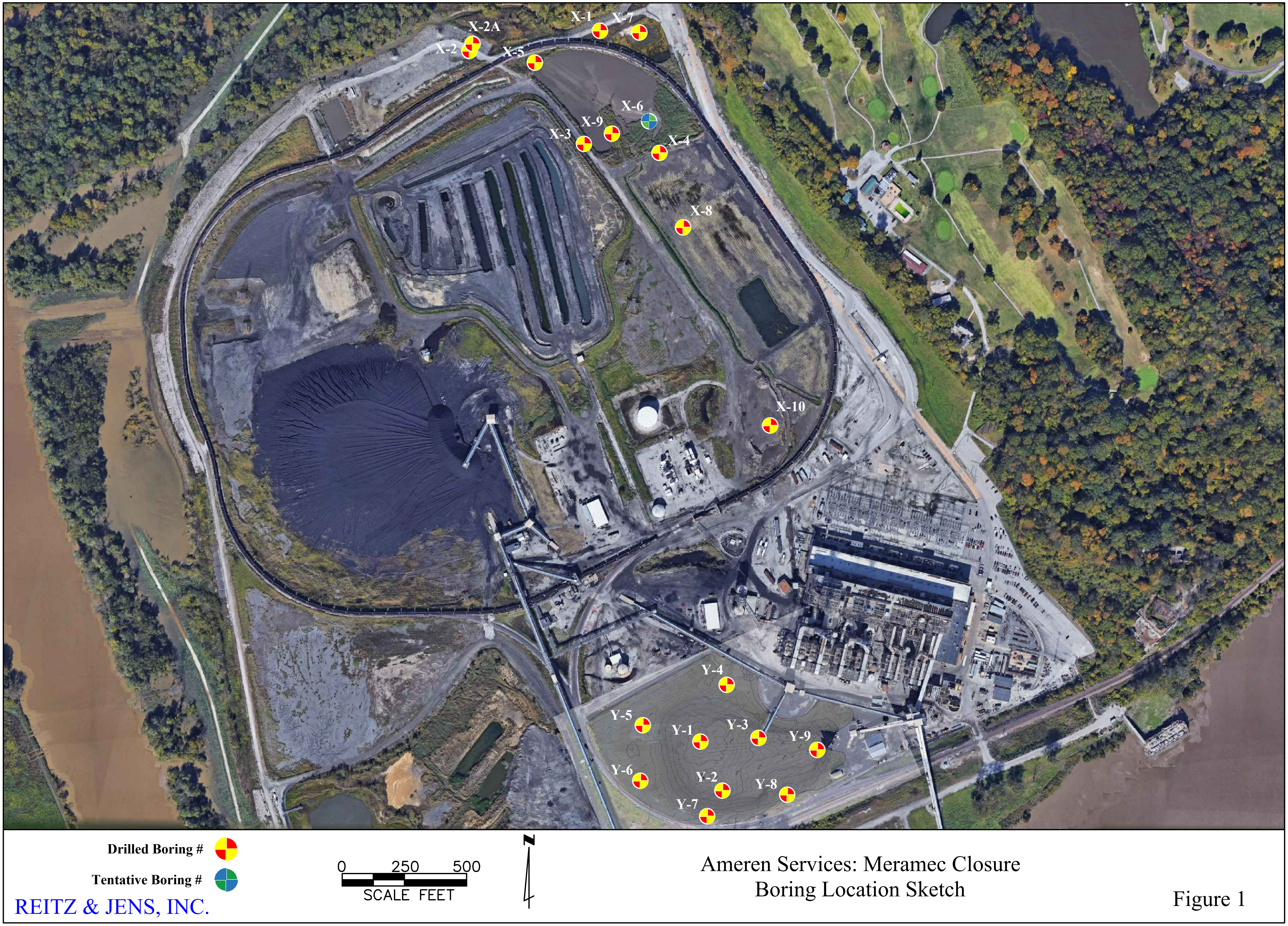
Operator:	A. Bredikhin		
Cone Used:	243	Location:	AmerenUE
CPT Date:	8/26/99	Job Number:	23-99000035
Total Unit Weight (ave.):	120 pcf	Water Table:	5 ft

Depth (meters)	Depth (feet)	q_c (ave) (tsf)	F_s (ave) (tsf)	R_f (ave) (%)	σ'_v (tsf)	Soil Behavior Type	Eq - D_r (%)	ϕ' (deg)	SPT N-value	s_u (tsf)	$(q_{c1})_{cs}$ (tsf)	CRR M=7.5
0.175	0.6	7.2	-0.02	-0.24	0.03	undefined	undefined	undefined	undefined	undefined	undefined	undefined
0.475	1.6	7.8	-0.01	-0.13	0.09	undefined	undefined	undefined	undefined	undefined	undefined	undefined
0.775	2.5	4.5	0.00	0.03	0.15	sand to silty sand	5	29	1	undefined	24.7	0.08
1.075	3.5	1.9	0.00	0.01	0.21	silty sand to sandy silt	undefined	23	0	undefined	49.2	0.09
1.375	4.5	2.6	0.00	-0.11	0.27	undefined	undefined	undefined	undefined	undefined	undefined	undefined
1.675	5.5	3.3	-0.01	0.08	0.31	undefined	undefined	undefined	undefined	undefined	undefined	undefined
1.975	6.5	4.1	-0.01	-0.16	0.34	undefined	undefined	undefined	undefined	undefined	undefined	undefined
2.275	7.5	5.2	0.00	0.00	0.37	silty sand to sandy silt	undefined	27	1	undefined	42.2	0.09
2.575	8.4	5.0	0.00	0.04	0.40	silty sand to sandy silt	undefined	27	1	undefined	42.6	0.09
2.875	9.4	1.7	-0.01	-0.27	0.43	undefined	undefined	undefined	undefined	undefined	undefined	undefined
3.175	10.4	1.4	0.00	0.67	0.46	clay	undefined	undefined	1	0.06	undefined	undefined
3.475	11.4	1.7	0.01	0.37	0.48	clay	undefined	undefined	1	0.07	undefined	undefined
3.775	12.4	2.4	0.00	0.00	0.51	clay	undefined	undefined	1	0.11	undefined	undefined
4.075	13.4	1.9	0.03	0.00	0.54	clay	undefined	undefined	1	0.08	undefined	undefined
4.375	14.4	4.7	0.25	5.86	0.57	clay	undefined	undefined	2	0.24	undefined	undefined
4.675	15.3	2.5	0.18	7.17	0.60	organic soil	undefined	undefined	1	0.11	undefined	undefined
4.975	16.3	2.8	0.10	3.69	0.63	clay	undefined	undefined	1	0.13	undefined	undefined
5.275	17.3	1.4	0.02	1.44	0.66	organic soil	undefined	undefined	2	0.04	undefined	undefined
5.575	18.3	1.8	0.06	3.35	0.68	organic soil	undefined	undefined	1	0.07	undefined	undefined
5.875	19.3	15.4	0.17	1.67	0.71	silty sand to sandy silt	18	31	4	undefined	59.6	0.10
6.175	20.3	18.2	0.11	0.82	0.74	silty sand to sandy silt	22	32	4	undefined	50.4	0.09
6.475	21.2	38.4	0.59	4.03	0.77	silty sand to sandy silt	43	36	8	undefined	70.0	0.11

D_r - All sands (Jamiolkowski et al. 1985) ϕ' - Terzaghi, Peck, and Mesri (1996)

s_u: $N_k = 17$ CRR: M = 7.5 Robertson and Fear (1996)

** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPT-INT



Ameren Services: Meramec Closure
Boring Location Sketch

REITZ & JENS, INC.

Figure 1

KEY TO BORING LOGS

Symbol	Description

KEY TO SOIL SYMBOLS

- Crushed Limestone
- Miscellaneous FILL
- Low plastic Clayey SILT (ML)
- Medium to high plastic CLAY
- High plastic CLAY (CH)
- Low plastic CLAY (CL)
- Low plastic Silty CLAY/ Clayey SILT (CL-ML)
- Clayey SAND or Sandy CLAY (SC)
- Low plastic Silty CLAY (CL)
- Silty SAND (SM)
- Poorly-graded GRAVEL (GP)
- Poorly-graded SAND (SP)
- Inorganic, non-plastic SILT (ML)
- COAL
- Clayey Sandy SILT (ML)
- Clayey GRAVEL or Gravelly CLAY (GC)

MISCELLANEOUS SYMBOLS

- Water table during drilling
- Delayed Reading of Water table
- Boring continues
- Moisture content (%)
- N-value from Standard Penetration Test, ASTM D-1586 (blows/ft)
- Shear strength from Pocket Penetrometer (tsf)

SOIL SAMPLERS

- 2-in. O.D. Split-Spoon
- 3-in. O.D. Shelby Tube

Notes:

1. Borings were completed by Bulldog Drilling under a subcontract with Reitz & Jens. Borings were made with a CME 55LC track drill rig using 4.25-inch I.D. hollow-stem augers. The drill rig is equipped with an automatic standard penetration test (SPT) hammer. The energy efficiency of the automatic hammer was measured at 95.3% in August 2018.

2. The borings were staked in the field by Reitz & Jens using a handheld GPS as close to the proposed boring locations as access, overhead and underground utilities and obstacles would allow. The location and elevation of the ground surface at each boring was measured after drilling by CDI, Inc. of St. Louis, Missouri.

3. The borings were logged in the field by a Reitz & Jens' NICET certified soil technician based upon the recovered samples, cuttings and drilling characteristics. Samples were transported to Reitz & Jens' lab for testing. Field logs were revised, if needed, based upon laboratory classification and testing.

4. Stratification lines shown on the log represent approximate soil boundaries; actual changes in strata may be gradual or occur between samples.

Figure 2-0

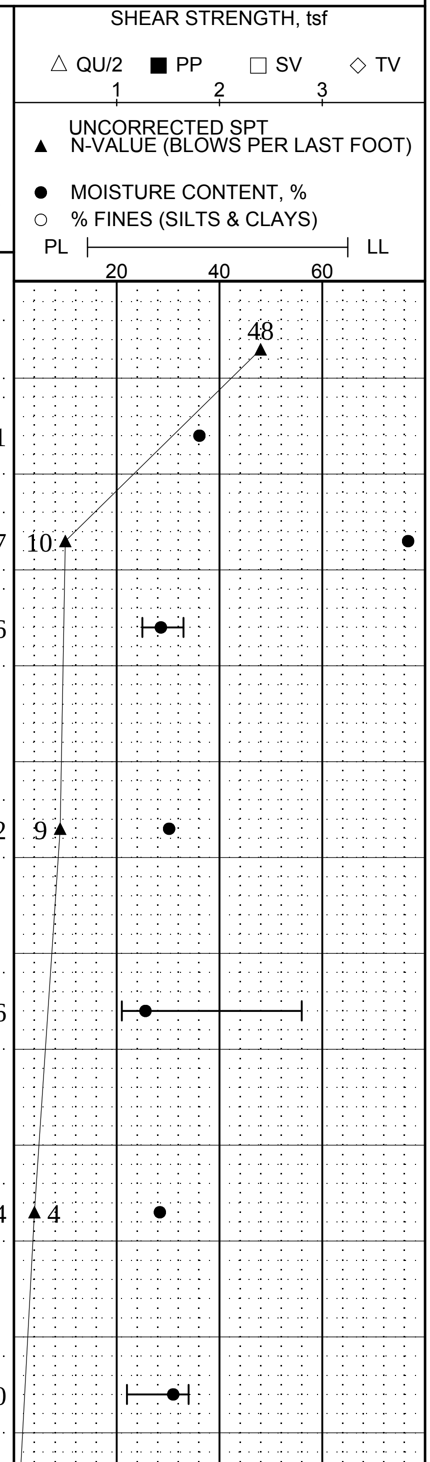
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG X-1

Ameren Meramec Ash Pond Closures
Meramec Energy Center
CLIENT: **Ameren**

LOCATION: N 937680.1 E 866182.2
ELEVATION: 414.09 DATUM: NAVD88
DATE DRILLED: 03-10-2021

DEPTH (FEET)	ELEVATION	WATER TABLE	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) / BLOWS PER 6 INCHES / RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT	UNCORRECTED SPT N-VALUE (BLOWS PER LAST FOOT)
0					Crushed Rock (8-inches), 2-inch minus			
			SPT	100	Crushed Rock (22-inches), 1-inch minus	17-23-25		48
	410		Tube	0	Bottom ASH, gray, tan and black, trace clay and rock fragments, very moist		36.1	
5		7 ft (during drilling)	SPT	100	Becoming medium-dense and with fine sand	1-2-8	76.7	10
10	405		Tube	92	FILL: Clayey SILT (ML), gray, with lignite, crushed limestone pieces, trace bottom ash and fine roots, moist	96.1	28.6	
15	400		SPT	100	CLAY (CL-CH), gray-brown, medium to high plastic, with lignite and limonite, very moist, stiff	1-3-6	30.2	9
20	395		Tube	88	Silty CLAY (CH), gray, high plastic, with lignite and limonite, moist, stiff	100.2	25.6	
25	390	25 ft (after 0 hours)	SPT	100	Silty CLAY (CL), gray-brown, with lignite and limonite, moist, firm	2-2-2	28.4	4
30	385		Tube	100	Becoming soft	92.9	31.0	



DRILLER: Bulldog Drilling
METHOD: 4.25" HSA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 95.3
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 7 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 25 FEET AFTER 0 HOURS
AT ___ FEET AFTER ___ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

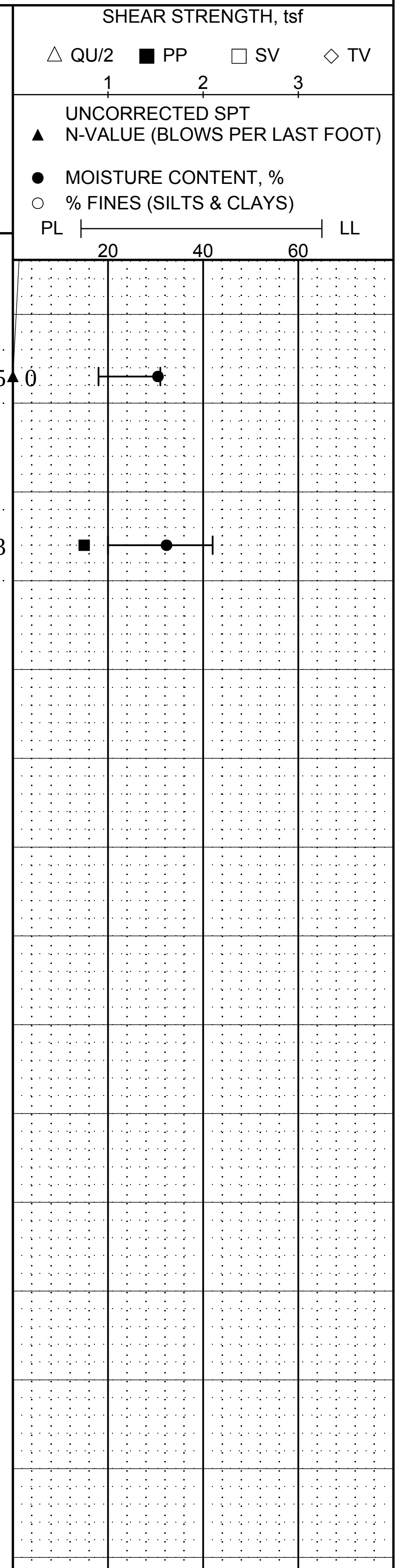
File: 2019012416

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG X-1

Ameren Meramec Ash Pond Closures

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	380				100	Clayey SILT (CL-ML), gray, very moist, very soft	0-0-0	30.5
35								
	375				17	Sandy CLAY (SC), gray, very moist	84.3	32.3
40						Boring terminated at 40'-0" in Sandy CLAY.		
	370							
45								
	365							
50								
	360							
55								
	355							
60								
	350							
65								



File: 2019012416

Figure 2-1 Sheet 2 of 2

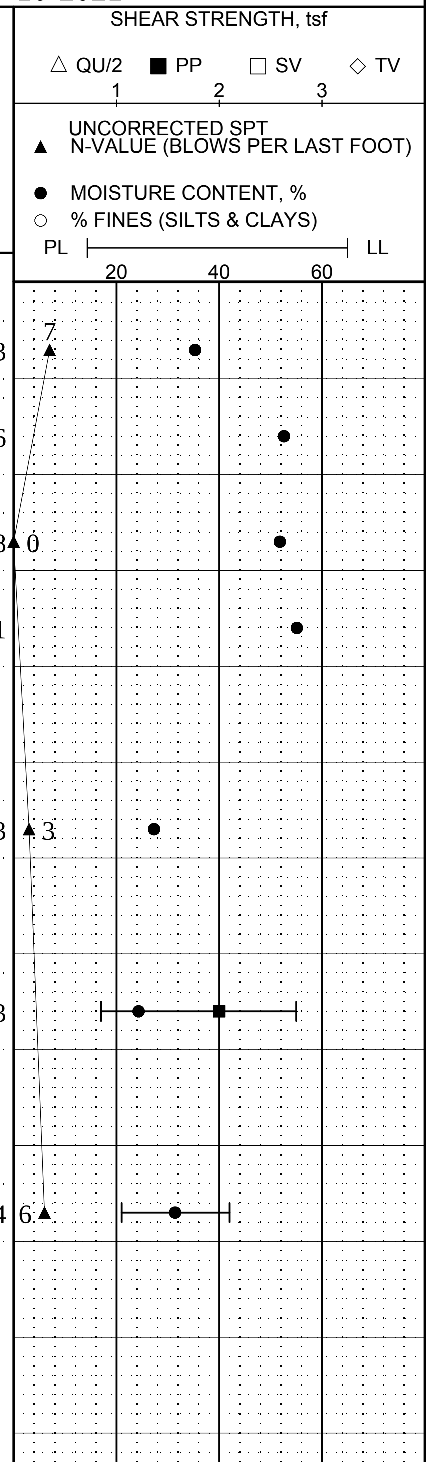
Reitz & Jens, Inc.
CONSULTING ENGINEERS

BORING LOG X-2

Ameren Meramec Ash Pond Closures
Meramec Energy Center
CLIENT: **Ameren**

LOCATION: N 937564.9 E 8655689.9
ELEVATION: 417.34 DATUM: NAVD88
DATE DRILLED: 03-10-2021

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0					100	Coal ASH, gray and black, with trace silt and organics, very moist, medium dense	4-3-4	35.3
	415				100	Becoming gray, with roots	63.2	52.6
5	410				100	Becoming very soft, with trace organics	0-0-0	51.8
					0	Note: Pushed spoon for sample recovery		55.1
10	405							
15					100	Silty CLAY (CL), gray-brown, with lignite and limonite, moist, firm	0-1-2	27.3
	400				88	Silty CLAY (CH), greenish-gray, high plastic, with lignite and limonite, moist, very stiff	103.1	24.3
20	395				100	Sandy and Silty CLAY (CL), gray-brown, with lignite and limonite, very moist, stiff	2-2-4	31.4
25						Boring terminated at 25'-0" in CLAY.		
	390							
30								



DRILLER: Bulldog Drilling
METHOD: 4.25" HSA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 95.3
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 6 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 18 FEET AFTER 0 HOURS
AT ______ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2019012416

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG X-2A

Ameren Meramec Ash Pond Closures
Meramec Energy Center
CLIENT: **Ameren**

LOCATION: N E
ELEVATION: 418.84 DATUM: NAVD88
DATE DRILLED: 03-12-2021

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) / BLOWS PER 6 INCHES / RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT	SHEAR STRENGTH, tsf / UNCORRECTED SPT N-VALUE (BLOWS PER LAST FOOT)
0						Crushed Rock (10-inches)			
					100	FILL: Silty CLAY (CL-CH), brown, medium plasticity, with lignite and limonite, moist, stiff	2-3-6	24.3	9
	415				58	FILL: Silty CLAY (CL), brown and gray, with lignite, limonte, trace gravel and rock fragments, moist, stiff	104.0	22.7	
5					100	With medium to high plastic clay inclusions	1-2-4	24.2	6
	410				83	Sandy SILT and SILT (SM), gray, with lignite and limonite, trace coarse gravel and horizontal seams of medium to high plasticity clay, organic odor, moist Note: Atterberg Limit conducted on horizontal clay seam.	103.7	23.0	
10									
	405				100	Silty CLAY (CL-CH), gray-brown, medium to high plastic, with lignite and limonite, moist, firm	0-2-3	24.5	5
15						Boring terminated at 15'-0" in CLAY.			
	400								
20									
	395								
25									
	390								
30									

Legend: △ QU/2 ■ PP □ SV ◇ TV (1, 2, 3); ▲ UNCORRECTED SPT N-VALUE (BLOWS PER LAST FOOT); ● MOISTURE CONTENT, %; ○ % FINES (SILTS & CLAYS); PL ├──┤ LL (20, 40, 60)

DRILLER: Bulldog Drilling
METHOD: 4.25" HSA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 95.3
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING DRY FEET
Y BORING DRY AT COMPLETION OF DRILLING
AT ______ FEET AFTER ____ HOURS
AT ______ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2019012416

BORING LOG X-3

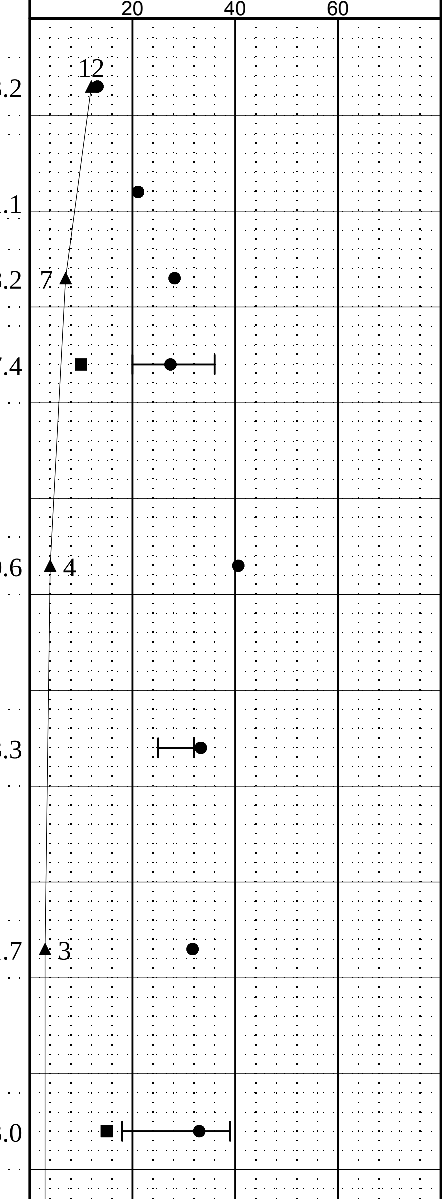
REITZ & JENS, INC.
CONSULTING ENGINEERS

Ameren Meramec Ash Pond Closures
Meramec Energy Center
CLIENT: **Ameren**

LOCATION: N 937213.5 E 866147.7
ELEVATION: 419.12 DATUM: NAVD88
DATE DRILLED: 03-12-2021

DEPTH (FEET)	ELEVATION	WATER TABLE	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) / BLOWS PER 6 INCHES / RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT	SPT N-VALUE
0			SPT	100	Coal ASH, primarily bottom ash with fly ash. Becoming medium-dense	5-6-6	13.2	12
	415		Tube	88				
5					FILL: Sandy and Clayey SILT (SM), gray, with lignite, ash, roots, and trace clay, moist	106.6	21.1	
			SPT	100	Silty CLAY or Clayey SILT (CL-ML), gray-brown, with lignite, moist, stiff	2-3-4	28.2	7
	410		Tube	92	Silty CLAY (CL), gray and brown, low plasticity	95.5	27.4	
10								
15	405		SPT	100	With organics, very moist, firm	0-2-2	40.6	4
20	400		Tube	50	Clayey SILT (ML), gray, very moist	90.0	33.3	
25	395	▽	SPT	100	With limonite, trace wood pieces, loose	0-1-2	31.7	3
30	390		Tube	96	CLAY (CL), gray, lignite and limonite, trace fine-grained sand, with silt, very moist, firm	91.2	33.0	

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
▲ UNCORRECTED SPT N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (SILTS & CLAYS)
PL ├──┤ LL



DRILLER: Bulldog Drilling
METHOD: 4.25" HSA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 95.3
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 24 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

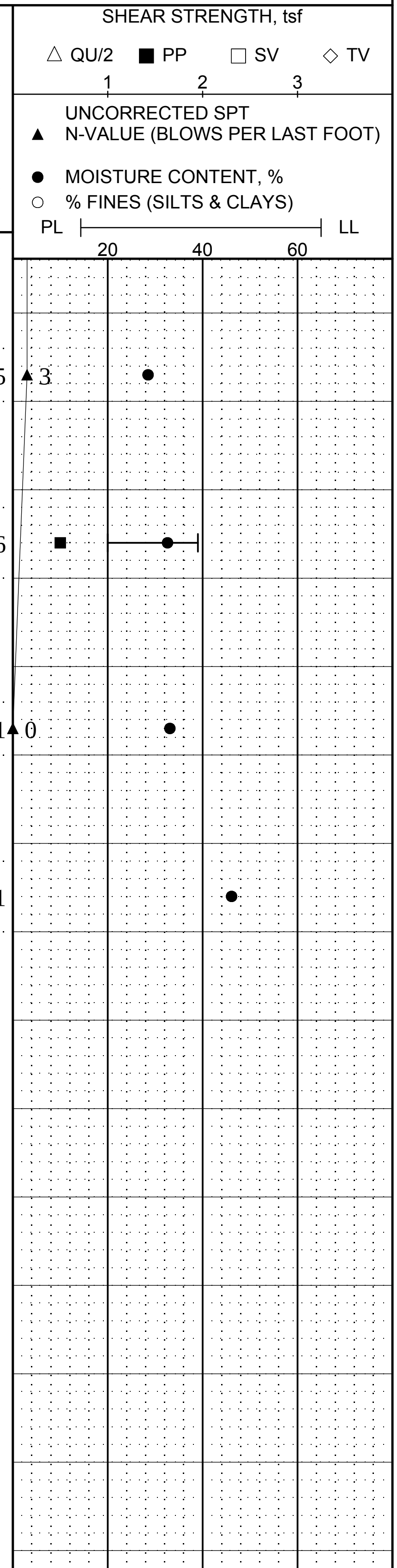
File: 2019012416

BORING LOG X-3

REITZ & JENS, INC.
CONSULTING ENGINEERS

Ameren Meramec Ash Pond Closures

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	385				100	Sandy SILT (SM), with clay seams, moist, loose	0-1-2	28.5
35								
	380				100	Silty CLAY (CL), gray, lignite, very moist	91.3	32.6
40								
	375				100	Without lignite, becoming very soft	0-0-0	33.1
45								
	370				63	Trace fine gravelly rock fragment	80.0	46.1
50						Boring terminated at 50'-0" in Silty CLAY.		
	365							
55								
	360							
60								
	355							
65								



File: 2019012416

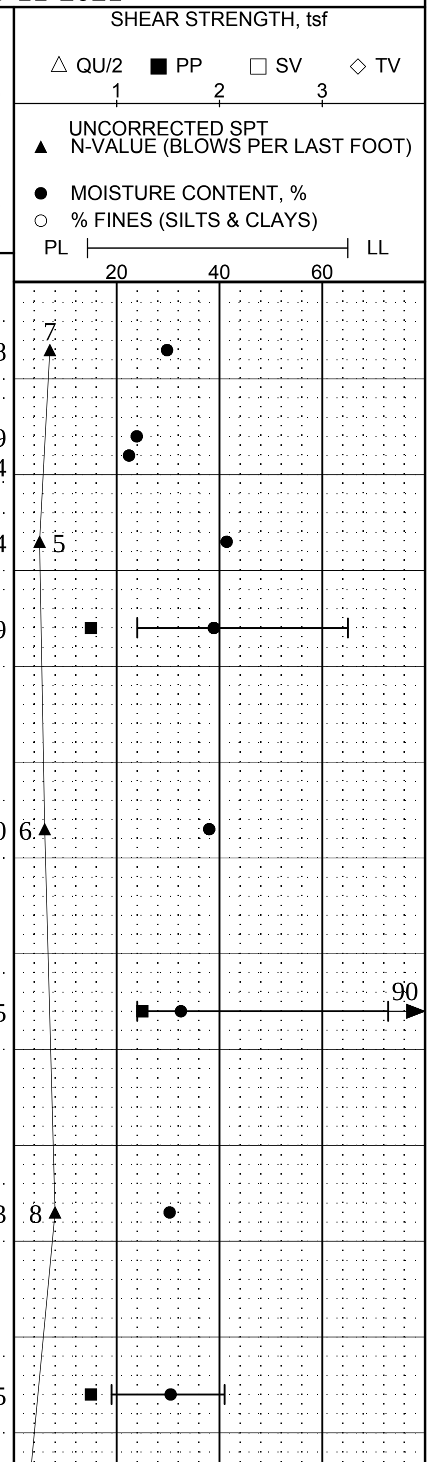
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG X-4

Ameren Meramec Ash Pond Closures
Meramec Energy Center
CLIENT: **Ameren**

LOCATION: N 937206.2 E 866477.7
ELEVATION: 414.61 DATUM: NAVD88
DATE DRILLED: 03-11-2021

DEPTH (FEET)	ELEVATION	WATER TABLE	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) / BLOWS PER 6 INCHES / RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0					Coal ASH, gray-black, primarily bottom ash with some fly ash, moist, medium dense		
			SPT	100		3-4-3	29.8
			ST	100	FILL: Silty CLAY (CL-CH), greenish-gray, medium to high plastic, with trace roots, moist	102.0	23.9
5	410					95.2	22.4
					Coal ASH, black, with clayey silt, fine gravel and trace fine roots		
			SPT	100	With trace gray silty clay and fine gravel.	4-3-2	41.4
			ST	83	Becoming mostly high plastic clay with bottom ash, organics and coal pieces, very moist, firm	80.9	38.9
10	405				CLAY (CH), gray and brown, high plasticity, with trace sand		
15	400		SPT	100	Becoming dark gray, brown, and black, stiff	1-3-3	38.0
20	395		ST	71		91.0	32.5
					CLAY (CL-CH), dark gray and brown, medium to high plastic, with limonite, trace sand and organics, very moist, stiff		
25	390		SPT	100		2-4-4	30.3
		▽					
30	385		ST	79	Silty CLAY (CL), brown, with lignite and limonite, very moist, firm	92.4	30.5



DRILLER: Bulldog Drilling
METHOD: 4.25" HSA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 95.3
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 28 FEET
U BORING DRY AT COMPLETION OF DRILLING
AT ______ FEET AFTER ____ HOURS
AT ______ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT ___ FEET

File: 2019012416

Figure 2-5 Sheet 1 of 2

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG X-4

Ameren Meramec Ash Pond Closures

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT	SPT N-VALUE
35	380				100	Becoming clayey silt or silty clay, brown and gray, and soft	0-0-1	30.9	1
40	375				0	Becoming gray silty clay and clayey silt Note: Pushed spoon for sample recovery		30.7	
45	370				100	GRAVEL (GP), fine gravel with coarse to fine sand, medium dense	2-4-5		9
50	365				44	SAND (SP), fine to coarse sand, with medium gravel, medium dense	6-8-8		16
						Boring terminated at 50'-0" in SAND.			
55	360								
60	355								
65	350								

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3
▲ UNCORRECTED SPT N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (SILTS & CLAYS)
PL |———| LL
20 40 60

File: 2019012416

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG X-5

Ameren Meramec Ash Pond Closures
Meramec Energy Center
CLIENT: **Ameren**

LOCATION: N 937566.4 E 865958.0
ELEVATION: 414.40 DATUM: NAVD88
DATE DRILLED: 03-10-2021

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) / BLOWS PER 6 INCHES / RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0			FILL: Silty CLAY (CL), brown, with bottom ash and coal pieces, moist, stiff		
		100	Coal ASH, black and gray, with bottom and fly ash	3-4-4	22.4
	410	67	With trace decaying wood, moist	81.9	26.7
5		78	Silty CLAY (CL-CH), gray, medium to high plastic, with lignite and limonite, trace ash and rock fragments, moist, stiff	2-3-5	29.4
	405	75	Becoming greenish-gray, with trace roots, organic odor	107.2	21.2
10					
15	400	100	Becoming gray-brown, with trace silt	1-3-5	25.3
20	395	54	Becoming silty with trace fine roots	100.2	25.6
25	390	100		1-2-4	29.0
30	385	100	Becoming brown with clayey sand and sandy clay lenses	97.1	28.0
			Boring terminated at 30'-0" in CLAY.		

SHEAR STRENGTH, tsf: △ QU/2 ■ PP □ SV ◇ TV (1, 2, 3)
▲ UNCORRECTED SPT N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (SILTS & CLAYS)
PL ├──┤ LL (20, 40, 60)

SPT N-values plotted: 8, 8, 8, 6

DRILLER: Bulldog Drilling
METHOD: 4.25" HSA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 95.3
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 28 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 28 FEET AFTER 0 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT __ FEET

File: 2019012416

Figure 2-6 Sheet 1 of 1

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG X-7

Ameren Meramec Ash Pond Closures
Meramec Energy Center
CLIENT: **Ameren**

LOCATION: N 937657.2 E 866328.1
ELEVATION: 410.00 DATUM: NAVD88
DATE DRILLED: 03-09-2021

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) / BLOWS PER 6 INCHES / RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT	UNCORRECTED SPT N-VALUE (BLOWS PER LAST FOOT)
0	410					Coal ASH, dark gray, primarily fly ash			
		▽ (3.5)			22	Becoming very loose and wet	0-0-0	88.2	0
5	405								
					100	Note: Augers charged with water before SS-2.	1-3-3	28.0	6
10	400					SILT (ML), gray, with fine-grained sand, very moist, loose			
					100	Becoming sandy and clayey	0-1-2	31.0	3
15	395								
					100	Silty CLAY (CL-CH), brown and gray, medium to high plastic, with lignite and limonite, moist, firm	1-3-2	29.0	5
20	390					Boring terminated at 20'-0" in CLAY.			
25	385								
30	380								

DRILLER: Bulldog Drilling
METHOD: 4.25" HSA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 95.3
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 3.5 FEET
U BORING DRY AT COMPLETION OF DRILLING
AT ______ FEET AFTER ____ HOURS
AT ______ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2019012416

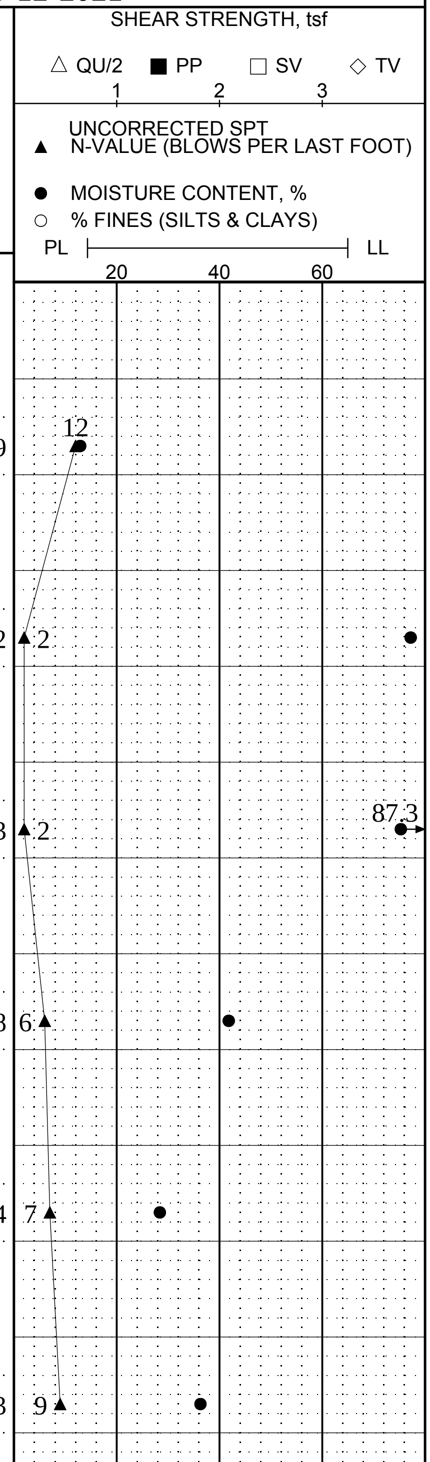
BORING LOG X-8

REITZ & JENS, INC.
CONSULTING ENGINEERS

Ameren Meramec Ash Pond Closures
Meramec Energy Center
CLIENT: **Ameren**

LOCATION: N 936880.3 E 866508.2
ELEVATION: 418.92 DATUM: NAVD88
DATE DRILLED: 03-12-2021

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT	UNCORRECTED SPT N-VALUE (BLOWS PER LAST FOOT)
0						Coal ASH, dark gray, primarily bottom ash			
5	415				100	Becoming medium-dense, with fine roots	2-6-6	12.9	12
10	410				100	Becoming very loose	1-1-1	77.2	2
15	405	▽			100		1-1-1	87.3	2
20	400				100	CLAY (CL-CH), gray, with limonite, medium to high plastic, very moist, stiff	1-2-4	41.8	6
25	395				100	CLAY (CH), gray, limonite, high plastic, moist, stiff	1-2-5	28.4	7
30	390				100		2-4-5	36.3	9
						Boring terminated at 30'-0" in CLAY.			



DRILLER: Bulldog Drilling
METHOD: 4.25" HSA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 95.3
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 14 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ______ FEET AFTER ____ HOURS
AT ______ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2019012416

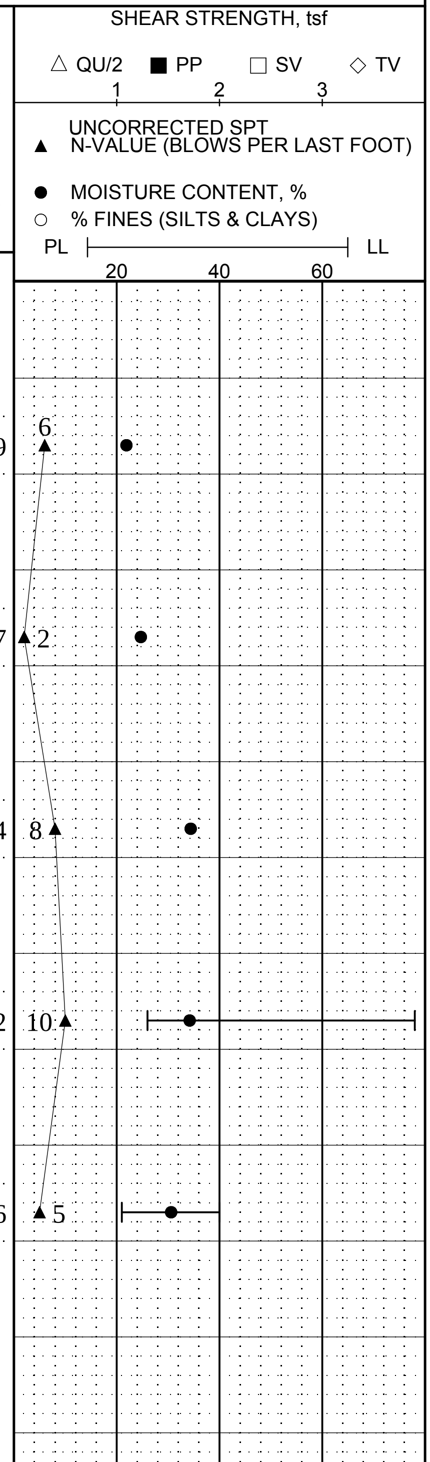
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG X-9

Ameren Meramec Ash Pond Closures
Meramec Energy Center
CLIENT: **Ameren**

LOCATION: N 937237.2 E 866257.3
ELEVATION: 412.84 DATUM: NAVD88
DATE DRILLED: 03-10-2020

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						FILL: Silty CLAY (CL), gray-brown, with trace ash and organics, moist, stiff		
	410							
5					89		3-3-3	21.9
	405							
10					22	FILL: Clayey and Sandy SILT (SM), gray, with ash, moist, very loose	0-1-1	24.7
	400							
15					100	Silty CLAY (CL-CH), gray-brown, medium to high plastic, with lignite and limonite, very moist, stiff	1-3-5	34.4
	395							
20					100	Becoming high plastic, very stiff	2-4-6	34.2
	390	▽						
25					100	Becoming firm and with low plasticity	1-2-3	30.6
						Boring terminated at 25'-0" in CLAY.		
	385							
30								



DRILLER: Bulldog Drilling
METHOD: 4.25" HSA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 95.3
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 23 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 23 FEET AFTER 0 HOURS
AT ______ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2019012416

REITZ & JENS, INC.
CONSULTING ENGINEERS

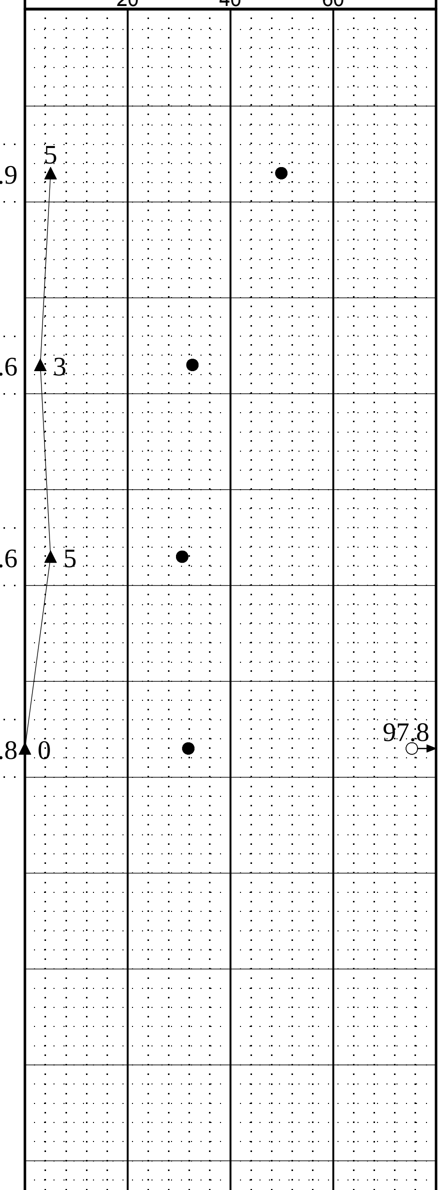
BORING LOG X-10

Ameren Meramec Ash Pond Closures
Meramec Energy Center
CLIENT: **Ameren**

LOCATION: N 936025.2 E 866810.4
ELEVATION: 411.53 DATUM:
DATE DRILLED: 03-09-2021

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0	410	▽ (1 ft)				Coal ASH, black and tan, primarily bottom ash with fly ash, very moist		
					100	Becoming loose	5-2-3	49.9
5	405							
					100	Note: Switched to mud rotary at 8.5 feet. Becoming greenish-gray fly ash	3-1-2	32.6
10	400					CLAY (CH), green-gray, high plastic		
						Note: Stiff drilling at 12 feet.		
					100	With limonite and fine sand, firm	0-2-3	30.6
15	395					Silty CLAY (CL), brown, lignite and limonite, very moist, very soft		
					100	Becoming silty and sandy clay	0-0-0	31.8
20	390					Boring terminated at 20'-0" in Silty CLAY.		
25	385							
30								

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3
▲ UNCORRECTED SPT N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (SILTS & CLAYS)
PL LL
20 40 60



DRILLER: Bulldog Drilling
METHOD: 4.25" HSA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 95.3
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 1 FEET
U BORING DRY AT COMPLETION OF DRILLING
AT ______ FEET AFTER ____ HOURS
AT ______ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2019012416

Figure 2-10 Sheet 1 of 1

APPENDIX B

PERIODIC HAZARD CLASSIFICATION

AMEREN MISSOURI MERAMEC ENERGY CENTER
EVALUATION OF CCR UNITS
40 CFR PART 257
ST. LOUIS COUNTY, MISSOURI

APPENDIX B: PERIODIC HAZARD POTENTIAL CLASSIFICATION 257.73(a)(2)

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AMEREN MISSOURI MERAMEC ENERGY CENTER
EVALUATION OF CCR UNITS
ST. LOUIS COUNTY, MISSOURI

APPENDIX B: PERIODIC HAZARD POTENTIAL CLASSIFICATION
§257.73(a)(2)

1.0 INTRODUCTION

The Meramec Energy Center is located at the southernmost point in St. Louis County, Missouri at the confluence of the Mississippi and Meramec Rivers, approximately 2.8 miles southeast of the City of Arnold. The Meramec Energy Center has ten surface impoundments used for managing coal combustion residuals (CCR) within an approximate 138-acre area. They are designated as Ponds 489, 490, 491, 492, 493, 494, 495, 496, 498 and Inactive Pond 498. Ponds 489, 490, 491, 494, 495 and Inactive Pond 498 no longer receive CCR and are inactive. Pond 498 was closed in 2021. The remaining active CCR surface impoundments are Ponds 492, 493 and 496. Stormwater, and discharge from the active ponds is routed to the Retention Pond prior to discharge through an NPDES permitted outfall. A map showing the location of the surface impoundments and the Retention Pond is attached as Figure 1.

1.1 Purpose

40 CFR Part §257.73(a)(2) requires the owner or operator of an existing surface impoundment to conduct an initial and periodic hazard potential classification assessment of the CCR unit. The owner or operator must document the hazard classification of each CCR unit as either a high hazard potential CCR surface impoundment, a significant hazard potential CCR surface impoundment, or a low hazard potential CCR surface impoundment. The owner or operator must obtain a certification from a qualified professional engineer stating that the initial and each subsequent periodic classification was conducted in accordance with the requirements of §257.73(a)(2). The following documents Reitz & Jens, Inc.'s hazard potential classification evaluation for active Pond 498 and Ponds 492, 493, and 496 at the Ameren Missouri Meramec Energy Center.

2.0 MERAMEC ENEREGY CENTER CCR UNITS

The Meramec Energy Center has two active surface impoundments, Pond 498 and Ponds 492, 493, and 496 that are interconnected to form the "Bottom Ash Pond". Ponds 492 and 496 are incised but hydraulically connected to Pond 493 which includes a perimeter earth embankment berm. The surface impoundment locations and the centerline of the embankments are shown in Figure 1.

The initial hazard potential classifications were determined for the active surface impoundments at the Meramec Energy Center based on the Federal Emergency Management Agency (FEMA) hazard potential classification criteria. Pertinent data regarding each surface impoundment are shown in Table 1.

Table 1 – Active surface impoundments at the Meramec Energy Center

CCR Unit	Maximum Surface Area (acres)	Dam Height (feet)	Crest Length (feet)	Normal Pool Elevation (feet)
Pond 498	13.5	19.5	3,320	418.0
Pond 493	5.1	24.7	1,200	409.5
Pond 492/496	6.0	Incised	NA	410.3

The FEMA classification system has three levels of Hazard Potential Classification: Low, Significant, and High. The hazard potential classification system categorizes dams based on the probable loss of human life and the impacts on economic, environmental, and lifeline interests should the dam fail. The classification system relies heavily on judgement and common sense, because all possibilities cannot be defined. Allowances for evacuation or emergency actions by the population were not considered because emergency procedures should not be a substitute for appropriate design, construction, and maintenance of dam structures. A summary for the FEMA hazard classification system of dams is shown in Table 2.

Table 2 - FEMA hazard classification system of dams

Hazard Potential Classification	Loss of Human Life	Economic, Environmental, Lifeline Losses
Low	None expected	Low and generally limited to owner
Significant	None expected	Yes
High	Probable. One or more expected	Yes (but no necessary for this classification)

2.1 Pond 498

Pond 498 is incised with a perimeter dike. The active portion of Pond 498 was built on top of portions of the Inactive Pond 498 and Pond 490. Inactive Pond 498 and Pond 490 were originally constructed in the 1950's and had been filled and were no longer receiving sluiced fly ash for several years prior to construction of Pond 498. Pond 498 no longer receives process waters and CCRs, has been dewatered and is currently being closed. The maximum height of the dam is 19.5 feet.

Failure of Pond 498 would result in the release of water and CCR into the surrounding CCR units which include Inactive Pond 498, and Ponds 490, 492, 493, and 494. The failure should not cause loss of life or significant environmental impacts. Therefore, according to the FEMA Hazard Potential Classification of Dams, Pond 498 should have a Low Hazard Potential Classification.

2.2 Ponds 492, 493 and 496

Ponds 492 and 496 are incised and bounded on the east by the railroad loop, on the north by Pond 493, on the west by Ponds 490 and 498, and on the south by plant fill. Pond 493 is partially incised and bounded on the north by a short section of the perimeter levee, on the west by Pond 498, on the south by Pond 492, and on the east by the railroad loop and high ground. The railroad loop crosses through Pond 493 from the west to east. Ponds 492, 493, and 496 impound liquid and bottom ash. The maximum height of the dam is 24.7 feet.

Failure of the Pond 493 perimeter levee would result in the release of water and CCR into a tributary of the Meramec River. The failure should not cause loss of life or significant environmental impacts. Therefore, according to the FEMA Hazard Potential Classification of Dams, Ponds 492, 493, and 496 should have a Low Hazard Potential Classification.

3.0 CONCLUSION

The initial hazard potential classifications for the active CCR surface impoundments at the Meramec Energy Center is Low Hazard Potential for Ponds 492, 493 and 496. The hazard potential classification should be re-evaluated within 5 years of the initial hazard potential classification.

4.0 REFERENCES

Environmental Protection Agency. (2015). "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities; Final Rule." 40 CFR Parts 257 and 261., Vol. 80, No. 74.

Federal Emergency Management Agency. (2004). "Federal Guidelines for Dam Safety, Hazard Potential Classification System for Dams." Interagency Committee on Dam Safety.

da_map.dwg 6/18/2021

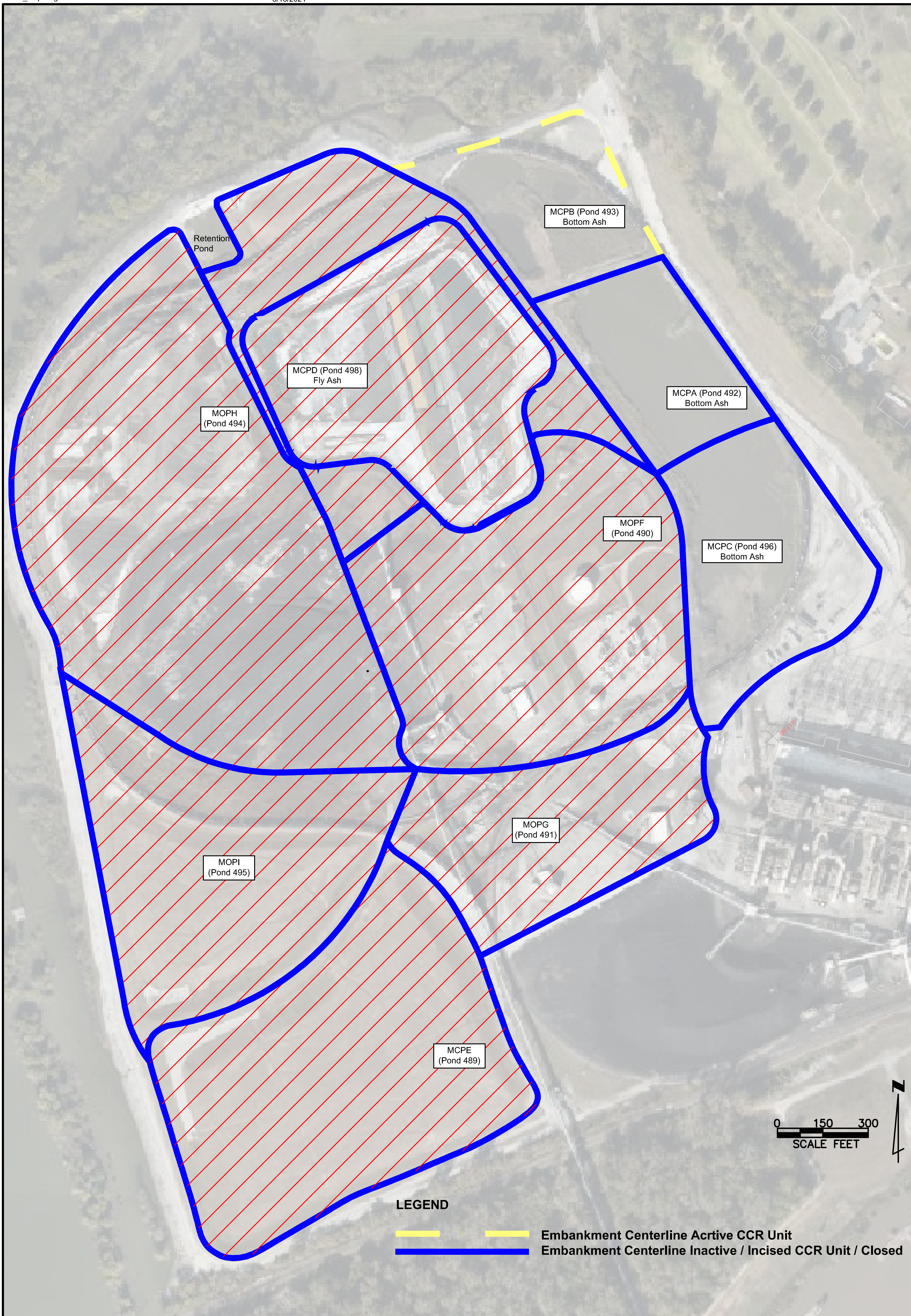

FIGURE 1	MERAMEC ENERGY CENTER ASH PONDS	Ameren Missouri 3700 S. Lindbergh St. Louis, MO 63127	Designed E.J.K. Checked Drawn E.J.K. Issued 8/13/2021	REITZ & JENS, INC. CONSULTING ENGINEERS 1055 CORPORATE SQUARE DRIVE ST. LOUIS MISSOURI 63132 (314) 993-4132 PROFESSIONAL ENGINEERING CORP., LICENSE #000215

APPENDIX C

PERIODIC STRUCTURAL STABILITY ASSESSMENT

AMEREN MISSOURI MERAMEC ENERGY CENTER
EVALUATION OF CCR UNITS
40 CFR PART 257
ST. LOUIS COUNTY, MISSOURI

APPENDIX C: PERIODIC STRUCTURAL STABILITY ASSESSMENT 257.73(d)(1)

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EVALUATION OF CCR UNITS
ST. LOUIS COUNTY, MISSOURI

APPENDIX C: PERIODIC STRUCTURAL STABILITY ASSESSMENT 257.73(d)(1)

1.0 INTRODUCTION

The Meramec Energy Center is located at the southernmost point in St. Louis County, Missouri at the confluence of the Mississippi and Meramec Rivers, approximately 2.8 miles southeast of the City of Arnold. The Meramec Energy Center has ten surface impoundments used for managing coal combustion residuals (CCR) within an approximate 138-acre area. They are designated as Ponds 489, 490, 491, 492, 493, 494, 495, 496, 498 and Inactive Pond 498. Ponds 489, 490, 491, 494, 495 and Inactive Pond 498 no longer receive CCR and are inactive. Pond 498 was closed in 2021. The remaining active CCR surface impoundments are Ponds 492, 493 and 496. Stormwater, and discharge from the active ponds is routed to the Retention Pond prior to discharge through an NPDES permitted outfall. A map showing the location of the surface impoundments and the Retention Pond is attached as Figure 1.

1.1 Purpose

40 CFR Part 257.73(d)(1) specifies that the owner or operator of all existing CCR surface impoundments, except for incised CCR units, shall conduct initial and periodic structural stability assessments and document whether the design, construction, operation and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater which can be impounded therein.

The purpose of this periodic structural stability assessment for Pond 498 and Ponds 492, 493 and 496 at the Meramec Energy Center is to provide the information required by 40 CFR Part 257.73(d)(1). Ponds 492 and 496 are incised but hydraulically connected to Pond 493 which includes a perimeter earth embankment berm. Therefore Ponds 492, 493, and 496 are considered a single surface impoundment. The periodic structural stability assessment consisted of field inspections, design and construction document review, and review of operation and maintenance records. Additional information for each CCR surface impoundment at the Meramec Energy Center is included in the History of Construction Report

2.0 FIELD INSPECTION

A field inspection of the existing surface impoundments at the Meramec Energy Center was conducted on October 27, 2020 by Reitz & Jens, Inc. personnel Jeff Bertel, P.E., Laura Sutton, P.E. and Ashley Martinez, E.I.; who were accompanied by Ameren Missouri personnel Mark Lueckenhoff, P.E. The weather was cloudy with light rain and temperatures in the mid-30s. The Meramec River stage at the Arnold gage was 6.62 or elevation 379.8, and the Mississippi River stage at the St. Louis gage was 7.1 or elevation 386.7. The field inspection consisted of walking the crest and toe of the perimeter berm for Pond 493, and visually reviewing the hydraulic outlet structures.

Observations made during the inspection were recorded on the Ameren Annual Inspection Check Sheet which are included in Appendix I. A photograph log of the main inspection findings is also included in Appendix I. Photographs taken during the inspection are included on a DVD contained Appendix II. Observations from the field inspection are summarized below for each CCR unit.

2.1 Ponds 492, 493, and 496

2.1.1 Embankment and Foundation Stability

Field inspection of the Pond 493 perimeter berm found no signs of instability. There was no visible vertical or horizontal misalignment of the crest. No slides, sloughs, tension cracking, slope depressions or bulges observed in the crest or either slope.

Historically, light seepage or saturated soil has been observed in the area north of the Pond 493 perimeter berm downstream toe. During the current inspection the ground was wet and saturated due to recent rain, some minor ponding was observed 30-50 feet north of the toe. The inspection team was unable to unable to compare the current condition to historical records; however, there were no signs of seepage that may be detrimental to the stability of the embankment. Ameren will continue to monitor the area and make observations relative to pond levels, recent precipitation events, and adjacent river levels.

The downstream slopes have been inundated multiple times from flooding of the tributary, Meramec River, and Mississippi River and there was no sign of instability due to sudden drawdown. The downstream slope is lined with riprap.

There is good access at the crown of the embankment for visually reviewing the crest and slopes. No operational activities, or adjacent developments were observed that might threaten the integrity of the embankment.

2.1.2 Slope Protection

The upstream slope of the perimeter berm is armored with riprap where the railroad loop is adjacent to the berm. The upstream slope of the perimeter berm is very flat and has a vegetative or crushed limestone cover east of the railroad loop to the abutment. The downstream slope is armored with riprap from the toe to the crest.

The upstream slopes were in good condition with no sign of instability or significant erosion. The riprap on the downstream slope was also in good condition and no significant displacement of stones was observed.

2.1.3 Hydraulic Structures

The Pond 493 water level was low and below the staff gage at the time of inspection. The pond level at the time of the inspection was less than the normal pool level. Ameren records pool level observations at least weekly during inspections by plant staff.

The principal spillway for Pond 493 is drop-inlet with an 18-inch carbon steel pipe outlet that discharges into the Retention Pond. The pipe inlet was submerged and could not be visually inspected. A skimmer placed above the inlet has rotated, but this condition has existed for several years without disruption to the operation. Ameren must continue to monitor the skimmer and provide access for inspection of the primary spillway inlet pipe when it is not submerged. The outlet for the principal spillway pipe into the Retention Pond was submerged and was also not visually inspected. There are no recent video inspections of the principal spillway pipe, however there is no practical way to isolate flow to the pipe to inspect it.

A secondary spillway or "overflow pipe" consists of a 24-inch corrugated metal pipe that discharges into an approximately 650-foot long overflow ditch that flows east, eventually emptying into a second 24-inch carbon steel pipe that discharges into the Retention Pond. The secondary spillway pipe was approximately one-quarter to one-third full of sediment. Ameren should maintain the pipe free of any obstructions. The area around the spillway pipe was heavily vegetated. This area should be cleared and maintained free of excess vegetation.

2.1.4 Ponds 492, 493 and 496 Field Investigation Conclusions

There were no significant deficiencies or signs of instability observed during the field inspection of Ponds 492, 493 and 496, however there are maintenance items and additional monitoring that should occur. The following remedial items should be addressed as soon as feasible. Ameren should prepare documentation detailing the corrective measures taken as these items are addressed.

- Continue monitoring the wet area on the north side of Pond 493 outside the perimeter berm. Monitoring should include documenting observations of the area relative to pond levels, recent precipitation events and adjacent river levels. If at any time water is observed flowing and carrying fines in this area, take immediate action as required to prevent degradation of the integrity of the embankment and foundation soils.
- Continue to monitor the condition of the principal spillway skimmer and provide access to the spillway inlet for future inspections.
- There are no recent video inspections of the principal or secondary spillway pipes. Video inspection of the principal spillway pipe is not practical because both ends are submerged. Calculations that assume no discharge from the principal spillway pipe show that the embankment does not overtop during the 100-year storm event, provided the secondary spillway pipe is functioning and flowing no more than half full at the start of the storm. The secondary

spillway pipe should be maintained free of any potential obstructions to flow and visually inspected.

2.2 Pond 498

2.2.1 Embankment and Foundation Stability

Field inspection of the Pond 498 perimeter berm found no signs of instability. There was no visible vertical or horizontal misalignment of the crest. No slides, sloughs, tension cracking, slope depressions or bulges observed in the crest or either slope.

A large animal burrow was observed on the embankment crest on the north side of the impoundment. The burrow should be excavated to its extents and filled with compacted clay soil.

The toe of the downstream slopes of the perimeter berm is at elevation 417 or higher. The regulatory 100-year flood elevation of the surrounding rivers is elevation 416. Inundation of these slopes during river flooding is expected to last for only a relatively short duration which is not expected to cause instability due to sudden drawdown.

There is good access at the crown of the perimeter berm for surveillance of the crest and slopes. There were no operational activities, or adjacent improvements observed that might threaten the integrity of the embankment.

2.2.2 Slope Protection

The upstream slopes of the Pond 498 perimeter berm are lined with HDPE. The downstream slopes are designed to be vegetated, however during the inspection there were large areas on the north side that were recently graded and bare. Ameren states they will seed and maintain this areas to establish a dense vegetative cover.

2.2.3 Hydraulic Structures

The Pond 498 water level was below the staff gauge at the time of the inspection.

The principal spillway for Pond 498 is a drop-inlet with timber stoplog structure and a 24-inch HDPE and carbon steel pipe outfall. A precast concrete manhole houses a butterfly valve on the outfall pipe approximately 25 feet upstream of its discharge into the Retention Pond. The visible portions of the stoplog structure and precast manhole were in good condition. There are no recent video inspections of the discharge pipe, however isolating the pipe from water on its upstream or downstream ends is not practical. The butterfly valve was not operated during the inspection, but Ameren reports that it is functional. The spillway pipe outlet in the Retention Pond was submerged at the time of inspection. The spillway will be abandoned during closure construction in 2021.

2.2.4 Pond 498 Field Investigation Conclusions

There were no significant deficiencies or signs of instability observed during the field inspection of Pond 498, however there are maintenance items or additional monitoring that should occur. The following remedial items should be addressed as soon as feasible. Ameren should prepare documentation detailing the corrective measures taken as these items are addressed.

- Seed and maintain the downstream slopes to establish a dense vegetative cover.
- Establish a ditch around the inside crest of the eastern perimeter berm to route any potential runoff into the interior of Pond 498.
- Monitor and repair inlet piping as necessary to prevent leakage outside the lined portion of the pond.

3.0 OPERATIONS AND MAINTENANCE REVIEW

The available operations and maintenance records were reviewed as part of the periodic structural stability assessment. The review included the O&M Manual, the preceding weekly and annual inspections for a period of 1-year, on-site meetings to discuss ongoing maintenance, and the most recent survey data provided by Ameren Missouri.

The O&M Manual specifies minimum requirements for maintenance and establishes operational requirements for CCR placement. The manual states that no alterations or repairs to structural elements should be made without the approval of the Chief Dam Safety Engineer. The O&M Manual is attached in Appendix III.

3.1 Ponds 492, 493, and 496

3.1.1 Operations

Ponds 492, 493 and 496 receive flow from the plant combined drained sump (CDS), bottom ash sluice flow and stormwater runoff from Ponds 490 & 491, the conveyor and coal pile area, portions of closed Pond 498 and the Switchyard. A significant volume of CCRs have been removed from the pond to facilitate closure of Pond 489. Additional CCR fill is being placed in the pond, but the net difference results in an increase in the available storage volume. Bottom ash sluiced to the pond is deposited on the south side of the Pond 496 and is hauled off site for beneficial use. As a result, the volume of impounded CCRs in these ponds has changes very little form year-to-year due to sluice flow. There have been no recent operational changes. Ameren has estimated the volume of CCR impounded in Pond 492, 493 and 496 at about 312,000 cubic yards. Based on the 2019 topographic survey there is approximately 229,000 cubic yards of storage capacity remaining in the bottom ash pond.

Table 1 includes pertinent data regarding the volume and depth of impounded CCR in Ponds 492, 493 and 496.

Table 1 – Volume and depth of impounded CCR in Ponds 492, 493 and 496

CCR Unit	Est. Volume of Water and CCR (CY)	Est. Bottom Elev. of CCR Unit (feet)	Est. Minimum CCR Elev. (feet)	Est. Minimum Depth of CCR (feet)	Est. Maximum CCR Elev. (feet)	Est. Maximum Depth of CCR (feet)
Pond 492	68,000	398	407	9	414	17
Pond 493	60,000	398	405	7	412	14
Pond 496	185,000	402	408	4	420	18

Ameren has no operational changes planned for Ponds 492, 493 and 496. Prior to the next periodic structural stability assessment, a new topographic survey of the pond interior will be required to update the estimated volume and depth of impounded CCR.

3.1.2 Maintenance

Weekly inspection check sheets from October 2019 through August 2020, and the 2016, 2017, 2018 and 2019 annual inspection check sheets were reviewed. No maintenance deficiencies were noted in the weekly inspection reports. The 2019 Annual Inspection noted that there was excess vegetation on the downstream slope of the Pond 493 perimeter berm, the secondary spillway outfall channel and around the primary discharge structure. The inspection report recommended that the vegetation be cleared. The report also notes that the staff gage should be cleaned and lowered to facilitate weekly readings. In general, the inspection reports indicate that the current level of maintenance is adequate, although the frequency of mowing and vegetation removal should be increased so that inspection of the embankment slopes and staff gage is not inhibited at any time. The 2019 Meramec Annual Levee Inspection is included in Appendix III.

3.2 Pond 498

3.2.1 Operations

Pond 498 receives process water used to condition the dry fly ash prior to disposal. There is no contributing watershed to this pond outside of the perimeter dike. The inlet piping for the pond is on the south side of the pond. The inlet piping is connected to a flexible hose, and the point of discharge of the flexible hose is moved periodically as part of pond operation. Water generally flows from south to north through interior pond ditches created in the CCR, and accumulates in the northwest corner before discharging through the outlet works. The pond is currently operated so that there is no net increase of fly ash in the pond. Ash is deposited in long narrow ditches and then excavated and hauled offsite for beneficial use or temporarily stockpiled on-site.

Table 2 includes pertinent data regarding the volume and depth of impounded CCR in Pond 498. The volume of available storage appears relatively unchanged since 2016. The approximate remaining storage capacity for the Pond 498 is approximately 60,000 cubic yards.

Table 2 - Volume and depth of impounded CCR in Pond 498

CCR Unit	Est. Volume of Water and CCR (CY)	Est. Bottom Elev. of CCR Unit (feet)	Est. Minimum CCR Elev. (feet)	Est. Minimum Depth of CCR (feet)	Est. Maximum CCR Elev. (feet)	Est. Maximum Depth of CCR (feet)
Pond 498	510,000	395	433	19	433	38

3.2.2 Maintenance

Weekly inspection check sheets from October 2019 through August 2020, and the 2016, 2017, 2018 and 2019 annual inspection check sheets were reviewed. The 2019 Annual Inspection noted that there are areas of poor sod cover on the north side of the pond. Weekly inspection reports also document poor sod cover in this area. The annual inspection report recommended that areas with poor sod cover be seeded. The report also notes that the staff gage should be cleaned. In general, the inspection reports indicate that the current level of maintenance is adequate, although the frequency of vegetation maintenance should be increased to establish dense sod cover. The 2019 Meramec Annual Levee Inspection is included in Appendix III.

4.0 DESIGN AND CONSTRUCTION DOCUMENT REVIEW

4.1 Ponds 492, 493 and 496

4.1.1 Embankment and Foundation Stability

Borings through the Pond 493 exterior embankment show the fill primarily material consists of clays and silts of alluvial origin, which were presumably excavated from the incised portions of the ash ponds. The consistency of the fill is firm to stiff. Portions of the embankment of been widened or raised with medium-dense to dense bottom ash or crushed limestone. The downstream slope is lined with MoDOT Type 4 Rock Ditch Liner that has a predominant size of 19 inches.

Embankment fill placed in the 1970's raised the crown of the Pond 493 embankment 0.5 to 2.5 feet, and fill added to the downstream slope to flatten it to 2H:1V. The plan sheet for the fill placement noted that the fill should be placed in 6-inch layers compacted to 95% Modified Proctor Density. About 300 feet of the embankment was subsequently enlarged and approximately 200 feet of the downstream slope was flattened to 3H:1V during the rail loop construction. Fill placed for the rail loop was compacted in systematic coverages with loose lift thicknesses not exceeding 12 inches. The fill was compacted to a dry unit weight equal to at least 92% of the Standard Proctor maximum dry density. This area was subsequently armored with riprap in 2015. The remaining downstream embankment slope east of the section modified during rail loop construction was armored with riprap at a 2H:1V slope to improve stability and provide erosion protection. The upstream slopes are currently buttressed with CCR or the railroad loop for a distance of 30 to 60 feet from the centerline of the original embankment.

The periodic safety factor assessment is provided in the *Ameren Missouri Meramec Energy Center: Evaluation of CCR Units* report Appendix D. This report shows that the minimum factors of safety specified in 40 CFR Part 257.73(d)(1) for the critical embankment cross sections are achieved for the range of loading expected.

4.1.2 Slope Protection

The perimeter berm for Pond 493 was originally designed with vegetated downstream and upstream slopes. Presently the downstream slopes adjacent to a tributary of the Meramec River are armored with riprap. The upstream slopes consist primarily of CCR. There are no design documents for the slope protection, however based on field inspection observations they appear to be functioning adequately.

4.1.3 Spillways

The principal spillway pipe for Ponds 492, 493 and 496 includes an 18-inch carbon steel pipe and 24-inch CMP secondary spillway. The *Ameren Missouri Meramec Energy Center: Evaluation of CCR Units* report Appendix E shows that the combination of spillways is adequate to manage flow during and following the peak discharge from the 100-year flood event.

4.2 Pond 498

4.2.1 Embankment and Foundation Stability

The perimeter berm for Pond 498 was constructed to elevation 425 with compacted fly ash above the existing ground surface, which was generally at about elevation 417 feet at the time of construction. The perimeter berms were constructed with 3H:1V downstream slopes and 4H:1V upstream slopes except for the west embankment which was sloped at 3H:1V. Additional fly ash fill was placed downstream of the perimeter berm on the west, north and south of the embankment slopes. The bottom of the pond was set at the top of natural clays which have an elevation of 395 to 398 feet.

Fly ash placed to construct the perimeter berm was moisture conditioned and compacted to a minimum of 95% of the maximum density determined by laboratory compaction characteristic tests using standard effort. Fill placement was monitored and moisture-density tests were conducted during construction.

The initial periodic safety factor assessment is provided in the *Ameren Missouri Meramec Energy Center: Evaluation of CCR Units* report Appendix D. This report shows that the minimum factors of safety specified in 40 CFR Part 257.73(d)(1) for the critical embankment cross sections are achieved for the range of loading expected.

4.2.2 Slope Protection

The perimeter berm was designed with vegetated downstream slopes and upstream slopes lined with HDPE. There are no design documents for the slope protection, however based on field inspection observations the slopes appear to be functioning adequately. The potential for erosion of the downstream slopes should be decreased by improving interior drainage and establishing and maintaining a dense vegetative cover.

4.2.3 Spillway

The spillway pipe for Pond 498 includes a 24-inch HDPE pipe and carbon steel pipe. The *Ameren Missouri Meramec Energy Center: Evaluation of CCR Units* report Appendix E shows that the spillway is adequate to manage flow during and following the peak discharge from the 100-year flood event.

5.0 PERIODIC STRUCTURAL STABILITY ASSESSMENT SUMMARY

The initial periodic structural stability assessment found no structural stability deficiencies, no significant issues with the current operations and maintenance, and that the design and construction of the embankments and spillways were adequate for the range of loading conditions under which the CCR unit should be subjected. However, the deficiencies listed below do need to be addressed.

5.1 Ponds 492, 493 and 496

- Continue monitoring the wet area on the north side of Pond 493 outside the perimeter berm. Monitoring should include documenting observations of the area relative to pond levels, recent precipitation events and adjacent river levels. If at any time water is observed flowing and carrying fines in this area, take immediate action as required to prevent degradation of the integrity of the embankment and foundation soils.
- Continue to monitor the condition of the principal spillway skimmer and provide access to the spillway inlet for future inspections.
- There are no recent video inspections of the principal or secondary spillway pipes for Pond 493. The secondary spillway pipe should be maintained free of any potential obstructions to flow and visually inspected.
- Prior to the subsequent periodic structural stability assessment obtain a topographic survey of the interior of the ponds and update the volume and depth estimates of impounded CCR.
- Increase the frequency of vegetation maintenance. Vegetation should be maintained so that the slopes and spillways can readily be inspected at any time.
- The O&M Manual states that all maintenance activities should be documented; however no maintenance records were available for review. The O&M Manual should be updated so that the responsibility and procedures for maintaining maintenance records are clearly defined.

5.2 Pond 498

- Seed and maintain the downstream slopes to establish a dense vegetative cover.

- Establish a ditch around the inside crest of the eastern perimeter berm to route any potential runoff into the interior of Pond 498.
- Monitor and repair inlet piping as necessary to prevent leakage outside the lined portion of the pond.
- Prior to the subsequent periodic structural stability assessment obtain a topographic survey of the interior of the ponds and update the volume and depth estimates of impounded CCR.

6.0 REFERENCES

Environmental Protection Agency. (2015). "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities; Final Rule." 40 CFR Parts 257 and 261., Vol. 80, No. 74.

da_map.dwg 6/18/2021

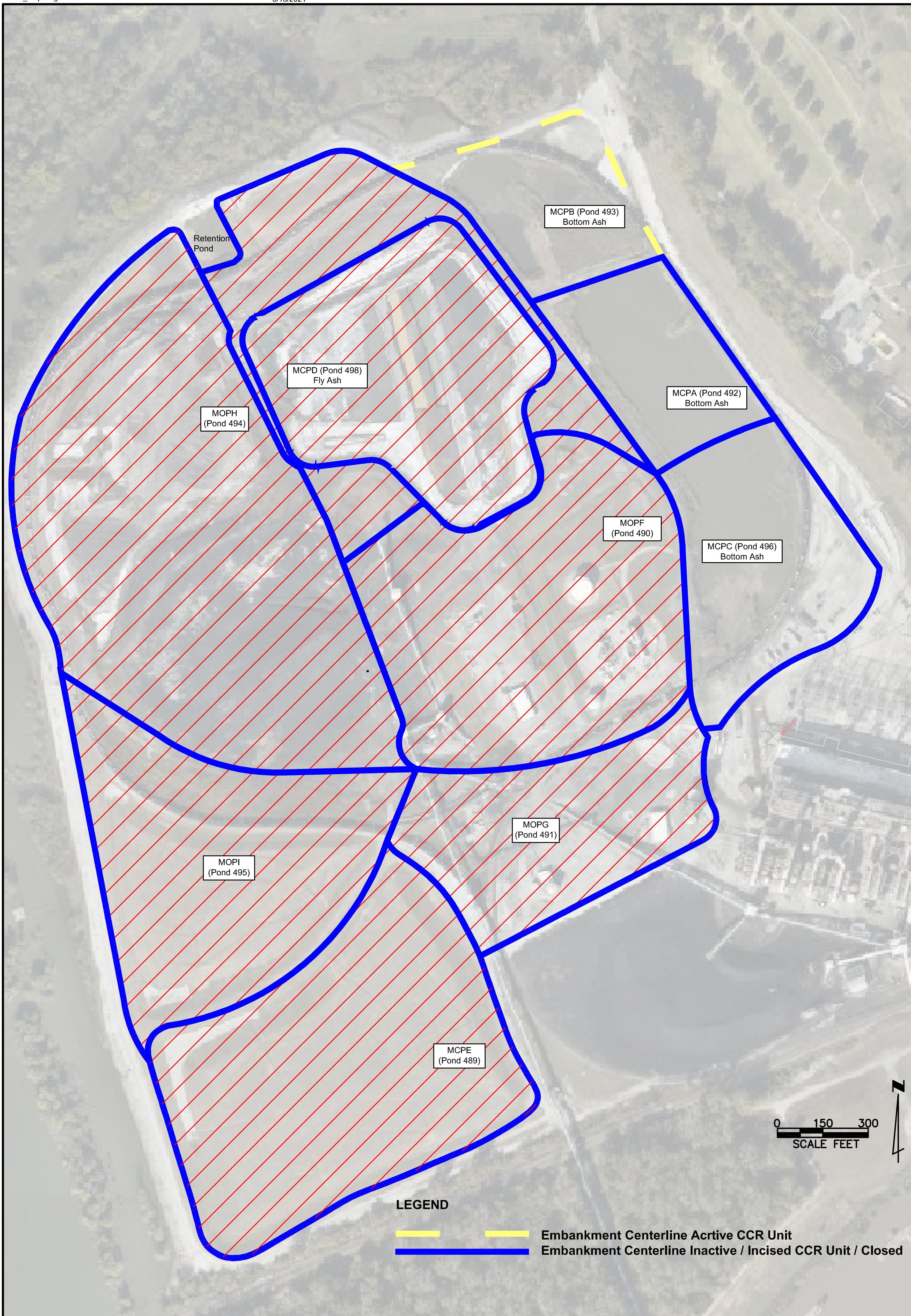

FIGURE 1	MERAMEC ENERGY CENTER ASH PONDS	Ameren Missouri 3700 S. Lindbergh St. Louis, MO 63127	Designed E.J.K. Checked ____ Drawn E.J.K. Issued 8/13/2021	REITZ & JENS, INC. CONSULTING ENGINEERS 1055 CORPORATE SQUARE DRIVE ST. LOUIS MISSOURI 63132 (314) 993-4132 PROFESSIONAL ENGINEERING CORP., LICENSE #000215

APPENDIX I

2020 PERIODIC INSPECTION CHECK SHEETS

2020 PERIODIC INSPECTION PHOTOGRAPH LOG

REITZ & JENS, INC.
CONSULTING ENGINEERS

1055 corporate square drive
st. louis, mo 63132
phone: 314.993.4132
fax: 314.993.4177
www.reitzjens.com

December 14, 2020

Jeffrey Greer, P.E.
Manager of Dam Safety & Hydro Licensing
Ameren Missouri
11149 Lindbergh Business Ct.
St. Louis, MO 63123

RE: Ameren Missouri – Meramec Energy Center
2020 Annual Surface Impoundment Inspection
MCPA (Pond 492), MCPB (Pond 493) and MCPC (Pond 496), MCPE (Pond 489), MOPI (Pond 494) and MOPH (Pond 495), Retention Pond and MCPD (Pond 498)

Dear Matt,

Enclosed herewith are Annual Inspection Check Sheets for the 2020 Annual Inspection of the active surface impoundments MCPA (Pond 492), MCPB (Pond 493) and MCPC (Pond 496), and MCPD (Pond 498), closed surface impoundments MCPE (Pond 489), MOPI (Pond 494) and MOPH (Pond 495) and the Retention Pond at Ameren Missouri's Meramec Energy Center conducted on October 27, 2020 by Reitz & Jens and Ameren Personnel. The Annual Inspection was in general accordance with 40 CFR Part 257.83(b), and included a review of available information regarding the status and condition of the CCR unit, including files available in the operating record.

No signs of structural weakness which would impact the operation and safety of the unit were observed. Minor maintenance items observed in the 2020 Annual Inspection associated with routine upkeep, presently do not impact the structural integrity of the embankment. Nonetheless, Ameren should address these minor maintenance items in a timely manner.

The following documents were reviewed as part of the Inspection:

1. *Ameren Missouri. (2011). "Operation and Maintenance Manual; Meramec Ash Pond Embankment, St. Louis, Missouri, St. Louis County." Dam Safety and Hydro Engineering, St. Louis, Missouri.*
2. *Ameren Missouri. (2016). "2016 Meramec Annual Inspection Checklist." September 2, 2016*
3. *Ameren Missouri. (2017). "2017 Meramec Annual Inspection Checklist." September 1, 2017*
4. *Ameren Missouri. (2018). "2018 Meramec Annual Inspection Checklist." August 30, 2018*

5. *Ameren Missouri. (2018). "Meramec Energy Center Ash Pond Closure Project Conforming to Construction Records."*
6. *Ameren Missouri. (2018). "Meramec Ash Pond Closure MCPE (Pond 489) Construction Quality Assurance Report." November 30, 2018*
7. *Ameren Missouri. (2019). "Meramec Ash Pond Closure MOPI (Impoundment 495) CQA Report." April 17, 2019*
8. *Ameren Missouri. (2019). "2019 Meramec Annual Inspection Checklist." August 29, 2019*
9. *Ameren Missouri. (2019). "Meramec Ash Impoundment, Weekly Inspection Checksheet." January 8 to December 19, 2019*
10. *Ameren Missouri. (2020). "Meramec Ash Impoundment, Weekly Inspection Checksheet." January 2 to August 11, 2020*
11. *Ameren Ash Volumes Inventory, Excel Spreadsheet*
12. *Ameren CCR Unit Inventory, Excel Spreadsheet*
13. *Dewberry & Davis, LLC. (2011). "Coal Combustion Waste Impoundment Round 7 – Dam Assessment Report, Meramec Power Station, Ameren Missouri, St. Louis, Missouri." USEPA Contract Number; EP-09W001727*
14. *Environmental Protection Agency (EPA). (2015). "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities." 40 CFR Parts 257 to 261. Vol. 80. No. 74. Federal Register*

The subsequent annual inspection must be conducted no later than October 27, 2021.

Sincerely,

Jeff Bertel

Jeff Bertel, P.E.
Project Manager
Reitz & Jens, Inc.

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MERAMEC ENERGY CENTER
MCPA (Pond 492), MCPB (Pond 493) and MCPC (Pond 496)
Annual Inspection Check Sheet

Date	10/27/2020
Inspector	J. Bertel, L. Sutton, A. Martinez, M. Lueckenhoff
Pool Level	Below Staff Gauge
River Level	El. 372
Temperature	34°F
Weather	Cloudy, Light Rain

Date of Previous Annual Inspection: 08/29/2019

Date of Previous Periodic Inspection: 09/03/2015

Description of Emergency (EC) or Immediate Maintenance (IM) conditions observed since the last annual inspection:
None

Describe any action taken to restore or improve safety and integrity of impounding structure:
None.

Describe any modifications to the geometry of the impounding structure since the previous annual inspection:
None.

Describe any modifications to the operation of the impounding structure since the previous annual inspection:
None.

List the approximate remaining storage capacity of the impounding structure:
Approx. 322,449 CY based on inventory numbers through July 2020, however the actual remaining storage is likely less due to active filling within the pond.

List the approximate maximum, minimum and present depth and elevation of the impounded water since the previous annual inspection:
Max – el. 411.3, depth unknown ft; Min – el. Below staff gauge, depth unknown; Present – el. Below staff gauge, depth unknown

List the approximate maximum, minimum and present depth and elevation of the impounded CCR since the previous annual inspection:
Max – el. 418 ft, depth 20 ft; Min – el. 405 ft, depth 7 ft; Present – el. 418 ft, depth 20 ft

Approximate volume of impounded water and CCR at the time of the inspection:
312,523 CY

Describe any changes to the downstream watershed:
None

MERAMEC ENERGY CENTER
MCPA (Pond 492), MCPB (Pond 493) and MCPC (Pond 496)
Annual Inspection Check Sheet

Inlet Outlet Works

Item	Condition Code	Comments
Outlet Pipe Condition	GC	The principal spillway is functional and clear of debris. The skimmer is slightly tilted but has been for several years. (IMG_3650)
Discharge (color and/or sediment)	NI	Discharge from the primary spillway was submerged in the retention pond. The water level was below the secondary spillway.
Obstructions	MM	The secondary spillway pipe has some excess vegetation around the inlet and is approximately a quarter to a third full of sediment. Remove excess vegetation around inlet and remove sediment from within conduit. (IMG_3653, IMG_3654 and IMG_3656)
Inlet Piping/ Supports Condition	GC	The inlet piping appeared in good condition. (IMG_3608)
Leakage	GC	No leakage was observed.
Other		

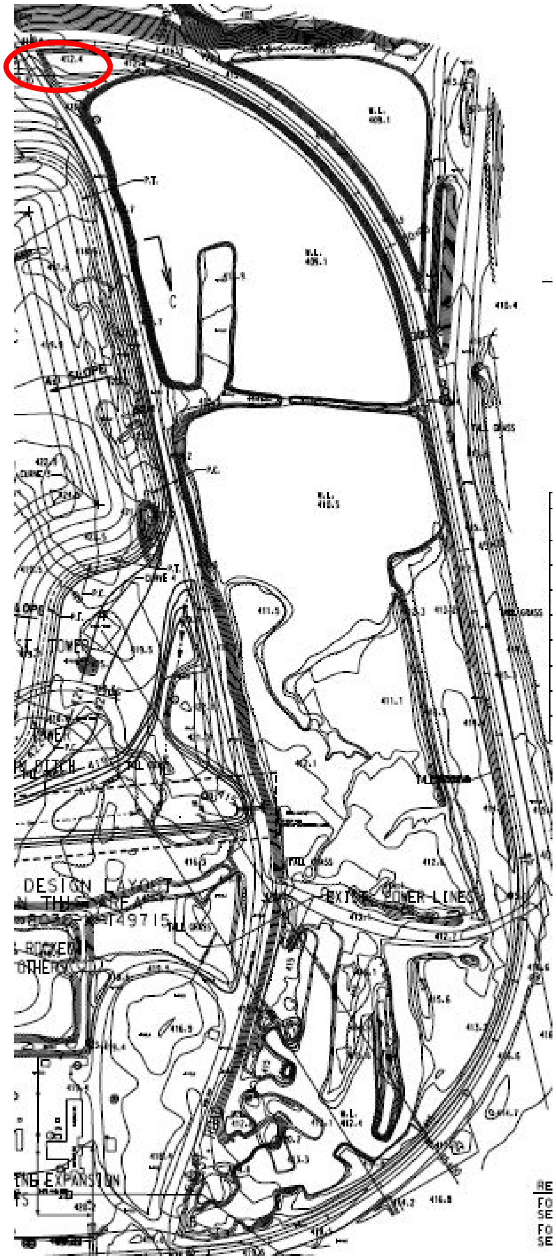
Earth Embankment

Item	Condition Code	Comments
Vertical & Horizontal Alignment of Crest	GC	No vertical or horizontal misalignment of the crest was observed. (IMG_3648)
Rip Rap Revetments	GC	Riprap on the downstream slope was in good condition. (IMG_ 20201027_085838)
Seepage/Wetness/ Ponding Areas	GC	During the inspection the ground was wet and saturated due to recent rain. Some minor ponding was observed approximately 30-50 feet from the North embankment section. (IMG_20201027_090942)
Erosion/Rutting	GC	No erosion or rutting was observed.
Fencing	GC	The fence was in good condition.
Vegetation	GC	The embankment slopes were generally free of excessive vegetation.
Sloughs/Slides/ Cracks	GC	No sloughs, slides or cracks were observed.

Earth Embankment		
Item	**Condition Code**	**Comments**
Animal Control	GC	No animal burrows were observed.
Other		

Note location of observation on attached plan sheet.

Secondary Spillway



Condition Code

EC = Emergency Condition. A serious dam safety condition exists that need immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work stoppage, plant stoppage.
IM = Item needing immediate maintenance to restore or ensure its safety and integrity. Remediation should be complete within 1 month or as required.
MM = Minor Maintenance. Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.
OB = Condition requires regular observation and potential future minor maintenance.
GC = Good Condition
NO = No observation possible.
NI = Not Inspected. State reason in comment column.

Figure 1 – Principal spillway skimmer.

Figure 2 - Excess vegetation around secondary spillway inlet.

Figure 3 - Excess vegetation around secondary spillway inlet.

Figure 4 - Secondary spillway approximately 1/4 to 1/3 full of sediment.

Figure 5 - Inlet piping.

Figure 6 - Perimeter embankment crest.

Figure 7 - Riprap on the downstream perimeter embankment slope.

Figure 8 - Minor ponding approximately 30-50 feet north of the perimeter embankment.

MERAMEC ENERGY CENTER
MCPD (Pond 498)
Annual Inspection Check Sheet

Date	10/27/2020
Inspector	J. Bertel, L. Sutton, A. Martinez, M. Lueckenhoff
Pool Level	Below staff gage
River Level	El. 372
Temperature	34°F
Weather	Cloudy, Light Rain

Date of Previous Annual Inspection: 08/29/2019

Date of Previous Periodic Inspection: 09/03/2015

Description of Emergency (EC) or Immediate Maintenance (IM) conditions observed since the last annual inspection:
None

Describe any action taken to restore or improve safety and integrity of impounding structure:
None.

Describe any modifications to the geometry of the impounding structure since the previous annual inspection:
None.

Describe any modifications to the operation of the impounding structure since the previous annual inspection:
None.

List the approximate remaining storage capacity of the impounding structure:
115,207 CY

List the approximate maximum, minimum and present depth and elevation of the impounded water since the previous annual inspection:
Max – el. 417.4 feet, depth 22.4 feet; Min – el. 417.4 ft, depth 22.4 feet; Present – el. unknown

List the approximate maximum, minimum and present depth and elevation of the impounded CCR since the previous annual inspection:
Max – el. 426 feet, depth 26 feet; Min – el. 414 ft, depth 14 feet; Present – el. 426 feet, depth 26 feet

Approximate volume of impounded water and CCR at the time of the inspection:
454,793 CY

Describe any changes to the downstream watershed:
None

Inlet Outlet Works

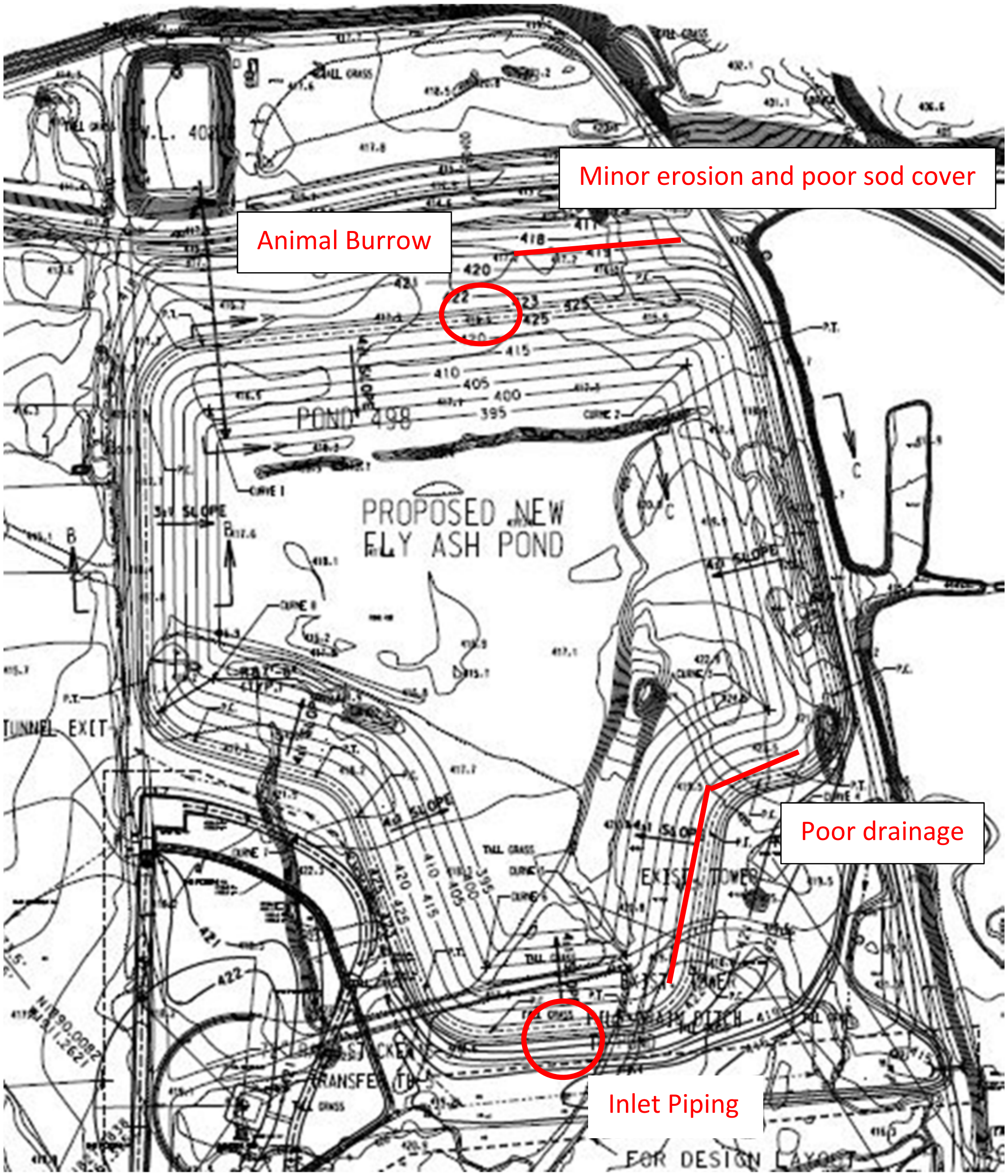
Item	Condition Code	Comments
Outlet Condition	GC	The outlet appeared functional. (IMG_3671)
Skimmer/Pipe Supports Condition	GC	The skimmer appeared attached to the pipe supports. The was no obvious damage to the pipe supports. (IMG_3671)
Valve Condition/ Operability	NI	
Discharge (color and/or sediment)	NI	The outlet was submerged in the retention pond.
Obstructions	GC	No obstructions were observed.
Inlet Piping/Supports Condition	OB	The inlet piping appeared to have recently ruptured, but had been repaired. Consider installing new inlet piping. (IMG_3686 and IMG_3688)
Leakage	OB	See comment above regarding inlet piping.
Other		

Earth Embankment

Item	Condition Code	Comments
Vertical & Horizontal Alignment of Crest	GC	No vertical or horizontal misalignment of the crest was observed. (IMG_3682)
HDPE Liner	GC	No tears or punctures were observed on the exposed HDPE liner.
Seepage/Wetness/ Ponding Areas	MM	A narrow area from the inlet piping and to the first gate to the east has ponding between an ash stockpile and the edge of the impoundment. This area has no apparent drainage. Create positive drainage to route stormwater into the impoundment. (IMG_3691 and IMG_3692)
Erosion/Rutting	OB	Minor erosion and poor sod cover on the north side of the impoundment. Repair erosion and seed. (IMG_20201027_091916)
Fencing	OB	Some damage observed to fencing surrounding impoundment. The fence may no longer

Earth Embankment		
Item	**Condition Code**	**Comments**
		have a useful purpose since it is within the plant's perimeter fence. (IMG_20201027_093151
Vegetation	OB	The vegetation on the crest and downstream slopes is sparse in areas. Consider amending soil and seeding to establish dense vegetative cover. (IMG_3690 and IMG_20201027_094350)
Sloughs/Slides/ Cracks	GC	No sloughs, slides or cracks were observed. (IMG_3700)
Animal Control	MM	Large animal burrow was observed on the crest near the center of the north section of the embankment. (IMG_3702)
Other		

Note location of observation on attached plan sheet.



Condition Code

EC = Emergency Condition. A serious dam safety condition exists that need immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work stoppage, plant stoppage.
IM = Item needing immediate maintenance to restore or ensure its safety and integrity. Remediation should be complete within 1 month or as required.
MM = Minor Maintenance. Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.
OB = Condition requires regular observation and potential future minor maintenance.
GC = Good Condition
NO = No observation possible.
NI = Not Inspected. State reason in comment column.

Figure 1 – Principal spillway skimmer, pipe supports and stoplogs.

Figure 2 – Inlet piping.

Figure 3 – Inlet piping.

Figure 4 – Area on inside of pond that has no apparent drainage.

Figure 5 – Minor erosion and poor sod cover on the north side of the impoundment.

Figure 6 – Damage to perimeter fence.

Figure 7 – Sparse vegetative cover on downstream slope.

Figure 8 – No sloughs, slides or cracks were observed.

Figure 9 – Large animal burrow was observed on the crest near the center of the north section of the embankment.

APPENDIX II

DVD CONTAINING 2020 PERIODIC INSPECTION PHOTOGRAPHS

APPENDIX III

OPERATIONS AND MAINTENANCE MANUAL

2019 MERAMEC ENERGY CENTER ANNUAL INSPECTION CHECK SHEET

OPERATION AND MAINTENANCE MANUAL

MERAMEC ASH POND EMBANKMENT
ST LOUIS, MISSOURI
ST. LOUIS COUNTY

MAY 23, 2011

DAM SAFETY & HYDRO ENGINEERING
3700 S. LINDBERGH BLVD
ST. LOUIS, MO 63127

OPERATION AND MAINTENANCE PLAN
MERAMEC ASH POND EMBANKMENT
ST. LOUIS COUNTY, MO

TABLE OF CONTENTS

SECTION 1

GENERAL

This operation and maintenance plan, (hereafter referred to as the O&M Manual), outlines objectives, proposed policies, responsibilities, and procedures for Ameren personnel who are responsible for the management of the Meramec Ash Pond Embankment.

REASONS FOR DEVELOPMENT AND DISSEMINATION OF THE O&M MANUAL

As an ash pond embankment owner, Ameren is responsible for the safety of the public and for maintaining the structures within the Ameren's jurisdiction for both safety and economy. The overall public interest is served by providing a document to serve as a basis for the safe and economical operation and maintenance of the ash pond embankment during both emergency and day-to-day conditions.

GENERAL RESPONSIBILITIES CONCERNING ASH POND EMBANKMENTS

Shift Supervisor

Contacts local agencies when emergency conditions exist at the Meramec Ash Pond Embankment.

Plant Engineer

Ensures operation and maintenance program is being implemented as outlined in this document. Ensures performance of weekly inspections. Performs annual assessment of the Operation and Maintenance Manual.

Chief Dam Safety Engineer

Reviews all updates to the Operation and Maintenance Manual.

Dam Safety Group

Performs annual ash pond embankment inspection with Plant Engineer.

SECTION 2

DEFINITIONS

Abutment - That part of the valley side or concrete walls against which the dam is constructed. Right and left abutments are those on respective sides of an observer when viewed looking downstream.

Appurtenant Works - The structures or machinery auxiliary to dams that are built to operate and maintain dams; such as outlet works, spillways, gates, valves, channels, etc.

Auxiliary Spillway - A spillway that works in conjunction with the principal spillway to control flood flows and is constructed of non-erodible materials.

Boil - A stream of water discharging from the ground surface downstream of the dam carrying with it a volume of soil that is distributed around the hole formed by the discharging water.

Berm - A horizontal step or bench in the sloping profile of an embankment dam.

Breach - A break, gap, or opening (failure) in a dam that releases impoundment water.

Concrete Block - An erosion protection method using interlocking concrete blocks, usually with openings that are filled with soil and grass.

Core - A zone of material of low permeability in an earthen dam.

Dam - A barrier built for impounding or diverting the flow of water.

Dike (Levee) - An embankment or structure built alongside a river to prevent high water from flooding bordering land.

Drain, Layer or Blanket - A layer of pervious material in a dam to facilitate the drainage of the embankment, including such items as a toe drain, a weep hole, and a chimney drain.

Drawdown - The resultant lowering of water surface level due to the controlled release of water from the impoundment.

Embankment - Fill material, usually earth or rock, placed with sloping sides.

Emergency Spillway - A spillway designed to operate very infrequently, only during exceptionally large floods, usually constructed of materials expected to erode slowly.

Earthen Dam - Any dam constructed of excavated natural materials.

Emergency Action Plan - A predetermined plan of action to be taken to reduce the potential for property damage and loss of lives.

Failure - An incident resulting in the uncontrolled release of water from a dam.

Freeboard - The vertical distance between a stated water level and the top of a dam.

Gate or Valve - In general, a device in which a leaf or member is moved across the waterway to control or stop the flow.

Groin - The junction of the upstream or downstream face of the dam with the valley wall.

Maintenance - The upkeep, involving labor and materials, necessary for efficient operation of dams and their appurtenant works.

Operation - The administration, management, and performance needed to operate the dam and appurtenant works.

Operation and Maintenance Inspection - Inspections conducted by the Plant Engineer. These inspections are frequent visual inspections of the dam surface and appurtenant works.

Outlet - An opening through which water can freely discharge for a particular purpose from an impoundment.

Phreatic Surface - The upper surface of saturation in an embankment.

Piping - The progressive development of internal erosion by seepage, appearing downstream as a hole or seam, discharging water that contains soil particles.

Principal Spillway - The main spillway that controls both normal and flood flows and is constructed of non-erodible materials.

Riprap - A layer of large stones, broken rock or precast blocks placed in a random fashion, usually on the upstream slope of an embankment dam, on a reservoir shore, or on the sides of a channel as a protection against current, wave and ice action.

Silt/Sediment - Soil particles and debris in an impoundment.

Slump/Slide Area - A portion of earth embankment that moves downslope, sometimes suddenly, often with cracks developing.

Spillway System - A structure or structures over or through which flows are discharged. If the flow is controlled by gates, it is considered a controlled spillway. If the elevation of the spillway crest is the only control of the flows, it is considered an uncontrolled spillway.

Stilling Basin - A basin constructed to dissipate the energy of fast flowing water, such as from a spillway, and to protect the stream bed from erosion.

Toe of Embankment - The junction of the face of the dam with the ground surface in the floodplain upstream or downstream of the dam.

Trash Rack - A structure of metal or concrete bars located in the waterway at an intake to prevent the entry of floating or submerged debris.

SECTION 3

INFORMATION ABOUT THE ASH POND EMBANKMENT

LOCATION

The Meramec Power Plant (Meramec Energy Center) is located at the southern most point in St. Louis County, Missouri near the confluence of the Meramec and Mississippi Rivers. The plant is located south of the City of Oakville and east of the City of Arnold. The Meramec River is adjacent to the plant on the west. To the east is the Mississippi River. The confluence of these two rivers is directly south of the plant. To the north of the plant is a small creek, wooded uplands and Meramec River floodplain. The ash pond embankment is located adjacent to the Mississippi River in the southwest quarter of Section 3, Township 42 North, Range 6 East of the 5th Principal Meridian.

DESCRIPTION OF ASH POND EMBANKMENT AND APPURTENANCES

The Meramec Ash Pond Embankment is a single stage industrial ash pond embankment. The ash pond embankment impounds an area of approximately 138-acres for coal combustion ash sedimentation and water treatment purposes. The perimeter of the ash pond embankment has a length of approximately 6,400-lineal-feet (lf) and a maximum height of 24.7-ft. The ash pond embankment forms the perimeter of several smaller impoundments. These impoundments include the Retention Pond, Pond 489, Ponds 490-496, and Pond 498. Ponds 490, 491, 494, and 495 have been filled near capacity with coal combustion ash, and are now supporting plant equipment.

Pond 489

Pond 489 is located in the southwest corner of the plant, and is used for fly ash sedimentation, water treatment and chemical stabilization purposes. The upstream slopes are approximately 3 (H) to 1 (V) and the downstream slopes are approximately 1.9 (H) to 1 (V). The embankment height is approximately 24.5 feet. Pond 489 has an outfall to the Meramec River that consists of a drop inlet, two 36-in diameter butterfly valves and a 36-in diameter high-density polyethylene (HDPE) pipe. There are four 12-in diameter polyvinyl chloride (PVC) pipes that form an overflow in Pond 489 at elevation 417.5-ft that drains to Pond 495 and ultimately to the Retention Pond through a drainage channel that runs along the outside perimeter of the rail loop.

Retention Pond

The Retention Pond is along the north boundary of the plant and used for water clarification and chemical stabilization. The pond has a drop inlet outfall that discharges to the Meramec River through a 24-in diameter carbon steel pipe. One 24-in diameter butterfly valve is installed on this pipe. The embankment height in this section is approximately 24.7 feet.

Bottom Ash Pond

The Bottom Ash Pond (Pond 496, 492, and 493) is along the northeast boundary of the plant and is used for bottom ash sedimentation. The pond outfall discharges to the Retention Pond through a drop inlet and carbon steel pipe.

Pond 498

Pond 498 is also used for fly ash sedimentation. The pond is located just south of the Retention Pond and was built on top of Pond 498. The outfall for the Pond 498 is a drop inlet with a 24-in HDPE pipe that discharges to the Retention Pond.

HAZARD CLASSIFICATION

The Meramec Ash Pond Embankment is not currently subject to MDNR dam safety regulations. If regulations did apply, the Meramec Plant Ash Pond Embankment would be classified as a Class III, LOW HAZARD POTENTIAL, as defined by Missouri Department of Natural Resources (MDNR), because there are no dwellings downstream. In addition, there are no dams currently registered with MDNR directly influencing the Meramec Plant Ash Pond Embankment.

PURPOSE OF ASH POND EMBANKMENT

The perimeter ash pond embankment forms several individual ponds. The active reservoirs are used for coal combustion sedimentation storage.

PERTINENT DATA

Pertinent data about the ash pond embankment, appurtenant works, and reservoir is presented in Table 1.

TABLE 1
PROJECT DATA

Drainage Area	187-Acres
Ash Pond Embankment:	
Type	Earth Embankment
Elevation, Top of Embankment	Varies from 413.3 to 419.5
Height Above Streambed	Approximately 24.7 feet
Upstream Slope	Varies from 1.6 (H) to 3 (H) on 1 (V)
Downstream Slope	Varies from 1.7 (H) to 2.5 (H) on 1 (V)
Length	6,400 feet
Top Width	Varies
Minimum Freeboard Requirements	2.5 Feet

Pond 489:	
Elevation, Top of Embankment	419.5 feet
Elevation, Normal Pool	415.8 feet
Height Above Streambed	24.5 feet
Area, Normal Pool	17.6 acres
Freeboard, Normal Pool	3.7 feet
Outlet Works:	
Inlet Invert Elevation	406 feet
Outlet Invert Elevation	408.5 feet
Overflow:	
Type	Four polyvinyl Chloride (PVC) overflow pipes
Inlet Elevation	417.5 feet
Retention Pond:	
Elevation, Top of Embankment	414 feet
Elevation, Normal Pool	404 feet
Height Above Streambed	18 feet
Area, Normal Pool	0.7 acres
Freeboard, Normal Pool	10 feet
Outlet Works:	
Inlet Invert Elevation	403.6 feet
Outlet Invert Elevation	396.8 feet
Bottom Ash Pond	
Elevation, Top of Embankment	417.4
Elevation, Normal Pool	409.5 feet
Height Above Streambed	24.7 feet
Area, Normal Pool	14 acres
Freeboard, Normal Pool	7.9 feet
Outlet Works:	
Inlet Invert Elevation	412 feet (Estimated)
Pond 498:	
Elevation, Top of Embankment	423 feet
Elevation, Normal Pool	418 feet
Height Above Streambed	19.5 feet
Area, Normal Pool	13.5 acres
Freeboard, Normal Pool	5 feet
Outlet Works:	
Inlet Invert Elevation	420 feet

SECTION 4

OPERATION ACTIVITIES

NORMAL OPERATION

The Retention Pond receives indirect flow from pond 489 and discharge from the Bottom Ash Pond and Pond 498 outfalls. Indirect flow from Pond 489 flows through Pond 495 and portions of Pond 494 outside the rail loop in a channel which is inside of the west perimeter road and into the Retention Pond. The indirect flow from Pond 489 occurs when the pool elevation of Pond 489 exceeds 417.5-ft. Indirect flow from Pond 498 and Bottom Ash Pond is through a single orifice and occurs when the available storage in each pond is filled to capacity.

The Retention Pond outfall consists of one 24-in diameter Carbon Steel pipe which is upturned on the upstream end to an elevation of 403.6. The downstream invert elevation is 396.8-ft. One 24-in diameter motor operated butterfly valve is used to control flow through this pipe. The valve is programmed to operate in response to water quality measurements. The pH is constantly monitored. When the pH is within acceptable water quality tolerances the valve is opened and water is discharged. When the pH exceeds acceptable levels the valve is closed.

Pond 489 water level is regulated by an outfall that discharges into the Meramec River. The outfall is a drop inlet and consists of one 36-in diameter HDPE pipe which has an invert elevation of 406-ft into the upstream discharge structure. The discharge structure consists of a 10-ft diameter galvanized multi-plate corrugated metal pipe. On the downstream end, the 36-in diameter pipe is upturned to an elevation of 408.5-ft. Flow through the HDPE pipe is regulated by two 36-in diameter motor operated butterfly valves. The valve is programmed to operate in response to water quality measurements. The pH is constantly monitored. When the pH is within acceptable water quality tolerances the valve is opened and water is discharged. When the pH exceeds acceptable levels the valve is closed.

INSTRUMENTATION MONITORING DATA

There is a staff gage in the northwest portion of pond 489 to obtain pool elevations. The staff gage is checked weekly to ensure that the reservoir level is at or below the standard operating level of 415.8-feet.

TYPES OF ASH POND EMBANKMENT INSPECTIONS

Weekly visual inspections are conducted at the ash pond embankment by plant operations staff. The Ameren Missouri Dam Safety Group performs annual inspections with plant operations. In addition, the Ameren Missouri Dam Safety Group may conduct unannounced safety inspections. The following sections describe each type of inspection.

Pond water level elevations should be maintained in accordance with Table 1. At no time should the water levels be above the minimum required 2.5 foot freeboard.

Weekly Inspection:

Weekly inspections are conducted by plant staff or support staff familiar with the ponds/ ash pond embankment. The weekly inspection consists of visually inspecting the crest and slopes of the ash pond embankment to identify any new or changed conditions. Checklists are completed and are made available to the Dam Safety Group for review. A recommended inspection checklist for the weekly inspection is included in ***Appendix A.***

Annual Inspection:

These inspections are conducted annually by the plant staff and the Ameren Missouri Dam Safety Group staff. The annual inspection is a detailed visual inspection of the ash pond embankment crest, interior and exterior slopes, downstream toe area, inlet/outlet works, and appurtenant structures. A recommended inspection checklist for the annual inspection is included in ***Appendix A.***

Records: An inspection Report is to be prepared by the Ameren Missouri Dam Safety Group staff that includes a description of the observations of the visual inspection, photographs of the facilities taken during the inspection, and a written evaluation of the results. A record of activities occurring at the ash pond embankment is to be kept current by the Ameren Missouri Dam Safety Group.

Special Inspection:

These inspections are conducted when extreme events which may impact stability (seismic activity, severe flooding, etc.). Special inspections are similar to the annual inspection, but may be focused on a particular area. If conditions are discovered during a weekly or annual inspection which create concern for the plant or dam safety staff, a special inspection will be conducted. Responsibility for performance of special inspections will be evaluated based on severity of the event. A recommended inspection checklist for the special inspection is included in ***Appendix A.***

Unannounced Inspections:

The Ameren Missouri Chief Dam Safety Engineer (CDSE) may conduct unannounced inspections at the site as deemed appropriate. The inspection may include a visual inspection of the facility, a review of the inspection documentation, and interviews with plant personnel to review their understanding of the required inspection procedure.

The inspections checklists are to be completed and filed for each inspection. The checklists for each inspection are located in ***Appendix A.*** Condition codes are given to each item listed on the inspection checklist. The condition codes are defined below.

EC - Emergency Condition. A serious dam safety condition exists that needs immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work stoppage, plant stoppage.

Examples: Whirlpools, piping situation, embankment slough extending through half crest width, sinkhole in crest

IM - Item needing immediate maintenance to restore or ensure its safety or integrity. Remediation should be completed within 1 month.

Examples: Sinkhole on downstream slopes, gate of valve failure

MM - Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.

Examples: Crest rutting, rodent holes and animal burrows, tree growth on embankment slope, minor downstream embankment slough

OB - Condition requires regular observation to ensure that the condition does not become worse.

Examples: Minor seepage – No evidence of material movement

GC - Good Condition.

NE - No evidence of a problem.

NI - Not Inspected. Reason should be stated in comment.

SECTION 5

MAINTENANCE ACTIVITIES

Timely repairs are a must after problem areas have been identified. The Plant Engineer is to specify the work by generating a Job Request (JR) and provide direction to correct items noted in the operation and maintenance and engineering inspections. Prioritization of maintenance JR's should be reviewed with the Dam Safety Group to ensure proper emphasis has been placed on the JR. Such items include mowing, seeding, tree and brush removal, painting, replacing riprap, repairing fences and locks, clearing debris, etc. The maintenance activities specified in the following sections are minimum requirements. Maintenance activities should be documented. NOTE: NO alterations or repairs to structural elements should be made without the approval of the Chief Dam Safety Engineer.

Ash Pond Stacking: Ash may be temporarily stacked up to an elevation of 15 feet above the top levee elevation with the toe of the slope of the stacked ash 125 feet from the existing ash containment levee. The ash stack slope shall be a minimum 3 horizontal to 1 vertical. No perched water level above the crest of the perimeter embankment is permissible.

Debris: Remove all trash, logs and other debris that may obstruct flow from the outlet works.

Concrete Block and Rip Rap: Replace or level blocks and rip rap as needed to provide adequate protection against erosion.

Vegetation Control:

(1) A good grass cover on the embankment should be maintained by seeding, fertilizing and mulching areas that are refilled, barren, or thinly vegetated. Seeding mixtures used for maintenance reseeding shall result in cover compatible with adjacent cover.

(2) Grassed areas such as the embankment and areas beyond the embankment toe for a distance of approximately 20 feet should be mowed at least twice annually, where physically accessible.

(3) All eroded areas should be filled and compacted, reseeded, fertilized and mulched to establish a thick erosion resistant cover.

(4) All trees and brush on the ash pond embankment should be removed to prevent development of a root system that could provide seepage paths. Herbicides utilized for tree and brush control are discussed in ***Appendix B***.

(5) All brush and trees should be removed to a distance of approximately 20 feet beyond the toe of the ash pond embankment, where physically accessible.

Animal Damage: Rodent holes should be filled with compacted clay dirt and reseeded. If rodents become a nuisance, an effective rodent control program as approved by the Missouri Department of Natural Resources District Wildlife Biologist should be implemented.

Concrete: Spalled and cracked areas on concrete structures should be patched to guard against any further deterioration of the structure. Concrete construction joints should be filled with a suitable joint filler, such as a bituminous sealant, to protect against weathering.

Drains: All drains and weep holes should be kept open and functional by cleaning them of silt and debris.

Painting: All metal work, fencing, railing, etc. should be properly prepared and repainted as necessary to protect against rusting.

Signs: All warning signs and staff gages should be maintained (repaired, painted, or replaced) as needed.

Sedimentation: As sediment accumulates in the reservoir, less storage is available for the control of flood waters from the watershed. Efforts should be made to work with the U.S. Department of Agriculture, Natural Resources Conservation Service and the upstream land owners to minimize the sediment being transported to the reservoir. A location for the placement of the sediment removed from the reservoir (if upstream of the ash pond embankment, above the top of the ash pond embankment) should be determined.

SECTION 6

EMERGENCY CONDITIONS

If a condition arises where there is a possibility of ash pond embankment failure, the following plan will be put into effect (Refs. Meramec EIP MP-EIP-DAMINT-16 and MP-EIP-NOTIFY-17).

(1) The pond level will be lowered by the primary spillway, and closely monitoring the area for changes in conditions. If the primary spillway should become inoperable, supplemental pumps will be used to lower the level of the pond.

(2) The following agencies would be notified by Ameren concerning the status of the ash pond embankment. These agencies will inform the public as to what action would be taken. Ameren will do whatever possible to minimize damage at downstream locations.

A. St. Louis County Sheriff	314-889-2341
B. St. Louis County Emergency Management	314-628-5400
C. MDNR –Water Resources Center	573-751-2867
D. Army Corps of Engineers (St. Louis District)	314-331-8567
E. MDNR – Dam Safety	573-368-2175
F. Ameren Chief Dam Safety Engineer	314-210-4356

FIGURES

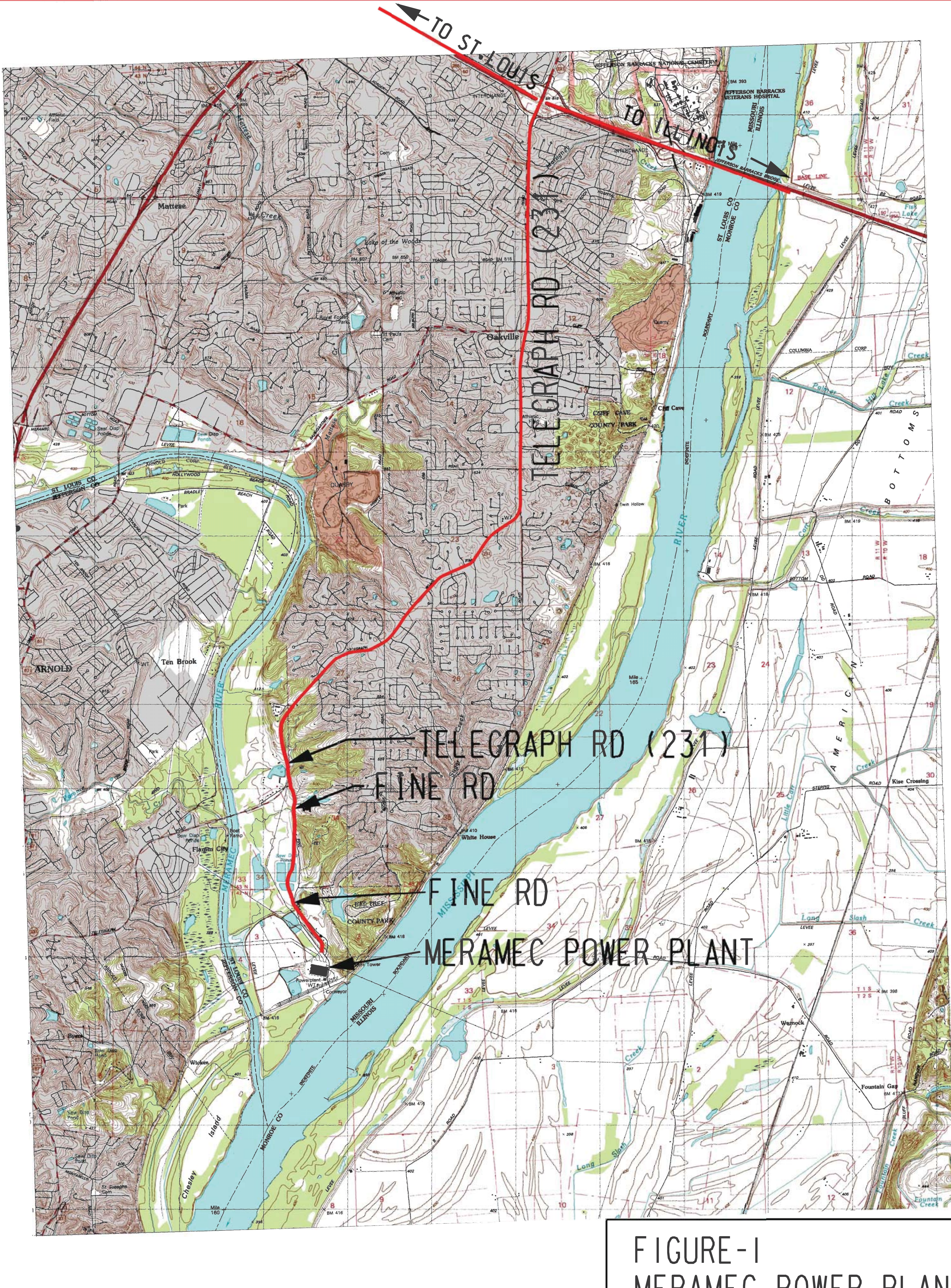


FIGURE-1
MERAMEC POWER PLANT
LOCATION MAP

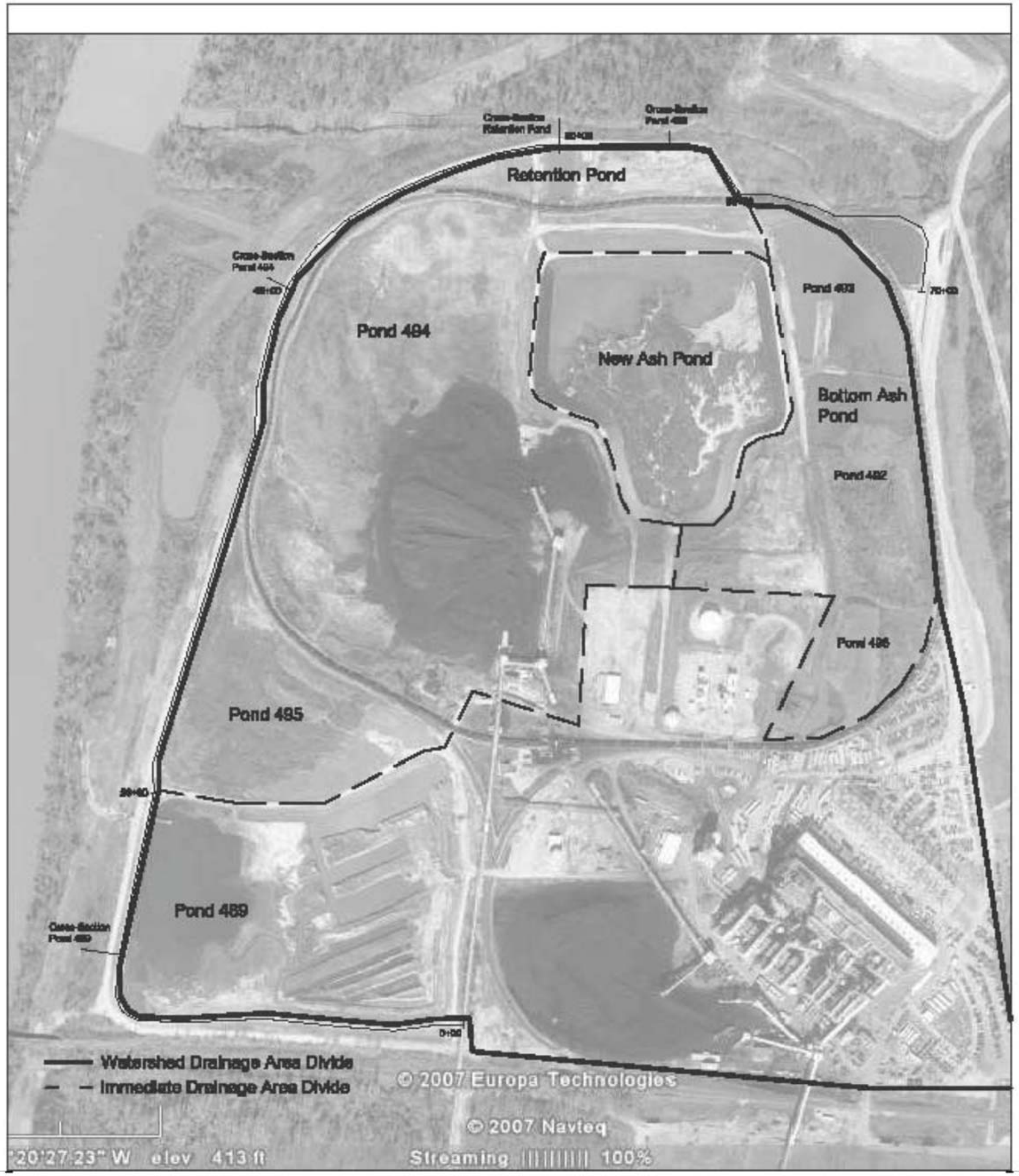


FIGURE 2
AERIAL PLAN
MERAMEC POWER PLANT

APPENDIX A

INSPECTION CHECKLISTS

Meramec Ash Impoundment

Weekly Inspection Checksheet

Date	
Inspector	
Lake Level	
Temperature	
Weather	

	Item	Condition Code *	Comments
Inlet / Outlet	Pond 489 Outfall Condition		
	Retention Pond Outfall Condition		
	Other		
Earth Embankment	Vertical & Horizontal Alignment of Crest		
	Seepage		
	Erosion		
	Vegetation		
	Unusual Movement or Cracking		
	New Fly Ash Pond Liner		
	Other		

Condition Codes

EC = Emergency Condition. A serious dam safety condition exists that needs immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work stoppage, plant stoppage.
IM = Item needing immediate maintenance to restore or ensure its safety or integrity. Remediation should be completed within 1 month.
MM = Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.
OB = Condition requires regular observation to ensure that the condition does not become worse.
GC = Good Codition.
NE = No evidence of a problem.
NI = Not Inspected. Reason should be stated in comment

New Fly Ash Pond

Annual Inspection Checksheet

Date	
Inspector	
Lake Level	
Temperature	
Weather	

	Item	Condition Code *	Comments
Inlet and Outlet	Obstruction		
	Inlet Piping Supports		
	Leakage		
	Outfall Pipe Condition		
	Outfall Valve		
	Other		
Earth Embankment	Vertical & Horizontal Alignment of Crest		
	Pond Liner		
	Seepage		
	Erosion		
	Fencing		
	Vegetation		
	Unusual Movement or Cracking At or Beyond Toe		
	Other		

Condition Codes

EC = Emergency Condition. A serious dam safety condition exists that needs immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work
IM = Item needing immediate maintenance to restore or ensure its safety or integrity. Remediation should be completed within 1 month.
MM = Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.
OB = Condition requires regular observation to ensure that the condition does not become worse.
GC = Good Codition.
NE = No evidence of a problem.
NI = Not Inspected. Reason should be stated in comment

Bottom Ash Ponds (492, 493, 496)
Annual Inspection Checksheet

Date	
Inspector	
Lake Level	
Temperature	
Weather	

	Item	Condition Code *	Comments
Inlet and Outlet	Obstruction		
	Inlet Piping Supports		
	Leakage		
	Outfall Pipe Condition		
	Outfall Valve		
	Other		
Earth Embankment	Vertical & Horizontal Alignment of Crest		
	Pond Liner		
	Seepage		
	Erosion		
	Fencing		
	Vegetation		
	Unusual Movement or Cracking At or Beyond Toe		
	Other		

Condition Codes

EC = Emergency Condition. A serious dam safety condition exists that needs immediate action.
IM = Item needing immediate maintenance to restore or ensure its safety or integrity. Remediation should
MM = Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is
OB = Condition requires regular observation to ensure that the condition does not become worse.
GC = Good Codition.
NE = No evidence of a problem.
NI = Not Inspected. Reason should be stated in comment

Pond 489

Annual Inspection Checksheet

Date	
Inspector	
Lake Level	
Temperature	
Weather	

	Item	Condition Code *	Comments
Inlet and Outlet	Obstruction		
	Inlet Piping Supports		
	Leakage		
	Outfall Pipe Condition		
	Outfall Valve		
	Other		
Earth Embankment	Vertical & Horizontal Alignment of Crest		
	Pond Liner		
	Seepage		
	Erosion		
	Fencing		
	Vegetation		
	Unusual Movement or Cracking At or Beyond Toe		
	Other		

Condition Codes

EC = Emergency Condition. A serious dam safety condition exists that needs immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work
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Retention Pond

Annual Inspection Checksheet

Date	
Inspector	
Lake Level	
Temperature	
Weather	

	Item	Condition Code *	Comments
Inlet and Outlet	Obstruction		
	Inlet Piping Supports		
	Leakage		
	Outfall Pipe Condition		
	Outfall Valve		
	Other		
Earth Embankment	Vertical & Horizontal Alignment of Crest		
	Pond Liner		
	Seepage		
	Erosion		
	Fencing		
	Vegetation		
	Unusual Movement or Cracking At or Beyond Toe		
	Other		

Condition Codes

EC = Emergency Condition. A serious dam safety condition exists that needs immediate action.
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MM = Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is
OB = Condition requires regular observation to ensure that the condition does not become worse.
GC = Good Codition.
NE = No evidence of a problem.
NI = Not Inspected. Reason should be stated in comment

New Fly Ash Pond

Special Inspection Checksheet

Date	
Inspector	
Lake Level	
Temperature	
Weather	

	Item	Condition Code *	Comments
Inlet and Outlet	Obstruction		
	Inlet Piping Supports		
	Leakage		
	Outfall Pipe Condition		
	Outfall Valve		
	Other		
Earth Embankment	Vertical & Horizontal Alignment of Crest		
	Pond Liner		
	Seepage		
	Erosion		
	Fencing		
	Vegetation		
	Unusual Movement or Cracking At or Beyond Toe		
	Other		

Condition Codes

EC = Emergency Condition. A serious dam safety condition exists that needs immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work
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OB = Condition requires regular observation to ensure that the condition does not become worse.
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NE = No evidence of a problem.
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Bottom Ash Ponds (492, 493, 496)

Special Inspection Checksheet

Date	
Inspector	
Lake Level	
Temperature	
Weather	

	Item	Condition Code *	Comments
Inlet and Outlet	Obstruction		
	Inlet Piping Supports		
	Leakage		
	Outfall Pipe Condition		
	Outfall Valve		
	Other		
Earth Embankment	Vertical & Horizontal Alignment of Crest		
	Pond Liner		
	Seepage		
	Erosion		
	Fencing		
	Vegetation		
	Unusual Movement or Cracking At or Beyond Toe		
	Other		

Condition Codes

EC = Emergency Condition. A serious dam safety condition exists that needs immediate action.
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GC = Good Codition.
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Pond 489

Special Inspection Checksheet

Date	
Inspector	
Lake Level	
Temperature	
Weather	

	Item	Condition Code *	Comments
Inlet and Outlet	Obstruction		
	Inlet Piping Supports		
	Leakage		
	Outfall Pipe Condition		
	Outfall Valve		
	Other		
Earth Embankment	Vertical & Horizontal Alignment of Crest		
	Pond Liner		
	Seepage		
	Erosion		
	Fencing		
	Vegetation		
	Unusual Movement or Cracking At or Beyond Toe		
	Other		

Condition Codes

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Retention Pond

Special Inspection Checksheet

Date	
Inspector	
Lake Level	
Temperature	
Weather	

	Item	Condition Code *	Comments
Inlet and Outlet	Obstruction		
	Inlet Piping Supports		
	Leakage		
	Outfall Pipe Condition		
	Outfall Valve		
	Other		
Earth Embankment	Vertical & Horizontal Alignment of Crest		
	Pond Liner		
	Seepage		
	Erosion		
	Fencing		
	Vegetation		
	Unusual Movement or Cracking At or Beyond Toe		
	Other		

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APPENDIX B

HERBICIDES

HERBICIDES

Site personnel should check with the Missouri Department of Natural Resources, Regional Fisheries Biologist and the Regional Wildlife Biologist before using any herbicide. Read the product label prior to use and follow the use directions and precautions accordingly.

On March 1, 1979 the U.S. Environmental Protection Agency (U.S.E.P.A.) halted the use of the herbicide 2, 4, 5-T in parks and recreation areas. The use of silvex (2, 4, 5-TP) around water has also been banned.

Some examples of approved herbicides are:

1)	Tordon RTU by DOW Chemical. (Can be obtained with blue dye.)
2)	WEEDONE 170 by Union Carbide
3)	WEEDONE, 2, 4-DP by Union Carbide
4)	A 1% to 2% solution of ROUNDUP
5)	Garlon by DOW Chemical
6)	Banvel by Sandoz

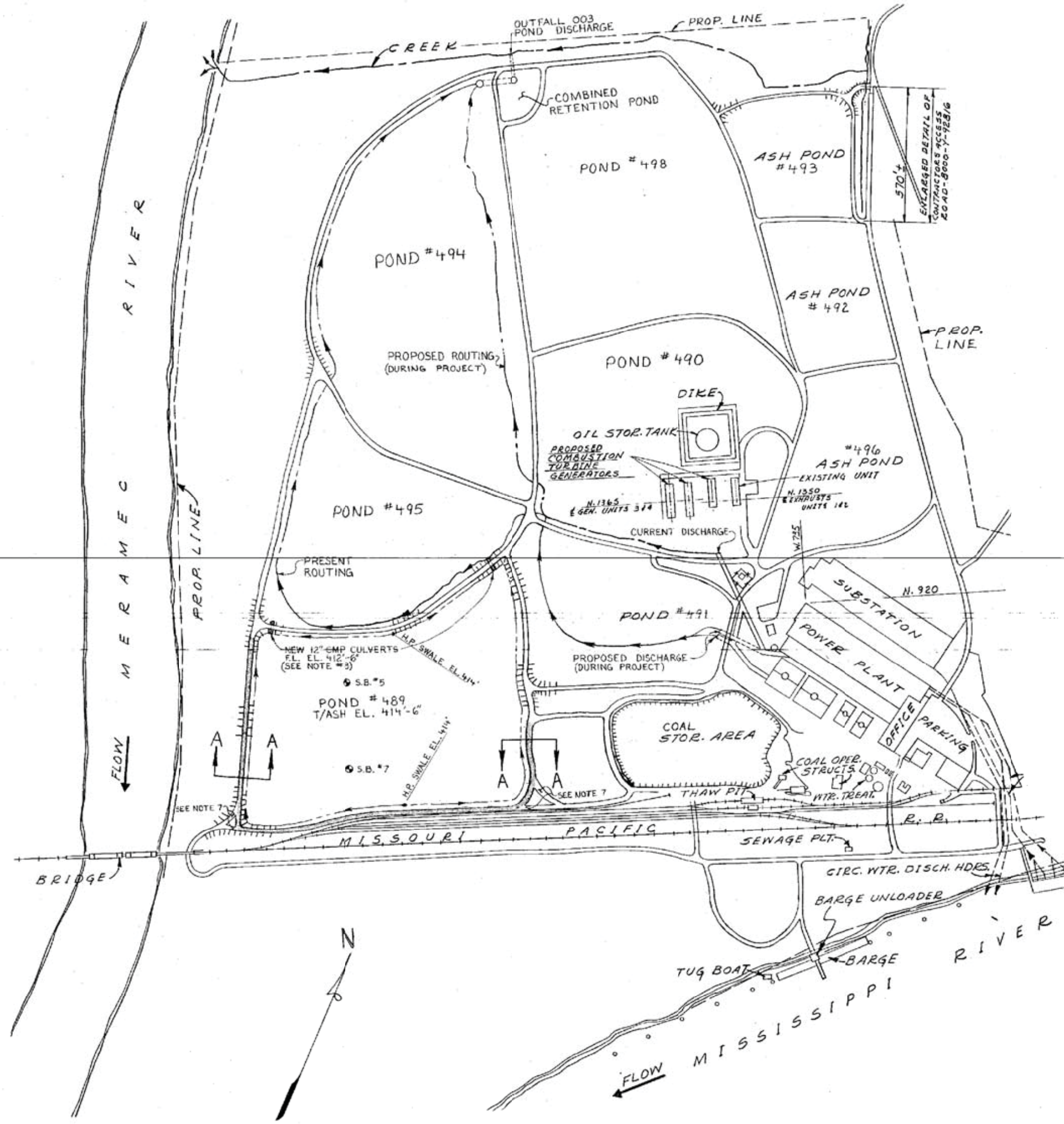
Your distributor may carry brand name herbicides other than those listed above. Be certain that the product does not contain the ingredients 2, 4, 5-T or 2, 4, 5-TP. An example of an unacceptable product is ESTERON 2, 4, 5 by DOW Chemical.

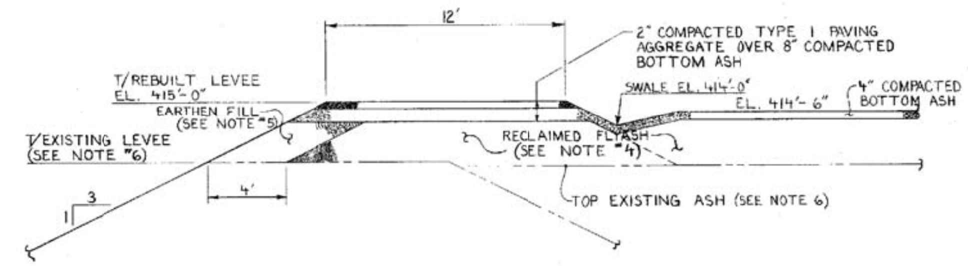
APPENDIX C

PROJECT DRAWINGS

REV	W.O.
0	E296
FIRST ISSUE	

8020-Y-122626





SECTION A-A
LEVEE RENOVATION

NOTES:

1) DEPRESSED SECTIONS OF POND #489 LEVEES SHALL FIRST BE RESTORED TO THEIR ORIGINAL TOP-OF-LEVEE ELEVATION 415', AS SHOWN IN SECTION A-A.

2) FLYASH SHALL BE RECLAIMED FROM POND #495 BY APPROPRIATE METHODS. FLYASH SHALL BE DRYED, PLACED AND COMPACTED IN POND #489, TO AN EL. OF 414'-6".

3) METHODS OF DRYING (IE. MOISTURE REDUCTION) SHALL BE RESTRICTED SUCH THAT ANY RESULTING RUNOFF BE KEPT WITHIN EXISTING ASH POND LIMITS AND BE ROUTED TO THE EXISTING PERMITTED DISCHARGE.

4) RECLAIMED FLYASH SHALL BE PLACED IN LOOSE LIFTS NOT TO EXCEED 8-12 INCHES, AND IMMEDIATELY COMPACTED AT OPTIMUM MOISTURE CONTENT BY MEANS OF A VIBRATORY ROLLER. SEE SPECIFICATION FOR COMPACTION REQUIREMENT. (SEE ALSO NOTE #9)

5) EARTHEN MATERIAL REQUIRED FOR EROSION PROTECTION AND CONTAINMENT SHALL CONFORM TO CL, CH, ML, OR MH SOIL CLASSIFICATIONS, AS GIVEN BY ASTM DESIGNATION D-2487. THIS MATERIAL SHALL BE COMPACTED WITH A SHEEPS-FOOT TYPE COMPACTOR. SEE SPECIFICATION FOR COMPACTION REQUIREMENT. (SEE ALSO NOTE #9)

6) SEE TOPOGRAPHIC MAP DRAWING 8020-W-122627 FOR EXISTING ELEVATIONS.

7) REBUILD ACCESS ROADS TO RENOVATED LEVEE TO PROVIDE SMOOTH TRANSITIONS FOR SMALL VEHICLES.

8) TWO NEW CULVERTS WILL BE INSTALLED AS SHOWN TO PROVIDE STORMWATER DRAINAGE FROM POND #489 INTO POND #495.

9) COMPACTION SPECIFICATIONS SHOULD YIELD PERMEABILITIES WITHIN THE REPAIRED LEVEE AS FOLLOWS:
CLAY FILL – LESS THAN 10^{-7} CM/SEC.
FLYASH – LESS THAN 10^{-6} CM/SEC.

10) SURVEY MONUMENT #2 SHALL BE RAISED TO ELEVATION 415'-0"±2". SEE DRAWING 8020-W-122627 FOR LOCATION.

11) S.B. #5/7 – SOIL BORINGS (SEE U.E. SPEC. EC-2392, APPENDIX E)

12) RENOVATED LEVEE SHOWN THUS

13) ALL WORK SHALL BE DONE IN ACCORDANCE WITH U.E. SPECIFICATION EC-2392.

REFERENCE DRAWING:
TOPOGRAPHIC MAP ______________ 8020-W-122627

8020-Y-122626

NOTICE OF LIMITED RESPONSIBILITY

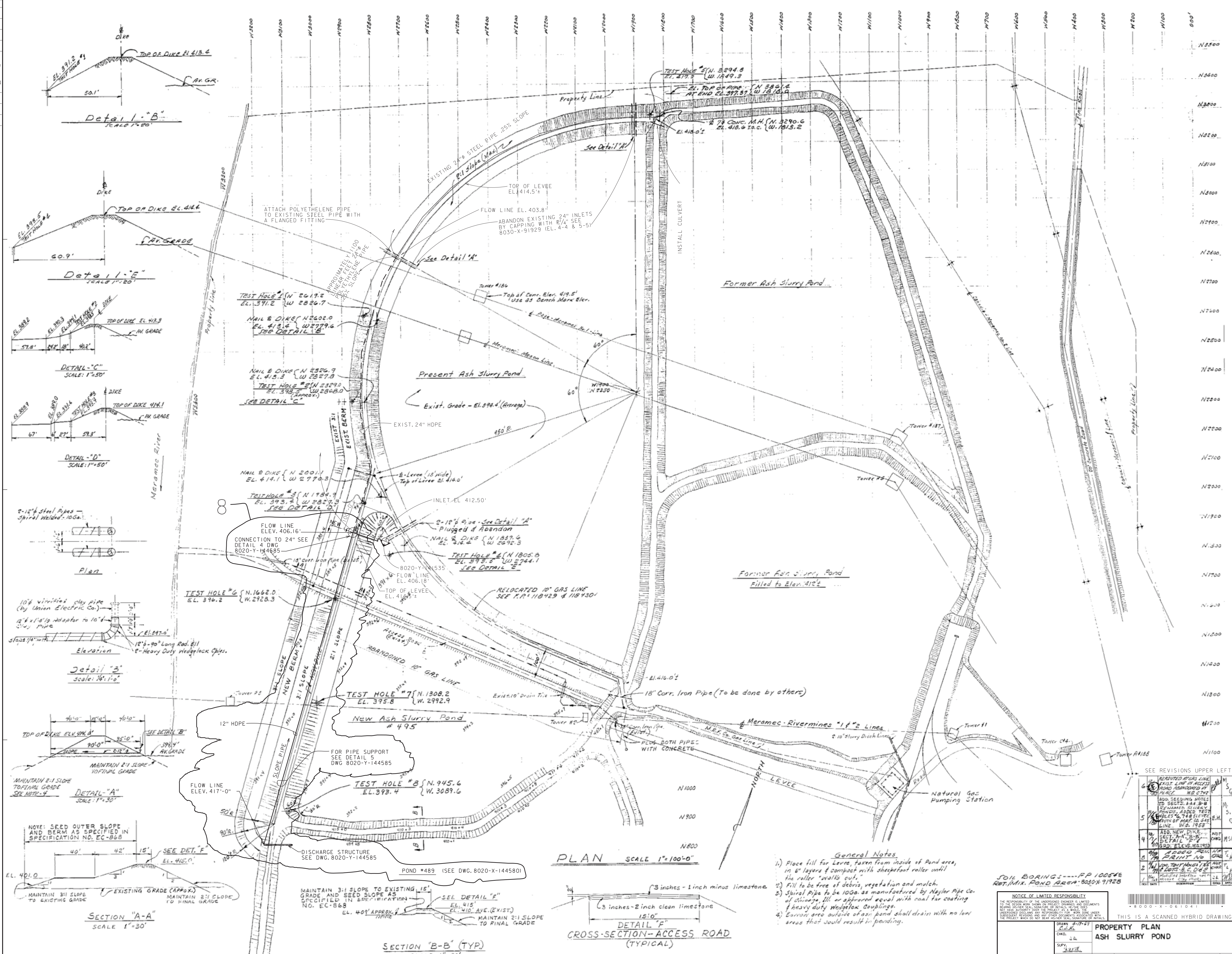
THE RESPONSIBILITY OF THE UNDERSIGNED ENGINEER IS LIMITED TO THE DESIGN WORK SHOWN ON PROJECT DRAWINGS AND DOCUMENTS BEARING HIS/HER SEAL, SIGNATURE OR INITIALS. HE/SHE DOES NOT HAVE AUTHORITY OVER THE PROJECT AS A WHOLE. THE UNDERSIGNED DISCLAIMS ANY RESPONSIBILITY FOR WORK DONE UNDER SUBSEQUENT REVISIONS AND ANY OTHER DOCUMENTS ASSOCIATED WITH THE PROJECT WHICH DO NOT BEAR HIS/HER SEAL, SIGNATURE OR INITIALS.

STATE OF MISSOURI
THOMAS LEE HOLLENKAMP
NUMBER E-15247
REGISTERED PROFESSIONAL ENGINEER

DRAWN 5/6/91 SCOTT HELD	**PROPERTY PLAN ASH RETENTION PONDS**		
CHKD. P.O.			
SUPV. 5-7-91			
APPD. 5-7-91 R. KINPER	LOCATION 001005	**MERAMEC PLANT**	CLASS 02010
UNION ELECTRIC COMPANY ST. LOUIS, MO.		**8020-Y-122626**	REV. 0

SCANNED HYBRID DRAWING

REV.	W.O.		
7	DATE 07/1996	DRAWN MGL	
CHKD NOT	SUPV SKO	APPD CWR	
W.O. 0P510			
DRAWING SCANNED ADD 1100' NEW POLY. PIPE & 1075' EX. PIPE ON POND #494 AND #495			
8	DATE 05/08	DRAWN RWV	
CHKD NOT			
W.O. 0E124			
ADD 12" HDPE PIPE TO POND 489			



General Notes

1.) Place fill for Levee, taken from inside of Pond area, in 6" layers & compact with sheepsfoot roller until the roller "walks out."
2.) Fill to be free of debris, vegetation and mulch.
3.) Spiral Pipe to be 10Ga. as manufactured by Naylor Pipe Co. of Chicago, Ill. or approved equal with coal tar coating & heavy duty Wedgelok Couplings.
4.) Borrow area outside of ash pond shall drain with no low areas that would result in ponding.

SOIL BORINGS----FP 10054E
RET./MIX. POND AREA-8030-X-91928

SEE REVISIONS UPPER LEFT

REV	DATE	DESCRIPTION	CHKD	APPD
4	10/7/80	ADD. NEW DIKE, SECT. "A-A", "B-B", DETAIL "F" & GRD. ELEVS. W.O. T953	NOT CHKD	MSG
3	8/20/79	ADDED PCN. PRINT No	NOT CHKD	[illegible]
2	[illegible]	LOC. TEST HOLES 1 & 5 & DETS. B, C, D & E	NOT CHKD	[illegible]
1	[illegible]	Modified overflow sect. account clay pipe.	[illegible]	[illegible]

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8000-X-061041

THIS IS A SCANNED HYBRID DRAWING

DRAWN 4-17-69

PROPERTY PLAN
ASH SLURRY POND

LOCATION 001005 | MERAMEC PLANT | CLASS 02010

UNION ELECTRIC COMPANY
ST. LOUIS, MO.

8000-X-61041 REV. 8

37-13-070 Rev. 9-85

8020-X-135359

ALL WATERSHED AREAS TO BE EXCAVATED OR FILLED DRAIN TO THE EXISTING SETTLING BASIN AT THE NORTH END OF POND 498. NO SILT FENCES, STAKED BALES OR OTHER EROSION CONTROL MEASURES WILL BE UTILIZED IN THIS PLAN.

EXISTING TOPOGRAPHY COMPILED FROM AERIAL SURVEY CONDUCTED BY WALKER & ASSOCIATES, FLOWN 4-20-94.

NOTICE OF LIMITED RESPONSIBILITY

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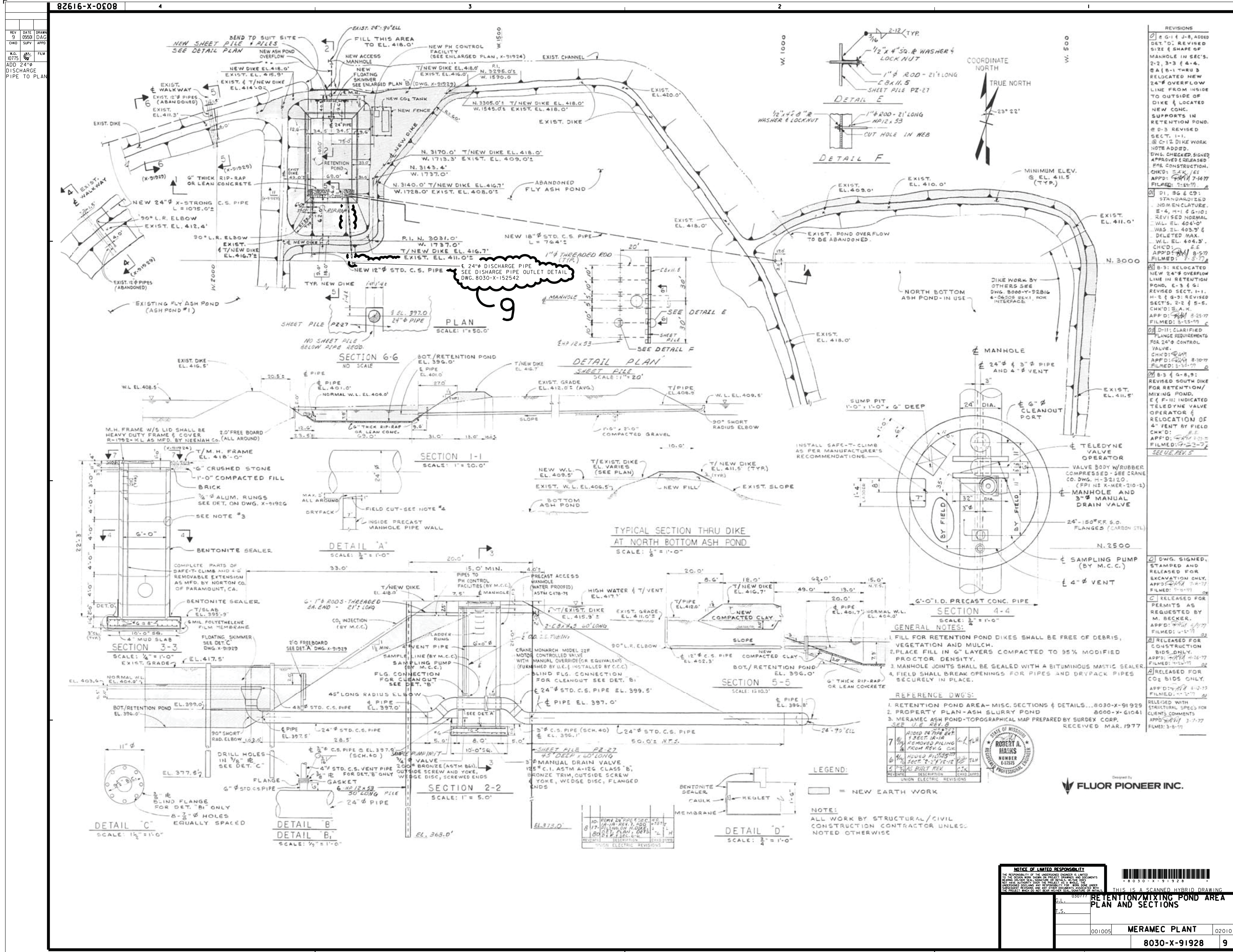
SEPTEMBER 19, 1994

DRAWN MRF	FLYASH POND 491 & 495 INTERIM GRADING PLAN	
CHKD. PHR		
SUPV.		
APPD.	LOCATION 001005 — MERAMEC POWER PLANT	CLASS 08010
UNION ELECTRIC COMPANY ST. LOUIS, MO.	8020-X-135359	REV. 0

Printed on: 04-11-2011 12:33:01


8030-X-91928
ADD 24"Ø DISCHARGE PIPE TO PLAN
PLAN
SCALE: 1"=50.0'
€ 24"Ø DISCHARGE PIPE
SEE DISHARGE PIPE OUTLET DETAIL
DWG. 8030-X-152542
9
NEW 12"Ø STD. C.S. PIPE
NEW 18"Ø STD. C.S. PIPE
L = 764'±
EXISTING FLY ASH POND (ASH POND #1)
ABANDONED FLY ASH POND
EXIST. CHANNEL
EXIST. DIKE
NORTH BOTTOM ASH POND - IN USE
EXIST. POND OVERFLOW TO BE ABANDONED
MINIMUM ELEV. @ EL. 411.5 (TYP.)
COORDINATE NORTH
TRUE NORTH
DETAIL E
DETAIL F
DETAIL PLAN
SHEET PILE
SCALE: 1"=20'
SEE DETAIL E
SEE DETAIL F
SECTION 6-6
NO SCALE
SECTION 1-1
SCALE: 1"=20.0'
DETAIL "A"
TYPICAL SECTION THRU DIKE AT NORTH BOTTOM ASH POND
SCALE: 1/8"=1'-0"
SECTION 3-3
SCALE: 1/4"=1'-0"
SECTION 2-2
SCALE: 1"=5.0'
SECTION 4-4
SCALE: 3/4"=1'-0"
SECTION 5-5
DETAIL "C"
DETAIL "B"
DETAIL "B1"
DETAIL "D"
GENERAL NOTES:
1. FILL FOR RETENTION POND DIKES SHALL BE FREE OF DEBRIS, VEGETATION AND MULCH.
2. PLACE FILL IN 6" LAYERS COMPACTED TO 95% MODIFIED PROCTOR DENSITY.
3. MANHOLE JOINTS SHALL BE SEALED WITH A BITUMINOUS MASTIC SEALER.
4. FIELD SHALL BREAK OPENINGS FOR PIPES AND DRYPACK PIPES SECURELY IN PLACE.
REFERENCE DWG'S:
1. RETENTION POND AREA - MISC. SECTIONS & DETAILS...8030-X-91929
2. PROPERTY PLAN - ASH SLURRY POND 8000-X-61041
3. MERAMEC ASH POND - TOPOGRAPHICAL MAP PREPARED BY SURDEX CORP. RECEIVED MAR. 1977
LEGEND:
= NEW EARTH WORK
NOTE:
ALL WORK BY STRUCTURAL/CIVIL CONSTRUCTION CONTRACTOR UNLESS NOTED OTHERWISE
REVISIONS
UNION ELECTRIC REVISIONS
FLUOR PIONEER INC.
NOTICE OF LIMITED RESPONSIBILITY
RETENTION/MIXING POND AREA PLAN AND SECTIONS
MERAMEC PLANT
8030-X-91928
9
SUPERSEDES 8030-X-9192B
THIS IS A SCANNED HYBRID DRAWING
THIS DRAWING HAS BEEN REFERENCED TO FILE(S):
Printed on: 04-11-2011 12:37:27

...135356.DGN 04/11/2011 1:39:03 PM

PRINT DIST.	
REVISIONS	
REV.	W.O.
0	E124
FIRST ISSUE	

8020-X-135356

SHEET 1 OF 2
JULY 13, 1995

MRF
PHR
PHR

LEGEND

Sidewalk	Spot Elevation (× 325.6)
Building	Single Tree
Foundation	Located Object
Fence	Catch Basin
Wall	Manhole
Tree Line	Pole
Stream	Sign
Index Contour	Railroad
Intermediate Contour	Paved Road
Depression Contour	Unpaved Road
Approximate Contour	Trail
Guard Rail	Pipe line
Swamp Symbol	Fire Hydrant
Control Point	Light Pole

NOTE: Elevations shown in ponds 490, 491, 494 & 498 are approximate top of HDPE liner. An additional 1.0 ft. thick soil layer shall be placed on top of liner per typical cross sections.

EXISTING TOPOGRAPHY FROM PHOTOGRAMMETRIC DIGITAL DATA. PHOTOS FLOWN BY WALKER & ASSOCIATES APRIL 20, 1994.

*ASH PONDS HAVE NOT BEEN MODIFIED TO THIS DESIGN

0010050201 0
8020-X-135356

PREPARED FOR AmerenUE

DRAWN 040398 M. ENGLUND	FLYASH PONDS 489 AND 495 RECLAMATION		
CHK/RVW			
SUPV.			
APPD.	LOCATION 001005	MERAMEC POWER PLANT	CLASS 02010
Ameren ST. LOUIS, MISSOURI	8020-X-135356		REV. 0

37-13-070 Rev. 9-85

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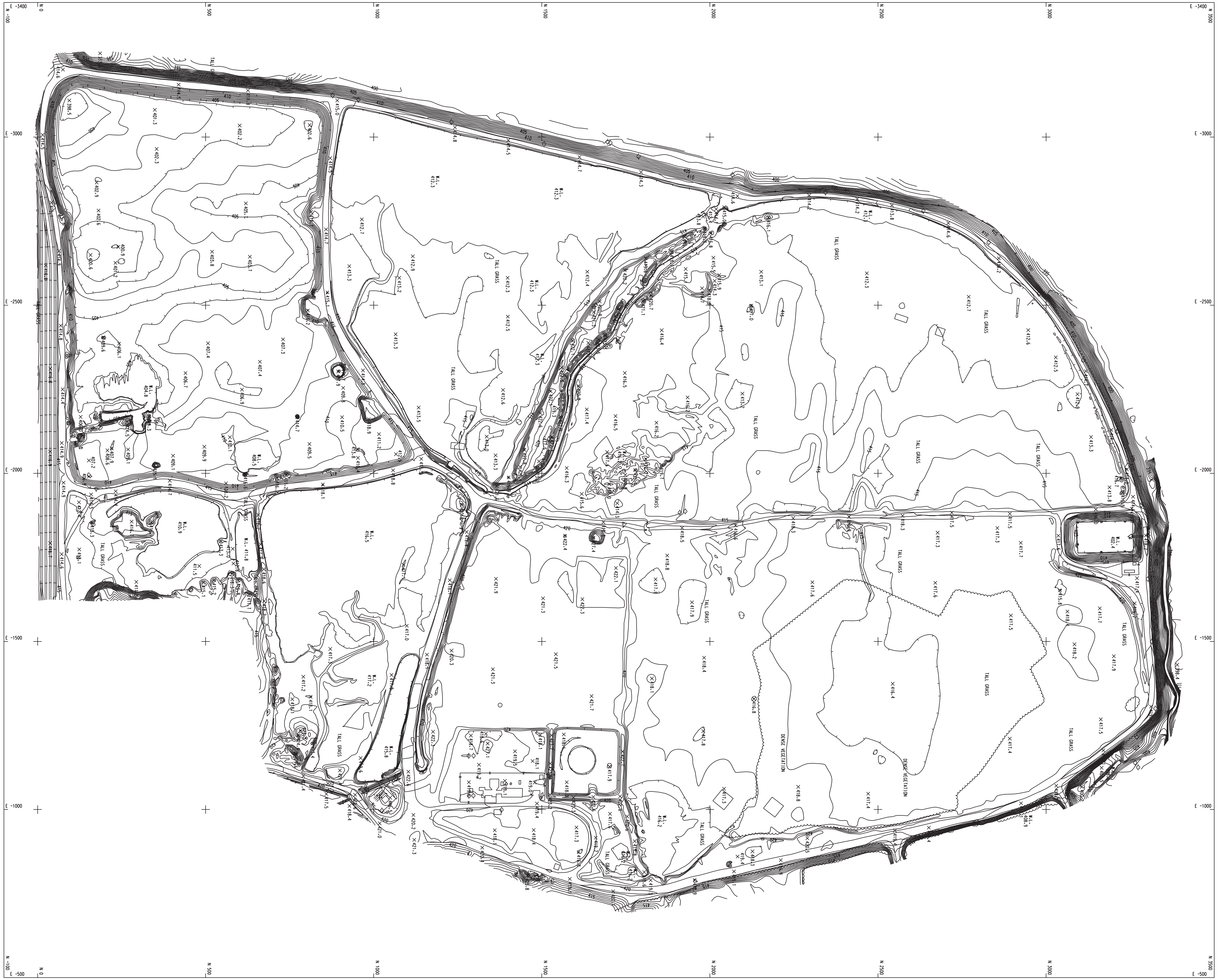
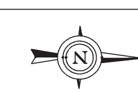
PRINT DIST.	
REVISIONS	
REV.	W.O.
0	E124

FIRST ISSUE

8020-X-144271



NOTE:
SEE AMEREN DRAWING NUMBER 8020-X-144288 FOR ASH POND 489 MODIFICATIONS



SCALE: 1"=100'

CONTOUR INTERVAL: 1'

LEGEND

Sidewalk	Index Contour	Spot Elevation	Railroad
Building	Intermediate Contour	Single Tree	Paved Road
Foundation	Depression Contour	Located Object	Unpaved Road
Fence	Guard Rail	Catch Basin	Trail
Wall	Swamp Symbol	Manhole	Pipe line
Tree Line	Control Point	Pole	Driveway
Stream		Sign	
Brush/Shrub Line		Fire Hydrant	
		Light Pole	

NOTE: DASHED CONTOURS MAY BE UNRELIABLE.

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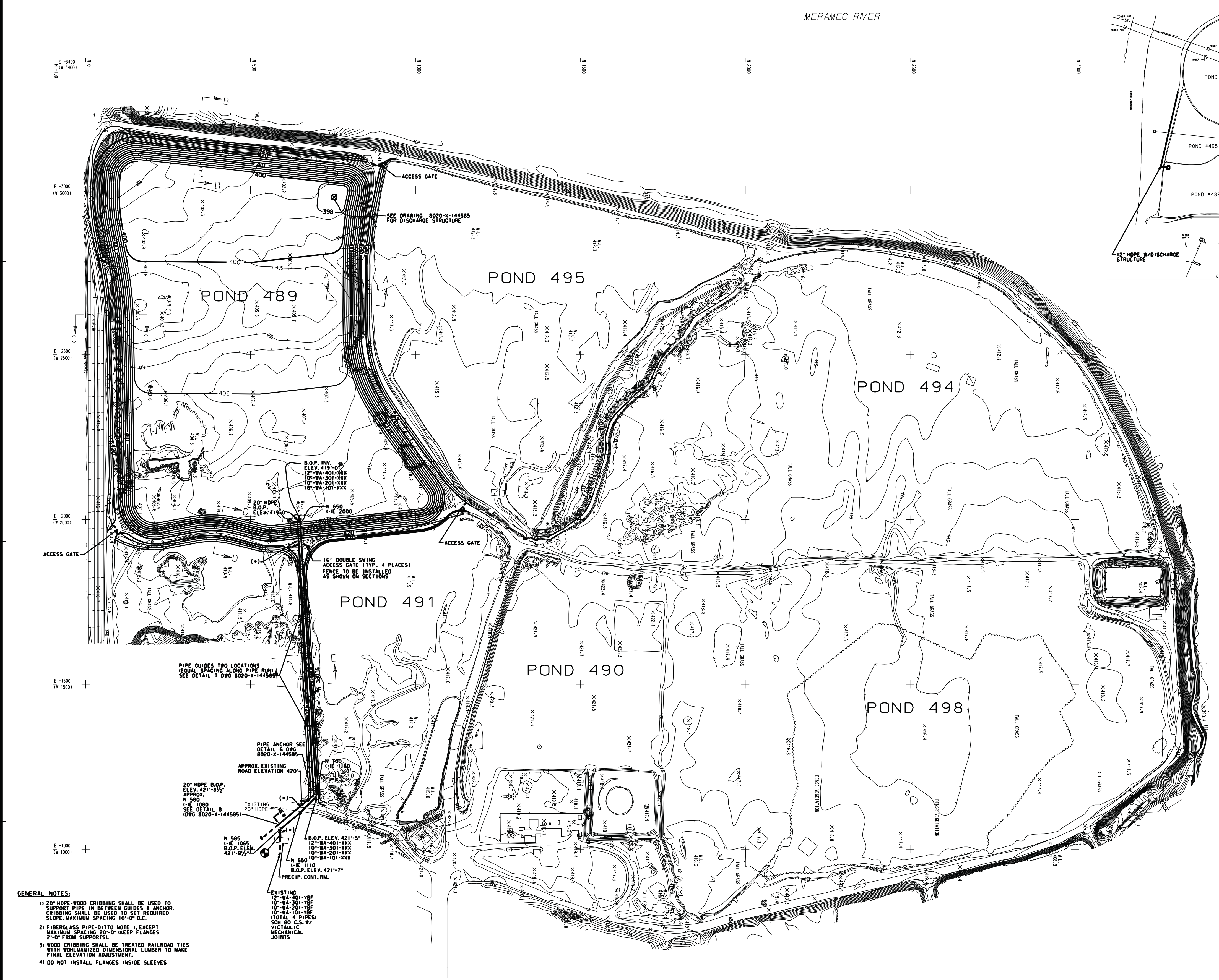
0010050 2010

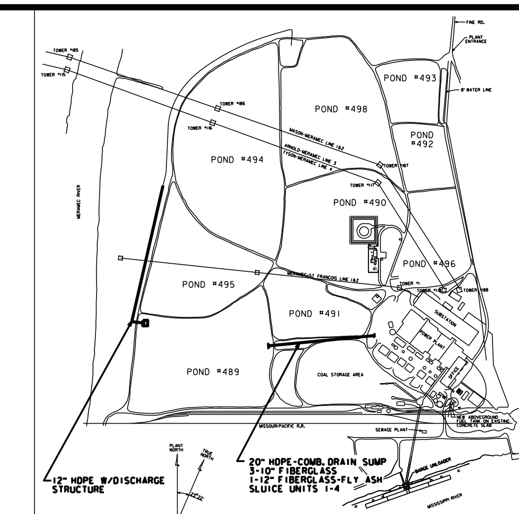
8020-X-144271

PREPARED FOR AmerenUE

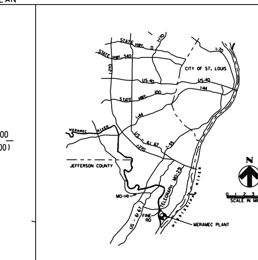
DRAWN 040298 M. ENGLUND	PROPERTY TOPO MAP ASH PONDS		
CHK/RVW			
SUPV.			
APPD.	LOCATION 001005	MERAMEC PLANT	CLASS 02010
Ameren	ST. LOUIS, MISSOURI	8020-X-144271	REV. 0

37-13-070 Rev. 9-85





KEY PLAN



VICINITY MAP

GENERAL NOTES:

1) 20" HDPE-WOOD CRIBBING SHALL BE USED TO SUPPORT PIPE IN BETWEEN GUIDES & ANCHOR. CRIBBING SHALL BE USED TO SET REQUIRED SLOPE, MAXIMUM SPACING 10'-0" O.C.
2) FIBERGLASS PIPE-DITTO NOTE 1, EXCEPT MAXIMUM SPACING 20'-0" (KEEP FLANGES 2'-0" FROM SUPPORTS).
3) WOOD CRIBBING SHALL BE TREATED RAILROAD TIES WITH WOLMANIZED DIMENSIONAL LUMBER TO MAKE FINAL ELEVATION ADJUSTMENT.
4) DO NOT INSTALL FLANGES INSIDE SLEEVES

(•) INSTALL PIPING INSIDE SCH. 40 C.S. SLEEVE COVER WITH 1" GRANULAR FILL (1'-0" ABOVE TOP OF SLEEVE) AND SLOPE 5% ON EITHER SIDE (SEE DETAIL 3 ON DWG 8020-X-96121).

SEE REFRENCE DWGS

8020-X-144585
8030-X-91925
8020-X-91921
8020-X-96120
8000-X-61041

SCALE: 1"=100'

LEGEND

Sidewalk	Index Contour	Spot Elevation
Building	Intermediate Contour	Single Tree
Foundation	Depression Contour	Located Object
Fence	Guard Rail	Catch Basin
Wall	Swamp Symbol	Manhole
Tree Line	Control Point	Pole
Stream		Sign
Brush/Shrub Line		Fire Hydrant
		Light Pole
Railroad	Paved Road	Unpaved Road
Trail	Pipe line	Driveway

NOTE: DASHED CONTOURS MAY BE UNRELIABLE.

NOTICE OF LIMITED RESPONSIBILITY

PREPARED FOR AmerenUE

PIPING-PLAN
DRAINS TO ASH POND 489
1998 MODIFICATIONS

MERAMEC PLANT

ST. LOUIS, MISSOURI

LOCATION 001005 — CLASS 05020

8020-X-144580 — REV. 0

REVISIONS

REV.	W.O.
0	0E124

FIRST ISSUE

UPDATED CONTOURS POND 489

REV	DATE	DRAWN
2	060198	RWV
CHKD	SUPV	APPD
NOT		
W.O.		FILM
0E124		

ADDED VICINITY MAP, NOTES, MERAEC RIVER NEW FLOODWAY, SILTATION FENCE, LOCATION OF MERAMEC RIVER & CO. ADDRESS

SCALE RATIO
THIS DRAWING HAS BEEN REFERENCED TO FILE(S):

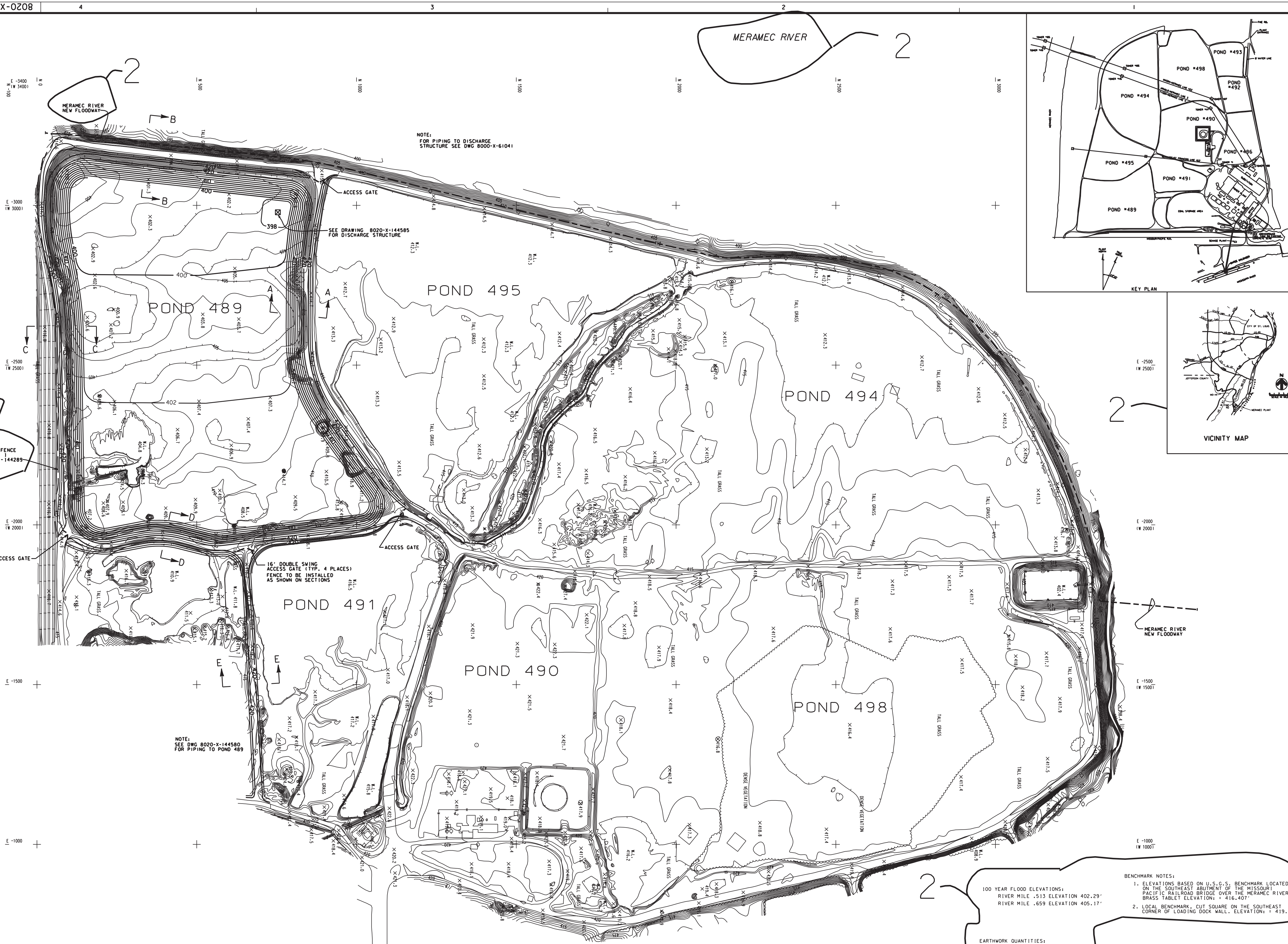
..\144288.DGN 04/11/2011 12:53:51 PM

PRINT DIST.

REVISIONS

REV.	W.O.	
0	E124	
FIRST ISSUE		
REV 1	DATE 050798	DRAWN RWV
CHKD NOT	SUPV RACH	APPD CWR
W.O. 0E124		FILM
UPDATED CONTOURS POND 489		
REV 2	DATE 060198	DRAWN RWV
CHKD NOT	SUPV	APPD
W.O. 0E124		FILM
ADDED VICINITY MAP, NOTES, MERAEC RIVER NEW FLOODWAY, SILTATION FENCE, LOCATION OF MERAMEC RIVER & CO. ADDRESS		

8020-X-144288



REFERENCE DRAWING:
PROPERTY - SECTIONS — — — 8020-X-144289

COMPANY ADDRESS
AMEREN UE
ONE AMEREN PLAZA
1901 CHOUTEAU AVE.
ST. LOUIS, MO 63103

COMPANY MAILING ADDRESS
AMEREN UE
P.O. BOX 66149
ST. LOUIS, MO 63166-6149

PLANT ADDRESS
AMEREN UE
MERAMEC PLANT
8200 FINE ROAD
ST. LOUIS COUNTY, MO 63129

LEGEND

Sidewalk, Building, Foundation, Fence, Wall, Tree Line, Stream, Brush/Shrub Line, Index Contour, Intermediate Contour, Depression Contour, Guard Rail, Swamp Symbol, Control Point, Spot Elevation, Single Tree, Located Object, Catch Basin, Manhole, Pole, Sign, Fire Hydrant, Light Pole, Railroad, Paved Road, Unpaved Road, Trail, Pipe line, Driveway

NOTE: DASHED CONTOURS MAY BE UNRELIABLE.

SCALE 1"=100'

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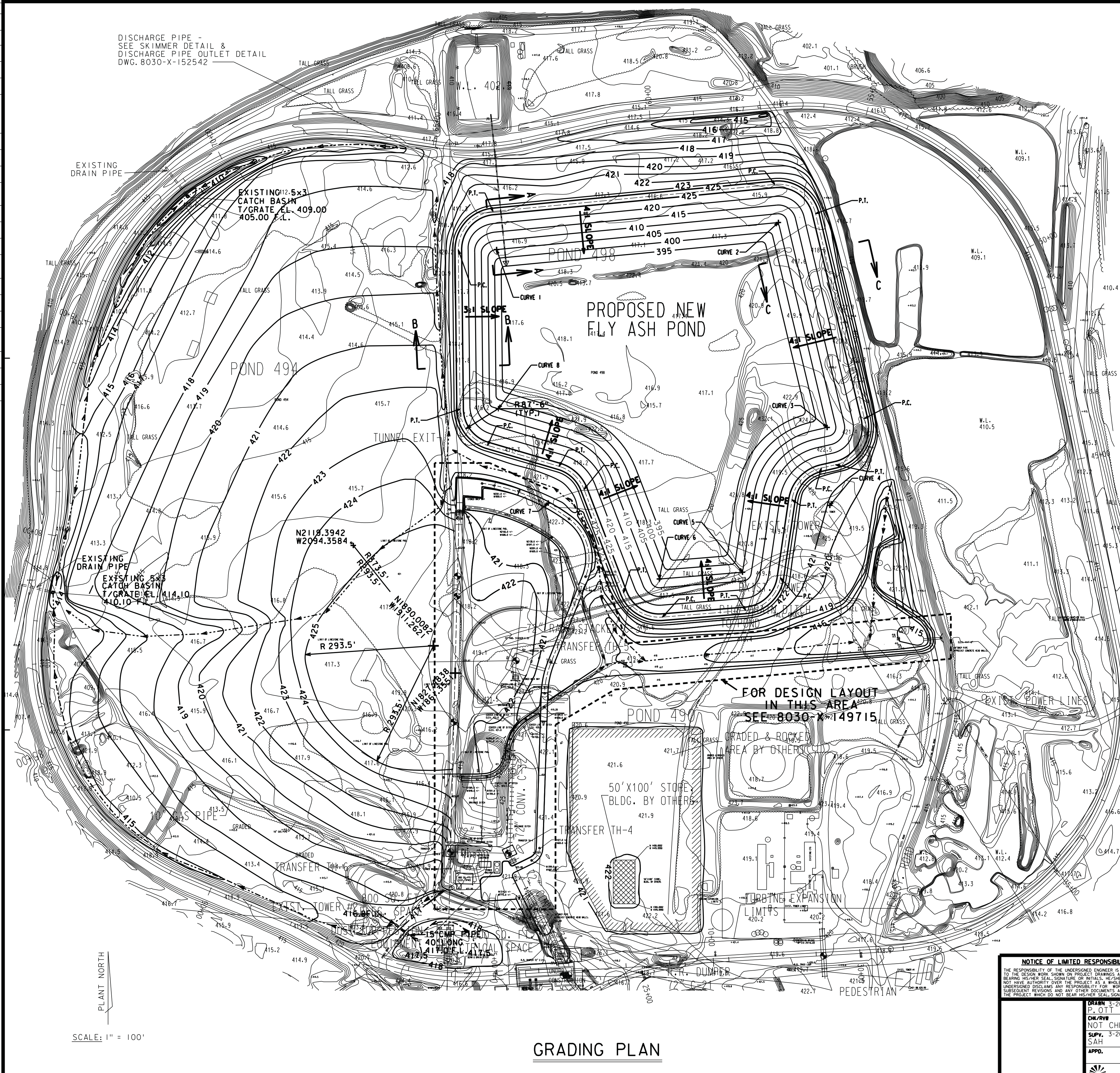
8020-X-144288

PREPARED FOR AmerenUE

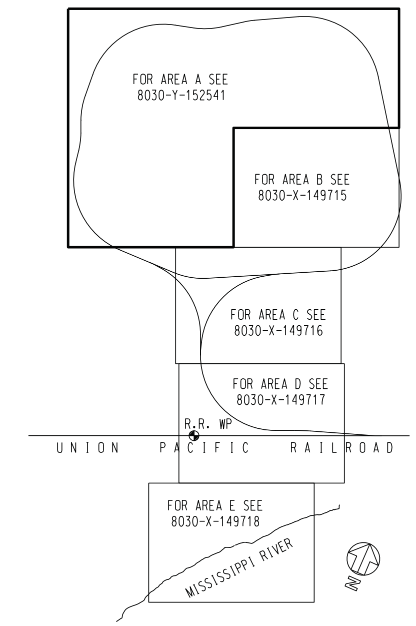
DRAWN 033198 M. ENGLUND	PROPERTY - PLAN FLYASH POND 489 RECLAMATION AND NEW LINER
CHK/RVW NOT CHK'D	
SUPV. 4-3-98 RACH	
APPD. 4-6-98 C.W. REZSONYA	LOCATION 001005 / MERAMEC PLANT / CLASS 02010
Ameren ST. LOUIS, MISSOURI	8020-X-144288 / REV. 2

37-13-070 Rev. 9-85

PRINT DIST.		
REVISIONS		
REV. 0	W.O. 10775	
FIRST ISSUE		
REV 1	DATE 032001	DRAWN PDO
CHKD NOT	SUPV SAH	APPD
W.O. 10775		FILM
ADDED COORDINATES AND RADIUS FOR NEW COAL PILE: SHOWED EXISTING CATCH BASINS		
REV 2	DATE 040201	DRAWN MLE
CHKD NOT	SUPV SAH	APPD
W.O. 10775		FILM
REVISED CONTOURS PER ENGINEERING COMMENTS		
REV 3	DATE 041701	DRAWN MGL
CHKD NOT	SUPV SAH	APPD
W.O. 10775		FILM
REVISED CONTOURS PER ENGINEERING COMMENTS		
REV 4	DATE 042001	DRAWN MGL
CHKD NOT	SUPV SAH	APPD
W.O. 10775		FILM
REVISED CONTOURS PER ENGINEERING COMMENTS		
REV 5	DATE 051501	DRAWN DAG
CHKD	SUPV	APPD
W.O. 10775		FILM
REVISED CONTOURS PER ENGINEERING COMMENTS; ADD DISCHARGE PIPE FROM FLY ASH POND TO RETENTION BASIN & TABLE		



GRADING PLAN



AREA KEY PLAN

TOTAL CUT 220,000yd^3
TOTAL FILL 221,800yd^3

TABLE

CURVE NO.	RADIUS	CENTER	(P.C.) POINT OF CURVATURE	(P.T.) POINT OF TANGENCY
1	87'-6"	N2795.9654 W1766.7163	N2794.9985 W1854.2110	N2883.0642 W1775.0847
2	87'-6"	N2857.8626 W1122.4817	N2944.9616 W1130.8501	N2878.1002 W1037.3542
3	87'-6"	N2389.1821 W1011.0613	N2409.4196 W925.9338	N2303.9035 W991.4702
4	87'-6"	N2211.0398 W1004.8965	N2296.3184 W1024.4876	N2223.8795 W1091.4493
5	87'-6"	N2058.1369 W1204.4941	N2045.2973 W1117.9412	N1970.9244 W1197.4075
6	87'-6"	N2042.6838 W1394.6702	N1955.4713 W1387.5836	N2011.3974 W1476.3856
7	87'-6"	N2216.2748 W1648.5213	N2247.5612 W1566.8058	N2300.2443 W1623.9170
8	87'-6"	N2432.0871 W1762.6952	N2348.1176 W1787.2994	N2431.1202 W1850.1898

REFERENCE DRAWINGS:
FOR SECTION CUTS AND TYPICAL SECTIONS SEE 8030-Y-152542
FOR ADDITIONAL DESIGN LAYOUTS SEE 8030-X-149714 & 8030-X-149715

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•8030-Y-152541•

PREPARED FOR AmerenUE

DRAWN 3-20-01 P. OTT	PROPERTY - SITE PLAN AREA A NEW ASH POND AND GRADING OVER PONDS 490, 494 & 498		
CHK/RVW NOT CHKD			
SUPV. 3-20-01 SAH			
APPD.	LOCATION 001005	MERAMEC PLANT	CLASS 02010
Ameren ST. LOUIS, MISSOURI	8030-Y-152541		REV. 5

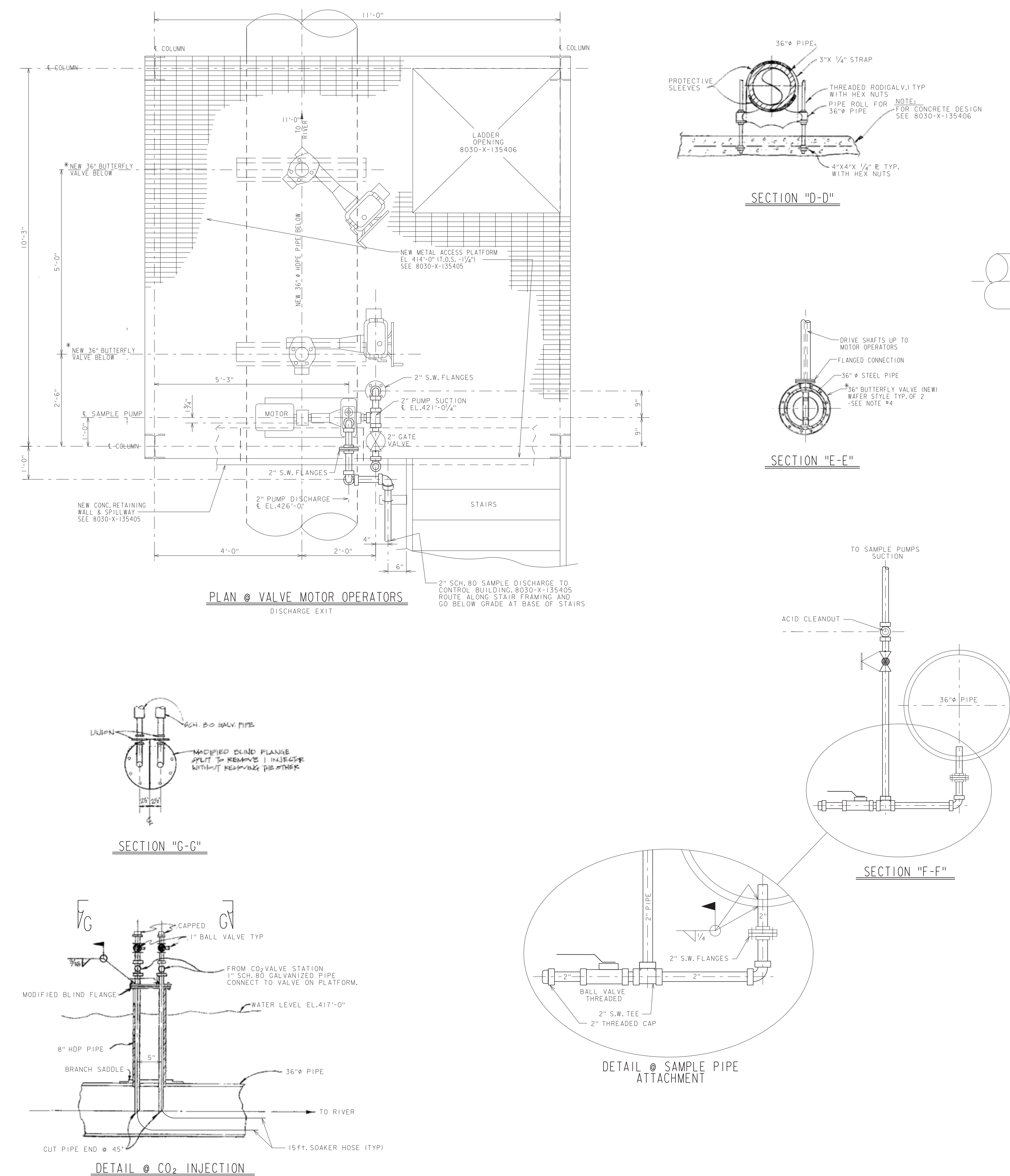
37-13-118 Rev. 9-85

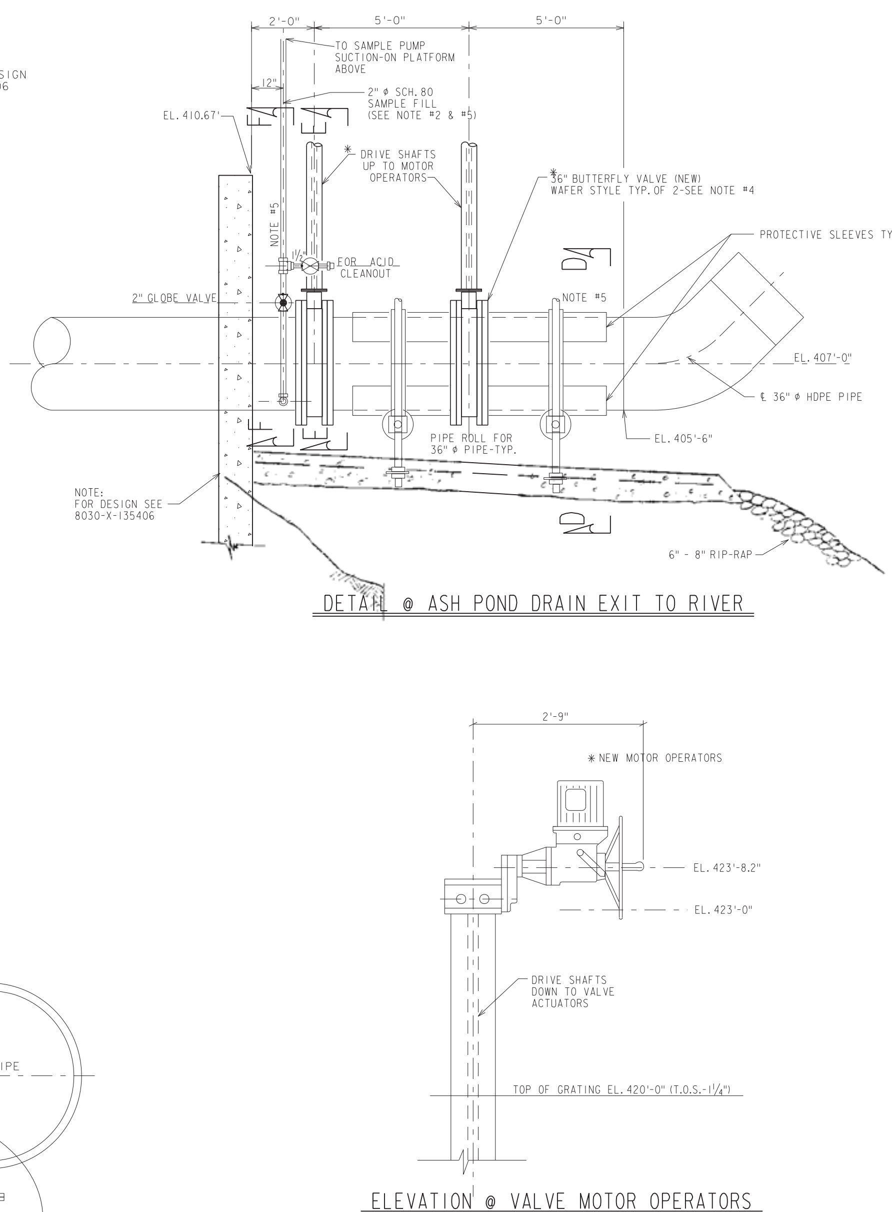
SCALE RATIO =100
THIS DRAWING HAS BEEN REFERENCED TO FILE(S):
GHOST ALL BUT 100

PRINT DIST. | 8030-X-135408

REVISIONS: REV. 0, W.O. 0018, FIRST ISSUE

AS-BUILT





NOTES

1. THIS WORK TO BE DONE IN ACCORDANCE WITH U.E. SPEC. NO. EC-4022
2. ALL 2" SCH. 80 PIPE ABOVE GROUND IS TO BE GALVANIZED. ALL 2" SCH. 80 PIPING BELOW GROUND SHALL BE COMMON CARBON STEEL.
3. ALL PIPING 2" & SMALLER TO BE SCHEDULE 80.
4. CONTRACTOR TO REAM PIPE FLANGES TO PERMIT FREE OPERATION OF 36" BUTTERFLY VALVES. ALSO TRIM OR REROUTE 2" SAMPLE LINE PER SAME CRITERIA.
5. INSTALL ¾" INSULATION AND HEAT TRACE ON 36" PIPE FROM CONCRETE WALL TO LAST PIPE ROLL. INSULATE 2" SAMPLE PUMP SUCTION FROM 36" PIPE TO PUMP & 2" SAMPLE TO CONTROL HOUSE FROM PUMP TO GROUND.
6. ALL HDPE PIPE CONNECTIONS SHALL BE FUSION WELDED.

* 7. SUPPLIED BY AMEREN UE AND INSTALLED BY CONTRACTOR.

REFERENCE DRAWINGS:

PROPERTY-PLAN-----------------------------------8030-X-135405

DRAWING HAS NO SCALE

1993 FLOOD LEVEL - 419.6

0010050503O

8030-X-135408

PREPARED FOR AmerenUE

DRAWN 051399	M. ENGLUND
CHK/RVW	MSB
SUPV. 112999	SAH
APPD. 121699	C.W. REZSONYA
LOCATION	001005
CLASS	05030
REV.	1

PIPING-INSTALLATION & DETAILS
ASH POND DISCHARGE
ASH POND #489

MERAMEC PLANT

Ameren ST. LOUIS, MISSOURI

8030-X-135408

37-13-070 Rev. 9-85

SCANNED HYBRID DRAWING

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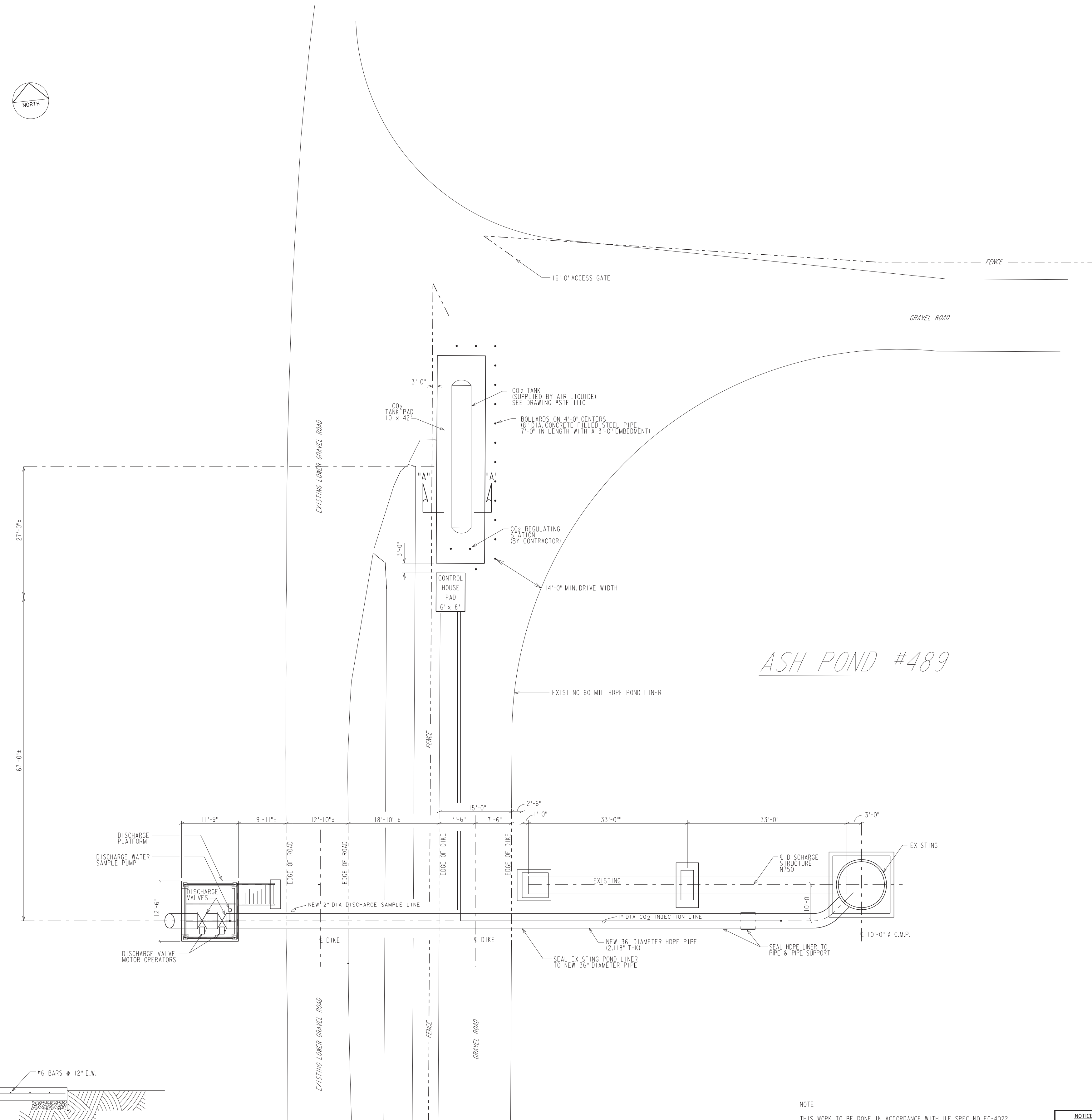
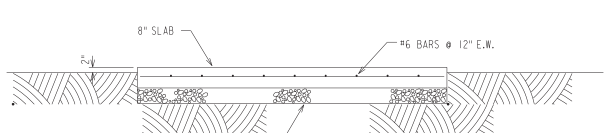
REVISIONS		
REV. 0	W.O. 10788	
FIRST ISSUE		
REV 1	DATE 01599	DRAWN MLE
CHKD NOT	SUPV SAH	APPD CWR
W.O.		FILM F
REVISED CONTROL HOUSE PAD AND 36" DIA. PIPE LOCATION		
REV 2	DATE 082900	DRAWN MLE
CHKD NOT	SUPV	APPD
W.O.		FILM
AS-BUILT		





SECTION "A-A"

NOTE

THIS WORK TO BE DONE IN ACCORDANCE WITH U.E. SPEC. NO. EC-4022.

STEEL FRAMING - INTAKE & DISCHARGE PLATFORM - - - - 8030-X-135406
CONCRETE DETAILS - ASH POND DISCHARGE - - - - - - - 8030-X-135521
BUILDING - CONTROL HOUSE - - - - - - - - - - - - - 8030-Y-135407
PIPING - ASH POND DISCHARGE - - - - - - - - - - - - 8080-X-135408
PIPING - CO2 REGULATING STATION - - - - - - - - - - 8030-X-135409

1993 FLOOD LEVEL - 419.6

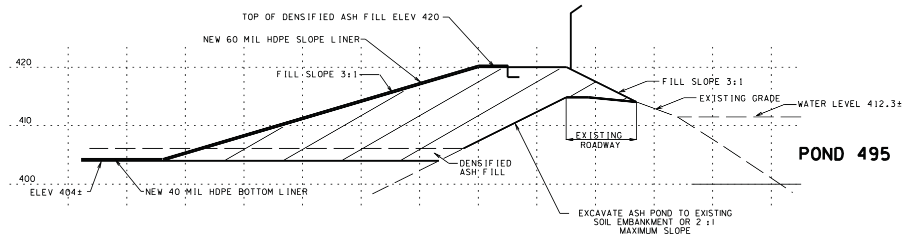
REV. 1 SEALED BY

STATE OF MISSOURI — CARL W. REZSONYA — NUMBER E-18282 — REGISTERED PROFESSIONAL ENGINEER

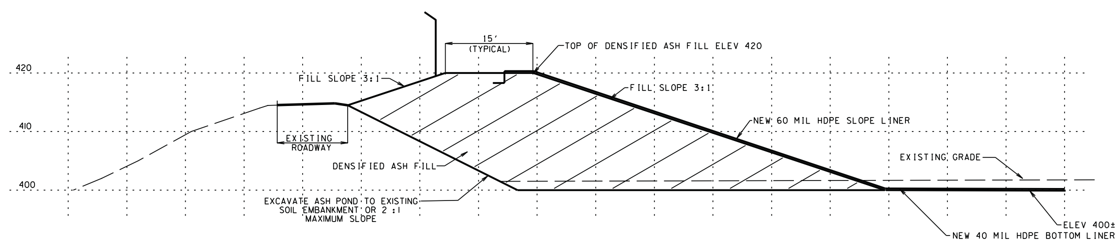
DRAWN M. ENGLUND 5/12/99	PROPERTY- SITE PLAN NEW ASH POND 489 DISCHARGE STRUCTURE
CHKD. NOT	
SUPV. SAH 11/29/99	
APPD. C.W. REZSOYA 12/6/99	LOCATION 00005 — MERAMEC PLANT — CLASS 02010
UNION ELECTRIC COMPANY ST. LOUIS, MO.	8030-X-135405 — REV. 2

...\135405.DGN 04/11/2011 1:48:21 PM

PRINT DIST.		
REVISIONS		
REV. 0	W.O. E124	(F)
FIRST ISSUE		
REV 1	DATE 05898	DRAWN RWV
CHKD NOT	SUPV RACH	APPD CWR
W.O. 0E124		FILM
ADDED SECTION E		
REV 2	DATE 06098	DRAWN RWV
CHKD NOT	SUPV	APPD
W.O. 0E124		FILM
ADDED SILTATION FENCE DETAIL		

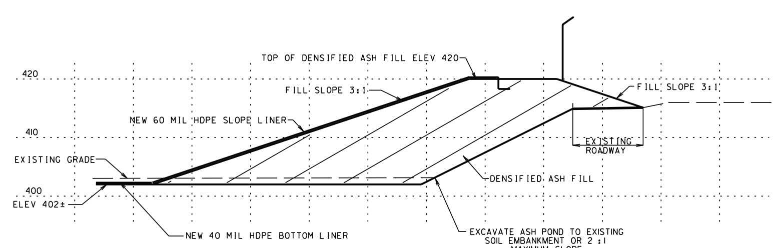


A-A

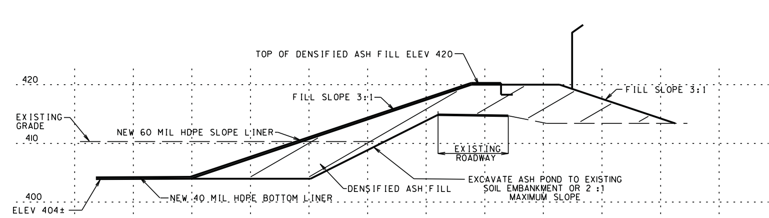


B-B

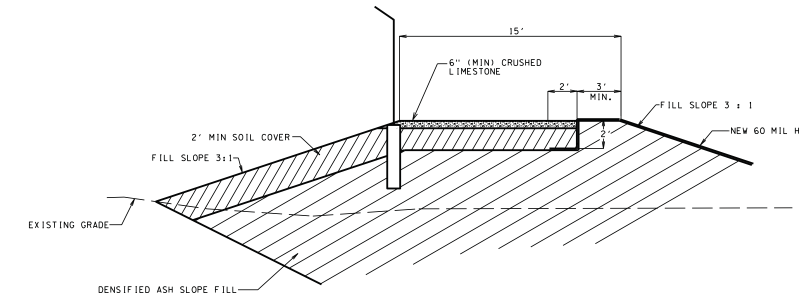
TYPICAL SECTIONS
SCALE 1" = 10'H
1" = 10'V



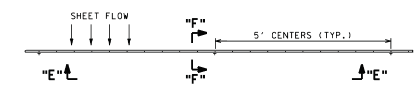
C-C



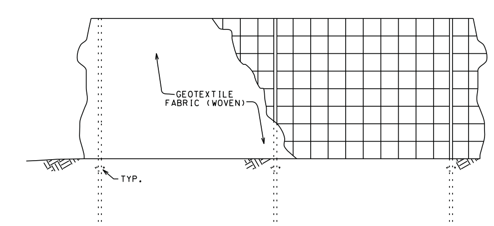
D-D



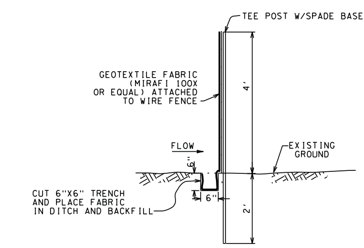
TYPICAL LEVEE CAP AT POND 489
SCALE 1/4" = 1'



PLAN

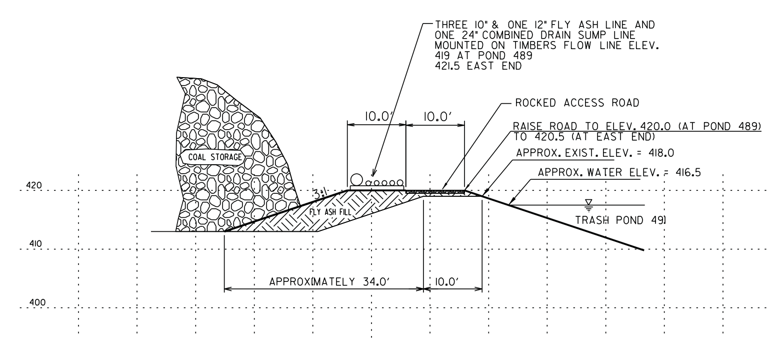


SECTION E-E



SECTION F-F

DETAIL 1
SILTATION FENCE
N.T.S.



E-E
SECTION LOOKING WEST THRU LEVEE
BETWEEN POND 491 & COAL PILE

NOTICE OF LIMITED RESPONSIBILITY

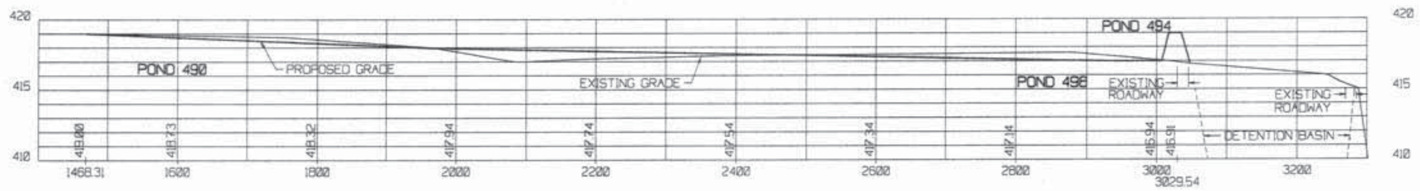
PREPARED FOR AmerenUE

DRAWN 032698 P. OTT	PROPERTY - SECTIONS FLYASH POND 489 RECLAMATION AND NEW LINER
CHK/RVW NOT CHKD	
SUPV. 4-3-98 RACH	
APPD. 4-3-98 REZSONYA	LOCATION 001005 — MERAMEC PLANT — CLASS 02010
Ameren — ST. LOUIS, MISSOURI	8020-X-144289 — REV. 2

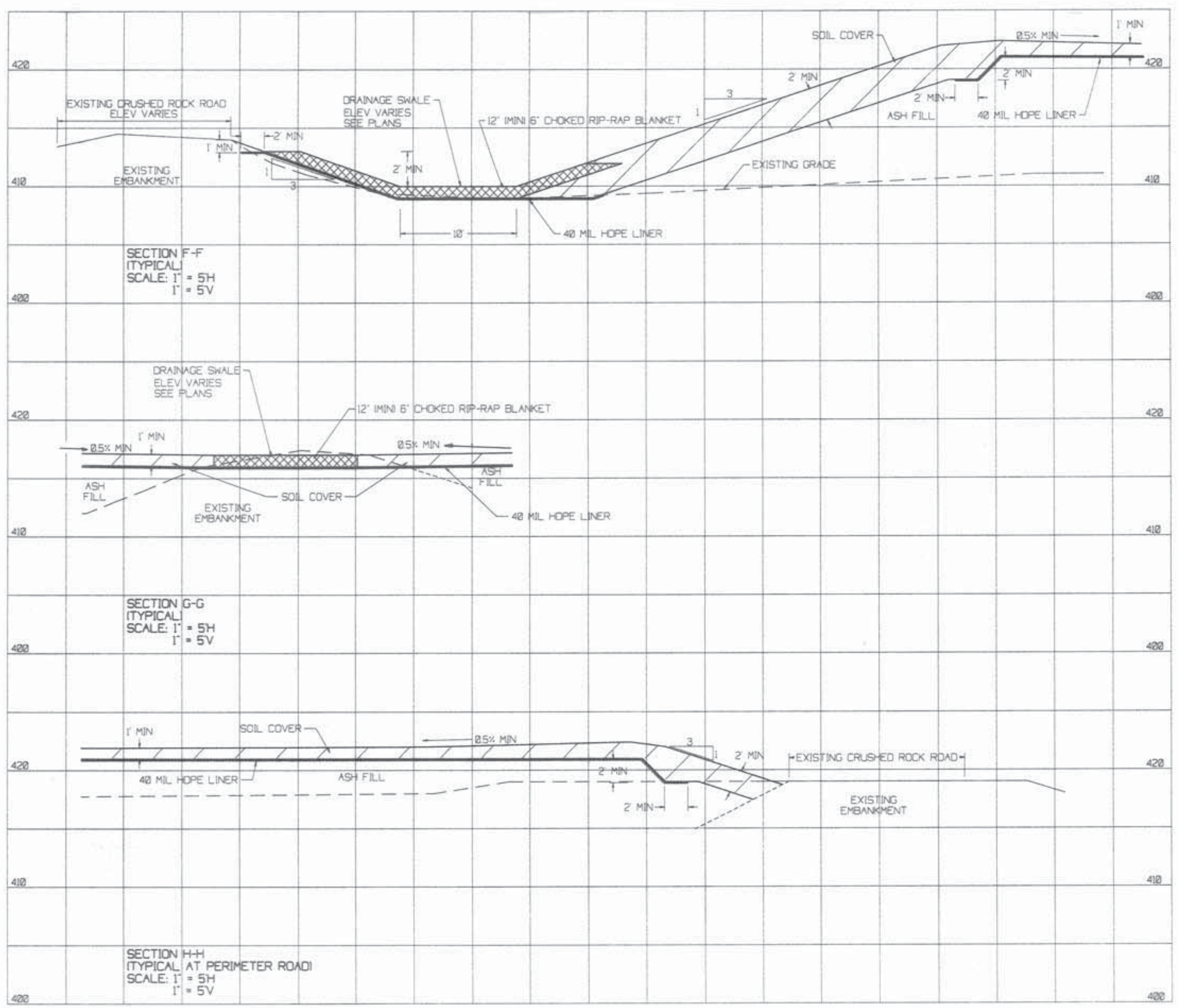
8020-X-144289

SCALE RATIO =10
THIS DRAWING HAS BEEN REFERENCED TO FILEVSR.

8020-X-135358



SECTION E-E (ROAD PROFILE)
SCALE 1" = 100'H
1" = 5'V



NOTICE OF LIMITED RESPONSIBILITY

SEPTEMBER 14, 1994

FLYASH POND 489
RECLAMATION

MERAMEC POWER PLANT

UNION ELECTRIC COMPANY
ST. LOUIS, MO.

8020-X-135358

SHEET 3 OF 3

8020-X-135357

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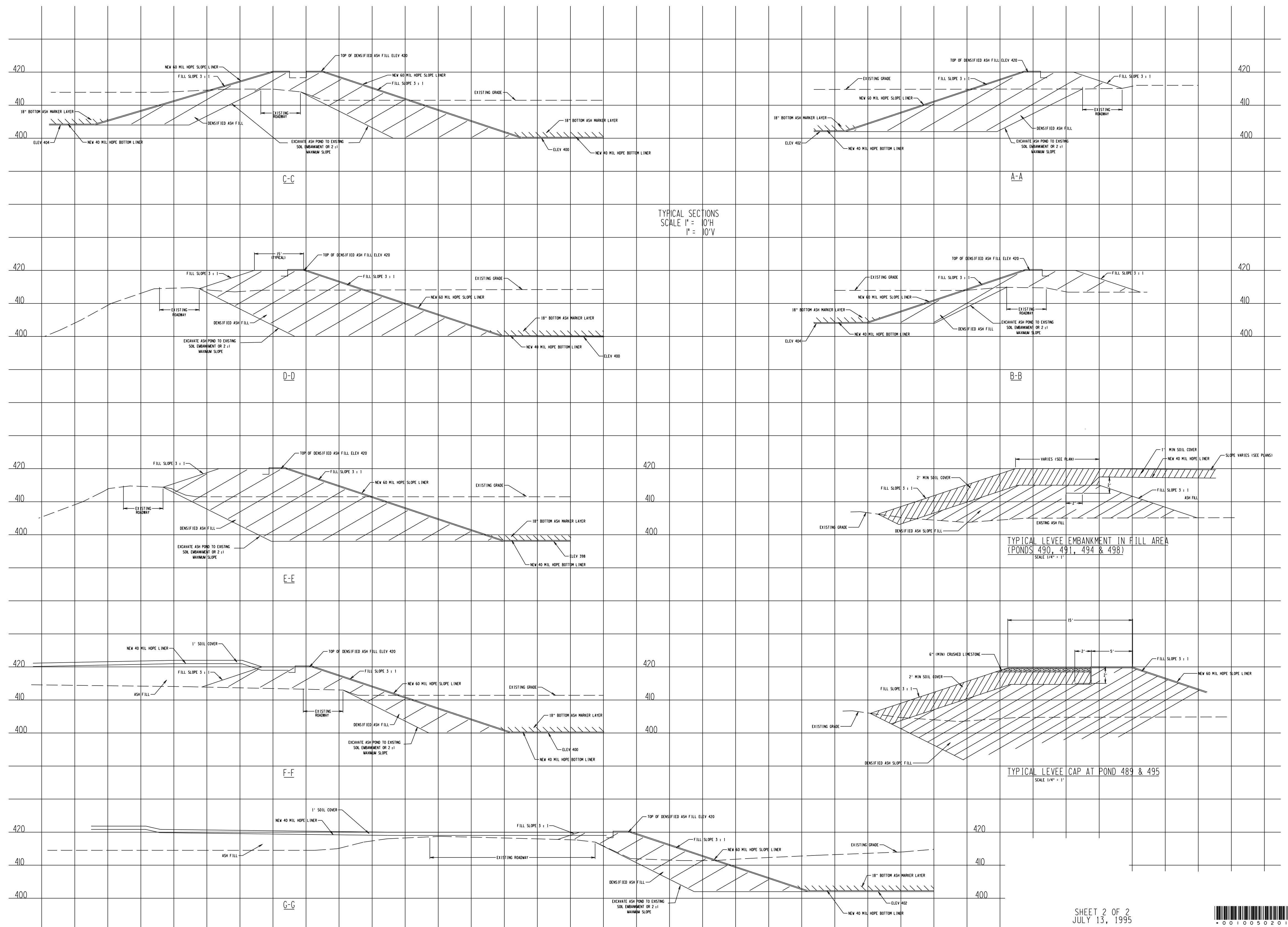


SHEET 2 OF 2
JULY 13, 1995

* ASH PONDS HAVE NOT BEEN MODIFIED TO THIS DESIGN

NOTICE OF LIMITED RESPONSIBILITY

PREPARED FOR AmerenUE

DRAWN	040298 M. ENGLUND
CHK/RVW	
SUPV.	
APPD.	

FLYASH PONDS 489 AND 495 RECLAMATION

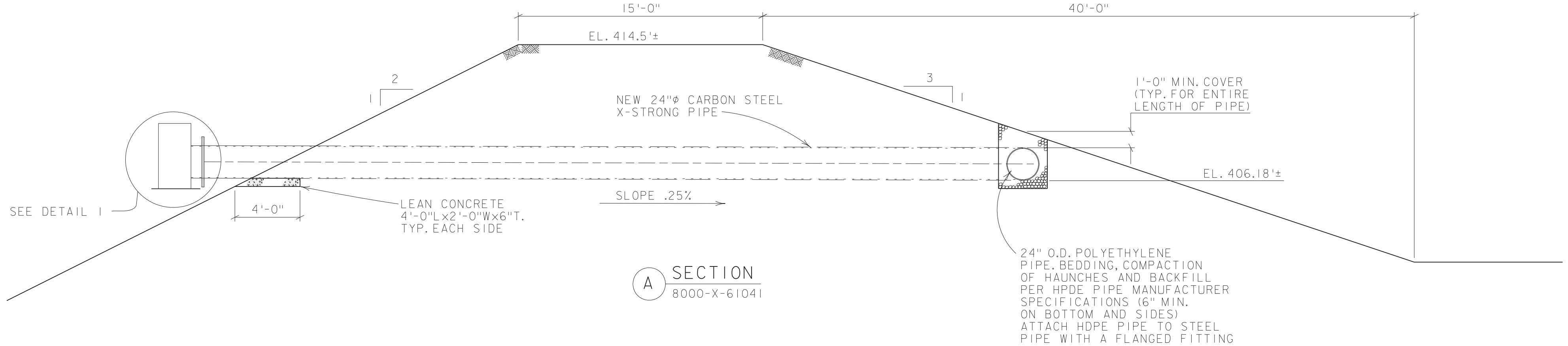
LOCATION		CLASS
001005	MERAMEC POWER PLANT	02010
Ameren ST. LOUIS, MISSOURI	8020-X-135357	REV. 0

* 8020-X-135357 *

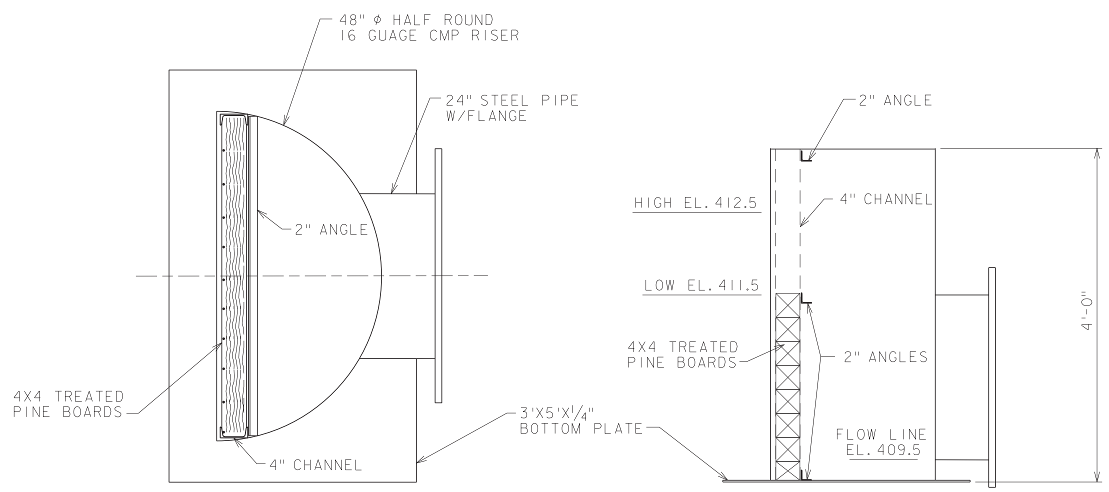
SCALE RATIO 10
THIS DRAWING HAS BEEN REFERENCED TO FILE(S):

PRINT DIST.	
REVISIONS	
REV. 0	W.O.
FIRST ISSUE	
REV 1	DATE 052298	DRAWN RWV
CHKD DAG	SUPV	APPD
W.O.	FILM
ADDED DECANT STRUCTURE	

8020-Y-141535



A SECTION
8000-X-61041



PLAN

ELEVATION

DETAIL 1
ENLARGED VIEW OF DECANT STRUCTURE

NOTES:

1. THIS WORK TO BE DONE IN ACCORDANCE WITH U.E. SPEC. NO. EC-3572

REFERENCE DRAWINGS:
8000-X-61041-----SITE PLAN
8030-X-91928-----PARTIAL PLAN & SECTIONS
8030-X-91929-----MISC. DETAILS

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• 8 0 2 0 - Y - 1 4 1 5 3 5 •

REV. 0 SEALED BY

STATE OF MISSOURI
CARL W. REZSONYA
NUMBER E-18282
REGISTERED PROFESSIONAL ENGINEER

DRAWN 071896 MIKE LOWRY	PIPING-ASH POND DISCHARGE POND #494 & #495 1996 ADDITION	
CHKD. NOT CHKD.		
SUPV. STEVE OTT		
APPD. 7-25-96 C.W. REZSONYA	LOCATION 001005 MERAMEC PLANT	CLASS 05030
UNION ELECTRIC COMPANY ST. LOUIS, MO.	8020-Y-141535	REV. 1

37-13-18 Rev. 9-85

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CHKD NOT	SUPV	APPD
W.O.		FILM

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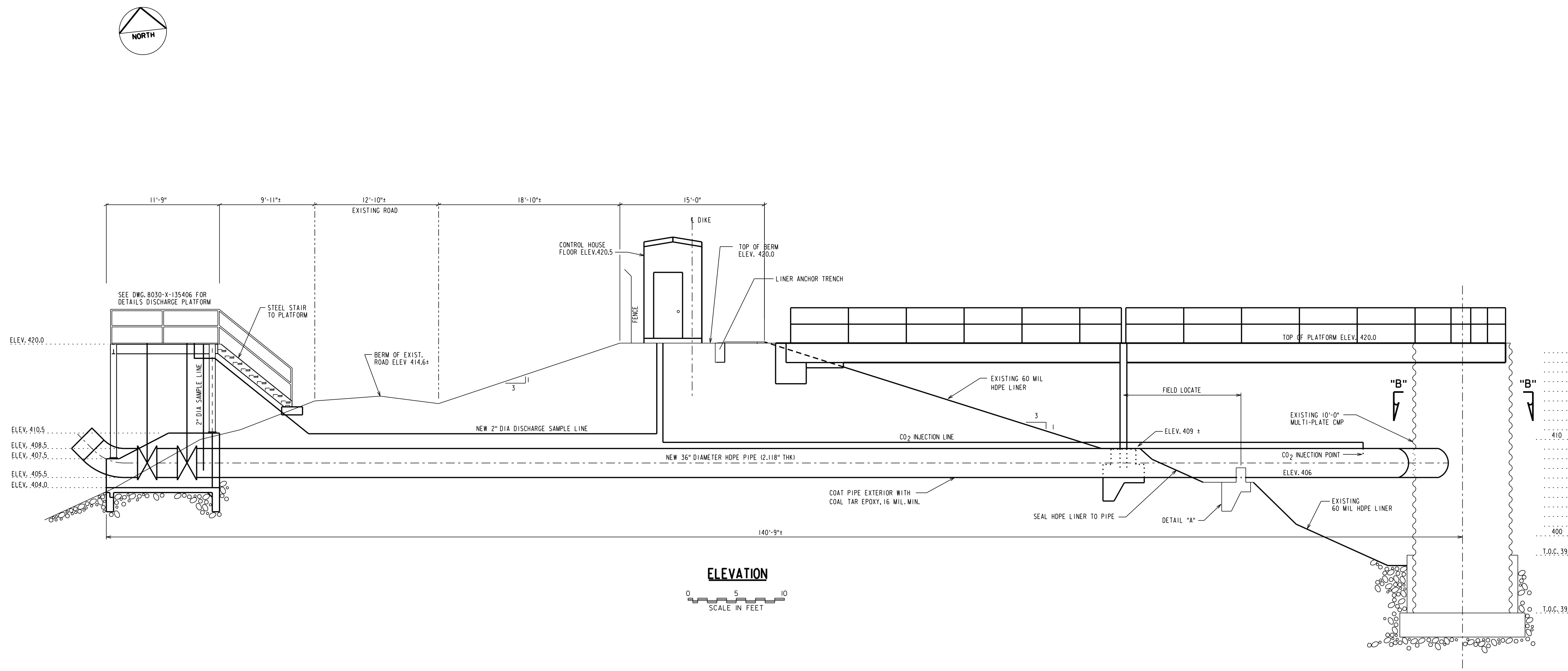
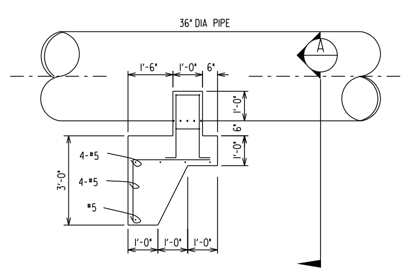
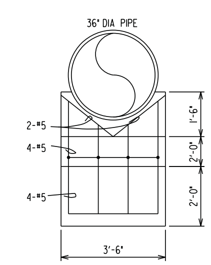


ELEVATION

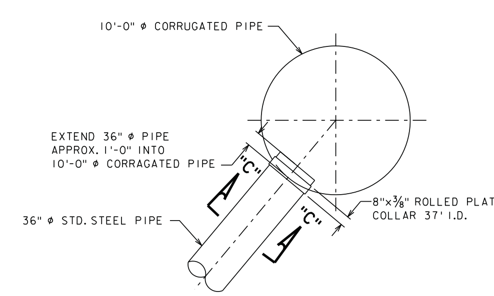
0 5 10 SCALE IN FEET



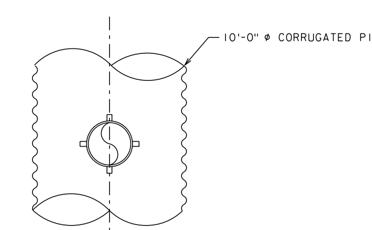
DETAIL "A"



SECTION "A"



SECTION "B"



SECTION "C"

NOTE

THIS WORK TO BE DONE IN ACCORDANCE WITH U.E. SPEC. NO. EC-4022.

STEEL FRAMING - INTAKE & DISCHARGE PLATFORM 8030-X-135406
CONCRETE DETAILS - ASH POND DISCHARGE 8030-X-135521
BUILDING - CONTROL HOUSE 8030-Y-135407
PIPING - ASH POND DISCHARGE 8080-X-135408
PIPING - CO2 REGULATING STATION 8030-X-135409

1993 FLOOD LEVEL - 419.6

NOTICE OF LIMITED RESPONSIBILITY

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•0010050201O•

•8030-X-147376•

PREPARED FOR AmerenUE

REV. 0 SEALED BY

STATE OF MISSOURI CARL W. REZSONYA NUMBER E-18282 REGISTERED PROFESSIONAL ENGINEER

DRAWN 072699 M.ENGLUND	PROPERTY - ELEVATION NEW ASH POND DISCHARGE STRUCTURE	
CHK/RVW NOT		
SUPV. 112999 SAH		
APPD. 072699 C.W. REZSONYA	LOCATION 001005 MERAMEC PLANT	CLASS 02010
Ameren ST. LOUIS, MISSOURI	8030-X-147376	REV. 1

37-13-070 Rev. 9-85

SCALE RATIO = 4

Printed on: 04-11-2011 14:10:24

THIS DRAWING HAS BEEN REFERENCED TO FILE(S):

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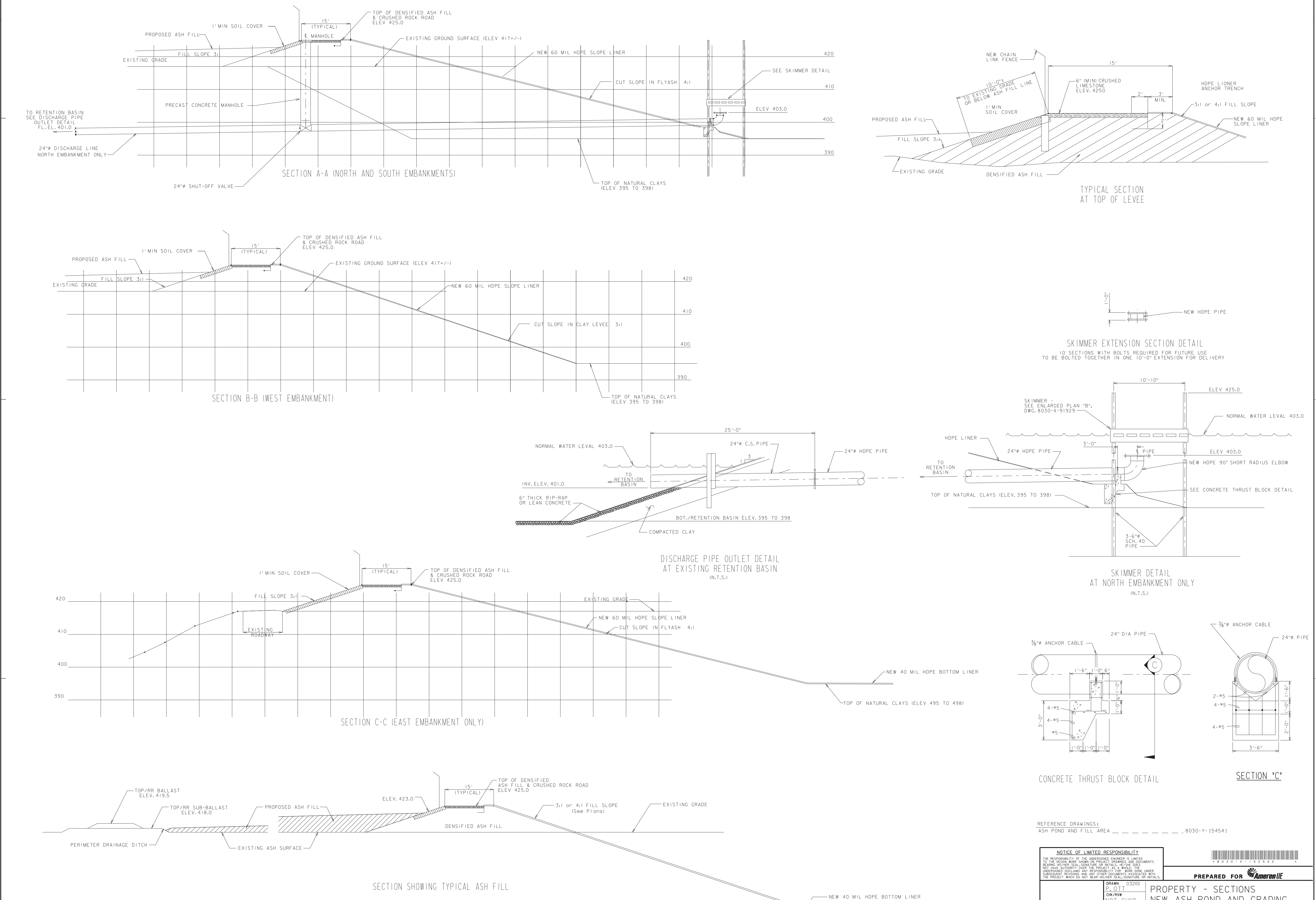
REVISIONS	
REV. 0	W.O.
FIRST ISSUE	
REV 1 DATE 04801 DRAWN MGL	CHKD NOT
W.O. 10775	
BOTTOM OF LINER WAS EL. 405.0'	
REV 2 DATE 05501 DRAWN DAG	
W.O. 10775	
REV. DWG. PER ENGINEER'S COMMENTS; REV. DWG. SIZE	

8030-X-152542



REFERENCE DRAWINGS:
ASH POND AND FILL AREA _ _ _ _ _ _ _ _ 8030-Y-154541

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PREPARED FOR AmerenUE

DRAWN 032101 P. OTT	PROPERTY - SECTIONS NEW ASH POND AND GRADING OVER PONDS 490, 494 & 498
CHK/RVW NOT CHKD	
SUPV. 032101 SAH	
APPD.	LOCATION 001005 — MERAMEC PLANT — CLASS 02010
Ameren ST. LOUIS, MISSOURI	8030-X-152542 — REV. 2

$SUPERSEDES 8030-Y-152542 REV 1 DATE 4/18/01

37-13-070 Rev. 9-85

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CHKD	SUPV	APPD
NOT		
W.O.		FILM

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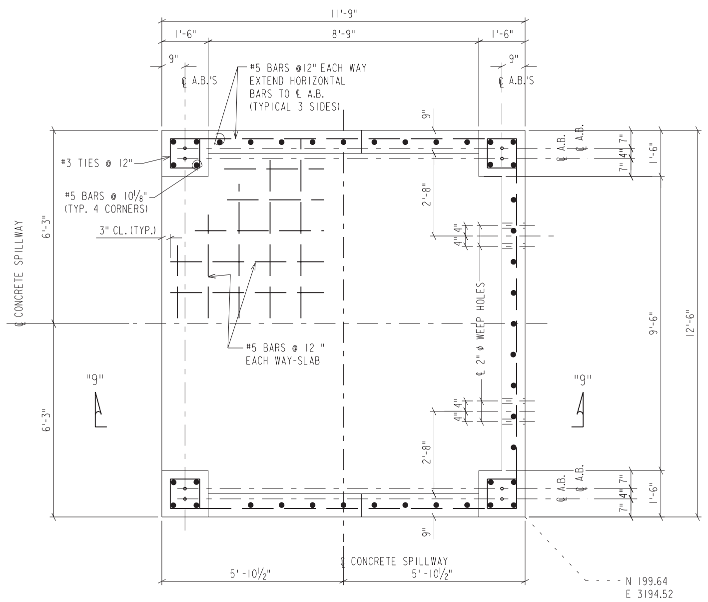
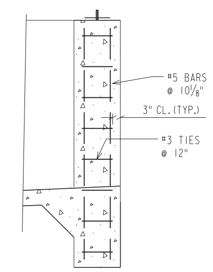


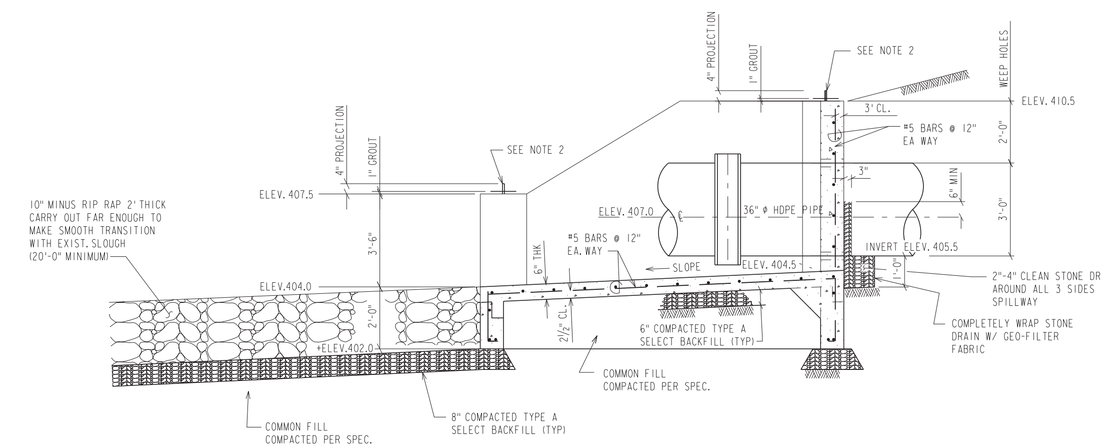
PLAN

CONCRETE SPILLWAY



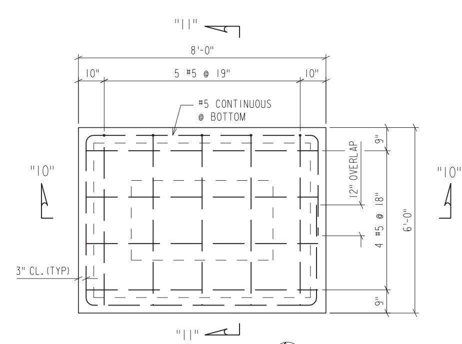
DETAIL

TYPICAL COLUMN SECTION



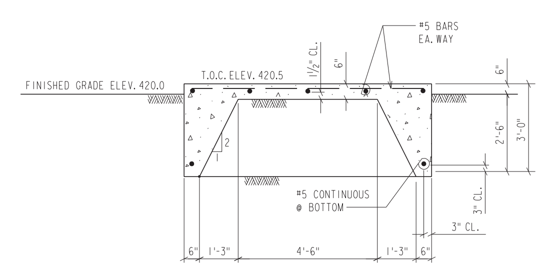
SECTION "9-9"

CONCRETE SPILLWAY

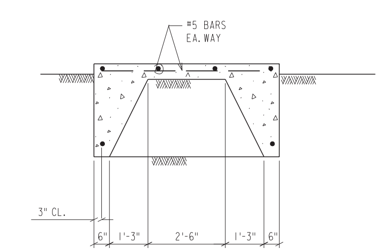


PLAN

CONTROL HOUSE FOUNDATION



SECTION "10-10"



SECTION "11-11"

SITE PLAN NEW ASH POND DISCHARGE. —— 8030-X-135405
STRUCTURE - STEEL FRAMING- INTAKE & DISCHARGE STRUCT. —— 8030-X-135406

NOTES

1. THIS WORK TO BE DONE IN ACCORDANCE WITH U.E. SPEC. NO. 4022.
2. ALL ANCHOR BOLTS TO BE ¾" ∅ x1'-6" LG (U.N.O.) VERTICLE LENGTH WITH 3" HOOK, GALVANIZE.
3. CONCRETE TO HAVE A MINIMUM COMPRESSIVE STRENGTH OF 4000 P.S.I. @ 28 DAYS

1993 FLOOD LEVEL - 419.6

NOTICE OF LIMITED RESPONSIBILITY

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0010050405 0
*8030-X-135521 *

REV. 0 SEALED BY

STATE OF MISSOURI
CARL W. REZSONYA
NUMBER E-18282
REGISTERED PROFESSIONAL ENGINEER

DRAWN 5/13/99 M. ENGLUND	STRUCTURE - CONCRETE ASH POND - DISCHARGE STRUCT.
CHKD. NOT	
SUPV. 11/29/99 SAH	
APPD. 12/16/99 C.W. REZSONYA	LOCATION 001005 — MERAMEC PLANT — CLASS 04050
UNION ELECTRIC COMPANY ST. LOUIS, MO.	8030-X-135521 — REV. 1

37-13-070 Rev. 9-85

Campbell, Gene A

From: Campbell, Gene A
Sent: Friday, November 22, 2019 11:28 AM
To: Healey, James M; Hart, Thomas J
Cc: Frerking, Matthew K; Greer, Jeff W
Subject: Meramec 2019 Annual Dam Safety Levee Inspection
Attachments: BAP.pdf; 498.pdf; 494 495.pdf; RP.pdf; Pond 489.pdf

All,

The 2019 Meramec Pond MCPA (492), Pond MCPB (Pond 493), Pond MCPC (496), Pond MCPD (498), Pond 494 and Pond 495, the Retention Pond, and Pond 489 annual levee inspection checklists are attached. The Inspection was performed by Gene Campbell and Jim Healey on August 29, 2019.

Inspection photos are located at P:\Meramec\Dam Safety\Annual Inspections\2019\08-29-19 Annual Inspection Photos

Overall the ponds are in good condition with minor maintenance items identified. The following are recommended action items from the annual inspection. Please review the action items and give me a call if you have any questions. Dam Safety will coordinate with our vegetation contractor to continue maintaining the vegetation on the levee.

Dam Safety and Maintenance Items from the Annual Inspection

Pond MCPA (492), MCPB (493), MCPC (496) (CCR Regulated Ponds)

1. Continue to clear the vegetation in the overflow channel between the bottom ash pond and the retention pond.
2. Continue to clear the vegetation around the primary discharge structure.
3. Continue to clear the vegetation in the rip rap at the north downstream side of pond 493.
4. The plant should clean the staff gage to facilitate readings.
5. The staff gage should be lowered to facilitate weekly water level readings.
6. Areas of standing water were present along the downstream toe of Pond 493, due to recent rain. The plant should continue to inspect this area during routine weekly inspections.

Pond MCPD (498) (CCR Regulated)

1. Continue to clear the vegetation on the upstream side of the pond, just inside the fence.
2. Clean the staff gage to facilitate readings.

Pond 494 and 495

1. Continue to clear the downstream vegetation in the rip rap.
2. Areas of standing water were present along the downstream toe of Pond 494 and 495. The water was located in ruts from vehicle traffic. The plant should continue to inspect this area during routine weekly inspections.
3. The ruts along the downstream toe should be repaired to allow positive drainage.

Retention Pond

1. The existing discharge valve leaks and needs to be replaced. JR124681 has been set up to replace the valve.
2. Continue to clear the vegetation in the downstream rip rap.
3. Continue to clear the north upstream side of the levee near the waterline.
4. Recommend cleaning and moving the staff gage to the east side of the pond.

Pond MCPE (489)

1. Ponded water was noted just off the west toe of the levee. The water was due to recent rain events. The plant should continue to inspect this area during routine weekly inspections.
2. Continue to clear the vegetation in the downstream rip rap.

Completed actions since the last inspection

1. Vegetation management completed Dam Safety's Vegetation Contractor.
2. The Meramec drainage project was completed to drain runoff water from the Ponds 494 and 495 to the Retention Pond. The HDPE pipe that runs along the downstream side of the levee has been grouted and abandoned.

Please let me know if you have any questions or comments.

Thank you,

::::::::::::::::::::::::

GENE CAMPBELL, P.E., PMP
Career Engineer
Dam Safety & Hydro Engineering
T 314.957.3432
C 618.444.0823
E gcampbell2@ameren.com

……………………

Ameren Missouri
11149 Lindbergh Business Ct.
St. Louis, Missouri 63123
AmerenMissouri.com

MERAMEC ENERGY CENTER
Pond MCPE (489)
Annual Inspection Check Sheet

Date	08/29/2019
Inspector	Gene Campbell Jim Healey
Pool Level	NA – Pond is Closed
River Level	390.7
Temperature	70°F
Weather	Sunny

Date of Previous Annual Inspection: July 13, 2018

Date of Previous Periodic Inspection: Not Applicable

Description of Emergency (EC) or Immediate Maintenance (IM) conditions observed since the last annual inspection:
None

Describe any action taken to restore or improve safety and integrity of impounding structure:
None

Describe any modifications to the geometry of the impounding structure since the previous annual inspection:
None

Describe any modifications to the operation of the impounding structure since the previous annual inspection:
The Pond was closed on April 6, 2018. The pond is no longer receiving any processed water or CCR material.

List the approximate remaining storage capacity of the impounding structure:
N/A. The Pond was closed on April 6, 2018. There is no more storage capacity of the impounding structure.

List the approximate maximum, minimum and present depth and elevation of the impounded water since the previous annual inspection:
N/A. The Pond was closed on April 6, 2018. There is no impounded water. The pond will no longer receive any processed water.

List the approximate maximum, minimum and present depth and elevation of the impounded CCR since the previous annual inspection:
The Pond was closed on April 6, 2018. Maximum elevation is 434 ft. and maximum depth is 32 ft. Minimum elevation is 398 and minimum depth is 0 ft. Present average elevation is 414 ft. and Present average depth is 12 ft.

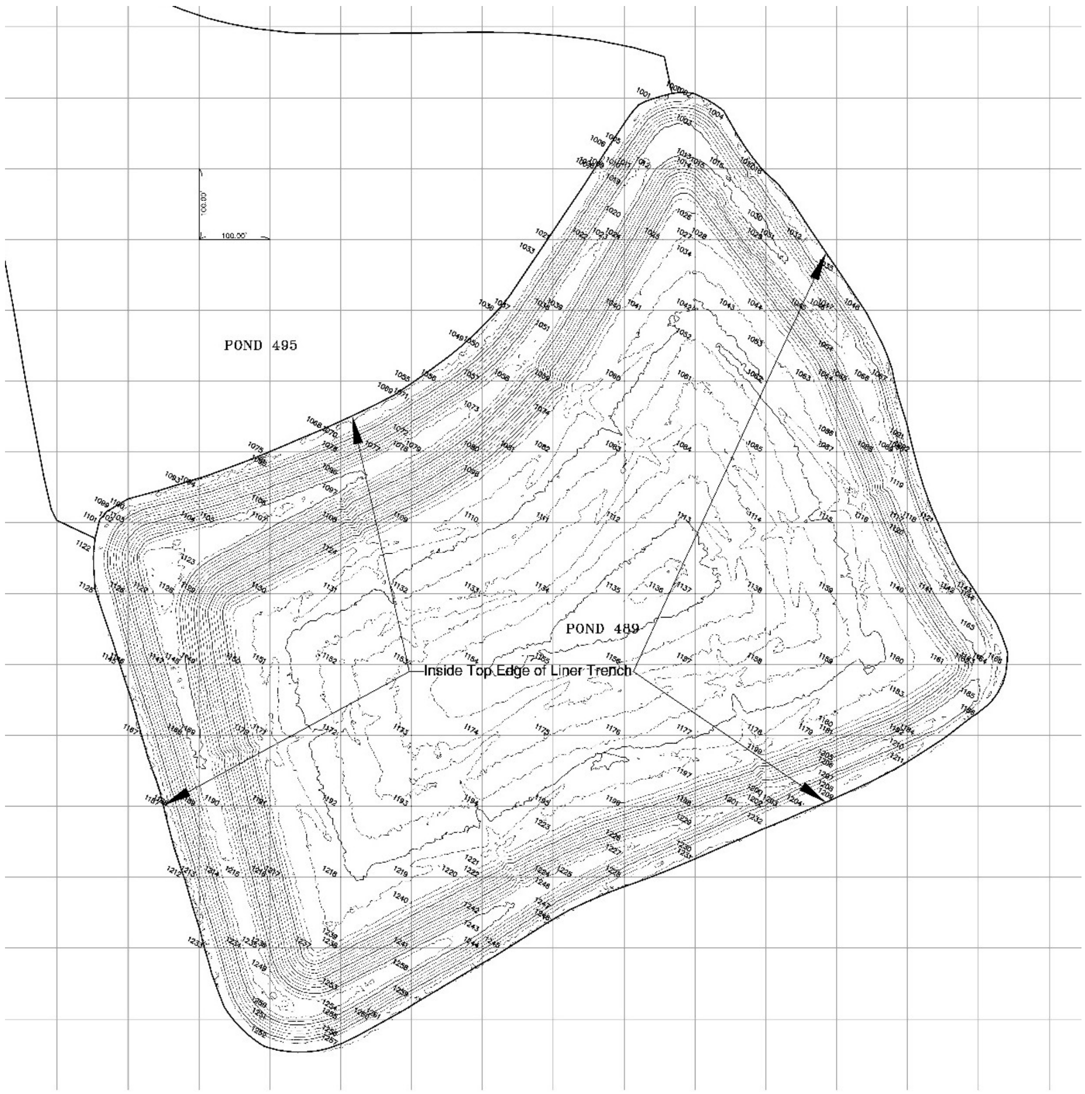
Approximate volume of impounded water and CCR at the time of the inspection:
The Pond was closed on April 6, 2018. There is no impounded water. The approximate volume of CCR in the closed pond is 685,000 CY.

Describe any changes to the downstream watershed:
None

Inlet and Outlet Works		
Item	**Condition Code**	**Comments**
Outlet Condition	GC	
Outfall Pipe Condition	GC	
Outlet Channel	GC	
Discharge (color and/or sediment)	NI	No discharge.
Obstructions	GC	
Leakage	GC	No leakage noted.
Other	-	

Earth Embankment		
Item	**Condition Code**	**Comments**
Vertical & Horizontal Alignment of Crest	GC	
Seepage/Wetness/ Ponding Areas	OB	Ponded water noted just off the west toe of the levee. The water was due to recent rain events. No flowing water was observed.
Erosion/Rutting	GC	
Fencing	GC	
Vegetation	GC	Vegetation has been cleared
Sloughs/Slides/ Cracks	GC	
Rip Rap Revetments	GC	
Animal Control	GC	No burrows present.
Other	-	

Note location of observation on attached plan sheet.



Condition Code

EC = Emergency Condition. A serious dam safety condition exists that need immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work stoppage, plant stoppage.
IM = Item needing immediate maintenance to restore or ensure its safety and integrity. Remediation should be complete within 1 month or as required.
MM = Minor Maintenance. Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.
OB = Condition requires regular observation and potential future minor maintenance.
GC = Good Condition
NO = No observation possible.
NI = Not Inspected. State reason in comment column.

40 CFR Parts 257

Checklist for Inspection Requirements for CCR Surface Impoundments
257.83 (b)

Meramec Power Station – MCPA (Pond 492), MCPB (Pond 493), and MCPC (Pond 496)

1. Annual Inspection

Requirements	Signs of actual or potential structural weakness	Disruptions or potential disruption to the operation and safety of the unit
CCR Unit and appurtenant structures 257.83(b)(ii)	None Observed	None Observed
Hydraulic structures underlying the base of the CCR unit 257.83(b)(iii)	None Observed	None Observed

The 2019 Annual Inspection included a review of available information regarding the status and condition of the CCR unit, including, but not limited to, files available in the operating record in general accordance with 257.83(b)(i).

Minor maintenance items (e.g. animal burrows, ruts, etc.) associated with routine upkeep observed during the 2019 Annual Inspection, presently do not impact the structural integrity of the embankment. Ameren plans to address these items in a timely manner through Ameren's work control process.

Engineer's Seal

Gene Campbell, P.E.
License: PE-2011020071
Date: November 22, 2019

MERAMEC ENERGY CENTER
MCPA (Pond 492), MCPB (Pond 493) and MCPC (Pond 496)
Annual Inspection Check Sheet

Date	08/29/2019
Inspector	G. Campbell Jim Healey
Pool Level	~ 408.3 ft. (Below Staff Gauge)
River Level	390.7
Temperature	70°F
Weather	Sunny

Date of Previous Annual Inspection: 8/30/18

Date of Previous Periodic Inspection: Not Applicable

Description of Emergency (EC) or Immediate Maintenance (IM) conditions observed since the last annual inspection:
None

Describe any action taken to restore or improve safety and integrity of impounding structure:
None

Describe any modifications to the geometry of the impounding structure since the previous annual inspection:
None

Describe any modifications to the operation of the impounding structure since the previous annual inspection:
None

List the approximate remaining storage capacity of the impounding structure:
Approx. 331,867 CY

List the approximate maximum, minimum and present depth and elevation of the impounded water since the previous annual inspection:
The maximum water level since the last inspection was above the staff gauge. However, adequate freeboard was maintained in the pond. The Minimum water level since the last inspection was below the staff gauge. The minimum water level was estimated at 408.5 ft., and the minimum depth was estimated at 4.5 ft. The present water level was below the staff gauge. The present elevation was estimated at 408.5 ft., and the present depth was estimated at 4.5 feet.

List the approximate maximum, minimum and present depth and elevation of the impounded CCR since the previous annual inspection:
There are no records of impounded CCR depth or elevation within the last year. Present Depth: Max – 10 ft. Min – 4ft. Present elevation: Max 410 ft. Min 404 ft.

Approximate volume of impounded water and CCR at the time of the inspection:
Approx. 313,933 CY

Describe any changes to the downstream watershed:
None

Inlet Outlet Works

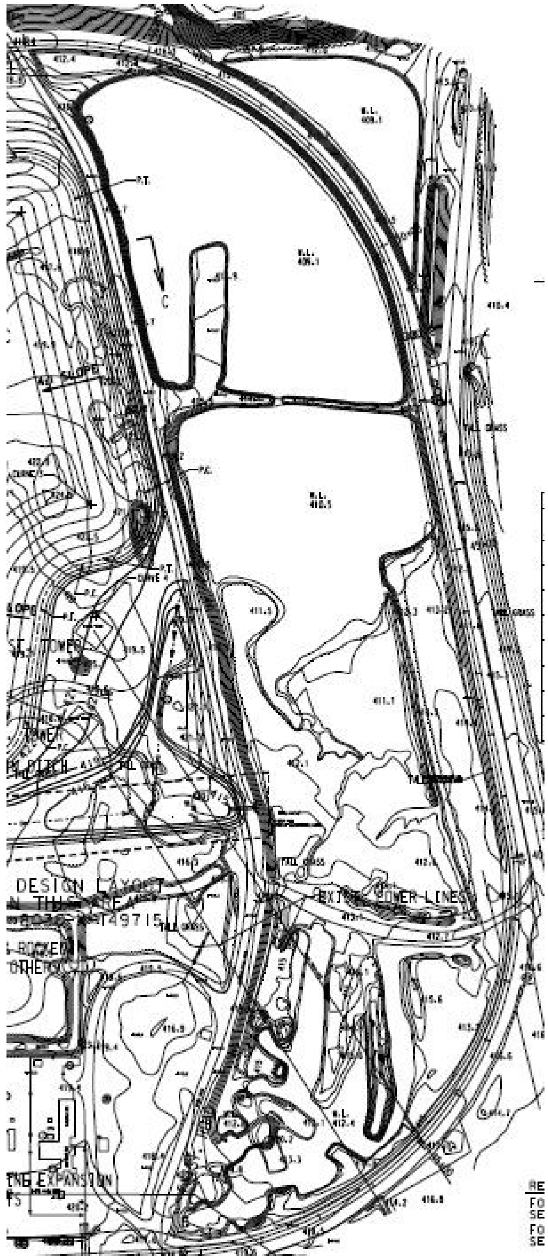
Item	Condition Code	Comments
Outlet Pipe Condition	OB	No deficiencies noted.
Discharge (color and/or sediment)	NO	No discharge.
Obstructions	OB	No obstructions.
Inlet Piping/ Supports Condition	GC	
Leakage	GC	No leakage was observed.
Other		

Earth Embankment

Item	Condition Code	Comments
Vertical & Horizontal Alignment of Crest	GC	There was no visible misalignment of the crest.
Rip Rap Revetments	GC	
Seepage/Wetness/ Ponding Areas	OB	Small areas of ponded water downstream north side of the BAP. The water was due to recent rainfall events.
Erosion/Rutting	GC	
Fencing	GC	
Vegetation	OB	Continue to spray and clear vegetation as needed.
Sloughs/Slides/ Cracks	GC	No sloughs, slides, or cracks were observed.
Animal Control	GC	No animal burrows observed.
Other	MM	Clean the staff gage.

Earth Embankment		
Item	**Condition Code**	**Comments**
		Lower the staff gage so that weekly readings can be taken.

Note location of observation on attached plan sheet.



Condition Code

EC = Emergency Condition. A serious dam safety condition exists that need immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work stoppage, plant stoppage.
IM = Item needing immediate maintenance to restore or ensure its safety and integrity. Remediation should be complete within 1 month or as required.
MM = Minor Maintenance. Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.
OB = Condition requires regular observation and potential future minor maintenance.
GC = Good Condition
NO = No observation possible.
NI = Not Inspected. State reason in comment column.

MERAMEC ENERGY CENTER
Pond 494 and 495
Annual Inspection Check Sheet

Date	08/29/2019
Inspector	G. Campbell Jim Healey
Pool Level	NA
River Level	390.7
Temperature	70°F
Weather	Sunny

Date of Previous Annual Inspection: 8/30/18

Date of Previous Periodic Inspection: Not Applicable

Description of Emergency (EC) or Immediate Maintenance (IM) conditions observed since the last annual inspection:
None

Describe any action taken to restore or improve safety and integrity of impounding structure:
None

Describe any modifications to the geometry of the impounding structure since the previous annual inspection:
None

Describe any modifications to the operation of the impounding structure since the previous annual inspection:
The pond no longer receives CCR

List the approximate remaining storage capacity of the impounding structure:
0 CY

List the approximate maximum, minimum and present depth and elevation of the impounded water since the previous annual inspection:
None

List the approximate maximum, minimum and present depth and elevation of the impounded CCR since the previous annual inspection:
Pond 495 – Max: el. – 421, depth – 31 ft; Min: el. – 414, depth – 24 ft
Pond 494 – Max: el. – 433, depth – 39 ft; Min: el. – 414, depth – 20 ft

Approximate volume of impounded water and CCR at the time of the inspection:
Pond 495 – 560,000 CY; Pond 494 – 1,350,000 CY

Describe any changes to the downstream watershed:
None

Earth Embankment		
Item	**Condition Code**	**Comments**
Vertical & Horizontal Alignment of Crest	GC	There was no visible misalignment of the crest.
Rip Rap Revetments	GC	
Seepage/Wetness/ Ponding Areas	OB	Small areas of ponded water were noted at multiple locations downstream of Pond 494 and Pond 495. The water was located in ruts from vehicle traffic. The water was due to recent rainfall events.
Erosion/Rutting	OB	Rutting was observed on the downstream side of the levee just off the toe of the embankment.
Fencing	GC	Fencing was repaired as part of the rip rap project in 2017.
Vegetation	GC	Vegetation has been cleared.
Sloughs/Slides/ Cracks	GC	
Interior Drainage/Culverts	GC	
Animal Control	GC	No animal burrows were observed.
Other		

Note location of observation on attached plan sheet.

Condition Code

EC = Emergency Condition. A serious dam safety condition exists that need immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work stoppage, plant stoppage.
IM = Item needing immediate maintenance to restore or ensure its safety and integrity. Remediation should be complete within 1 month or as required.
MM = Minor Maintenance. Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.
OB = Condition requires regular observation and potential future minor maintenance.
GC = Good Condition
NO = No observation possible.
NI = Not Inspected. State reason in comment column.

40 CFR Parts 257

Checklist for Inspection Requirements for CCR Surface Impoundments
257.83 (b)

Meramec Power Station – MCPD (Pond 498)

1. Annual Inspection

Requirements	Signs of actual or potential structural weakness	Disruptions or potential disruption to the operation and safety of the unit
CCR Unit and appurtenant structures 257.83(b)(ii)	None Observed	None Observed
Hydraulic structures underlying the base of the CCR unit 257.83(b)(iii)	None Observed	None Observed

The 2019 Annual Inspection included a review of available information regarding the status and condition of the CCR unit, including, but not limited to, files available in the operating record in general accordance with 257.83(b)(i).

Minor maintenance items (e.g. animal burrows, ruts, etc.) associated with routine upkeep observed during the 2019 Annual Inspection, presently do not impact the structural integrity of the embankment. Ameren plans to address these items in a timely manner through Ameren's work control process.

Engineer's Seal

Gene Campbell, P.E.
License: PE-2011020071
Date: November 22, 2019

MERAMEC ENERGY CENTER
MCPD (Pond 498)
Annual Inspection Check Sheet

Date	08/29/2019
Inspector	Gene Campbell Jim Healey
Pool Level	~417.5 ft.
River Level	390.7
Temperature	70°F
Weather	Sunny

Date of Previous Annual Inspection: 8/30/18

Date of Previous Periodic Inspection: Not Applicable

Description of Emergency (EC) or Immediate Maintenance (IM) conditions observed since the last annual inspection:
None

Describe any action taken to restore or improve safety and integrity of impounding structure:
None

Describe any modifications to the geometry of the impounding structure since the previous annual inspection:
None

Describe any modifications to the operation of the impounding structure since the previous annual inspection:
None

List the approximate remaining storage capacity of the impounding structure:
Approx. 112,327 CY

List the approximate maximum, minimum and present depth and elevation of the impounded water since the previous annual inspection:
Max: el. 417.6, depth – 22.6 ft.; Min: el. 417.1 depth – 22.1 ft.; Present: el. 417.5, depth – 22.5 ft.

List the approximate maximum, minimum and present depth and elevation of the impounded CCR since the previous annual inspection:
Present Depth: Max – 39 ft Min – 23 ft; Present Elevation: Max 434 ft Min 418 ft

Approximate volume of impounded water and CCR at the time of the inspection:
Approx. 457,673 CY

Describe any changes to the downstream watershed:
None

Inlet Outlet Works

Item	Condition Code	Comments
Outlet Condition	GC	
Skimmer/Pipe Supports Condition	GC	
Valve Condition/ Operability	NI	The valve was not inspected, but it is functional.
Discharge (color and/or sediment)	NI	No Discharge.
Obstructions	GC	No obstructions observed.
Inlet Piping/Supports Condition	GC	
Leakage	GC	No leakage observed
Other		

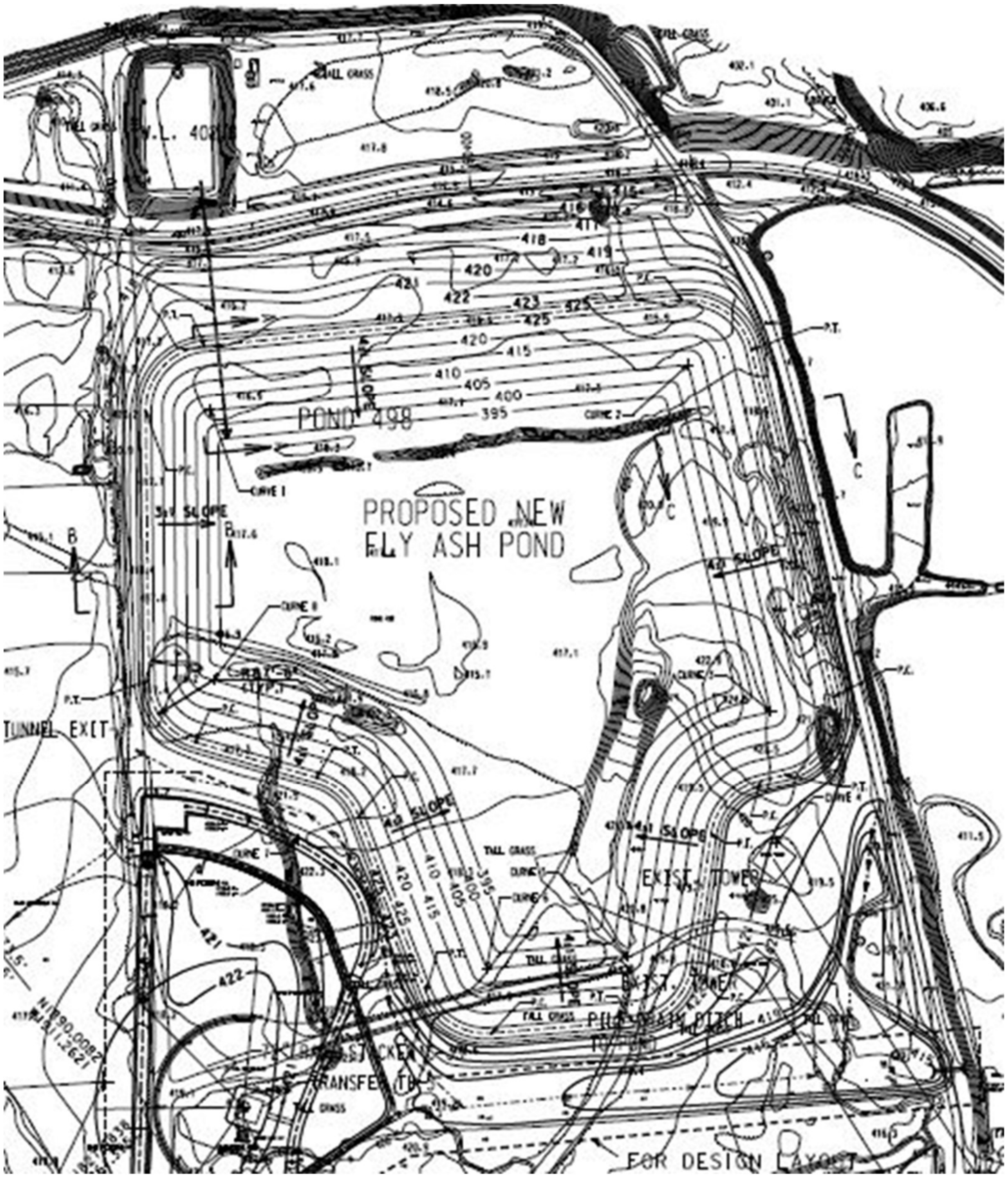
Earth Embankment

Item	Condition Code	Comments
Vertical & Horizontal Alignment of Crest	GC	No deficiencies noted.
HDPE Liner	GC	Visible portion of the liner was in god condition.
Seepage/Wetness/ Ponding Areas	GC	No seepage, wetness, or ponding observed.
Erosion/Rutting	OB	No rutting or erosion observed.
Fencing	GC	
Vegetation	MM	Bare areas on the north downstream slope. Recommend seeding.

Earth Embankment

Item	Condition Code	Comments
Sloughs/Slides/ Cracks	GC	No sloughs, slides, or cracks observed.
Animal Control	GC	No animal burrows noted.
Other	MM	Clean the staff gage.

Note location of observation on attached plan sheet.



Condition Code

EC = Emergency Condition. A serious dam safety condition exists that need immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work stoppage, plant stoppage.
IM = Item needing immediate maintenance to restore or ensure its safety and integrity. Remediation should be complete within 1 month or as required.
MM = Minor Maintenance. Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.
OB = Condition requires regular observation and potential future minor maintenance.
GC = Good Condition
NO = No observation possible.
NI = Not Inspected. State reason in comment column.

MERAMEC ENERGY CENTER
Retention Pond
Annual Inspection Check Sheet

Date	08/29/2019
Inspector	Gene Campbell Jim Healey
Pool Level	~ 404 ft.
River Level	390.7
Temperature	70°F
Weather	Sunny

Date of Previous Annual Inspection: 8/30/18

Date of Previous Periodic Inspection: Not Applicable

Description of Emergency (EC) or Immediate Maintenance (IM) conditions observed since the last annual inspection:
None

Describe any action taken to restore or improve safety and integrity of impounding structure:
None

Describe any modifications to the geometry of the impounding structure since the previous annual inspection:
None

Describe any modifications to the operation of the impounding structure since the previous annual inspection:
None

List the approximate remaining storage capacity of the impounding structure:
Approx.10,000 CY

List the approximate maximum, minimum and present depth and elevation of the impounded water since the previous annual inspection:
The maximum water level since the last inspection was above the staff gage. However, adequate freeboard was maintained in the pond. The minimum water level since the last inspection was approximately elevation 404 ft. The present elevation was approximately elevation 404 ft., and the depth is unknown.

List the approximate maximum, minimum and present depth and elevation of the impounded CCR since the previous annual inspection:
The retention pond is for water treatment only.

Approximate volume of impounded water and CCR at the time of the inspection:
Unknown volume of water. No CCR.

Describe any changes to the downstream watershed:
None

Inlet Outlet Works

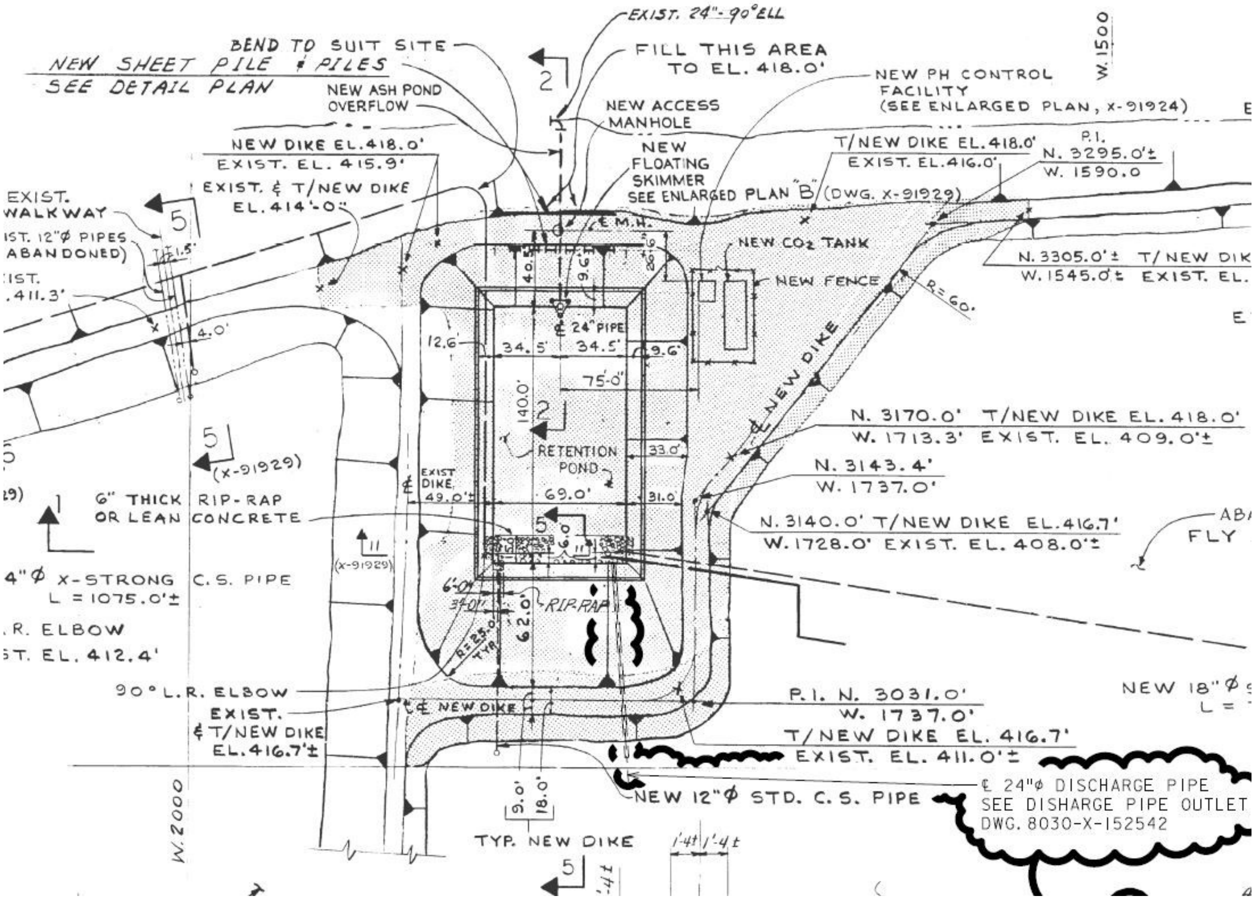
Item	Condition Code	Comments
Outlet Condition	GC	
Skimmer/Pipe Supports Condition	GC	A new skimmer was installed in 2018.
Valve Condition/ Operability	OB	The existing valve leaks. The plant is evaluating the need to replace. REF JR124681
Discharge (color and/or sediment)	GC	Discharge water was clear.
Obstructions	GC	No obstructions observed.
Inlet Piping/ Support Condition	GC	
Leakage	OB	The existing valve leaks. The plant is evaluating the need to replace. REF JR124681
Other		

Earth Embankment

Item	Condition Code	Comments
Vertical & Horizontal Alignment of Crest	GC	There was no visible misalignment of the crest.
Riprap Revetments	GC	
Seepage/Wetness/ Ponding Areas	GC	None observed.
Erosion/Rutting	GC	No erosion or rutting observed.
Fencing	GC	
Vegetation	GC	Vegetation was cleared
Sloughs/Slides/	GC	No sloughs, slides, or cracks observed

Earth Embankment		
Item	**Condition Code**	**Comments**
Cracks		
Animal Control	GC	No animal burrows observed
Other	MM	Clean staff gauge and move to the east side of the pond.

Note location of observation on attached plan sheet.



Condition Code

EC = Emergency Condition. A serious dam safety condition exists that need immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work stoppage, plant stoppage.
IM = Item needing immediate maintenance to restore or ensure its safety and integrity. Remediation should be complete within 1 month or as required.
MM = Minor Maintenance. Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.
OB = Condition requires regular observation and potential future minor maintenance.
GC = Good Condition
NO = No observation possible.
NI = Not Inspected. State reason in comment column.

APPENDIX D

PERIODIC SAFETY FACTOR ASSESSMENT

AMEREN MISSOURI MERAMEC ENERGY CENTER
EVALUATION OF CCR UNITS
40 CFR PART 257
ST. LOUIS COUNTY, MISSOURI

APPENDIX D: SAFETY FACTOR ASSESSMENT §257.73(e)

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EVALUATION OF CCR UNITS
ST. LOUIS COUNTY, MISSOURI

APPENDIX D: SAFETY FACTOR ASSESSMENT §257.73(e)

1.0 INTRODUCTION

The Meramec Energy Center is located at the southernmost point in St. Louis County, Missouri at the confluence of the Mississippi and Meramec Rivers, approximately 2.8 miles southeast of the City of Arnold. The Meramec Energy Center has ten surface impoundments used for managing coal combustion residuals (CCR) within an approximate 138-acre area. They are designated as Ponds 489, 490, 491, 492, 493, 494, 495, 496, 498, and Inactive Pond 498. Ponds 489, 490, 491, 494, 495 and Inactive Pond 498 no longer receive CCR and are inactive. Pond 498 was closed in accordance with the CCR Rule in 2021. The remaining active CCR surface impoundments are MCPA, MCPB and MCPC. Stormwater, and discharge from the active ponds is routed to the Retention Pond prior to discharge through an NPDES permitted outfall. A map showing the location of the surface impoundments and the Retention Pond is attached as Figure 1.

1.1 Purpose

40 CFR §257.73(e) requires that the owner or operator of an existing CCR surface impoundment to conduct initial and periodic safety factor assessments for each CCR unit and document whether the calculated factors of safety for each CCR unit achieve the minimum factors of safety for the critical cross section of the embankment. The critical cross section is the cross section anticipated to be the most susceptible of all cross sections to structural failure based on appropriate engineering considerations, including loading conditions. The safety factor assessments should be supported by appropriate engineering calculations. The specified minimum safety factors are shown in Table 1.

Table 1 - Minimum Safety Factors

Loading Condition	Minimum Factor of Safety
Static, long-term, maximum storage pool	1.50
Static, maximum surcharge pool	1.40
Seismic	1.00
Liquefaction	1.20

A periodic safety factor assessment has been conducted for the active surface impoundments at the Meramec Energy Center, which includes MCPA, MCPB and MCPC. MCPA and MCPC are incised but hydraulically connected to MCPC which includes a perimeter earth embankment.

2.0 PERIODIC SAFETY FACTOR ASSESSMENT

2.1 Static Stability Analyses

Slope stability analyses were performed in general accordance with United States Army Corps of Engineers (USACE) EM1110-2-1902 *Slope Stability* and MSHA's 2009 *Engineering and Design Manual for Coal Refuse Disposal Facilities* and using the computer program SLIDE2. This program uses the Spencer method in a limit-equilibrium analysis, which resolves the static forces on each vertical slice of soil profile along a given circular or irregular assumed failure surface. The program searches for the minimum Factor of Safety (FS) against slope failure for each center point in the grid by incrementally varying the radius of the failure surface. The plotted results from the program show the minimum FS, and the center and radius of the failure surface with the minimum FS. The output of the program also plots contours of equal FS within the grid of possible center points.

2.2 Seismic Stability Analyses

The critical cross-section was analyzed using a pseudo-static acceleration as a horizontal body force on the soil mass to calculate the minimum factor of safety for a seismic event. The seismic acceleration was based upon the USGS 2014 seismic hazard maps for a Peak Horizontal Ground Acceleration (PHGA) for seismic loading event with a 2% probability of exceedance in 50 years. The PHGA was factored for the seismic site class in accordance with ASCE 7 *Minimum Design Loads for Buildings and Other Structures, International Building Code*. A seismic coefficient of 0.5 was applied to the PHGA, which is consistent with MSHA's 2009 *Engineering and Design Manual for Coal Refuse Disposal Facilities*, in particular Chapter 7, "Seismic Design: Stability and Deformation Analyses." The manual cites research by Hynes-Griffen and Franklin (1984) which found that for seismic coefficient of 0.5 would result in deformations of less than 3 feet for a safety factor of 1.0.

The published 2014 USGS hazard map for the Meramec Energy Center is reproduced in Figure 2. This is the latest map available from the USGS website. The probabilistic PHGA for the design earthquake at the Meramec site is 0.273g (that is, 27.3% of standard gravity acceleration of 32.2 feet/sec^2). This value takes into account attenuation of bedrock shaking with distance from the probable sources and general soil interactions such as damping for a hypothetical soil profile. This value is meant to be a conservative estimate. Based upon the data, the most probable earthquake magnitudes (M_w) for these accelerations are between 7.0 and 8.0. We applied a multiplier of 1.254 to the base PHGA to account for the soil profile at the Meramec Energy Center to obtain a site specific PHGA of 0.342g. Therefore, the pseudo-static seismic load was 0.171g.

2.3 Liquefaction Stability Analyses

The liquefaction slope stability analysis is a post-earthquake, static analysis which includes the effects of potential liquefaction or softening of the soils. Liquefaction occurs when ground shaking is sufficient to produce cyclic particle movements that cause excess pore water pressures to build to the point that most of the shear strength of the soil is lost. Liquefaction occurs in loose sandy soils with less than about 35% fines (soils which are finer than standard U.S.#200 or 0.075mm). Liquefaction can occur in very loose soils with up to 50 percent fines, and soils up to the size of fine gravel. Liquefaction also only occurs below the ground water table (phreatic surface). The presence of soil susceptible to liquefaction in the top

50 feet of the soil profile at the Meramec Energy Center is uncommon. For stiff cohesive soils, the undrained strength was assumed no greater than 80% of the peak undrained strength.

3.0 MCPA, MCPB AND MCPC

3.1 Critical Section and Assumptions

The critical section for MCPA, MCPB and MCPC is located at the north side of MCPB, where the perimeter berm is adjacent to a tributary of the Meramec River. A plan showing the location of the section is in Figure 3, and a cross-section through the perimeter berm at this location is shown as Section 51+00 in Figure 4. The section at this location is about 15 feet high.

The groundwater table for stability analysis was assumed to be at the bottom of the drainage ditch at the downstream toe, at approximately el. 399, with no water ponded in the ditch. The water level in MCPB was assumed to be at the normal pool of el. 409.5. The water surface elevation was increased to el. 413.2 feet for the maximum surcharge pool, at which elevation overtopping could occur.

Soil parameters used for stability analysis of the MCPB critical section were derived from borings drilled during the design of the railroad loop in 1999, borings made for the design of Pond 498, borings and CPT soundings made in 2010 for the Ash Pond Stability Analysis Project and borings for the geotechnical investigation for Ash Pond Closures and Coal Pile Sampling in 2021. The boring logs are attached in Appendix I.

The perimeter berm was constructed of fine-grained soil excavated from the incised portion of the pond, CCRs and crushed limestone. A boring drilled through the MCPB perimeter berm show the crushed limestone and CCRs are medium-dense to very dense. A consolidated-undrained triaxial shear strength test was run on a sample obtained in the fine-grain berm fill, and the results were used in the analyses. Borings drilled for the railroad loop embankment and those for ash pond closures show the foundation consists of lean and high plastic clay to depths of about 30 to 80 feet. Conservative assumptions were made for the undrained and effective stress analysis based on borings or CPT soundings. The soil parameters assumed in the stability analyses are summarized in Table 4.

Table 2 – Soil Properties Assumed in the MCPA, MCPB and MCPC Critical Section Stability Analyses

Material	Unit Weight		Normal/Max Pool		Seismic		Liquefaction	
	γ (pcf)	γ' (pcf)	c' (psf)	ϕ' (°)	c (psf)	ϕ' (°)	c (psf)	ϕ' (°)
MoDOT Type 4	110	47.6	0	40	0	40	0	40
Crushed Limestone	130	67.6	0	37	0	37	0	37
CCR Fill	110	47.6	0	30	0	30	0	30
Clay & Silt Fill	123	60.6	40	29	100	21	40	29
Fat Clay	125	62.6	100	27	1200	0	960	0
Lean Clay	121	58.6	100	28	550	0	440	0
Sand and	125	63	0	30	0	30	0	30

Material	Unit Weight		Normal/Max Pool		Seismic		Liquefaction	
	γ (pcf)	γ' (pcf)	c' (psf)	ϕ' (°)	c (psf)	ϕ' (°)	c (psf)	ϕ' (°)
Gravel								

3.2 Stability Analysis Results

The results of the stability analyses for MCPA, MCPB and MCPC for each load case are presented in Table 5. The search for critical failure surfaces was limited to those that significantly impact the dam. The analyses showed that the calculated factors of safety exceed the minimum presented in §257.73(e) for each loading condition. Graphical outputs of the results of the stability analyses are shown in Appendix II.

Table 2 – MCPA, MCPB and MCPC Stability Analyses Results

Loading Condition	Minimum Factor of Safety	Calculated Factor of Safety
Static, long-term, maximum storage pool	1.50	1.62
Static, maximum surcharge pool	1.40	1.45
Seismic	1.00	1.12
Liquefaction	1.20	1.91

4.0 MCPD

The initial periodic safety factor assessment for MCPD was completed in October 2016. The initial assessment found that the calculated factors of safety for the critical cross-section meet or exceed the minimum factors of safety for each loading condition required by 40 CFR §257.73(e). MCPD no longer receives CCRs, has been dewatered and is currently being closed. The current conditions are no longer representative of those used in the 2016 assessment. A safety factor assessment for the closed condition has been performed by Reitz & Jens, Inc. Our assessment found that the static and seismic stability factors of safety meet or exceeds the minimum requirements.

5.0 CONCLUSIONS

The periodic safety factor assessment for the Meramec Energy Center MCPA, MCPB and MCPC found that the calculated factors of safety for the critical cross-sections at each CCR unit exceed the minimum factors of safety for each loading condition required by 40 CFR §257.73(e). The subsequent periodic safety factor assessment should be conducted within 5 years of the date of this report.

The MCPD was closed in 2021. A safety factor assessment for the closed condition has been performed by Reitz & Jens, Inc. Our assessment found that the static and seismic stability factors of safety meet or exceeds the minimum requirements.

6.0 REFERENCES

Ameren Missouri (2011), "Operation and Maintenance Manual; Meramec Ash Pond Embankment, St. Louis, Missouri, St. Louis County." Dam Safety and Hydro Engineering, St. Louis, Missouri.

American Society of Civil Engineers (2013), *Minimum Design Loads for Buildings and Other Structures*, Standards ASCE/SEI 7-10, 3rd Printing.

EM1110-2-1902 (2003), *Slope Stability*. U.S. Army Corps of Engineers, Washington, D.C.

Hynes-Griffen, M.E. and A.G. Franklin (1984), "Rationalizing the Seismic Coefficient Method," Miscellaneous Paper GL-84-13, U.S. Department of the Army, Corps of Engineers, Waterways Experiment Station, Vicksburg, MS.

Mine Safety and Health Administration (2010), *Engineering and Design Manual, Coal Refuse Disposal Facilities*. Second Edition.

Naval Facilities Engineering Command (1986). *Soil Mechanics, Design Manual 7.01*. Alexandria, Virginia.

<u>**APPENDIX I**</u>

GEOTECHNICAL BORINGS AND CPT's

REPORT

PHASE I
GEOTECHNICAL INVESTIGATION FOR
MERAMEC POWER PLANT RAIL LOOP
ST. LOUIS, MISSOURI

Prepared for

AMEREN SERVICES
St. Louis, Missouri

Prepared by

REITZ & JENS, Inc.
Consulting Engineers
St. Louis, Missouri

STATE OF MISSOURI
JEFFREY
FOUSE
NUMBER
E-21043
12/8/99
REGISTERED PROFESSIONAL ENGINEER

December 8, 1999

The Professional, whose signature and personal seal appear hereon, assumes responsibility only for what appears in the attached report and disclaims (pursuant to Section 327.411 RSMo) any responsibility for all other plans, specifications, estimates, reports, or other documents or instruments not sealed by the undersigned Professional relating to or intended to be used for any part or parts of the project to which this report refers.

REITZ & JENS, Inc.
CONSULTING ENGINEERS
· 1055 Corporate Square Drive · St. Louis, Missouri 63132 · 314 993-4132
FAX · 314 993-4177

December 8, 1999

Ameren Services
One Ameren Plaza
1901 Chouteau Avenue
P.O. Box 66149, MC 402
St. Louis, Missouri 63166-6149

Attention: Mr. Thomas Hollenkamp, P.E.
Supervising Engineer, Engineering & Construction

Re: Report of Phase I Geotechnical Investigation for
Meramec Power Plant Rail Loop
St. Louis, Missouri

Gentlemen:

This report presents our findings and recommendations for Phase I of the geotechnical investigation for the proposed rail loop at the Meramec Power Plant. The purpose of this investigation was to further study the feasibility of alternative methods for improving the capabilities of the flyash in the various ponds at the Meramec Plant to support the new rail loop. Phase I included four borings and three cone penetrometer soundings to obtain characteristics of the subsurface materials. However, the number and locations of the borings were restricted due to lack of access into the flyash ponds that still have surface water. Only Ponds 491 and 498 could actually be investigated. We relied primarily on borings that Reitz & Jens and others have done for previous studies at the Meramec Power Plant dating back to 1937.

Where the proposed railroad embankment will be constructed on the flyash ponds, we propose removing the existing flyash to a depth of five feet, and drying and compacting the flyash on top of a 2-foot thick blanket of compacted granular backfill. This provides a densified base "mat" on which the embankment may then be constructed. This report also contains recommendations pertaining to the coal car hopper, the stability of the existing Meramec River levee, miscellaneous foundations, and other pertinent issues, plus recommendations for Phase II.

We look forward to working with Ameren Services and Design Nine during the design and construction phases. Thank you for selecting Reitz & Jens.

Sincerely,
REITZ & JENS, INC.

Jeffrey L. Fouse

Jeffrey L. Fouse, P.E.
Senior Project Engineer

Executive Summary

This is the report of our geotechnical investigation for the proposed rail loop for coal trains at the Meramec Power Plant. The study was done in general accordance with our proposal dated July 21, 1999. The purpose of this investigation was to further study the feasibility of alternative methods for improving the capabilities of the flyash in the various ponds at the Meramec Plant to support the new rail loop. Some alternatives and preliminary construction cost estimates were presented in our design memorandum, dated April 9, 1999. The alternatives considered included: 1) complete removal of the flyash, drying, and backfilling; or 2) *in situ* densification of the flyash by vibro-replacement stone columns.

The recommendations in our previous design memorandum were based upon: 1) a requirement to limit settlement of the sub-ballast to 1 inch, and 2) the depth of the flyash equal to about 35 feet. We understand from further discussion with Design Nine that settlements of several inches may be tolerated by the track structure. Differential settlement adjacent to the deep hopper pit should be limited to 1 inch, however. Also, further research of previous borings along the track alignment, and new borings made for this investigation, indicate that the average depth of the flyash is about 25 feet. Therefore, our new recommendation is a partial removal-and-replacement of the flyash.

Where the railroad loop embankment will cross the flyash ponds, we recommend removing the flyash to a depth of 5 feet. The bottom of this overdig will vary between about el. 406 and el. 411, which should be above the maximum Mississippi River stage in most years. The flyash that is removed may be dried for use as fill. A 2-foot thick of compacted granular fill should be placed in the bottom of the overdig, with a woven geofabric such as Mirafi HP570 at about the center of the granular fill. This blanket will provide a base upon which to place and compact the flyash to build the embankment. Where the embankment will cross the bottom ash ponds, we recommend constructing the embankment using coarse "shot rock" fill. The bottom ash is coarser than the flyash, so it should not be necessary to overexcavate the bottom ash to create a base.

The lower floor of the proposed coal car hopper will be at el. 365.63. Deep dewatering wells will not be used, to avoid creating a hydraulic connection between the flyash pond and the deep sands and gravels. Therefore, we recommend driving a rectangular sheetpile cofferdam, and excavating within the cofferdam without dewatering to 5 to 10 feet below the proposed bottom of the floor slab, and then using a tremie to pour a 5- to 10-foot thick concrete "mud mat." The mud mat is to provide a seal and a stable bottom so that the cofferdam may be unwatered. Interior wales and struts will be required to support the sheetpile cofferdam until the excavation is backfilled.

The proposed railroad loop will be about 75 feet from the interior of the Waste Water Treatment Pond (WWTP); therefore, the additional load should not affect the retaining wall of the WWTP. The stability of the existing Meramec River Levee at the closest points of the proposed railroad embankment is adequate for static load conditions. However, the minimum factor of safety against a deep slope failure is less than 1 for seismic loads. This is discussed further in this report.

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Meramec Power Plant Rail Loop
St. Louis, Missouri

INTRODUCTION

A railroad loop is planned for the Ameren/U.E. Meramec Power Plant in south St. Louis County, for unloading coal trains. The railroad loop will cross existing flyash and bottom ash ponds. The purpose of this investigation was to further study the feasibility of alternative methods for improving the capabilities of the flyash and bottom ash in the various ponds to support the new railroad track and embankment. This report summarizes our findings and recommendations for Phase I of this investigation, which included four borings and three cone penetrometer soundings to obtain characteristics of the subsurface materials. Because of the limited amount of field exploration under Phase I, our findings and recommendations are primarily based upon borings that Reitz & Jens and others have done for previous studies at the Meramec Power Plant dating back to 1937. The goals of Phase I were:

- develop a cross-section for the railroad track embankment where it will cross the flyash and bottom ash ponds to provide a stable subbase and to limit settlements to less than 2 inches over the first several years,
- provide foundation recommendations for the coal car hopper,
- provide recommendations for miscellaneous shallow foundations,
- provide lateral earth pressures for the design of the coal car hopper,
- check the stability of the existing Meramec River levee under the imposed load of the new railroad loop,
- check the stability of the Waste Water Treatment Pond under the imposed load of the new railroad loop, and
- provide recommendations for Phase II of the investigation.

Because the scope of services and level of effort are specific to the needs of this project, the contents of this report may not address items critical to other projects. Therefore, this report is not to be used for other projects or by third parties without Reitz and Jens' written authorization.

PROJECT DESCRIPTION

The proposed railroad loop is shown in Figure 1. Partial plans are shown in Figures 2 through 7, with the profile of the top of rail. The proposed loop is 9,263 feet long, with a connecting wye or spur track, 978 feet long, where the coal car hopper and car heaters will be located. The proposed top of rail is at about el. 419 where it will connect to the U.P.R.R. tracks (at Sta. 0+00) and rises to about el. 425 to cross the pipes that feed Ash Pond 489. The top of rail varies between about el. 417 to el. 424 around the loop. The top of rail at the coal car hopper is el. 424.38.

The typical embankment proposed by Design Nine, Inc. will be 24 feet wide, with a minimum of 12 inches of subballast. The subballast will be crushed limestone, sand and gravel, with a gradation in accordance with Missouri Department of Transportation (MoDOT) Type 2 Aggregate (100 percent passing a 1-inch sieve, 15 to 35 percent passing a No. 40 sieve, and less than 5 to 12 percent passing a No. 200 sieve). The track section will have a minimum of 10 inches of ballast below the ties.

A plan and sections of the proposed coal car hopper are shown in Figure 8. The overall interior dimensions of the hopper are 119 feet by 25 feet wide. The upper floor of the hopper is 33 feet below the top of rail. The lower floor of the hopper is 58.75 feet below the top of rail, or at el. 365.63. A permanent dewatering system will not be used. Therefore, the walls of the hopper must be designed for hydrostatic pressure and the floor slabs must be designed for the uplift pressure. The total soil bearing pressure of the coal car hopper will be 6000 psf.

Other features of the project include a "bad order" track and coal car heaters located adjacent to the hopper. Also, the railroad loop will cross an existing high-pressure natural gas pipeline at two or three locations. The depth of the gas pipeline is not known.

The existing waste water treatment pond (WWTP) located at the north end of the railroad loop has about 3 feet of water. The bottom of the pond is at el. 396. The top of the retention system is about 2.5 feet above the water level. The retention system consists of double channels with 3-inch lagging boards. The slope above the retention system is about 1.5(h) to 1(v). The approximate ground surface surrounding the WWTP is at el. 417. The centerline of the proposed railroad loop is about 75 feet from the interior wall of the pond. No additional height of embankment is planned in the vicinity of the WWTP, except for the minimum subballast and ballast.

Our findings and recommendations are based in part upon our understanding of this project, as described above. Changes or discrepancies in loads, geometry, location, or the scope of the project from the above description should be considered to invalidate our findings and recommendations until we have reviewed the differences and, if necessary, modified our findings and recommendations accordingly.

SITE DESCRIPTION

The Ameren/U.E. Meramec Power Plant is located adjacent to the confluence of the Meramec and the Mississippi Rivers, in the southern corner of St. Louis County. The site is underlain by floodplain deposits of the two rivers. The Meramec River is a relatively steeply-graded river, and carries a greater percentage of sand and gravel sediments than the Mississippi River. The deposits from the Mississippi River consist more of fine sand, silts and clays. Because of the location of the site, the deposits will be very heterogeneous, both vertically and horizontally. Deposits of soft, high plastic clay tend to occur in lenses or long channels, where temporary backwater situations were created by the relative stages of the two rivers.

The readings from piezometers previously installed at the Meramec Power Plant indicate that the general groundwater levels follow closely with the stage of the adjacent Mississippi River. Historic records of the Mississippi River stages, between 1990 and 1997, indicate that the stage varies between about el. 369 and el. 406.5, except in 1993 and 1995 when the high water stage reached about el. 416.5 and el. 412, respectively.

From Sta. 0+00 to about 4+30, the proposed railroad loop will cross the existing railroad tracks. From Sta. 4+30 to about Sta. 11+20, the loop will cross the area of the coal storage pile and the surface pipelines that carry flyash from the plant to Ash Pond 489. The wye of the loop and the coal car hopper will be located within the limits of Flyash Pond 491, also referred to as the "trash pond." This pond is inactive. The surface is at about el. 416.5 to 417.5. Therefore, up to 6 feet of fill will be required in this area. A thin crust of dry flyash provides some support. However, the all-terrain vehicle (ATV) drill rig broke through the crust several times.

From about Sta. 16+30 to Sta. 45+30, the railroad loop will cross Flyash Ponds 495 and 494. These ponds are not receiving flyash, but are used to convey excess water from Ash Pond 489 to the WWTP. So, most of the site of the proposed embankment is currently under water. Up to about 9 feet of fill will be required in Flyash Pond 495, and up to about 9 feet in 494. The centerline of the railroad loop will be about 56 feet from the top of the existing levee at Sta. 29+00 and again at Sta. 30+50.

From about Sta. 45+30, in the vicinity of the WWTP, the railroad loop will run along an existing levee, and then cross Flyash Pond 498 from Sta. 47+00 to Sta. 53+00. This pond is inactive and is dry. The surface elevation is at about 417.5. The height of the embankment will be limited to the minimum thicknesses of subballast and ballast.

From about Sta. 53+00 to Sta. 61+00, the railroad loop will cross Bottom Ash Pond 493. This pond is currently flooded. The water level was at el. 408.9 on the date of the topographic survey (September 21, 1999). The current depth of the pond and the thickness of the bottom ash are not known. From Sta. 61+00 to about Sta. 80+00, the loop will run along the edges of Bottom Ash Ponds 492 and 496, and then cross Pond 496. These ponds are either currently flooded or heavily over-grown with brush and trees. A boring was planned for this Phase I investigation in Pond 496, but we could not gain access because of the surface water. Beyond Sta. 80+00, the railroad loop will cross the existing levee and road, and join the wye to be located in Flyash Pond 491.

PREVIOUS INVESTIGATIONS

For this Phase I investigation, we reviewed subsurface information which we have in our files for projects dating back to 1937 (the original borings for the plant). The approximate locations of those historic borings pertinent to the railroad loop are shown in Figures 1 through 7.

Reitz & Jens performed an investigation for the proposed Union Colliery plant that was to be located in Bottom Ash Pond 496. Fourteen borings were made in 1975. Several of these borings, labeled "UC-" are shown in Figures 1 through 7. Consolidation tests were performed on 12 samples of the underlying low plastic and high plastic clays. These data were used in the settlement analyses for this Phase I study.

Reitz & Jens, Union Electric and an earthwork contractor experimented with methods of densifying and excavating the flyash in 1975. In general, the surface of the flyash was made trafficable by densifying with vibratory compactors and by providing a means to collect and remove the water displaced by the densification. The initial densification was done with light-weight equipment. Subsequently, heavier compactors and equipment could be used as the surface density was increased. The dry unit weight of the flyash was increased from about 60 lbs/ft ^{3} to between 78 and 88 lbs/ft^3. This indicates a possible shrinkage of about 20 percent.

Reitz & Jens investigated a number of slides in the Meramec River levee between 1978 and 1987. Fourteen borings were made in Flyash Ponds 490 and 498 in 1988 for a study for the transfer of flyash between ponds. The data from these borings indicated that there is a relatively "weak clay layer" throughout the site between about el. 350 and el. 370.

<u>Design Memorandum of Geotechnical Considerations/Cost Estimate</u>

As directed by Ameren Services on March 19,1999, we have reviewed our internal records and the existing site conditions to develop the following preliminary recommendations for constructing the railroad loop. No more than 1 inch of differential settlement in the subballast was to be considered at that time. Two options are available for reworking the bottom ash: 1) complete removal and replacement of the flyash, and 2) in-situ densification.

Using previous records of the material properties of the flyash in the ponds, we estimated the temporary and permanent slopes and cross-sections required to construct and support the anticipated railroad loads. The existing data suggested a temporary excavation up to 35 feet deep would require approximately 4.5:1 side slopes to be stable without dewatering the ponds. Based on these slopes, we estimated that a total of 1,400,000 c.y. of flyash would be excavated and temporarily stockpiled. Approximately 390,000 c.y. of this material would be dried and recompacted to create the 1:1 slopes. We assumed that the remaining 1,000,000 c.y. of flyash would be pushed back into the excavation to confine the new slope. Approximately 16,600 c.y. (29,000 tons) of MODOT Type 2 aggregate would be needed to cap the flyash fill above the existing ground surface and to construct the subballast. An additional 10,000 c.y. (15,500 tons) of shot rock would be required to create the desired cross-section across the existing bottom ash pond.

The total estimated cost to create an adequate railroad subgrade using the remove and replace method was $ 7.3 million.

An alternative to the complete removal and replacement that was considered was to densify the existing flyash fills in place. We contacted Hayward Baker, Inc. to discuss alternative methods for densifying the existing flyash fills in this manner. They advised they had recently completed a similar project in a flyash pond for Pekin Energy in Pekin, Illinois. Hayward Baker 's preliminary recommendations for the Meramec railroad loop were to densify the existing flyash beneath the new embankment using vibro-replacement stone columns. Their preliminary estimate would require 3-ft. diameter stone columns to the underlying natural soils on an 8-foot by 8-foot grid. Their preliminary cost estimate for densifying an area of flyash 44 feet wide by 35 feet deep and 6500 feet long was $4.2 million. The cost for building the fills in the bottom ash ponds, raising the tracks above the existing ponds, and importing the necessary MODOT Type 2 aggregate for the subballast added approximately $ 700,000.

On the basis of these preliminary construction cost estimates, we proceeded with this Phase I investigation. Initially, deep soil mixing was also considered to improve the characteristics of the flyash in-situ. Some laboratory tests using the flyash and several admixtures were performed. From further discussions with Design Nine, we understand that settlements of several inches may be tolerated by the track structure. Differential settlement adjacent to the deep hopper pit should be limited to 1 inch, however.

SUBSURFACE INVESTIGATION

The field work for this investigation consisted of four test holes and four cone penetrometer soundings, the approximate locations of which are shown in Figures 1 through 7. Test holes were located by Reitz & Jens using existing features. The elevation of the existing ground surface at each boring was estimated from the contour lines on the topographic survey dated September 21, 1999. The test holes were drilled between August 26 and September 1, 1999, by Brotcke Well and Pump, Inc., using a CME 750 drilling rig mounted on an all-terrain vehicle (ATV). The test holes were advanced using 4-¼ in. I.D. hollow-stem augers. Borings TH-H and TH-N were drilled to auger or sampler refusal on bedrock, about 108 feet and 106.5 feet deep, respectively. Borings TH-A and TH-L were drilled into through the flyash and into the underlying natural clay. The field investigation was done under the direction of a Reitz & Jens ' Senior Soils Technician, who determined the sampling intervals and the termination depths, and logged the borings. Detailed boring logs included in Appendix A. Graphic representations of the major soil strata encountered in the borings are shown in Figures 2 through 7.

Samples of subsurface materials were obtained at about 2.5-foot intervals for the first 10 feet, and at 5-foot intervals below 10 feet. Two types of samplers were used: 1) a hydraulically pushed, 3-in. O.D., thin-walled "Shelby tube" sampler (ASTM D-1587); and 2) a 2-in. O.D., split-spoon sampler driven by a 140-lb. hammer in conjunction with a Standard Penetration Test (ASTM D-1586). The blow counts from these tests are shown on the boring logs. The disturbed split-spoon samples obtained were visually classified in the field and sealed in glass jars to prevent loss of moisture, for later testing in the laboratory. The relatively undisturbed Shelby tube samples were sealed in the tubes for testing in the laboratory. Borings were logged in the field based upon recovered samples, cuttings, and drilling characteristics. Boring logs were subsequently modified as appropriate based on laboratory test results.

In addition to the borings, cone penetrometer sounds through the flyash were made at TH-G, and adjacent to Borings TH-H and TH-L. This was done to develop correlations between the results of the cone penetrometer and the borings, which may be used in Phase II of this investigation. The results of the cone penetrometer readings are included in Appendix C.

LABORATORY TESTING PROGRAM

All recovered samples were visually described in general accordance with the Unified Soil Classification System and the Standard Test Method for Classification, Description, and Identification of Soils (ASTM D-2487 and D-2488). Index tests performed included: water content and dry unit weight (ASTM D-2216), liquid and plastic limits (ASTM D-4318), unconfined compressive strength (ASTM D-2166). The results of these index tests appear on the detailed borings logs. A consolidated and undrained triaxial shear strength test with pore pressure readings was performed on a flyash sample from Boring TH-N. Eight consolidation tests were performed on samples of the flyash and the underlying clays. The number of triaxial and consolidation tests were limited because of the difficulty in obtaining and preparing relatively undisturbed samples of the flyash. The results of the triaxial and consolidation tests are presented in Appendix B.

Testing of Admixtures to Flyash

As stated previously, deep soil mixing was considered to improve the properties of the flyash in place. Deep soil mixing involves the mixing of an additive, such as cement, lime or flyash, to the soil by use of rotating "paddles" arranged in a row. We simulated the in-situ mixing of the flyash with a blender, using dough-hooks and a limited mixing time of 1 minute, as suggested by Hayward-Baker. We mixed combinations of flyash and cement, flyash and Type "C" flyash, flyash and hydrated lime, and part cement and part Type "C" flyash. We formed miniature cylinders, which were moist cured and tested for unconfined compressive shear strength at 3, 7 and 14 days. We had numerous difficulties in preparing and forming the cylinders. Our initial results indicated that adding the Type "C" flyash had little benefit compared to the disturbance by the mixing itself. Substantial gains in strength were achieved using cement or hydrated lime, but this significantly increases the costs of the deep soil mixing. We stopped further testing when it was decided that a partial remove-and-replacement scheme would be effective.

SUMMARY OF SUBSURFACE CONDITIONS ENCOUNTERED

Generalized subsurface profiles are shown along the railroad loop in Figures 2 through 7. The depths of the flyash in the existing ponds ranged from about 11 to 30 feet deep, and averaged about 25 feet deep. Underlying the flyash are strata of low plastic silty clays, silts, and high plastic clays, with various intermediate strata of sands and gravels. The stratification is very variable due to the alluvial origin of the deposits, as discussed earlier. Generally, the clay strata contained layers and seams of fine sand and silty sand. Also, the clay strata are generally near normally-consolidated, that is the strata have not previously been subjected to higher overburden pressures than exist at present.

Where present, the top of the underlying sand and gravel stratum varied between el. 325 and about el. 368. A few deep borings encountered high plastic clays all the way to the top of the underlying limestone bedrock. The top of the limestone ranged between el. 304 and el. 310, and generally sloped slightly toward the Mississippi River.

EVALUATION AND RECOMMENDATIONS

Railroad Track

Flyash Ponds

Where the railroad loop embankment will cross the flyash ponds, we recommend removing the flyash to a depth of 5 feet. The typical track section is shown in Figure 9. The bottom of this overdig will vary between about el. 406 and el. 411, which should be above the maximum Mississippi River stage in most years. The flyash that is removed may be dried for use as fill. A 2-foot thick of compacted granular fill should be placed in the bottom of the overdig, with a woven geofabric such as Mirafi HP570 at about the center of the granular fill. This blanket will provide a base upon which to place and compact the flyash to build the embankment. The fill should be compacted as recommended under "Fill Materials and Placement."

With a confining pressure from the surrounding ash, the design criteria can be adequately met with dried and recompacted flyash at a 1(v) to 1(h) slope. Where there is no confining pressure, 1(v)-to-3(h) slopes should be used for compacted flyash fills greater than 10 feet high, and 1(v)-to-2(h) slopes for fills under 10 feet high. Any flyash fills exposed to surface runoff should be covered with 2 feet of non-erodible material, such as the MoDOT Type 2 aggregate used to build the track subballast.

Using this section, we anticipate that the total settlement in the flyash ponds below the embankments will vary from about 3 to 14 inches. However, this settlement should occur during the construction of the embankment itself, due to the rapid consolidation of the flyash. The lower clays are subject to less change in stress, and the numerous horizontal sand seam and layers will promote more rapid settlement than may be estimated based upon laboratory test data. Secondary consolidation will take place following the construction of the embankment. The estimated rate of secondary settlement is about 4 inches over the first two years.

Bottom Ash Ponds

Where the embankment will cross the bottom ash ponds, we recommend constructing the embankment using coarse "shot rock" fill. The bottom ash is coarser than the flyash, so it should not be necessary to overexcavate the bottom ash to create a base. A typical track section is shown in Figure 9.

Meramec River Levee

The proposed railroad loop will require fill to achieve grade, and will approach close to the existing levee near Sta. 29+00. The stability of the existing levee with the added fill and train load was analyzed using data obtained from previous investigations of the slides in the levee.

The maximum top of rail elevation is assumed to be 422. The rail centerline is about 21 feet from the top of levee centerline. This area adjacent to station 29+00 is in the vicinity of previous landslides along the outer and inner face of the levee. Inner face slides occurred during construction in 1980. The outer face slides occurred about 1988. The outer face slides were repaired with the addition of a stability berm at the outside toe of the levee. The following table shows the calculated factors of safety for different loading conditions.

Calculated Factors of Safety Station 29+00

LOAD CONDITION	Static Condition	Seismic Event $a = 0.15g$
Existing Embankment	1.98	0.88
Track Embankment Added	1.60	0.82
Loaded Train on Track	1.53	0.81

An example of the stability analyses at Sta. 29+00 is shown in Figure 10. The calculated factors of safety indicate that the static condition should be stable. The factors of safety less than 1.0 for the seismic event required calculation of the required shear strengths needed for the soft clays at depth to provide a factor of safety equal to 1.0, and inversely what seismic acceleration can be tolerated for the existing strength of the soils. The soft clay soils need to have a shear strength of about 610 psf, versus the indicated strength of 450 psf. The present soils can resist a seismic acceleration of about 0.096g.

The track embankment construction will require about 8.5 feet of embankment fill. The calculated factors of safety are greater than 2.0 for all load conditions on the inside side of the proposed track loop.

Opposite Station 30+50 the track alignment is about the same distance from the top of existing levee, but the levee section does not have the stabilizing berm at the outside toe. The following table shows some of the calculated factors of safety at this station.

Calculated Factors of Safety Station 30+50

LOAD CONDITION	Static Condition	Seismic Event a = 0.15g
Existing Embankment	1.837	0.870
Track Embankment Added	1.473	NOT CALC.
Loaded Train on Track	1.409	0.795

The above analysis utilized the soil strengths measured in clays that were not loaded from an embankment. The location opposite Sta. 30+50 is at the location of an older levee section and ash disposal pond. It is thought that the soils have gained strength from a longer period of consolidation, and that these slightly lower calculated factors of safety for the static conditions are acceptable, based on the probable presence of soils stronger than the analyzed strengths.

The soil strengths should be sampled and tested to obtain a better understanding of the seismic resistance, if the owner wishes to have protection for an event with an acceleration greater than 0.09g.

Waste Water Treatment Pond

The proposed top of rail in the vicinity of the WWTP is about el. 420, or 24 feet above the bottom of the pond. The centerline of the track is about 75 feet from the near face of the pond. Therefore, the WWTP should be stable without any corrective measures.

Coal Car Hopper

The excavation for the coal car hopper will be largely influenced by the stage of the Mississippi River. Historic river stages from 1990 through 1997 are shown in Figure 11. Based upon this data, it appears that a normal high water to be used in the design of the temporary excavation shoring is about el. 406.5, which generally occur during April through June. The design of the permanent walls and floor slabs should be based upon maximum possible water level before the hopper would become flooded. The 100-year flood level is el. 418.

The lower floor of the proposed coal car hopper will be at el. 365.63. Deep dewatering wells will not be used, to avoid creating a hydraulic connection between the flyash pond and the deep sands and gravels. Therefore, we recommend driving a rectangular sheetpile cofferdam, and excavating within the cofferdam without dewatering to 5 to 10 feet below the proposed bottom of the floor slab, and then using a tremie to pour a 5- to 10-foot thick concrete "mud mat." The mud mat is to provide a seal and a stable bottom so that the cofferdam may be unwatered. Interior wales and struts will be required to support the sheetpile cofferdam until the excavation is backfilled. The thickness of the mud mat will have to be designed to resist the upward water pressure.

Recommended lateral earth pressures for various design conditions are shown in Figure 12. The design of the temporary sheetpile cofferdam should be based upon the total of the lateral earth pressure and the hydrostatic water pressure for a water level at el. 406.5. The total is about 4000 psf at the base of the excavation. If PZ-27 sheetpiles with a yield strength of 50 ksi are used, then the cofferdam will require horizontal wales and struts at about 14 feet on centers vertically.

The permanent reinforce concrete walls should be designed for two lateral earth pressures - short-term and long-term, as shown in Figure 12. The short-term distribution of lateral earth pressures will govern the design of the upper part of the wall. Over time, the lateral earth pressures will redistribute as shown for the long-term pressures in Figure 12. Therefore, the lower part of the wall should be designed to resist the higher long-term lateral earth pressures. The total design pressure on the wall is the total of the lateral earth pressures, either short-term or long-term, and the hydrostatic pressure for a water level at el. 424.38 (the top of rail).

The short interior cross-wall should be designed to resist the lateral surcharge pressure due to the upper floor (with an assumed soil bearing pressure of 6000 psf), and the lateral earth pressure of the granular fill, as shown in Figure 12.

The coal car hopper must also be designed to resist the uplift hydrostatic pressure, or buoyancy. If the dead load of the hopper and equipment is less than the uplift pressure (3978 psf), then additional vertical resistance may be obtained by using rock bolts grouted into the underlying limestone.

Some differential settlement should be expected between the hopper and the adjacent railroad embankment. This may be reduced by using reinforced concrete approach slabs on either end of the hopper.

Miscellaneous Foundations

Shallow footings bearing on the compacted flyash section may be designed for bearing pressures of 1500 psf for continuous or wall footings, and 1800 psf for isolated square footings that are on level ground (that is, where the horizontal distance from the near edge of a footing to the face of a slope is more than three times the footing width). These values may be increased by 33 percent for temporary or transient loads, such as wind loads.

Resistance to lateral loads may be based on a design base shear of 500 psf between cast-in-place concrete and the compacted fill. The passive lateral resistance of the soil against vertical faces between 3 and 7 feet deep may be based on an "equivalent fluid pressure" using an equivalent unit weight of 300 lb/ft^3. These values are for footings on level ground, as defined above, and are for "ultimate" soil resistance; a minimum factor of safety of 1.5 should be used for design.

Exterior footings, or interior footings that may be subjected to the same temperature extremes as exterior footings, should be founded below the potential for heave due to frost penetration or dessication. This is generally accepted to be 2.5 feet in the St. Louis area.

Continuous footings should be a minimum of 18 inches wide. Square or rectangular footings should have a minimum dimension of 30 inches.

Crossing Gas Pipeline

The railroad loop will cross the existing high pressure gas line in 2 or 3 locations. A reinforce concrete slab will probably be required to reduce the vertical stress on the pipeline. The design of the slab will depend upon the depth of the pipeline, which is not known at this time, and the adjacent soil properties. Recommendations may be presented in Phase II of this study, if needed.

General Recommendations

Site Preparation

Prior to fill placement or paving construction, vegetation and soil containing significant amounts of organics be stripped and wasted or used in landscaped areas. Where fill is to be placed on an existing slope that is steeper than 4(h) to 1(v), the existing slope should be notched or benched to tie each lift of fill into the existing soil, to prevent the formation of a weak sliding plane.

Site Excavations and Slopes

Temporary cut slopes should be no steeper than 1(h) to 1(v). OSHA guidelines should be followed for all excavations or trenches greater than 4 feet deep. Permanent slopes in fills less than 10 feet high should be no steeper than 2(h) to 1(v), and 3(h) to 1(v) over 10 feet high.

Fill Materials and Placement

Imported fill materials should consist of uncontaminated, inert, non-expansive soils classified as silty clay (CL), clayey silt (ML), sand (SP, SM, SW, SC) or gravel (GP, GW, GC). The liquid limit of clayey soils should be less than 50 percent, and the plasticity index should be at least 10 percent. Imported fill material should not contain roots or other similar organic matter, trash, frozen material, chemical contamination, or rock or concrete fragments larger than 6 inches in the maximum dimension.

Fill materials should be placed in uniform, horizontal lifts, and compacted in systematic coverages of the entire lift. The thickness of the loose lift (prior to compaction) should not exceed 12 inches where large, self-propelled compaction equipment can be used. In confined areas or immediately adjacent to retaining walls, where manual compactors are required, the lift thickness should not exceed 6 inches prior to compaction.

The compaction characteristics of fine-grain soils, such as clays or clayey silts or the flyash, are dependent upon water content. For these materials, the water content should be adjusted prior to compaction, either by sprinkling additional water, or by scarifying, discing and drying to lower the water content. Normally, materials on site will have to be dried prior to compaction.

Fill should be compacted to a dry unit weight equal to at least 92 percent of the maximum dry unit weight determined by the modified Proctor method (ASTM D-1557). Fill in other areas may be compacted to 85 percent of the maximum dry unit weight.

The compaction of granular materials is based on the minimum and maximum densities determined by laboratory tests (ASTM D-4253 and D-4254). Granular fill should be compacted to a relative density of 75 percent. Granular fill behind retaining walls where potential surface settlement is not a problem may be compacted to a minimum relative density of 70 percent.

Seismic Considerations

St. Louis is situated near one of the more currently active seismic regions in the central and eastern United States. Slightly more than 100 miles to the south, three of the largest earthquakes ever to occur in the interior of a tectonic plate rocked the New Madrid region during the winter of 1811-1812. Although the New Madrid zone is the most seismically active region in the vicinity of St. Louis, potentially damaging earthquakes have also occurred outside of the New Madrid zone in Missouri and southern Illinois.

The following recommendations are based on the 1996 BOCA requirements. The minimum seismic forces are based in part on the effective peak velocity-related acceleration (A_v), the effective peak acceleration (A_a), and the site coefficient (S). The values of A_v and A_a would vary slightly across the St. Louis region. Therefore, St. Louis County has adopted values of $A_v = 0.13$ and $A_a = 0.12$ for use throughout the County. The site coefficient (S) = 2.0, which corresponds to a soil profile type S_4.

Two effects of a seismic event that may affect this project are slope failures and liquefaction. The problems associated with slope failure are discussed under "Meramec River Levee." Liquefaction rarely occurs in sands and silts that have more than 35 percent of "fines" (that is passing the No. 200 sieve.) Based upon previous test data, it appears that the flyash has a minimum of 60 percent of fines. Therefore, liquefaction should not be a problem.

RECOMMENDATIONS FOR FURTHER INVESTIGATION

Borings and Cone Penetrometer Soundings

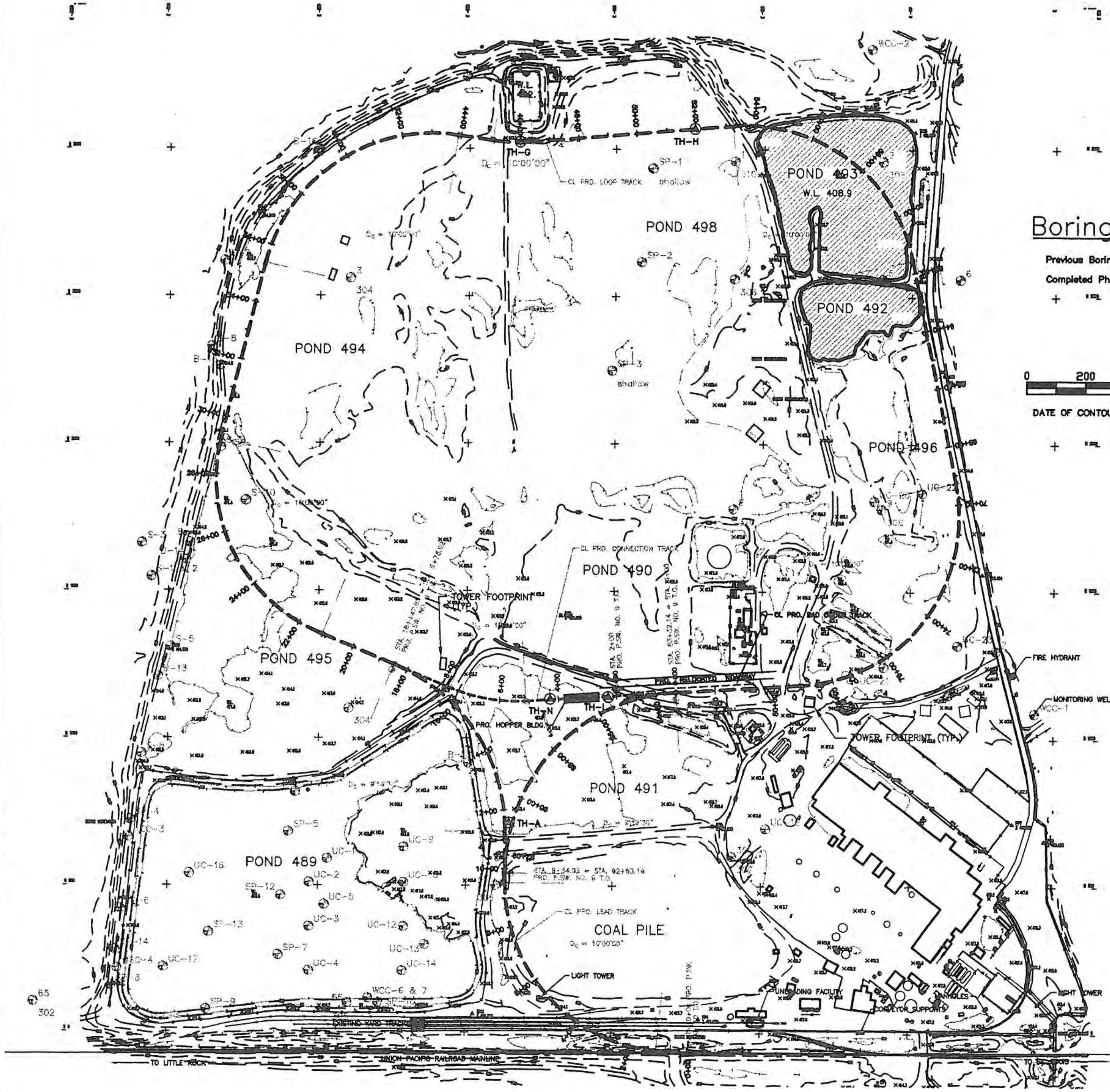
The original proposal for this investigation included borings along the centerline of the railroad loop in the flyash ponds where there are no previous borings. The primary purpose of these borings is to determine the thickness of the flyash. Using the data from the cone penetrometer soundings and borings for Phase I, cone penetrometer soundings may be used in lieu of borings. However, site access is still a problem because the flyash ponds are being used to convey waste water to the WWTP. Depending upon the final design, some additional sounding should be done, particularly in the vicinity of Sta. 29+00 to 30+50 where the railroad loop is close to the Meramec River levee.

Construction of Test Section

We recommend constructing a test section in Flyash Pond 495. This will provide information on the constructability of the proposed track section, the ability to drain the existing flyash in the temporary excavation, and settlement. Also, we recommend performing deflection tests on the constructed subballast using a fully-loaded dump truck or scraper, to provide data on the modulus of the subballast.

LIMITATIONS

The boring logs depict subsurface conditions for specific locations and dates. The recommendations and observations presented in the report assume that significant variations do not occur. Non-uniform conditions, however, often cannot be determined by the procedures described. Where present, such conditions may necessitate additional expenditures to obtain a properly constructed project. We recommend that a contingency fund be budgeted to accommodate such possible variations.



Boring Legend

- Previous Boring — 1
- Completed Phase 1 Boring — TH-A

0 200 400

DATE OF CONTOURS 9/21/99

KEY TO SOIL SYMBOLS

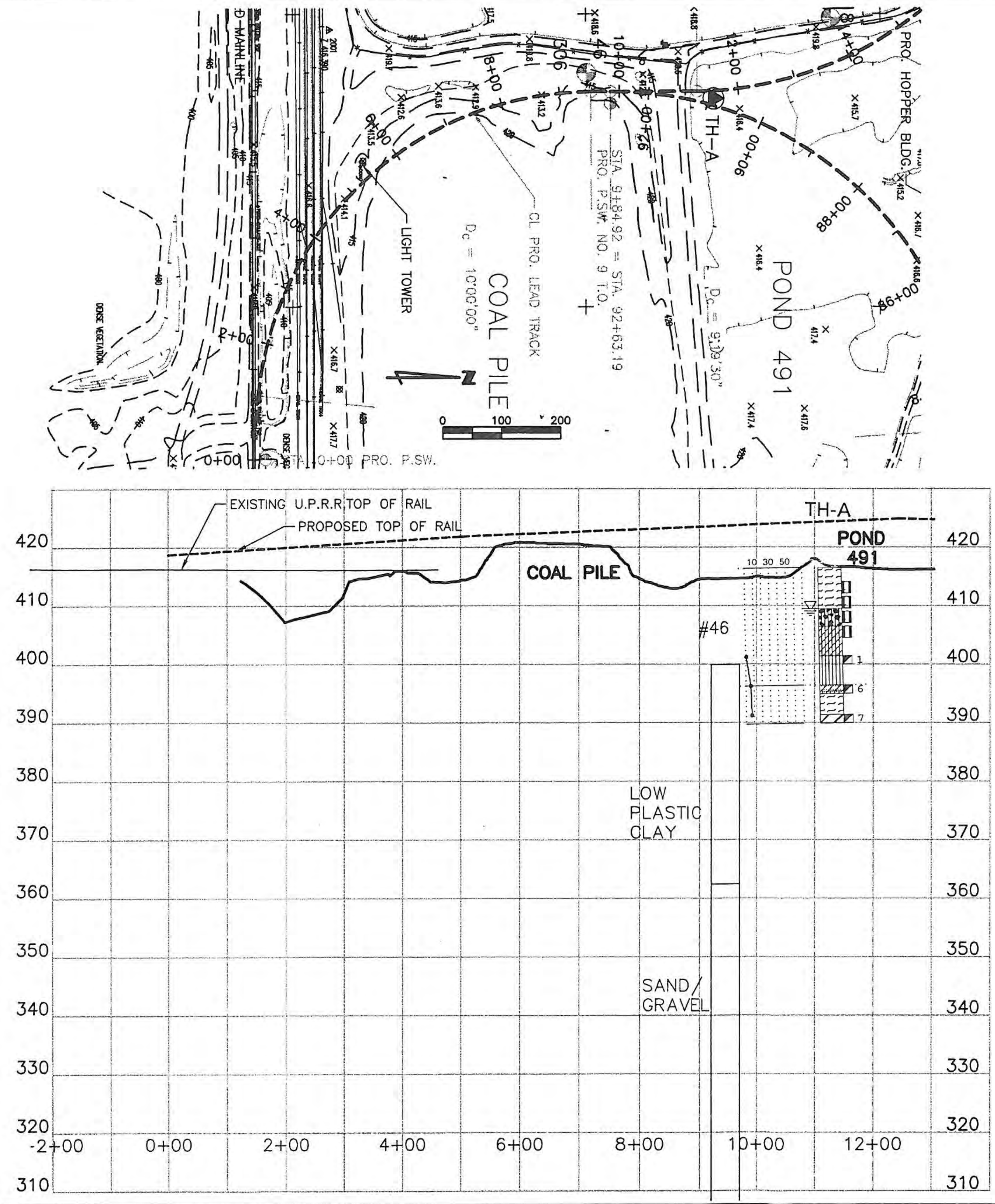
- FLYASH
- Silty GRAVEL (GM)
- Low plastic Silty CLAY/ Clayey SILT (CL-ML)
- Silty SAND or Sandy SILT (SM)
- High plastic CLAY (CH)
- Inorganic, non-plastic SILT (ML)
- Clayey SAND or Sandy CLAY (SC)

SCALE: HORZ 1"= 400'

RAIL LOOP BORING LOCATION	
REITZ & JENS, INC. Consulting Engineers	FIGURE 1

10/19/99

92199TOPO.DWG



SCALE: HORZ 1"= 200'
VERT. 1"= 20'

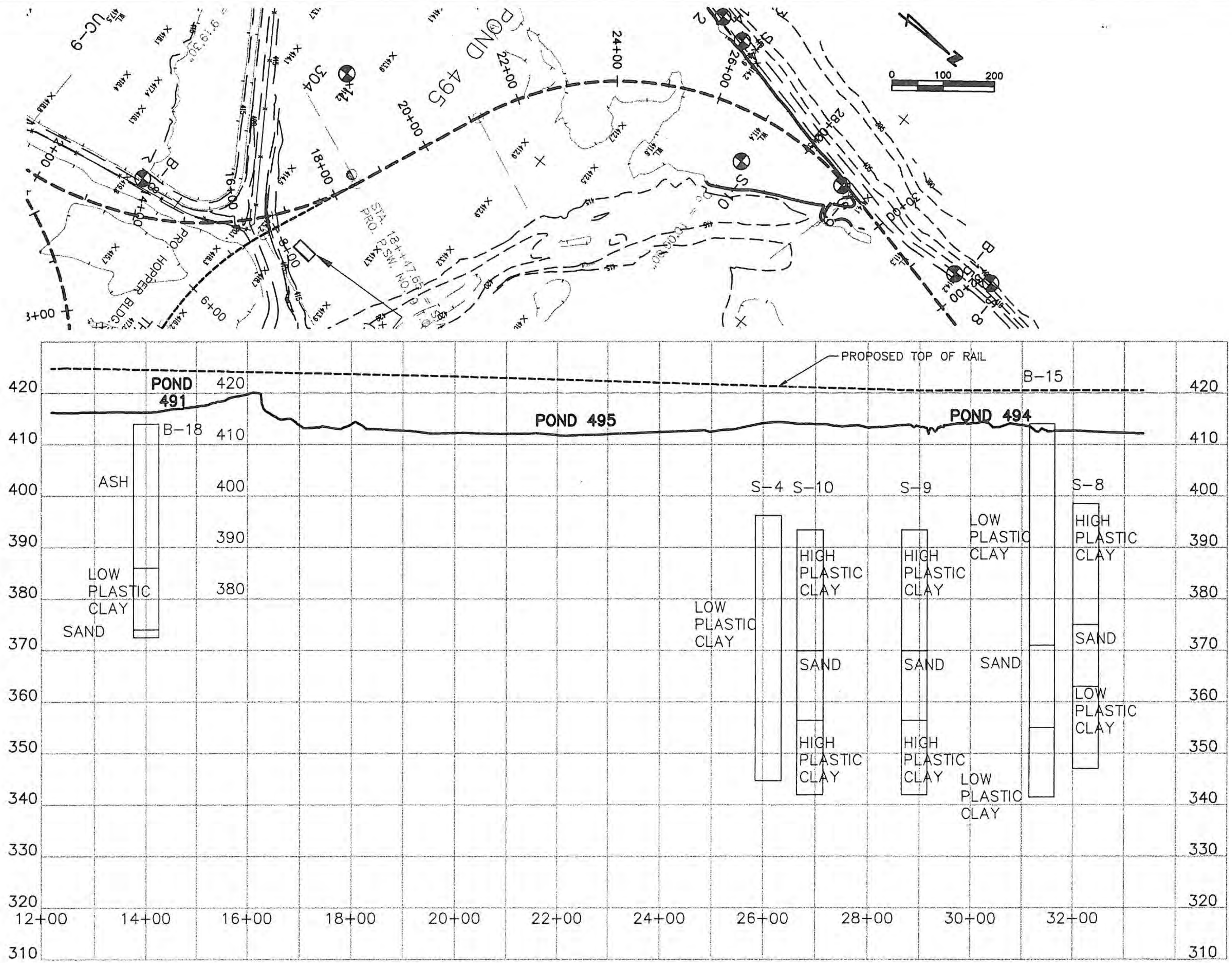
RAIL LOOP 0+00 TO 12+00
PLAN & PROFILE

REITZ & JENS, INC.
Consulting Engineers

FIGURE
2

12/8/99

RLP1.DWG



SCALE: HORZ 1"= 200'
VERT. 1"= 20'

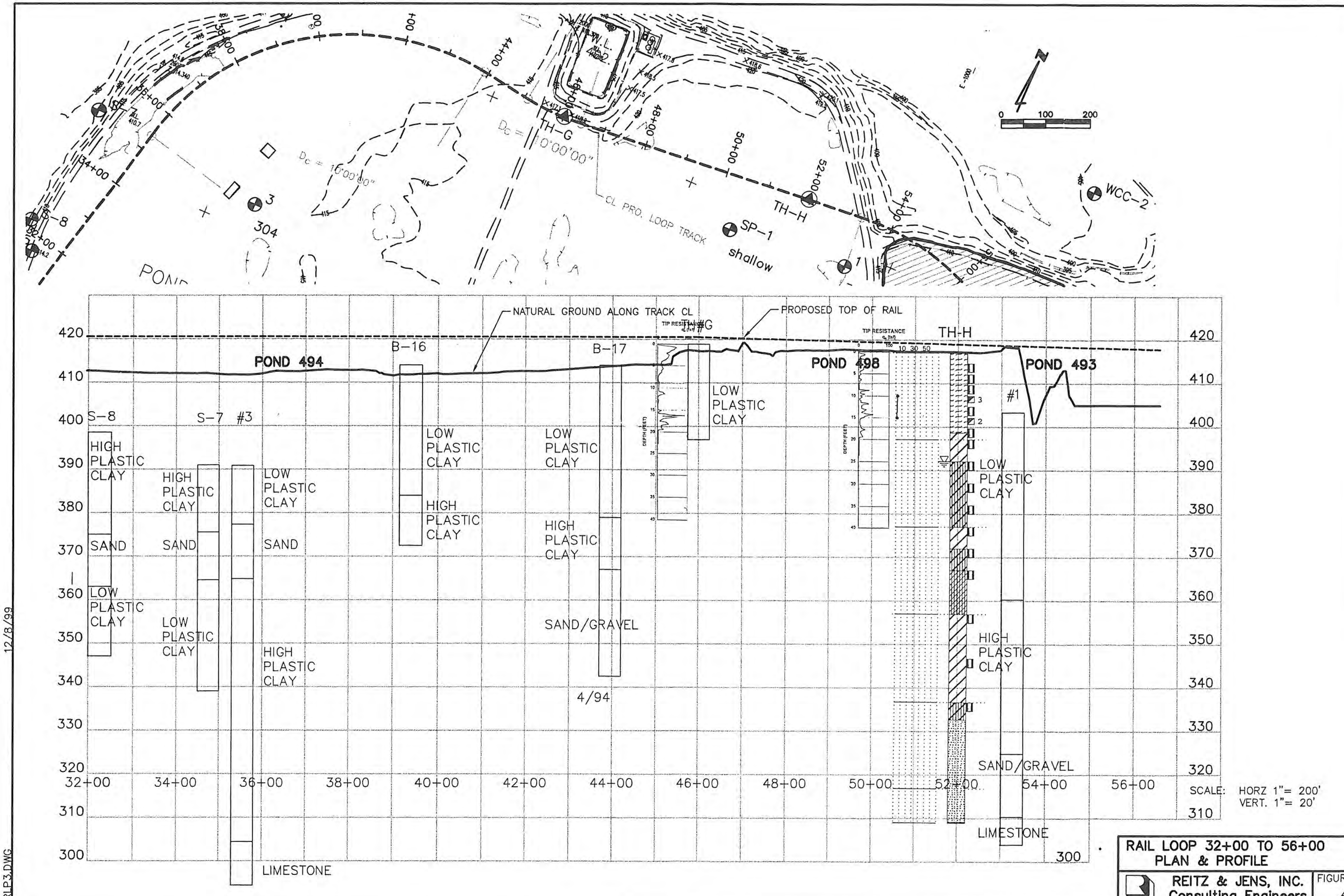
12/8/99

RLP2.DWG

RAIL LOOP 12+00 TO 32+00
PLAN & PROFILE

REITZ & JENS, INC.
Consulting Engineers

FIGURE 3



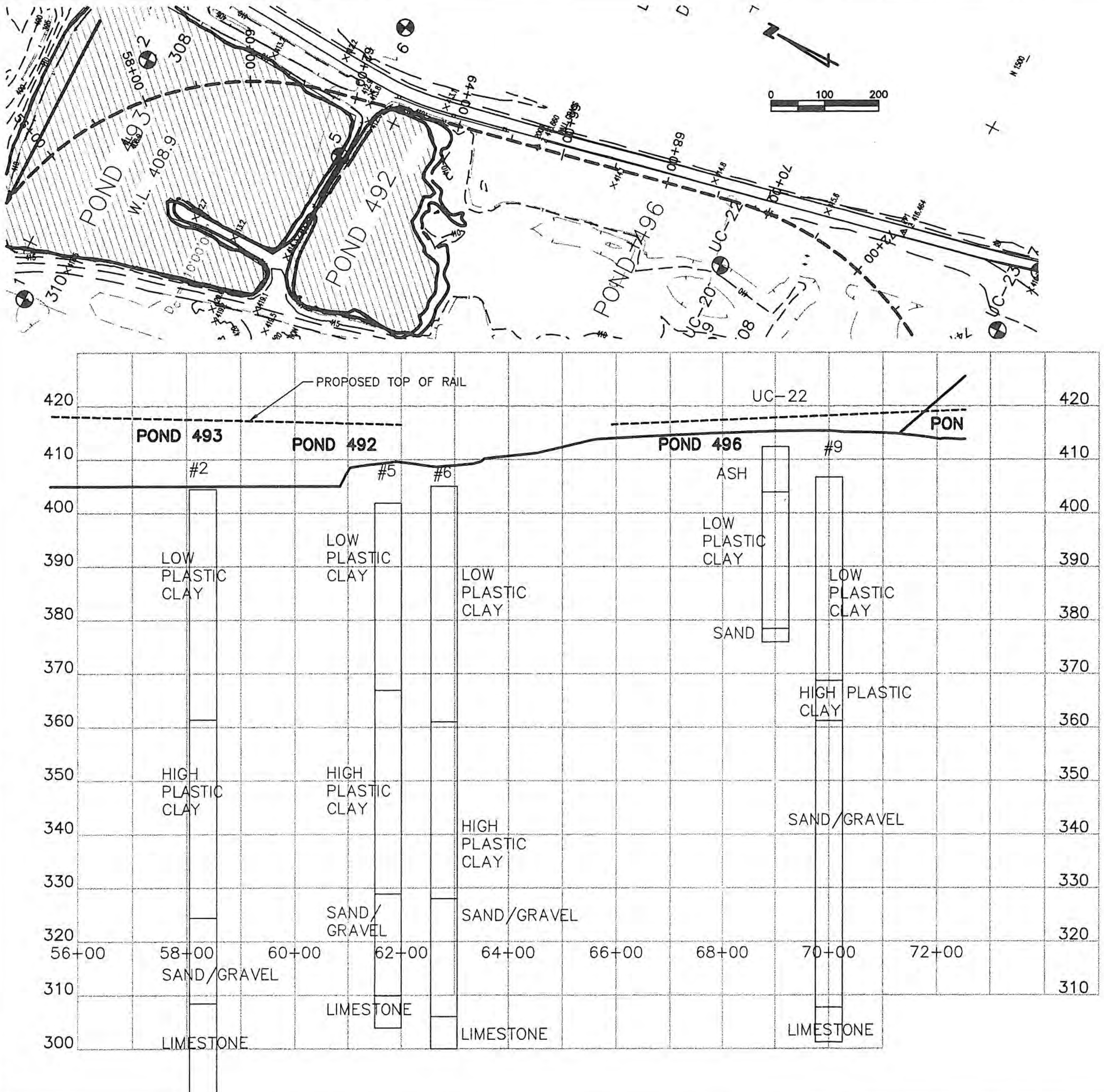
RAIL LOOP 32+00 TO 56+00
PLAN & PROFILE

REITZ & JENS, INC.
Consulting Engineers

FIGURE 4

12/8/99

RLP3.DWG



SCALE: HORZ 1"= 200'
VERT. 1"= 20'

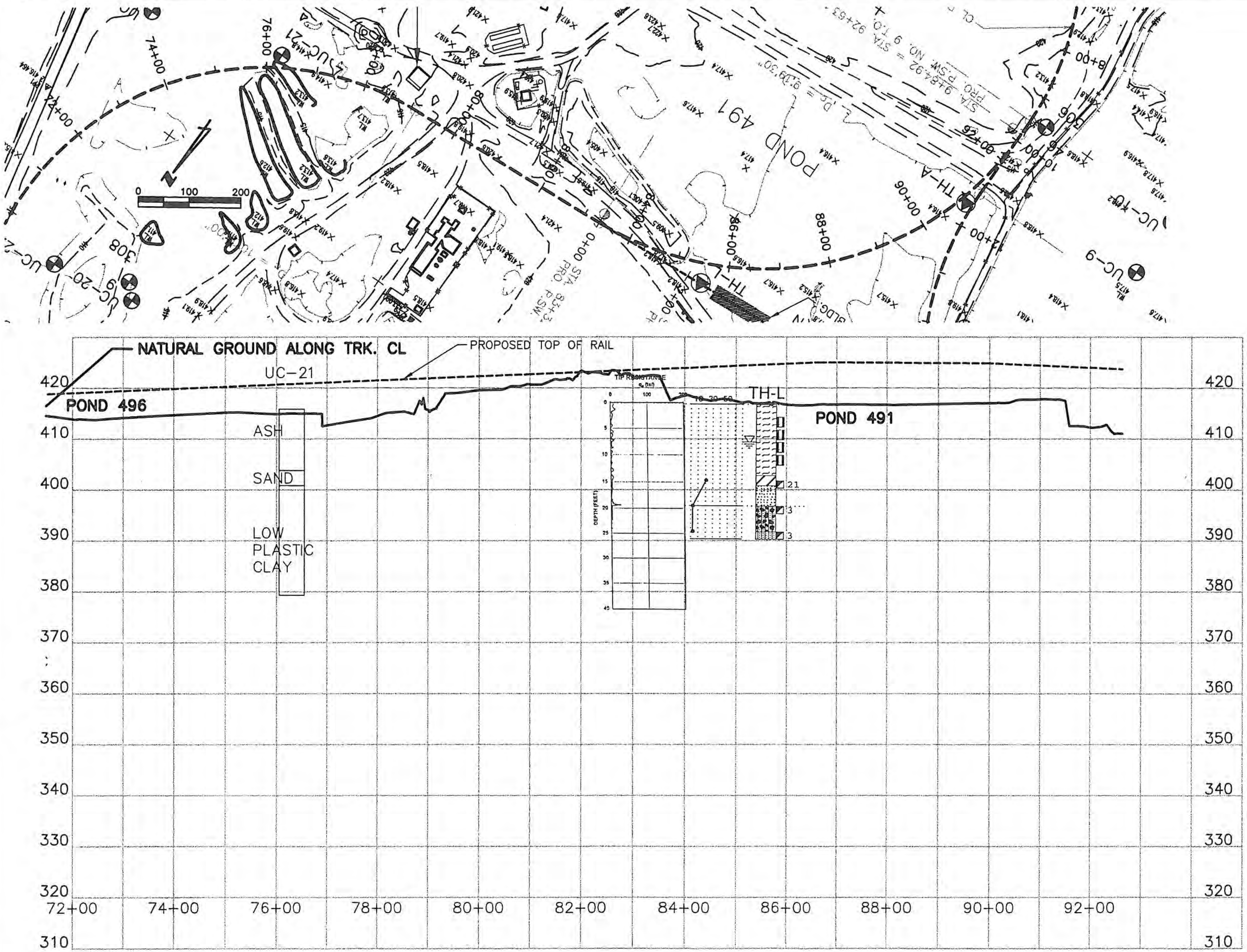
RAIL LOOP 56+00 TO 72+00
PLAN & PROFILE

REITZ & JENS, INC.
Consulting Engineers

FIGURE
5

12/8/99

RLP4.DWG

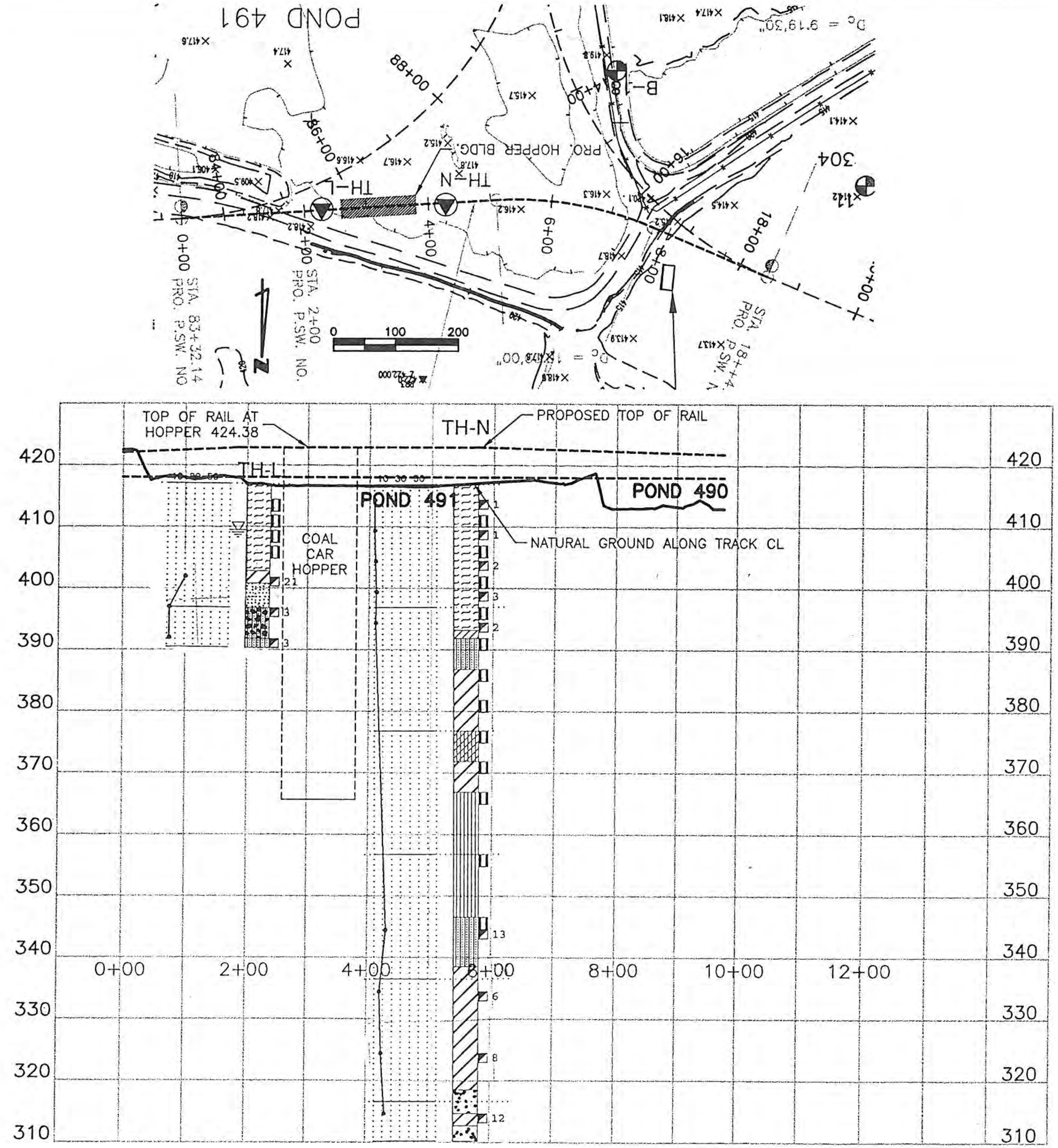


SCALE: HORZ 1"= 200'
VERT. 1"= 20'

12/8/99

RLP5.DWG

RAIL LOOP 72+00 TO 92+00 PALN & PROFILE	
REITZ & JENS, INC. Consulting Engineers	FIGURE 6



SCALE: HORZ 1"= 200'
VERT. 1"= 20'

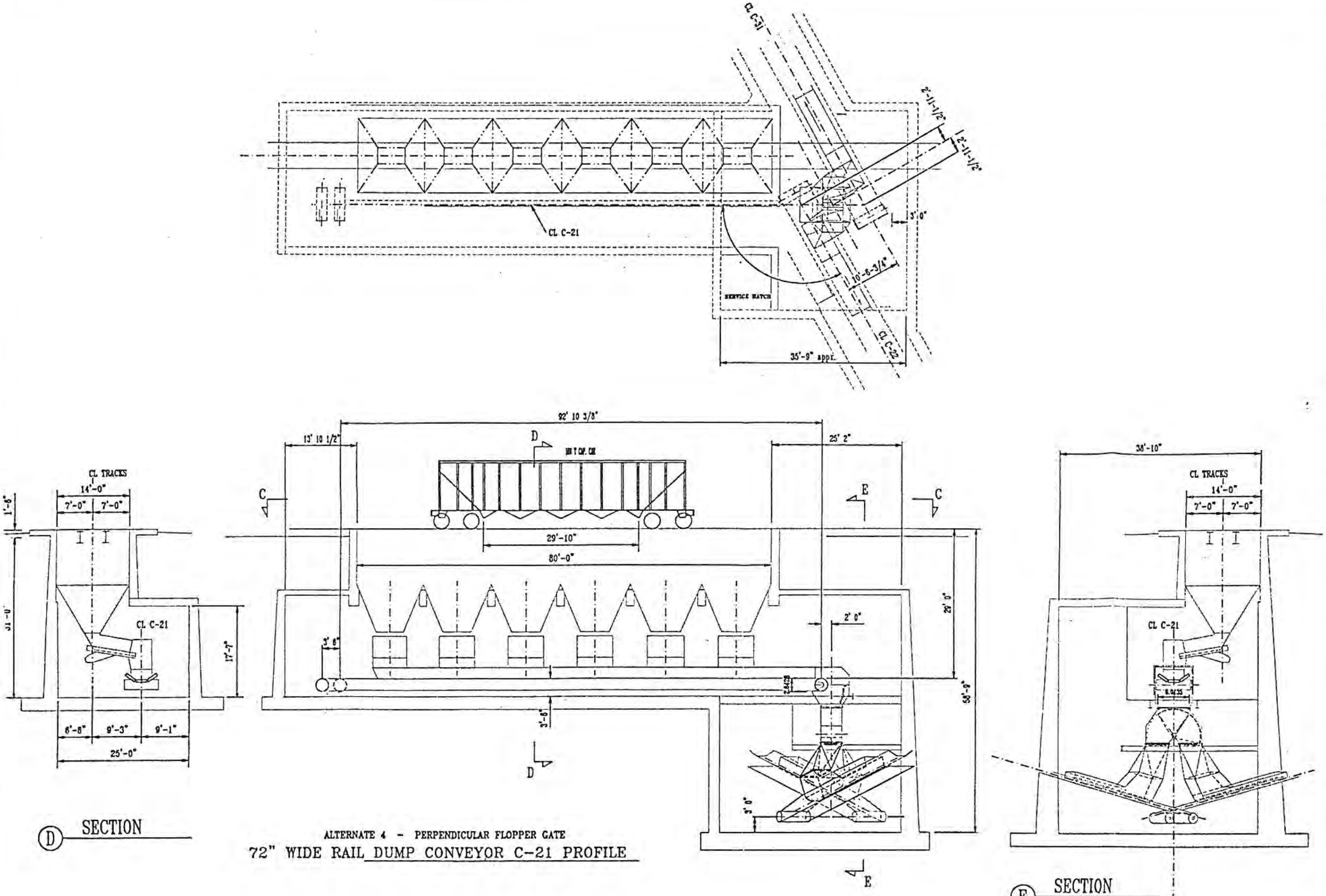
HOPPER SPUR 0+00 TO 12+00
PLAN & PROFILE

REITZ & JENS, INC.
Consulting Engineers

FIGURE
7

12/8/99

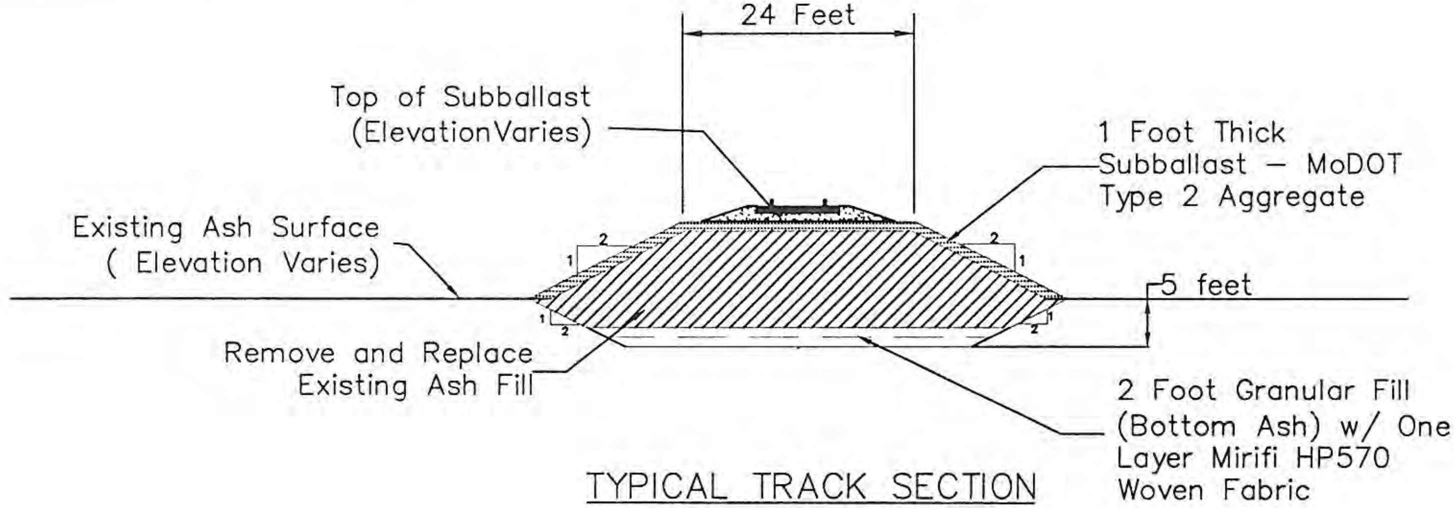
RLP6.DWG



PROPOSED COAL CAR HOPPER

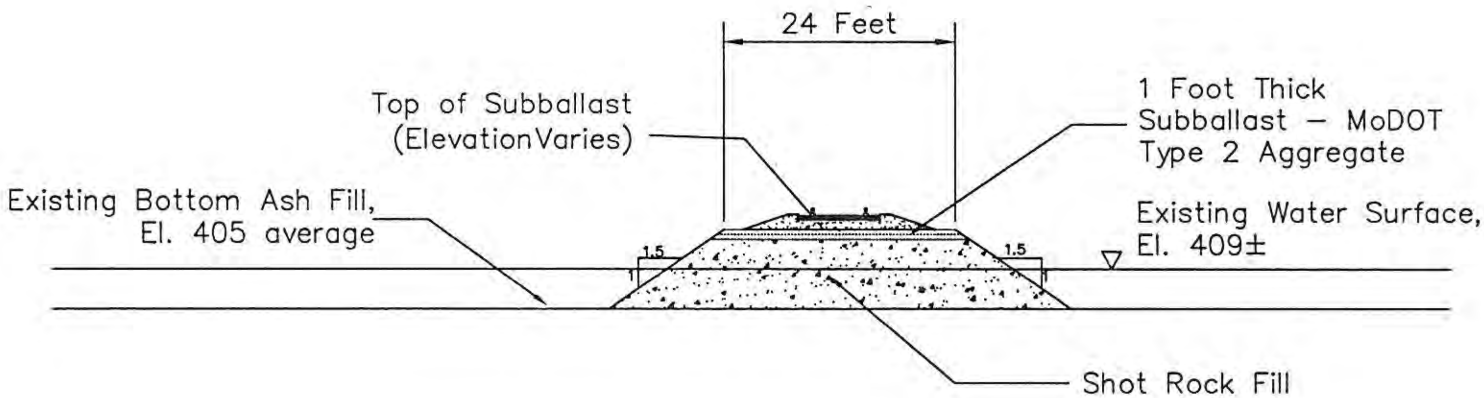
REITZ & JENS, INC.
Consulting Engineers

FIGURE 8



TYPICAL TRACK SECTION

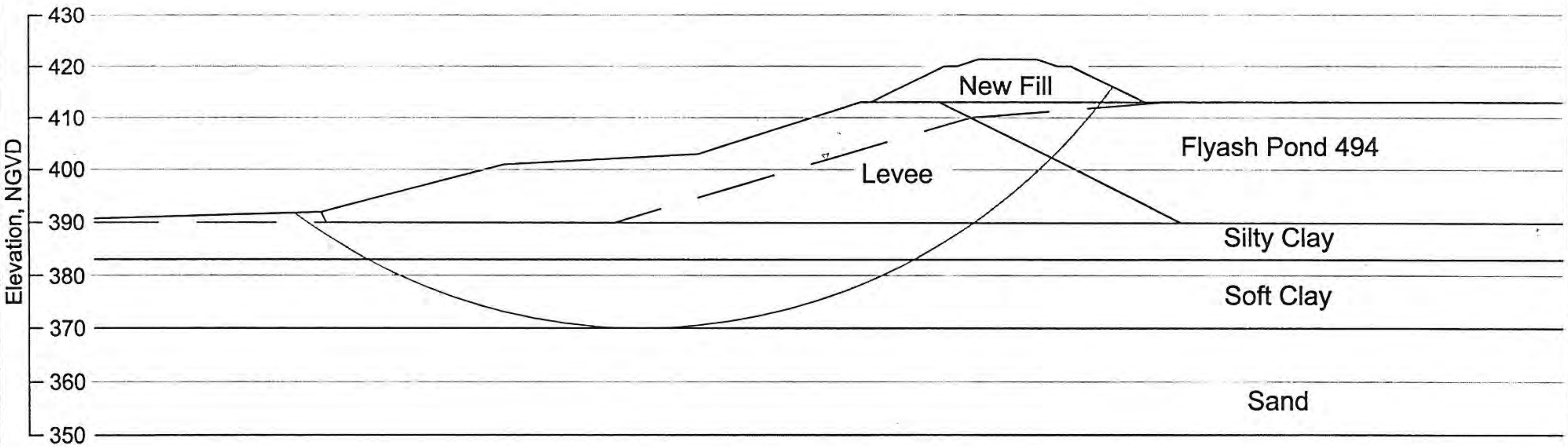
SCALE: 1" = 20 feet



TRACK SECTION FROM STA 53+00 TO 61+00

SCALE: 1" = 20 feet

TYPICAL TRACK SECTION	
REITZ & JENS, INC. Consulting Engineers	FIGURE 9



Section at Sta. 29+00

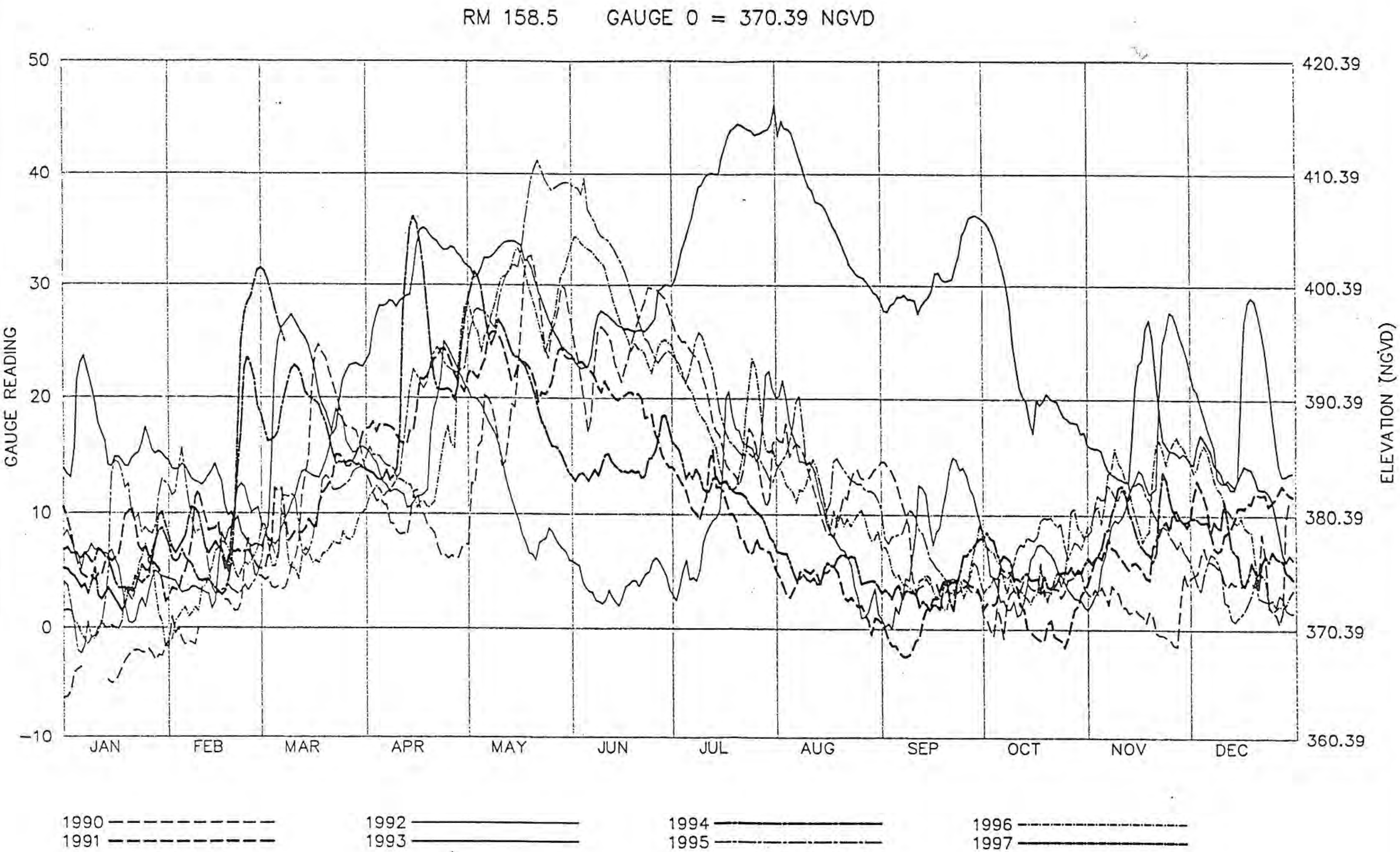
Minimum Factor of Safety = 1.53 (without seismic)

Minimum Factor of Safety = 0.81 (with a=0.15g)

STABILITY ANALYSES OF LEVEE AND RAILROAD EMBANKMENT

REITZ & JENS, INC.
Consulting Engineers

FIGURE 10

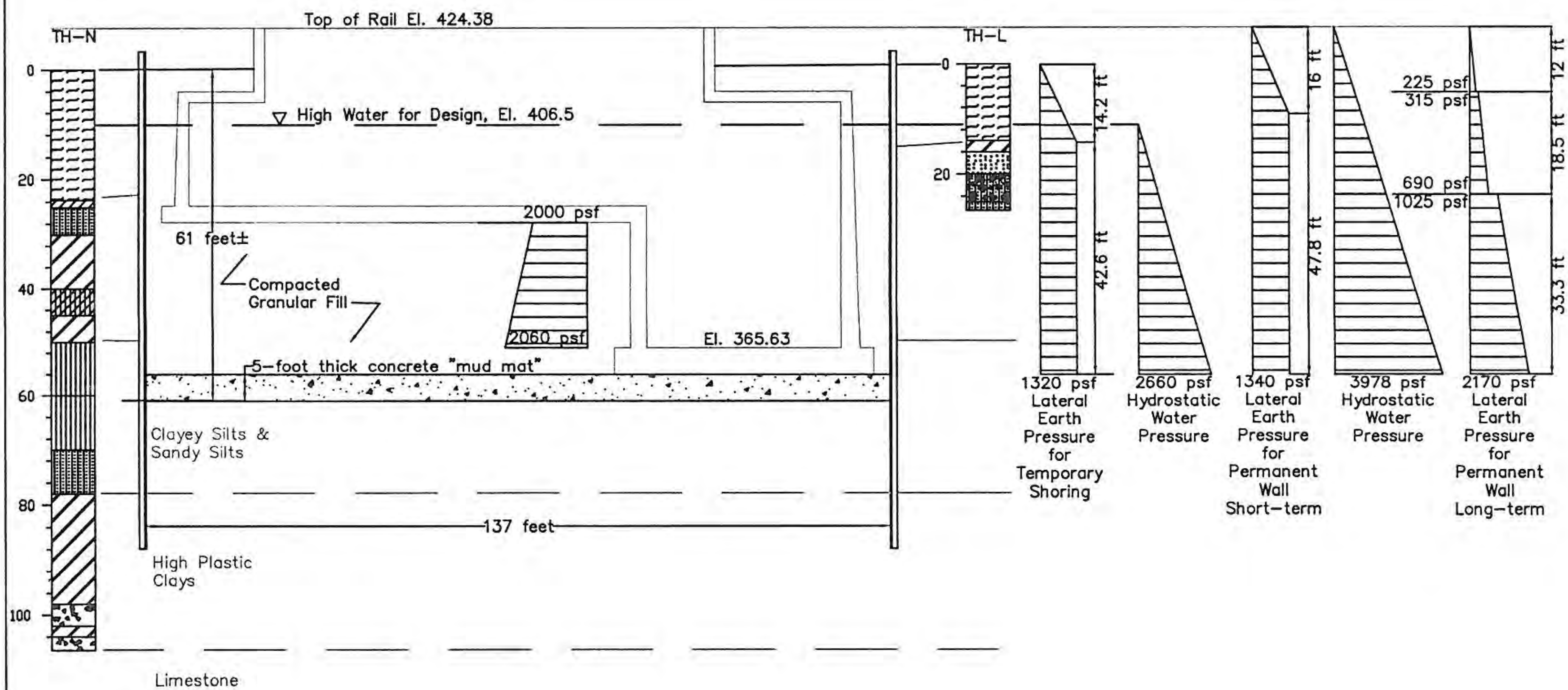


Note: Water's Point Gauge is about 1.5 river miles from Meramec Plant.

MISSISSIPPI RIVER STAGES AT WATER'S POINT GAGE

REITZ & JENS, INC.
Consulting Engineers

FIGURE 11



COAL CAR HOPPER
LATERAL EARTH PRESSURES

REITZ & JENS, INC.
Consulting Engineers

FIGURE 12

APPENDIX A

INDIVIDUAL BORING LOGS

KEY TO SYMBOLS

Symbol	Description
	KEY TO SOIL SYMBOLS
	FLYASH
	Silty GRAVEL (GM)
	Low plastic Silty CLAY/ Clayey SILT (CL-ML)
	Inorganic, non-plastic SILT (ML)
	Clayey SAND or Sandy CLAY (SC)
	Silty SAND or Sandy SILT (SM)
	High plastic CLAY (CH)
	Low plastic Silty CLAY (CL)
	Poorly-graded SAND with no fines (SP)
	LIMESTONE
	Mixed Silty SAND & GRAVEL (GM)
	Low plastic CLAY (CL)
	Poorly-graded GRAVEL (GP)

Symbol	Description
	MISCELLANEOUS SYMBOLS
□	Shear strength from from Shear Vane (tsf)
△	Shear strength from Unconfined Compression Test, ASTM D-2166 (tsf)
■	Shear strength from Pocket Penetrometer (tsf)
——	Range Plastic Limit (PL) to Liquid Limit (LL), ASTM D-4318
●	Moisture content (%)
▲	N-value from Standard Penetration Test, ASTM D-1586 (blows/ft)
	Boring continues
	SOIL SAMPLERS
	3-in. O.D. Shelby Tube
	2-in. O.D. Split-Spoon

Notes:

1. Borings made using CME-75 drill rig mounted on all-terrain vehicle (ATV) owned and operated by Brotcke Well and Pump, between August 26 and September 1, 1999. Borings advanced using 4.5-in. I.D. hollow-stem augers (HSA), or using rotary drilling with drilling mud, as noted.

2. Borings were logged in the field based upon recovered samples, cuttings, and drilling characteristics. The field logs were modified as appropriate based upon the results of laboratory testing.

3. Stratification lines on the boring logs represent approximate boundaries of changes in soil or rock classification; actual changes in strata may be gradual.

Figure A-1

Reitz & Jens, Inc.
Consulting Engineers

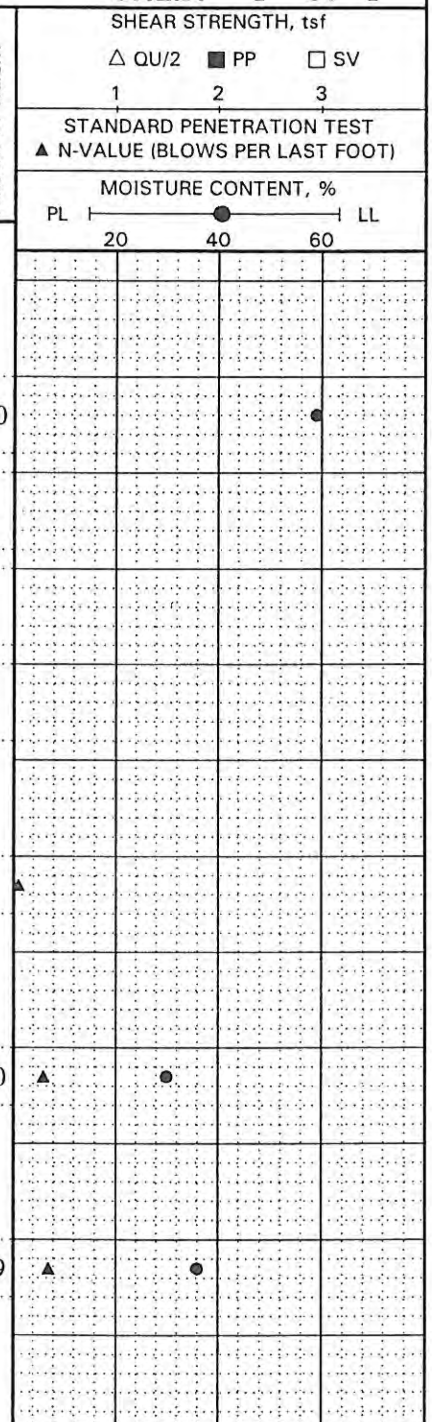
BORING LOG

Meramec Power Plant Rail Loop
Ameren Services

DATE MADE: 9/1/99

BORING NO: TH-A
LOCATION: Ash Pond 491
ELEVATION: 416.8 **DATUM:** ft, NGVD
FIGURE: A-2 **SHEET** 1 **OF** 1

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) / BLOWS PER 6 INCHES	MOISTURE CONTENT PERCENT BY WEIGHT
0			Loose, gray, dry FLYASH		
	415	38		53.2	59.0
5		100	Becoming moist		
	410	0	Very loose, saturated, Silty GRAVEL (coal or bottom ash) Note: no recovery with Shelby tube; split-spoon sampler sank under own weight.		
10	405	0	Soft, brown, wet, Silty CLAY/Clayey SILT Note: split-spoon sampler sank under own weight.		
15	400	100	Very loose, black, very fine Coal and Silt mixture, with fine Sand	0-0-1	
20		100	Soft, gray, Sandy CLAY	1-2-4	30.0
	395		Very loose, very fine SAND		
			Loose, FLYASH; with very fine Sand, very fine Coal particles, oily		
25		94	Firm, brown and gray, high plastic CLAY	1-3-4	35.9
	390		Bottom of boring @ 26.5 feet		
30					



THE STRATIFICATION LINES REPRESENT APPROXIMATE SOIL BOUNDARIES: ACTUAL STRATIFICATION MAY BE GRADUAL.

DRILLER: Brotcke Well
METHOD: Hollow-stem augers
LOGGED BY: J. Fouse

WATER LEVELS: DURING DRILLING 7.0 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ____ FEET

File: UERAIL Date Printed: November 28, 1999

Reitz & Jens, Inc.
Consulting Engineers

BORING LOG

Meramec Power Plant Rail Loop
Ameren Services

DATE MADE: 8/26/99

BORING NO: TH-H
LOCATION: Ash Pond 498
ELEVATION: 417.5 **DATUM:** ft, NGVD
FIGURE: A-3 **SHEET** 1 **OF** 4

SHEAR STRENGTH, tsf: △ QU/2 ■ PP □ SV (1, 2, 3)
STANDARD PENETRATION TEST ▲ N-VALUE (BLOWS PER LAST FOOT)
MOISTURE CONTENT, %: PL —●— LL (20, 40, 60)

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES	MOISTURE CONTENT PERCENT BY WEIGHT
0			Loose, gray, dry, FLYASH		
	415	50			
5		58		72.7	34.7
	410	0			
10		100		1-2-1	
	405	21			
15		100		0-1-1	
	400	96	Firm to stiff, brown and gray, high plastic CLAY	99.7	27.3
20		83		99.9	24.9
	395				
25		100	Soft to firm, tannish brown and gray, low plastic, Silty CLAY; with lignite & limonite	94.6	28.1
	390				
30					

THE STRATIFICATION LINES REPRESENT APPROXIMATE SOIL BOUNDARIES: ACTUAL STRATIFICATION MAY BE GRADUAL.

DRILLER: Brotcke Well
METHOD: HSA & rotary w/mud
LOGGED BY: Deryl Calvert

WATER LEVELS: DURING DRILLING 25 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT ____ FEET

Reitz & Jens, Inc.
Consulting Engineers

BORING LOG

Meramec Power Plant Rail Loop
Ameren Services

DATE MADE: 8/26/99

BORING NO: TH-H
LOCATION: Ash Pond 498
ELEVATION: 417.5 **DATUM:** ft, NGVD
FIGURE: A-3 **SHEET** 2 **OF** 4

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) / BLOWS PER 6 INCHES	MOISTURE CONTENT PERCENT BY WEIGHT
		100	Same: soft to firm, tannish brown and gray, low plastic, Silty CLAY; with lignite & limonite	89.1	33.1
	385				
35		100	Becoming gray	92.5	29.5
	380				
40		100	Soft, gray, high plastic CLAY; with fine Sandy Silt and very fine horizontal Sand seams	79.7	33.0
	375				
45		100	Gray Silty CLAY		
	370				
50		100	Firm, gray, Clayey SILT; with some Sand	96.6	28.1
	365				
55					
	360				
60					

Graph columns: SHEAR STRENGTH, tsf (△ QU/2, ■ PP, □ SV; 1, 2, 3); STANDARD PENETRATION TEST ▲ N-VALUE (BLOWS PER LAST FOOT); MOISTURE CONTENT, % (PL, LL; 20, 40, 60). Columns: GRAPHIC LOG, SAMPLE TYPE.

THE STRATIFICATION LINES REPRESENT APPROXIMATE SOIL BOUNDARIES: ACTUAL STRATIFICATION MAY BE GRADUAL.

DRILLER: Brotcke Well
METHOD: HSA & rotary w/mud
LOGGED BY: Deryl Calvert

WATER LEVELS: DURING DRILLING 25 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT ____ FEET

File: UERAIL Date Printed: November 28, 1999

Reitz & Jens, Inc.
Consulting Engineers

BORING LOG

Meramec Power Plant Rail Loop
Ameren Services

DATE MADE: 8/26/99

BORING NO: TH-H
LOCATION: Ash Pond 498
ELEVATION: 417.5 **DATUM:** ft, NGVD
FIGURE: A-3 **SHEET** 3 **OF** 4

SHEAR STRENGTH, tsf: △ QU/2 ■ PP □ SV (1, 2, 3)
STANDARD PENETRATION TEST ▲ N-VALUE (BLOWS PER LAST FOOT)
MOISTURE CONTENT, %: PL ├──●──┤ LL (20, 40, 60)

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES	MOISTURE CONTENT PERCENT BY WEIGHT
		100	Firm, gray, high plastic CLAY; with some Clayey Silt and light gray fine Sand seams	62.8	63.1
	355				
65					
	350				
70		100			
	345				
75					
	340				
80		100	Stiff, gray, Silty CLAY; with Clayey Silt	92.4	29.8
	335				
			SAND		
85					
	330				
90					

95

THE STRATIFICATION LINES REPRESENT APPROXIMATE SOIL BOUNDARIES: ACTUAL STRATIFICATION MAY BE GRADUAL.

DRILLER: Brotcke Well
METHOD: HSA & rotary w/mud
LOGGED BY: Deryl Calvert

WATER LEVELS: DURING DRILLING 25 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ____ FEET

File: UERAIL Date Printed: November 28, 1999

Reitz & Jens, Inc.
Consulting Engineers

BORING LOG

Meramec Power Plant Rail Loop
Ameren Services

DATE MADE: 8/26/99

BORING NO: TH-H
LOCATION: Ash Pond 498
ELEVATION: 417.5 **DATUM:** ft, NGVD
FIGURE: A-3 **SHEET** 4 **OF** 4

DEPTH (FEET)	ELEVATION	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES	MOISTURE CONTENT PERCENT BY WEIGHT	SHEAR STRENGTH, tsf (△ QU/2 ■ PP □ SV; 1 2 3) STANDARD PENETRATION TEST ▲ N-VALUE (BLOWS PER LAST FOOT) MOISTURE CONTENT, % (PL — LL; 20 40 60)
	325				Note: Sand blowing up into hollow-stem augers; switch to rotary with drilling mud. Lost 600 gal. of drilling mud. Could not hold hole open to get samples.			
95	320							
100	315							
105	310				LIMESTONE			
					Bottom of boring @ 108 feet			
110	305							
115	300							
120								

THE STRATIFICATION LINES REPRESENT APPROXIMATE SOIL BOUNDARIES: ACTUAL STRATIFICATION MAY BE GRADUAL.

DRILLER: Brotcke Well
METHOD: HSA & rotary w/mud
LOGGED BY: Deryl Calvert

WATER LEVELS: DURING DRILLING 25 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT ____ FEET

File: UERAIL Date Printed: November 28, 1999

Reitz & Jens, Inc.
Consulting Engineers

BORING LOG

Meramec Power Plant Rail Loop
Ameren Services

DATE MADE: 9/1/99

BORING NO: TH-L
LOCATION: Ash Pond 491
ELEVATION: 417.5 **DATUM:** ft, NGVD
FIGURE: A-4 **SHEET** 1 **OF** 1

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) / BLOWS PER 6 INCHES	MOISTURE CONTENT PERCENT BY WEIGHT
0			Loose, gray, moist, FLYASH		
	415	50		53.0	35.0
5		12			39.5
	410	8	Becoming wet		48.6
10		15			72.9
	405				
15		100	Stiff, brown and gray, high plastic CLAY; with Coal fragments	1-10-11	33.0
	400		Medium-dense, medium-grained, brown with black SAND		
20		83	Loose, coarse Coal fragments	2-1-2	
	395				
25		100	Loose, brown and gray, saturated Sandy SILT; with iron stains	1-1-2	37.2
	390		Bottom of Boring @ 26.5 feet		
30					

SHEAR STRENGTH, tsf: △ QU/2 ■ PP □ SV (1, 2, 3)
STANDARD PENETRATION TEST ▲ N-VALUE (BLOWS PER LAST FOOT)
MOISTURE CONTENT, %: PL ● LL (20, 40, 60)

THE STRATIFICATION LINES REPRESENT APPROXIMATE SOIL BOUNDARIES: ACTUAL STRATIFICATION MAY BE GRADUAL.

DRILLER: Brotcke Well
METHOD: Hollow-stem augers
LOGGED BY: J. Fouse

WATER LEVELS: DURING DRILLING 7.5 FEET
BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ____ FEET

File: UERAIL Date Printed: November 28, 1999

Reitz & Jens, Inc.
Consulting Engineers

BORING LOG

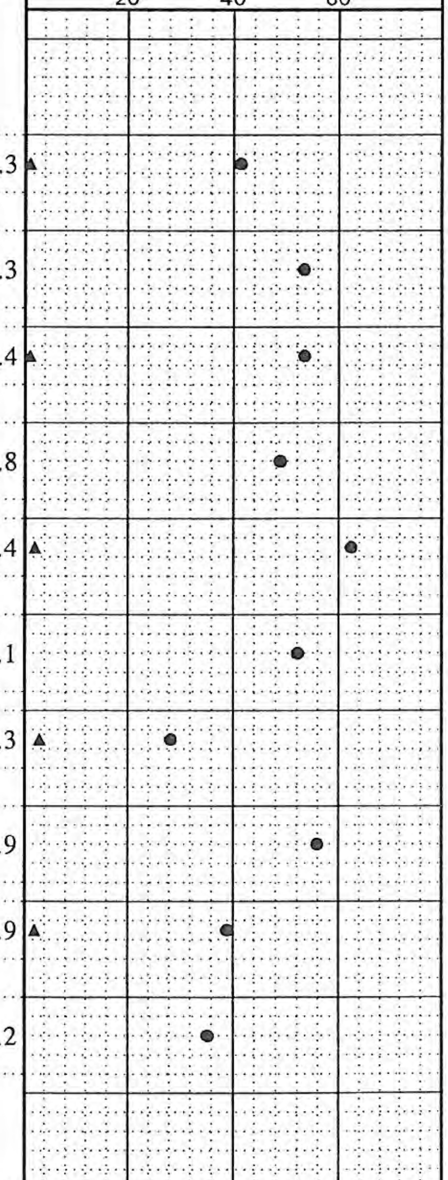
Meramec Power Plant Rail Loop
Ameren Services

DATE MADE: 8/31/99

BORING NO: TH-N
LOCATION: Ash Pond 491
ELEVATION: 416.5 **DATUM:** ft, NGVD
FIGURE: A-5 **SHEET** 1 **OF** 4

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) / BLOWS PER 6 INCHES	MOISTURE CONTENT PERCENT BY WEIGHT
0			Loose, dry, FLYASH		
	415	33		1-0-1	41.3
5	410	58		60.5	53.3
		50		1-0-1	53.4
10	405	0			48.8
		100		0-1-1	62.4
15	400	75			52.1
		56		1-1-2	28.3
20	395	100		62.6	55.9
		100		0-1-1	38.9
			Soft, gray, CLAY		
25	390	100	Loose, gray and brown Sandy SILT; with Clay, strong organic odor		35.2
30					

SHEAR STRENGTH, tsf: △ QU/2 ■ PP □ SV (1, 2, 3)
STANDARD PENETRATION TEST ▲ N-VALUE (BLOWS PER LAST FOOT)
MOISTURE CONTENT, %: PL — LL (20, 40, 60)



THE STRATIFICATION LINES REPRESENT APPROXIMATE SOIL BOUNDARIES: ACTUAL STRATIFICATION MAY BE GRADUAL.

DRILLER: Brotcke Well
METHOD: HSA & rotary w/mud
LOGGED BY: Deryl Calvert

WATER LEVELS: DURING DRILLING ______ FEET
______ BORING DRY AT COMPLETION OF DRILLING
AT ______ FEET AFTER ______ HOURS
AT ______ FEET AFTER ______ HOURS

PIEZOMETER: INSTALLED AT ______ FEET

Reitz & Jens, Inc.
Consulting Engineers

BORING LOG

Meramec Power Plant Rail Loop
Ameren Services

DATE MADE: 8/31/99

BORING NO: TH-N
LOCATION: Ash Pond 491
ELEVATION: 416.5 **DATUM:** ft, NGVD
FIGURE: A-5 **SHEET** 2 **OF** 4

DEPTH (FEET)	ELEVATION	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) / BLOWS PER 6 INCHES	MOISTURE CONTENT PERCENT BY WEIGHT	SHEAR STRENGTH, tsf (△ QU/2 ■ PP □ SV); STANDARD PENETRATION TEST ▲ N-VALUE (BLOWS PER LAST FOOT); MOISTURE CONTENT, % (PL – LL)
	385			96	Firm, light gray, high plastic CLAY; with light gray Sand seams, traces of lignite	81.3	37.0	
35	380			100		74.6	38.7	
40	375			100	Firm, gray, Clayey SILT	84.3	34.7	
45	370			100	Firm, gray, high plastic CLAY	57.5	69.0	
50	365			100	Medium-dense, gray, slightly Clayey, Sandy SILT Note: lost lead hollow-stem auger in hole; moved hole over 10 feet and augered to 60 feet to continue boring.	89.6	32.0	
55	360							
60					THE STRATIFICATION LINES REPRESENT APPROXIMATE SOIL BOUNDARIES: ACTUAL STRATIFICATION MAY BE GRADUAL.			

Chart scale: shear strength 1, 2, 3; moisture content 20, 40, 60.

DRILLER: Brotcke Well
METHOD: HSA & rotary w/mud
LOGGED BY: Deryl Calvert

WATER LEVELS: DURING DRILLING ______ FEET
______ BORING DRY AT COMPLETION OF DRILLING
AT ______ FEET AFTER ______ HOURS
AT ______ FEET AFTER ______ HOURS

PIEZOMETER: INSTALLED AT ______ FEET

Reitz & Jens, Inc.
Consulting Engineers

BORING LOG

Meramec Power Plant Rail Loop
Ameren Services

DATE MADE: 8/31/99

BORING NO: TH-N
LOCATION: Ash Pond 491
ELEVATION: 416.5 **DATUM:** ft, NGVD
FIGURE: A-5 **SHEET** 3 **OF** 4

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) / BLOWS PER 6 INCHES	MOISTURE CONTENT PERCENT BY WEIGHT
	355	100	Same: medium-dense, gray, slightly Clayey, Sandy SILT; with strong organic odor	84.2	34.9
65	350				
70	345	0	Loose, gray, fine SAND; with some Silt and trace Gravel Note: sand came up in HSA. Resumed hole 9/1/99 using rotary drilling. Hole collapsed up to 47 feet overnight. Drilled back down to 72 feet.		
		83		5-6-7	33.3
75	340				
			Soft, gray, high plastic CLAY		
80	335	100		2-3-3	33.7
85	330				
90					

SHEAR STRENGTH, tsf: △ QU/2 ■ PP □ SV (1, 2, 3)
STANDARD PENETRATION TEST ▲ N-VALUE (BLOWS PER LAST FOOT)
MOISTURE CONTENT, %: PL — ● — LL (20, 40, 60)

THE STRATIFICATION LINES REPRESENT APPROXIMATE SOIL BOUNDARIES: ACTUAL STRATIFICATION MAY BE GRADUAL.

DRILLER: Brotcke Well
METHOD: HSA & rotary w/mud
LOGGED BY: Deryl Calvert

WATER LEVELS: DURING DRILLING ____ FEET
____ BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT ____ FEET

Reitz & Jens, Inc.
Consulting Engineers

BORING LOG

Meramec Power Plant Rail Loop
Ameren Services

DATE MADE: 8/31/99

BORING NO: TH-N
LOCATION: Ash Pond 491
ELEVATION: 416.5 **DATUM:** ft, NGVD
FIGURE: A-5 **SHEET** 4 **OF** 4

SHEAR STRENGTH, tsf: △ QU/2 ■ PP □ SV (1, 2, 3)
STANDARD PENETRATION TEST ▲ N-VALUE (BLOWS PER LAST FOOT)
MOISTURE CONTENT, %: PL —●— LL (20, 40, 60)

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES	MOISTURE CONTENT PERCENT BY WEIGHT
	325		Same: soft, gray, high plastic CLAY		
		100		2-3-5	
95	320				
			Medium-dense, fine to medium GRAVEL		
100	315				
		100	Stiff, gray, high plastic CLAY	5-6-6	29.3
105			Medium-dense, fine to medium GRAVEL		
	310		Refusal on Limestone @ 106.5 feet		
110	305				
115	300				
120					

THE STRATIFICATION LINES REPRESENT APPROXIMATE SOIL BOUNDARIES: ACTUAL STRATIFICATION MAY BE GRADUAL.

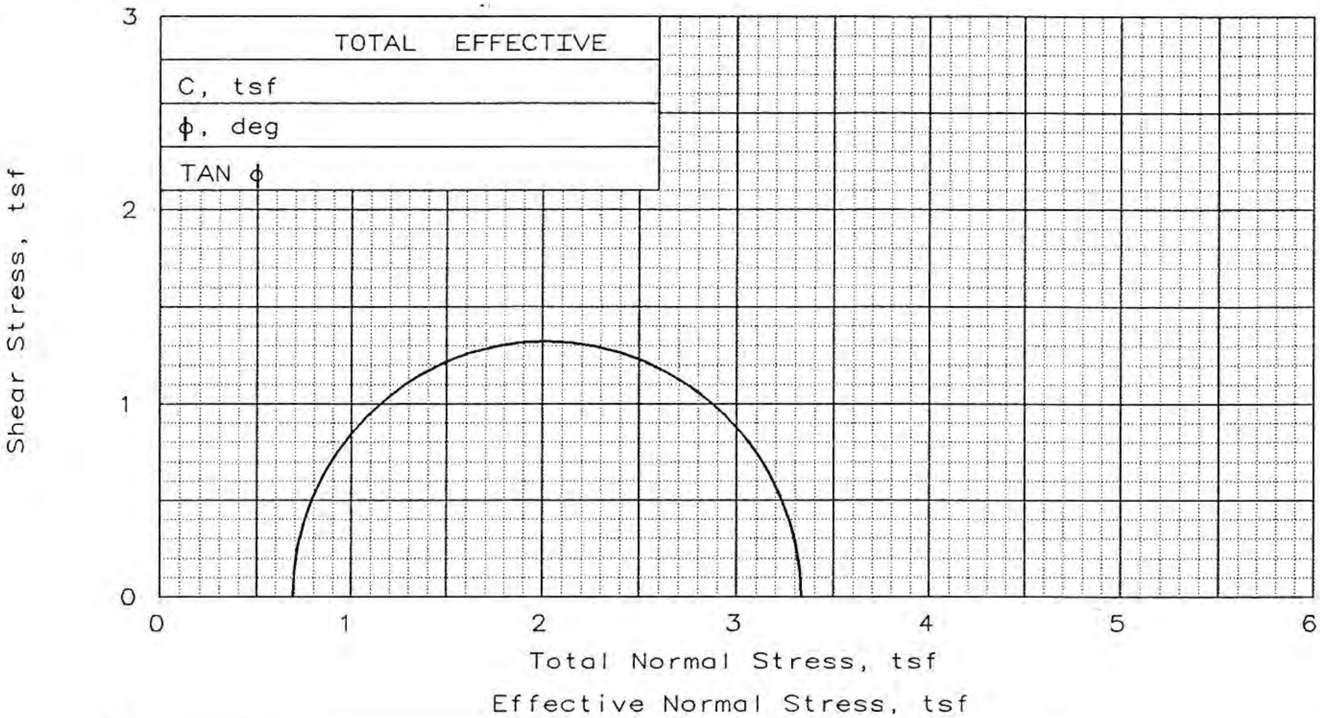
DRILLER: Brotcke Well
METHOD: HSA & rotary w/mud
LOGGED BY: Deryl Calvert

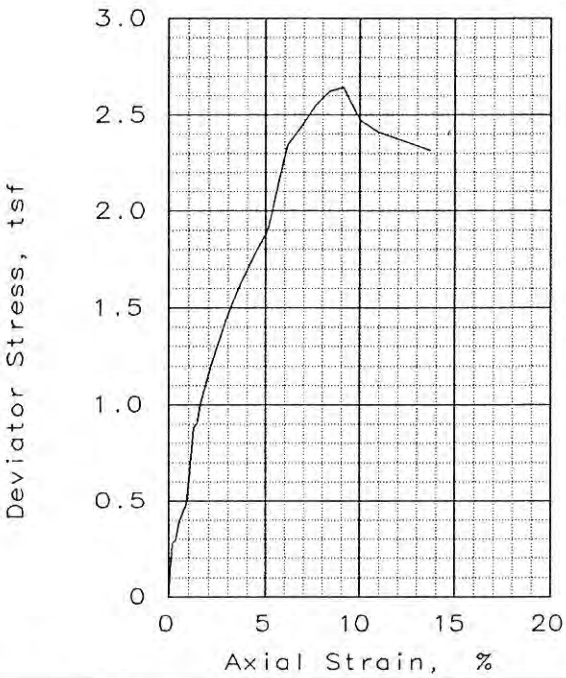
WATER LEVELS: DURING DRILLING ______ FEET
______ BORING DRY AT COMPLETION OF DRILLING
AT ______ FEET AFTER ______ HOURS
AT ______ FEET AFTER ______ HOURS

PIEZOMETER: INSTALLED AT ______ FEET

APPENDIX B

RESULTS OF LABORATORY TESTS





Sample No.:		1
INITIAL	WATER CONTENT, %	53.3
	DRY DENSITY, pcf	60.5
	SATURATION, %	86.7
	VOID RATIO	1.476
	DIAMETER, in	2.85
	HEIGHT, in	5.60
AT TEST	WATER CONTENT, %	55.0
	DRY DENSITY, pcf	64.6
	SATURATION, %	100.0
	VOID RATIO	1.319
	DIAMETER, in	2.79
	HEIGHT, in	5.48
Strain rate, %/min		1.00
EFF CELL PRESSURE, tsf		0.69
FAIL. STRESS, tsf		2.64
TOTAL PORE PR., tsf		5.79
STRAIN, %		9.1
ULT. STRESS, tsf		2.64
TOTAL PORE PR., tsf		5.79
STRAIN, %		9.1
$\bar{\sigma}_1$ FAILURE, tsf		3.34
$\bar{\sigma}_3$ FAILURE, tsf		0.69

TYPE OF TEST:
CU with Pore Pressures

SAMPLE TYPE: Shelby tube

DESCRIPTION: Flyash

SPECIFIC GRAVITY= 2.4

REMARKS:

CLIENT: Ameren U.E.

PROJECT: Meramec Rail Loop

SAMPLE LOCATION: TH-N, Depth 5.0 - 7.0 ft

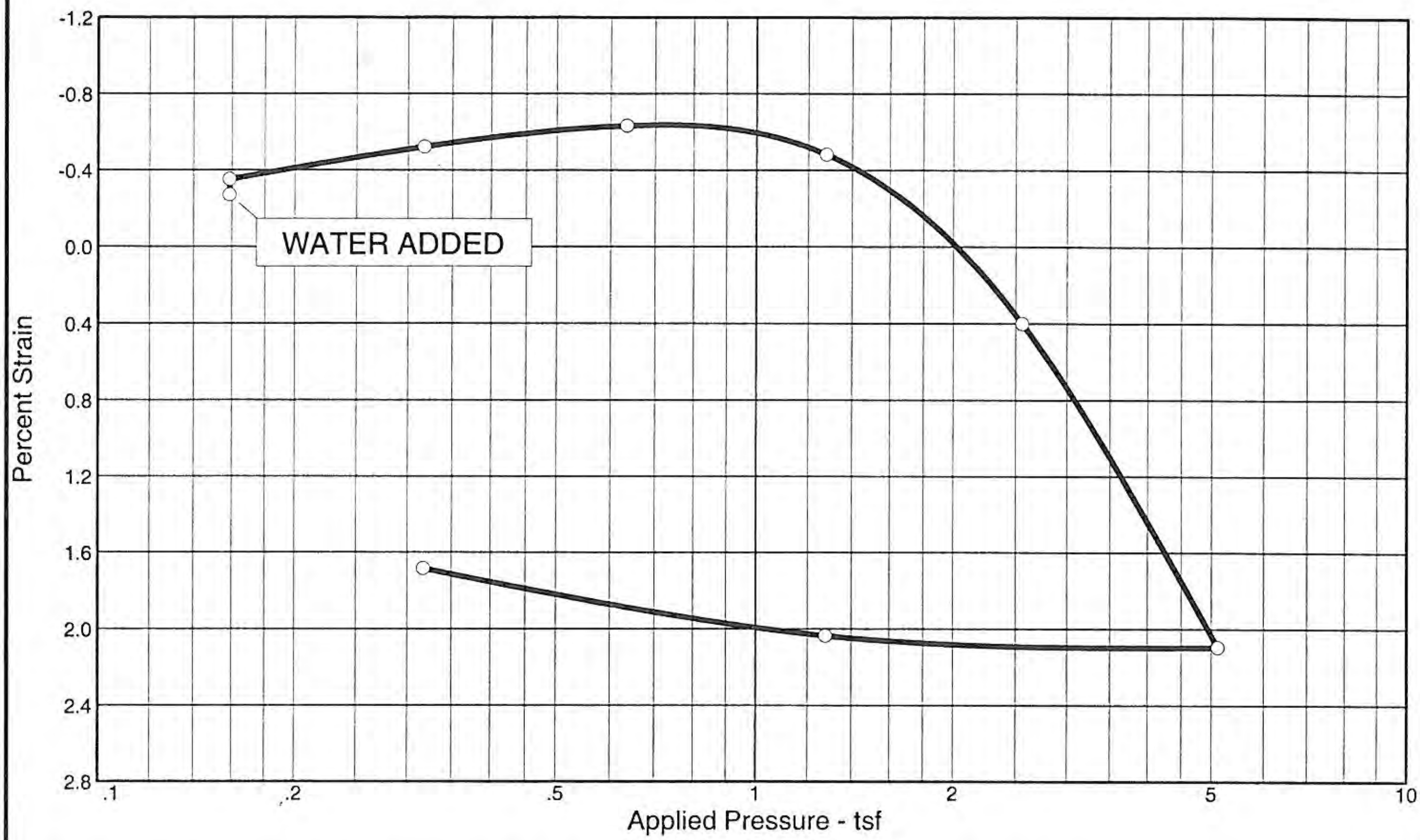
PROJ. NO.: 1999012402 DATE: 9/17/99

TRIAXIAL SHEAR TEST REPORT

REITZ & JENS, Inc.

Fig. No.: B-1

CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation											
No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α
2	0.16	0.02									
3	0.32	0.32	0.000								
4	0.63	0.20	0.000								
5	1.28	0.04	0.000								
6	2.56	0.64	0.001								
7	5.12	0.77	0.000								
8	1.28	0.78	0.000								
9	0.32	0.20	0.000								

Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
74.7 %	59.0 %	53.2			2.6	0.12	1.96	0.18	0.01	2.052

MATERIAL DESCRIPTION	USCS	AASHTO
Flyash		

Project No. 1999012402 **Client:** Ameren U.E.

Project: Meramec Rail Loop

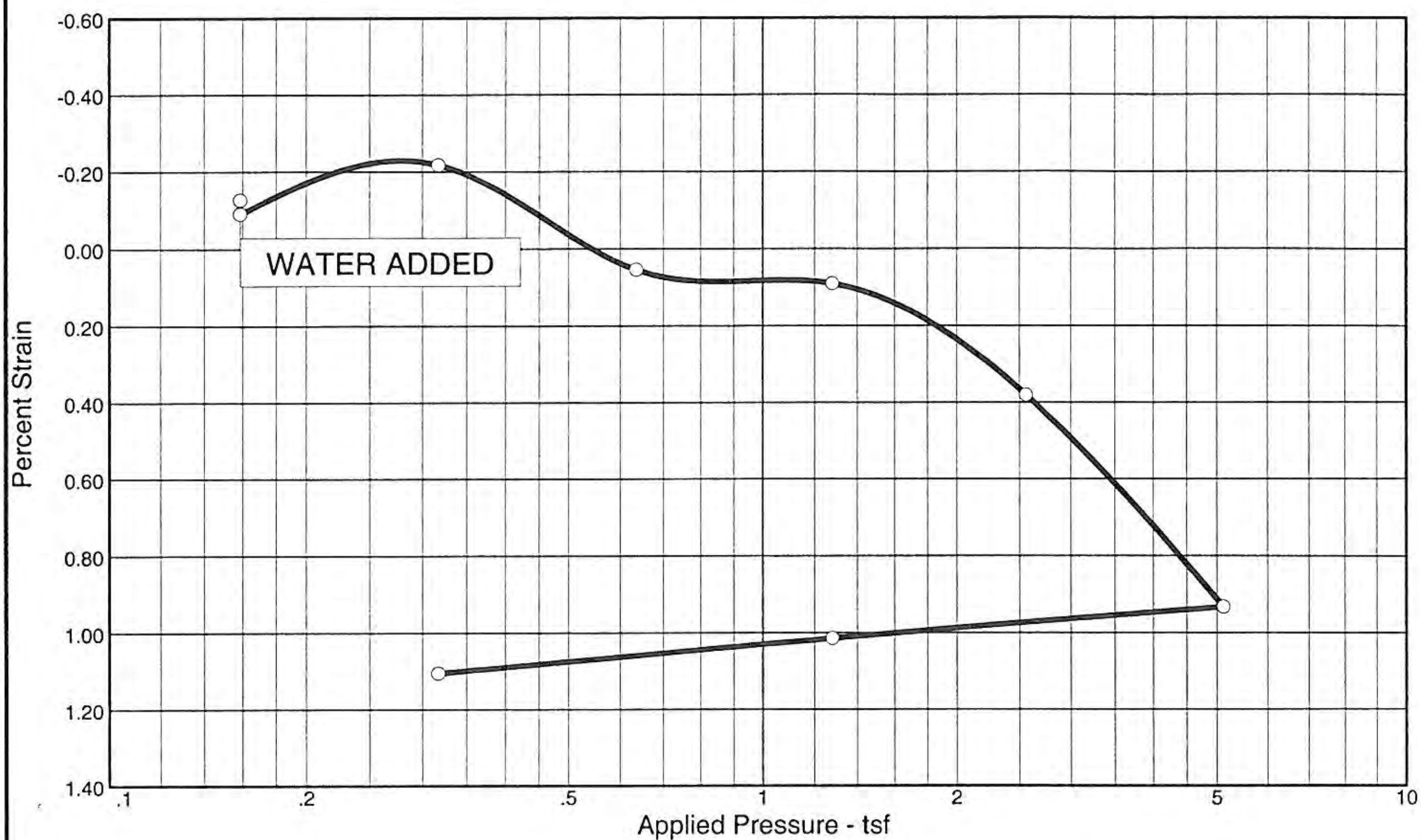
Source: TH-A **Sample No.:** ST-1 **Elev./Depth:** 2.5 to 4.5 feet

Reitz & Jens, Inc.
Consulting Engineers

Remarks:

Figure B-2

CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation											
No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α
1	0.16	0.63	0.001								
3	0.32	1.86	0.000								
4	0.63	0.54	0.000								
5	1.28	0.04	0.000								
6	2.56	1.57	0.001								
7	5.12	3.96	0.001								
8	1.28	0.08	0.000								
9	0.32	0.18									

Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
71.1 %	34.7 %	72.7			2.7	0.30	1.32	0.04	0.00	1.318

MATERIAL DESCRIPTION	USCS	AASHTO
Flyash		

Project No. 1999012402 **Client:** Ameren U.E.

Project: Meramec Rail Loop

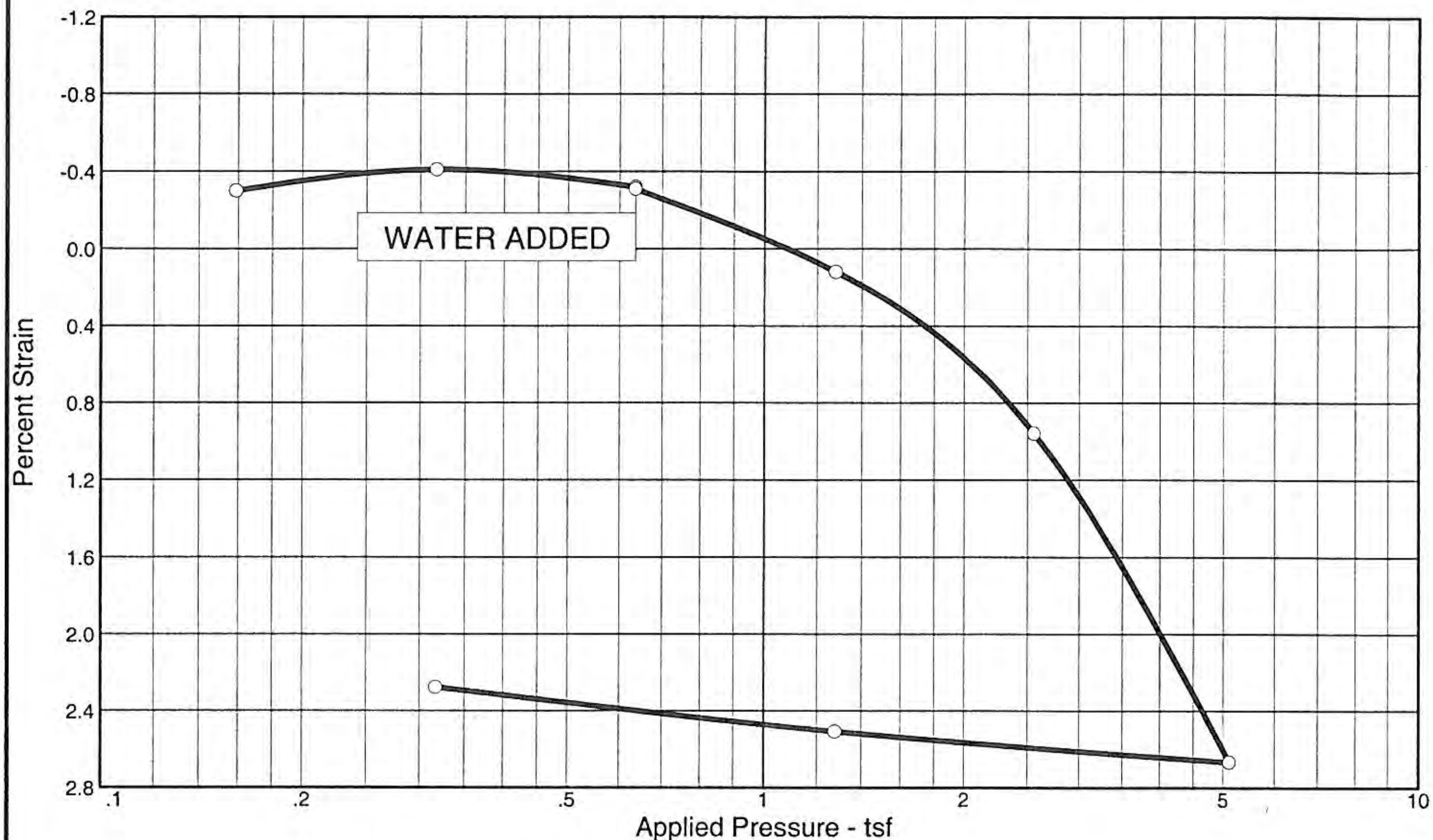
Source: TH-H **Sample No.:** ST-2 **Elev./Depth:** 5 to 7 feet

Reitz & Jens, Inc.
Consulting Engineers

Remarks:

Figure B-3

CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation											
No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α
2	0.32	0.06	0.000								
3	0.63	0.02	0.001								
4	0.63	0.02	0.000								
5	1.28	1.32	0.001								
6	2.56	4.25	0.001								
7	5.12	0.87	0.003								
8	1.28	0.59	0.000								
9	0.32	0.03	0.000								

Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
97.8 %	29.0 %	93.6	40	20	2.7	1.02	1.55	0.11	0.00	0.801

MATERIAL DESCRIPTION	USCS	AASHTO
Tannish brown with gray, Silty CLAY with large lignite deposits	CL	

Project No. 1999012402 **Client:** Ameren U.E.

Project: Meramec Rail Loop

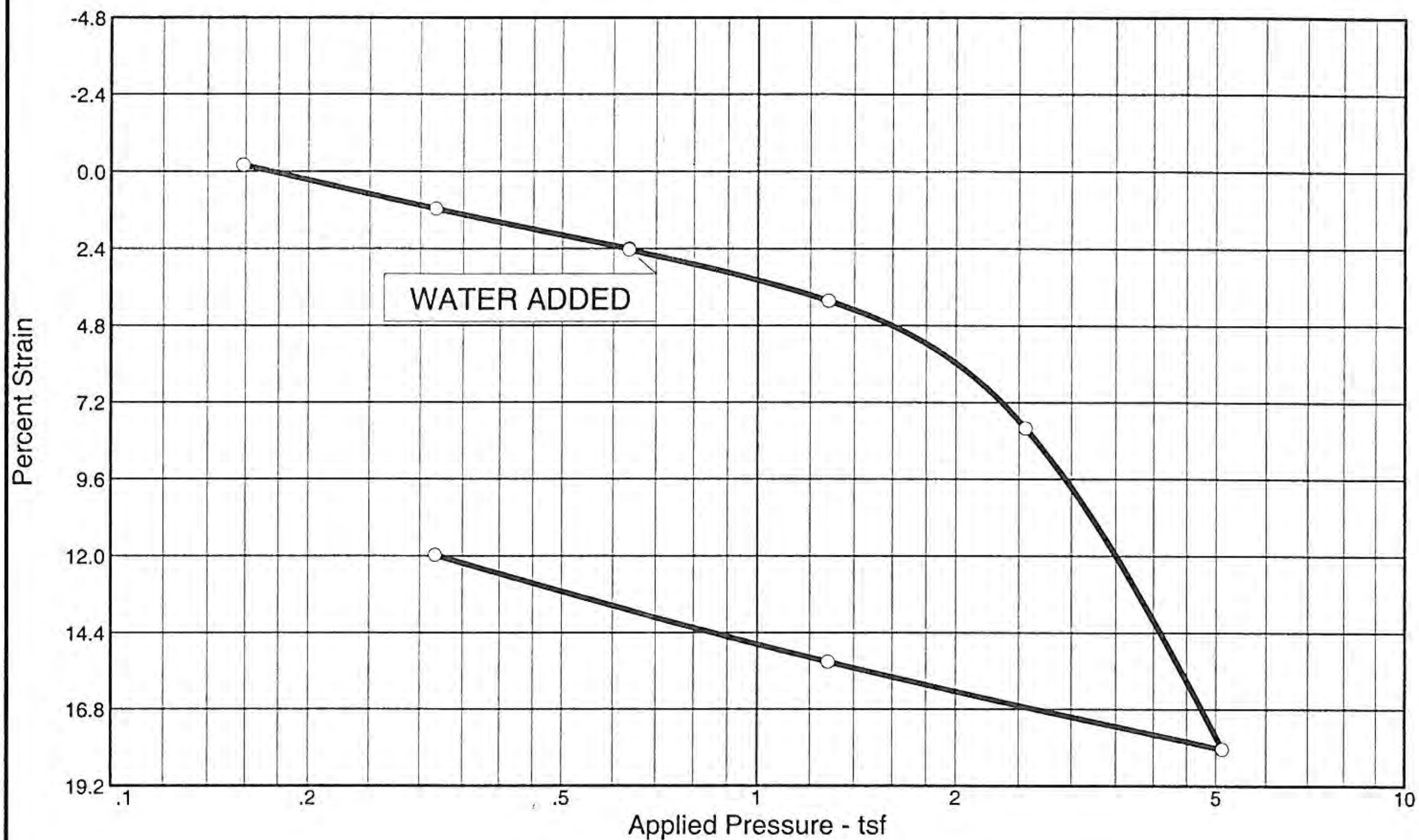
Source: TH-H **Sample No.:** ST-9 **Elev./Depth:** 25 to 27 feet

Reitz & Jens, Inc.
Consulting Engineers

Remarks:

Figure B-4

CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation											
No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α
1	0.16	0.70	0.000								
2	0.32	0.07	0.002								
3	0.63	0.05	0.001								
5	1.28	0.04	0.002								
6	2.56	0.03	0.008								
7	5.12	0.01	0.016								
8	1.28	0.01									
9	0.32	0.01									

Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
100.0 %	63.1 %	62.8	95	67	2.76	2.25	2.38	0.95	0.14	1.742

MATERIAL DESCRIPTION	USCS	AASHTO
Dark gray with traces of blackish gray, high plastic CLAY; with light gray fine Sand seams	CH	

Project No. 1999012402 **Client:** Ameren U.E.

Project: Meramec Rail Loop

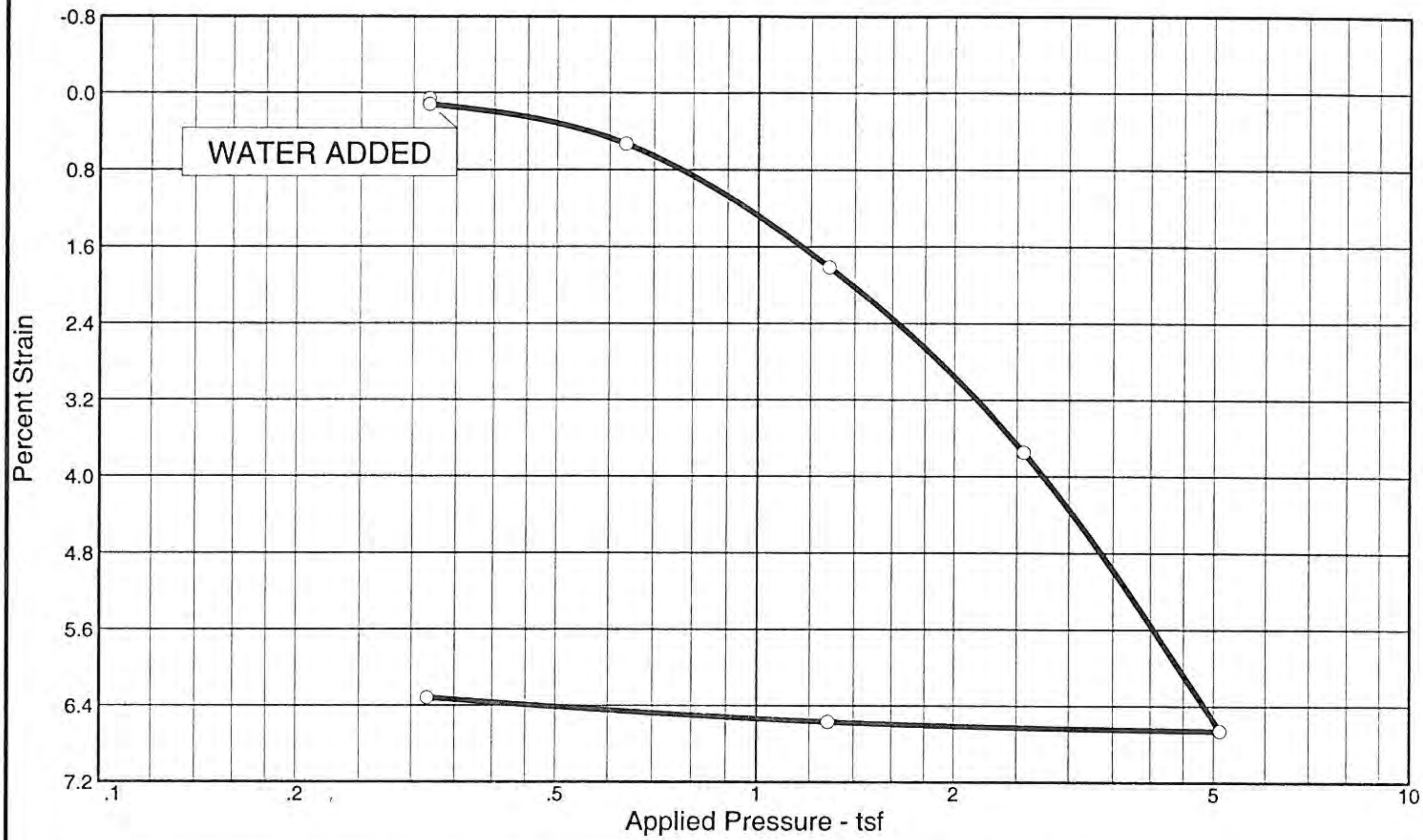
Source: TH-H **Sample No.:** ST-15 **Elev./Depth:** 60 to 62 feet

Remarks:

Reitz & Jens, Inc.
Consulting Engineers

Figure B-6

CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation											
No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α
1	0.32	0.35	0.001								
2	0.32	0.02	0.000								
3	0.63	3.91	0.001								
6	5.12	2.24	0.002								
8	0.32	1.07									

Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
90.2 %	55.9 %	62.6			2.65	0.92	1.38	0.26	0.01	1.642

MATERIAL DESCRIPTION	USCS	AASHTO
Flyash		

Project No. 1999012402 **Client:** Ameren U.E.

Project: Meramec Rail Loop

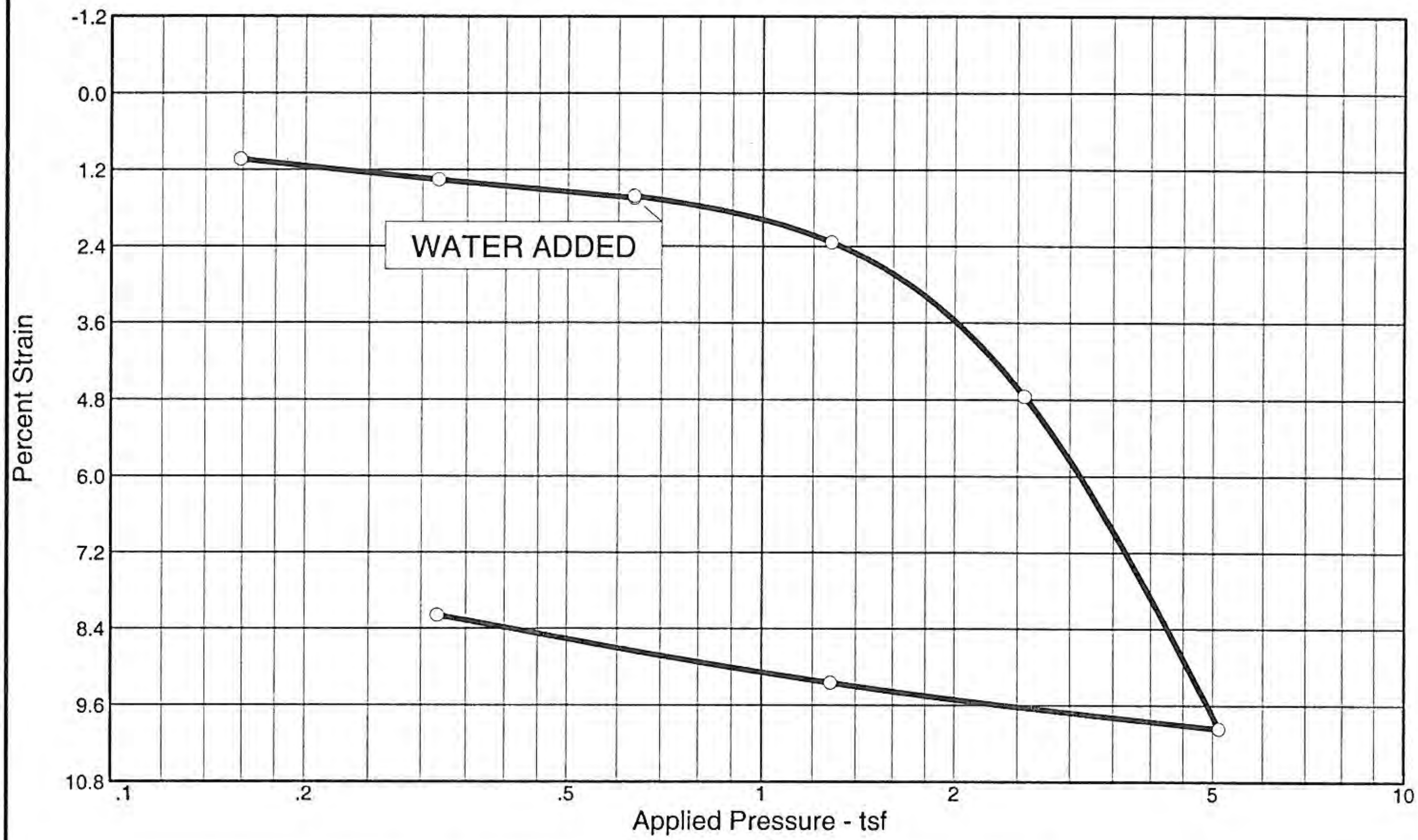
Source: TH-N **Sample No.:** ST-8 **Elev./Depth:** 20 to 22 feet

Remarks:

Reitz & Jens, Inc.
Consulting Engineers

Figure B-7

CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation											
No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α
1	0.16	0.42	0.001								
2	0.32	0.06	0.002								
3	0.63	0.04	0.001								
4	0.63	1.13	0.000								
5	1.28	0.22	0.002								
6	2.56	0.16	0.004								
7	5.12	0.06	0.007								
8	1.28	0.12									
9	0.32	0.04									

Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
100.0 %	38.7 %	83.9	53	28	2.8	1.43	2.19	0.37	0.03	1.083

MATERIAL DESCRIPTION	USCS	AASHTO
Medium-dark gray, high plastic CLAY; with light gray Sand seams, traces of lignite	CH	

Project No. 1999012402 **Client:** Ameren U.E.

Project: Meramec Rail Loop

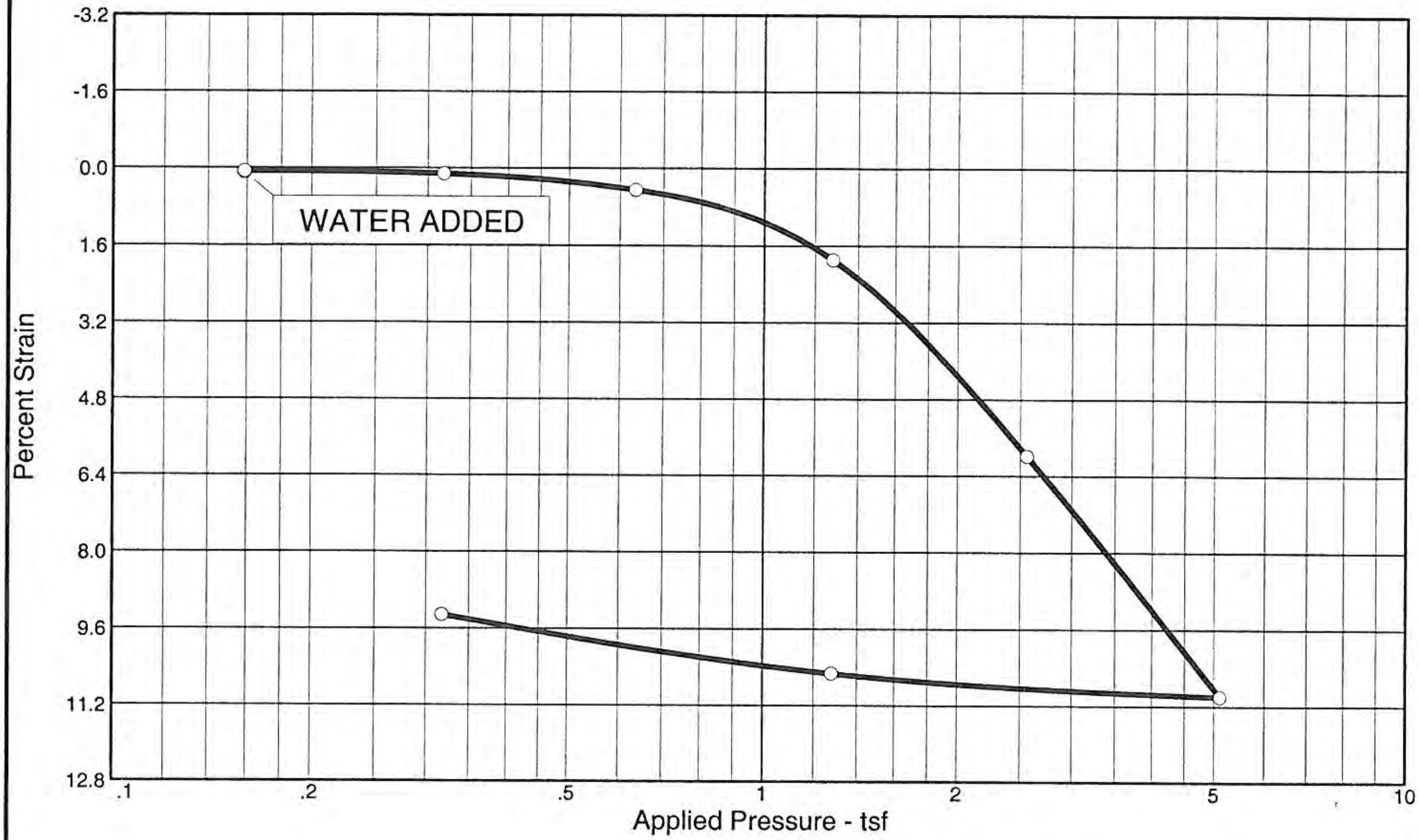
Source: TH-N **Sample No.:** ST-12 **Elev./Depth:** 35 to 37 feet

Reitz & Jens, Inc.
Consulting Engineers

Remarks:

Figure B-8

CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation											
No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α	No.	Load (tsf)	C_v (ft.^{2}/day)	C_α
1	0.16	2.97	0.000								
3	0.32	0.26	0.000								
4	0.63	0.09	0.000								
5	1.28	0.11	0.001								
6	2.56	3.85	0.002								
7	5.12	0.83	0.003								
8	1.28	1.32									
9	0.32	0.07									

Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
43.7 %	35.0 %	53.0			2.65	0.13	1.41	0.52	0.04	2.121

MATERIAL DESCRIPTION	USCS	AASHTO
Flyash		

Project No. 1999012402 **Client:** Ameren U.E.

Project: Meramec Rail Loop

Source: TH-L **Sample No.:** ST-1 **Elev./Depth:** 2.5 to 4.5 feet

Remarks:

Reitz & Jens, Inc.
Consulting Engineers

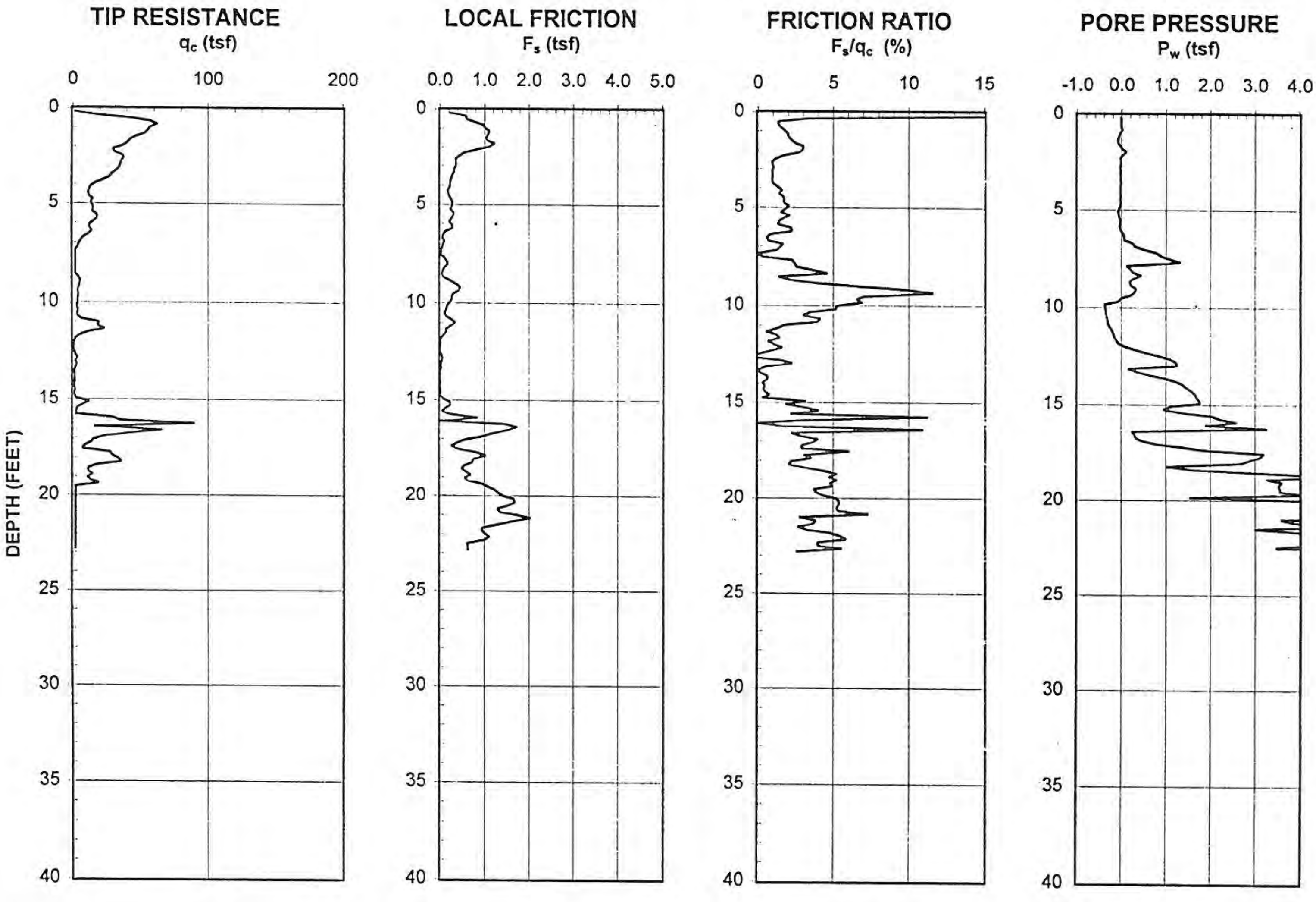
Figure B-9

APPENDIX C

RESULTS OF PIEZOMETRIC
CONE PENETRATION TESTS

URS GREINER WOODWARD CLYDE
TH-G

Operator:	A. Bredikhin	CPT Date:	8/26/99
Page:	1 of 1	Location:	AmerenUE
Cone Used:	243	Job Number:	23-99000035



URS GREINER WOODWARD CLYDE
TH-G

Operator:	A. Bredikhin			
Cone Used:	243		Location:	AmerenUE
CPT Date:	8/26/99		Job Number:	23-99000035
Total Unit Weight (ave.):	120	pcf	Water Table:	6 ft

Depth (meters)	Depth (feet)	q_c (ave) (tsf)	F_s (ave) (tsf)	R_f (ave) (%)	σ'_v (tsf)	Soil Behavior Type	Eq - D_r (%)	ϕ' (deg)	SPT N-value	s_u (tsf)	$(q_{c1})_{cs}$ (tsf)	CRR M=7.5
0.175	0.6	39.7	0.69	4.76	-0.01	sand to silty sand	88	44	7	undefined	218.5	0.93
0.475	1.6	45.8	1.10	2.46	-0.02	sand to silty sand	78	42	8	undefined	155.5	0.39
0.775	2.5	34.3	0.48	1.44	-0.01	sand to silty sand	63	40	6	undefined	91.8	0.14
1.075	3.5	27.2	0.28	1.04	-0.02	sand to silty sand	51	37	5	undefined	64.8	0.10
1.375	4.5	13.0	0.22	1.72	-0.03	silty sand to sandy silt	27	33	3	undefined	53.0	0.09
1.675	5.5	16.1	0.26	1.65	-0.05	silty sand to sandy silt	30	33	4	undefined	54.9	0.09
1.975	6.5	10.8	0.15	1.37	0.11	silty sand to sandy silt	17	31	3	undefined	53.5	0.09
2.275	7.5	3.6	0.06	1.28	0.78	clay	undefined	undefined	1	0.19	undefined	undefined
2.575	8.4	4.0	0.11	3.03	0.26	clay	undefined	undefined	1	0.21	undefined	undefined
2.875	9.4	4.2	0.34	8.17	0.06	clay	undefined	undefined	2	0.22	undefined	undefined
3.175	10.4	3.9	0.16	4.16	-0.34	clay	undefined	undefined	1	0.20	undefined	undefined
3.475	11.4	13.3	0.15	1.15	-0.17	silty sand to sandy silt	18	31	3	undefined	55.1	0.09
3.775	12.4	1.5	0.01	0.78	0.69	organic soil	undefined	undefined	1	0.06	undefined	undefined
4.075	13.4	1.8	0.01	0.70	0.76	clay	undefined	undefined	1	0.07	undefined	undefined
4.375	14.4	1.4	0.01	0.44	1.58	organic soil	undefined	undefined	1	0.05	undefined	undefined
4.675	15.3	5.0	0.17	4.27	1.58	clay	undefined	undefined	2	0.26	undefined	undefined
4.975	16.3	46.3	1.12	3.43	1.44	silty sand to sandy silt	50	37	10	undefined	84.2	0.13
5.275	17.3	15.9	0.57	3.77	1.81	clayey silt to silty clay	undefined	undefined	4	0.89	undefined	undefined
5.575	18.3	23.1	0.69	3.42	2.68	clayey silt to silty clay	undefined	undefined	6	1.32	undefined	undefined
5.875	19.3	19.7	0.85	4.54	3.61	clayey silt to silty clay	undefined	undefined	5	1.11	undefined	undefined
6.175	20.3	28.9	1.48	5.14	4.92	clayey silt to silty clay	undefined	undefined	8	1.65	undefined	undefined
6.475	21.2	42.6	1.50	3.93	4.35	silty sand to sandy silt	45	36	10	undefined	87.7	0.14
6.775	22.2	18.2	0.88	4.93	5.74	clayey silt to silty clay	undefined	undefined	5	1.02	undefined	undefined

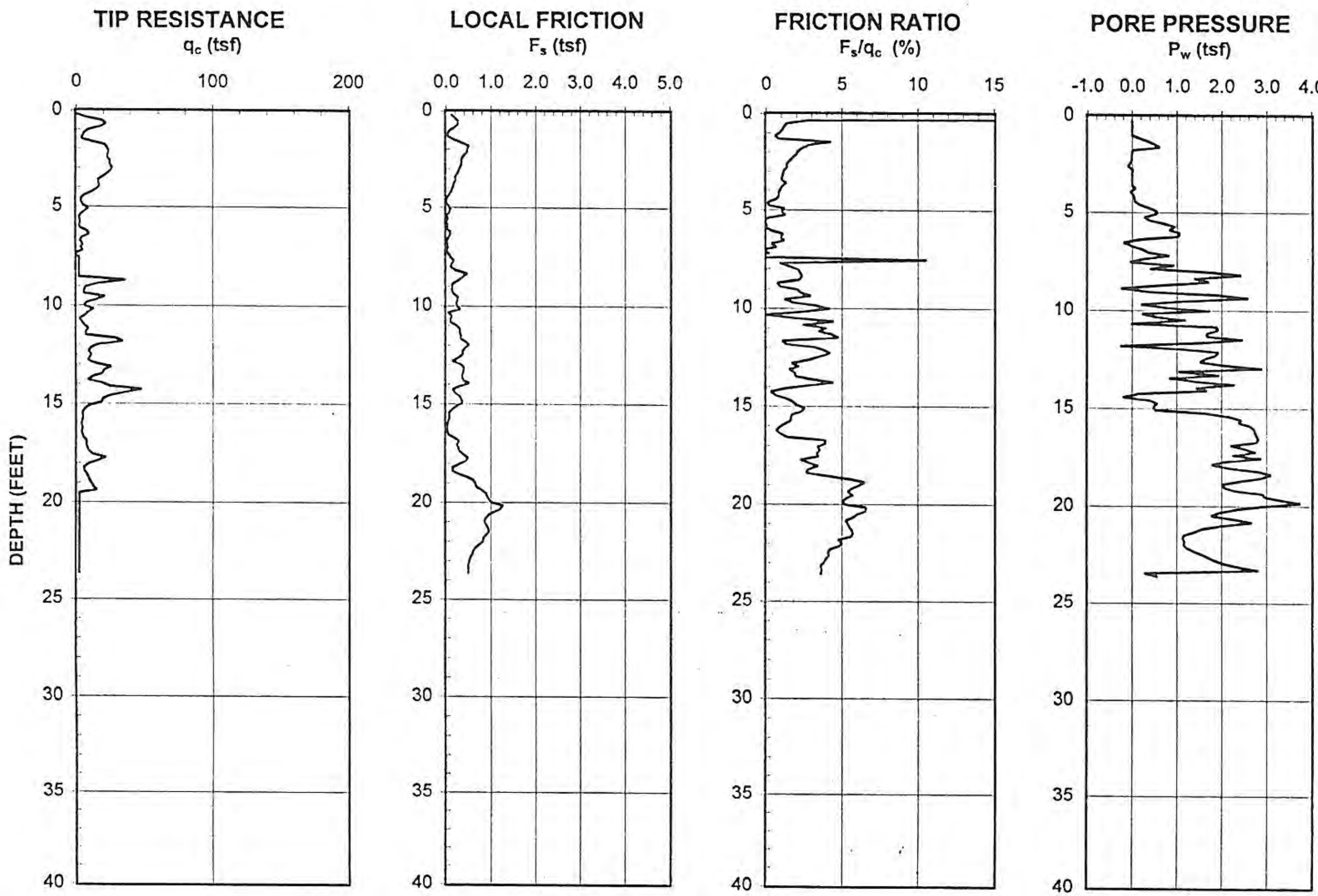
D_r - All sands (Jamiolkowski et al. 1985) ϕ' - Terzaghi, Peck, and Mesri (1996)

s_u: N_k = 17 CRR: M = 7.5 Robertson and Fear (1996)

** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPT-INT

URS GREINER WOODWARD CLYDE
TH-H

Operator:	A. Bredikhin	CPT Date:	8/26/99
Page:	1 of 1	Location:	AmerenUE
Cone Used:	243	Job Number:	23-99000035



URS GREINER WOODWARD CLYDE
TH-H

Operator:	A. Bredikhin		
Cone Used:	243	Location:	AmerenUE
CPT Date:	8/26/99	Job Number:	23-99000035
Total Unit Weight (ave.):	120 pcf	Water Table:	4 ft

Depth (meters)	Depth (feet)	q_c (ave) (tsf)	F_s (ave) (tsf)	R_f (ave) (%)	σ'_v (tsf)	Soil Behavior Type	Eq - D_r (%)	ϕ' (deg)	SPT N-value	s_u (tsf)	$(q_{c1})_{cs}$ (tsf)	CRR M=7.5
0.175	0.6	39.7	0.69	4.76	-0.01	sand to silty sand	55	38	2	undefined	68.6	0.11
0.475	1.6	45.8	1.10	2.46	-0.02	silty sand to sandy silt	39	35	2	undefined	54.1	0.09
0.775	2.5	34.3	0.48	1.44	-0.01	sand to silty sand	53	38	5	undefined	69.9	0.11
1.075	3.5	27.2	0.28	1.04	-0.02	sand to silty sand	42	36	4	undefined	53.2	0.09
1.375	4.5	13.0	0.22	1.72	-0.03	silty sand to sandy silt	11	30	2	undefined	42.0	0.09
1.675	5.5	16.1	0.26	1.65	-0.05	silty sand to sandy silt	-8	26	1	undefined	53.1	0.09
1.975	6.5	10.8	0.15	1.37	0.11	silty sand to sandy silt	-1	28	1	undefined	53.4	0.09
2.275	7.5	3.6	0.06	1.28	0.78	clayey silt to silty clay	undefined	undefined	1	0.31	undefined	undefined
2.575	8.4	4.0	0.11	3.03	0.26	silty sand to sandy silt	30	33	4	undefined	55.1	0.09
2.875	9.4	4.2	0.34	8.17	0.06	silty sand to sandy silt	14	30	2	undefined	61.7	0.10
3.175	10.4	3.9	0.16	4.16	-0.34	clayey silt to silty clay	undefined	undefined	2	0.37	undefined	undefined
3.475	11.4	13.3	0.15	1.15	-0.17	silty sand to sandy silt	24	32	4	undefined	62.5	0.10
3.775	12.4	1.5	0.01	0.78	0.69	clayey silt to silty clay	undefined	undefined	3	0.61	undefined	undefined
4.075	13.4	1.8	0.01	0.70	0.76	silty sand to sandy silt	25	32	4	undefined	65.0	0.10
4.375	14.4	1.4	0.01	0.44	1.58	silty sand to sandy silt	39	35	6	undefined	58.3	0.10
4.675	15.3	5.0	0.17	4.27	1.58	clayey silt to silty clay	undefined	undefined	2	0.44	undefined	undefined
4.975	16.3	46.3	1.12	3.43	1.44	clay	undefined	undefined	1	0.21	undefined	undefined
5.275	17.3	15.9	0.57	3.77	1.81	clayey silt to silty clay	undefined	undefined	3	0.59	undefined	undefined
5.575	18.3	23.1	0.69	3.42	2.68	clay	undefined	undefined	3	0.46	undefined	undefined
5.875	19.3	19.7	0.85	4.54	3.61	clay	undefined	undefined	4	0.75	undefined	undefined
6.175	20.3	28.9	1.48	5.14	4.92	clayey silt to silty clay	undefined	undefined	5	1.04	undefined	undefined
6.475	21.2	42.6	1.50	3.93	4.35	clayey silt to silty clay	undefined	undefined	5	0.92	undefined	undefined
6.775	22.2	18.2	0.88	4.93	5.74	clayey silt to silty clay	undefined	undefined	5	0.88	undefined	undefined
7.275	23.9	4.1	0.11	0.43	1.21	clayey silt to silty clay	undefined	undefined	0	0.76	undefined	undefined

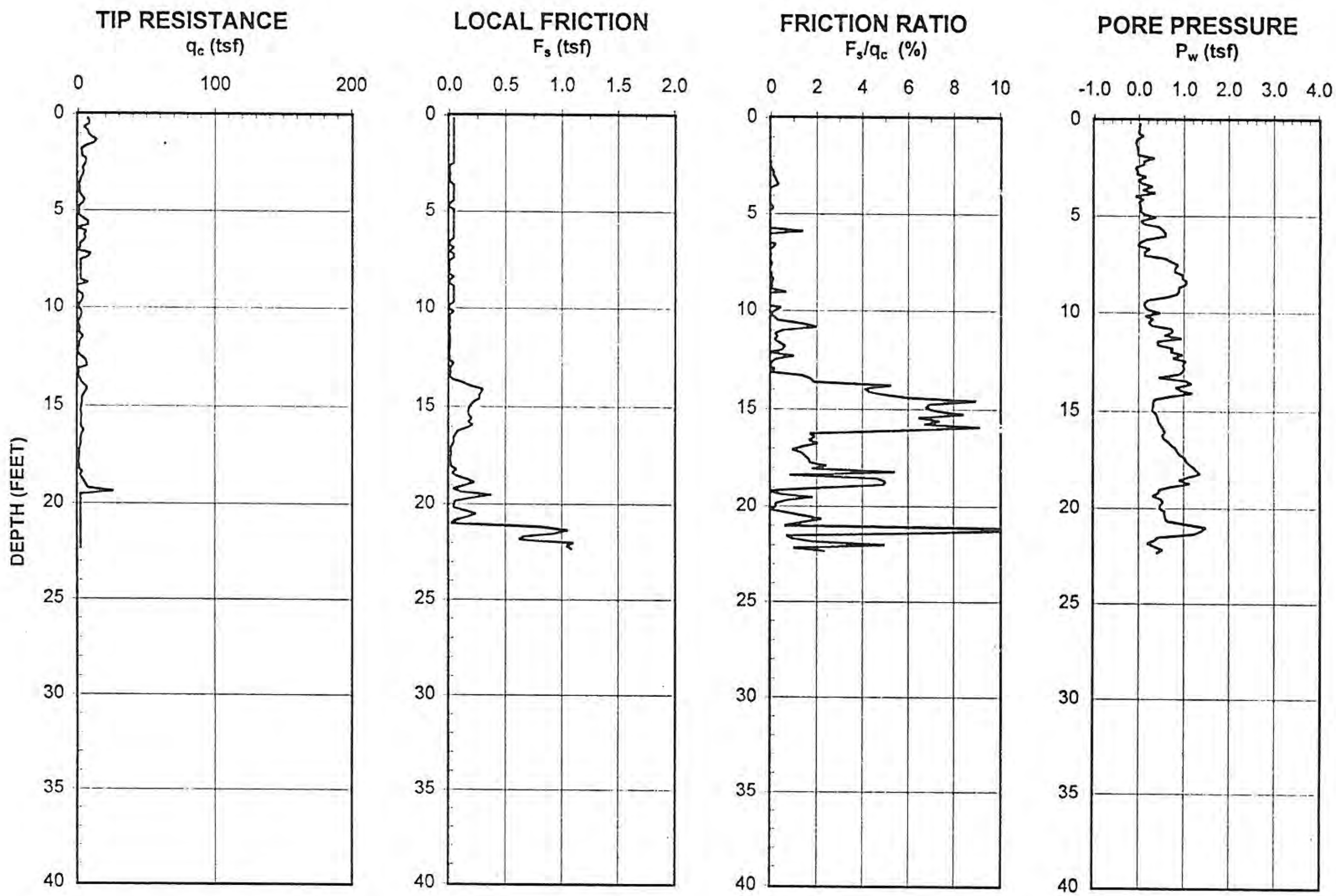
D_r - All sands (Jamiolkowski et al. 1985)　　ϕ' - Terzaghi, Peck, and Mesri (1996)

s_u: $N_k = 17$　　CRR: M = 7.5 Robertson and Fear (1996)

** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPT-INT

WOODWARD-CLYDE CONSULTANTS
TH-L

Operator:	A. Bredikhin	CPT Date:	8/26/99
Page:	1 of 1	Location:	AmerenUE
Cone Used:	243	Job Number:	23-99000035



URS Greiner Woodward Clyde
TH-L

Operator:	A. Bredikhin		
Cone Used:	243	Location:	AmerenUE
CPT Date:	8/26/99	Job Number:	23-99000035
Total Unit Weight (ave.):	120 pcf	Water Table:	5 ft

Depth (meters)	Depth (feet)	q_c (ave) (tsf)	F_s (ave) (tsf)	R_f (ave) (%)	σ'_v (tsf)	Soil Behavior Type	Eq - D_r (%)	ϕ' (deg)	SPT N-value	s_u (tsf)	$(q_{c1})_{cs}$ (tsf)	CRR M=7.5
0.175	0.6	7.2	-0.02	-0.24	0.03	undefined	undefined	undefined	undefined	undefined	undefined	undefined
0.475	1.6	7.8	-0.01	-0.13	0.09	undefined	undefined	undefined	undefined	undefined	undefined	undefined
0.775	2.5	4.5	0.00	0.03	0.15	sand to silty sand	5	29	1	undefined	24.7	0.08
1.075	3.5	1.9	0.00	0.01	0.21	silty sand to sandy silt	undefined	23	0	undefined	49.2	0.09
1.375	4.5	2.6	0.00	-0.11	0.27	undefined	undefined	undefined	undefined	undefined	undefined	undefined
1.675	5.5	3.3	-0.01	0.08	0.31	undefined	undefined	undefined	undefined	undefined	undefined	undefined
1.975	6.5	4.1	-0.01	-0.16	0.34	undefined	undefined	undefined	undefined	undefined	undefined	undefined
2.275	7.5	5.2	0.00	0.00	0.37	silty sand to sandy silt	undefined	27	1	undefined	42.2	0.09
2.575	8.4	5.0	0.00	0.04	0.40	silty sand to sandy silt	undefined	27	1	undefined	42.6	0.09
2.875	9.4	1.7	-0.01	-0.27	0.43	undefined	undefined	undefined	undefined	undefined	undefined	undefined
3.175	10.4	1.4	0.00	0.67	0.46	clay	undefined	undefined	1	0.06	undefined	undefined
3.475	11.4	1.7	0.01	0.37	0.48	clay	undefined	undefined	1	0.07	undefined	undefined
3.775	12.4	2.4	0.00	0.00	0.51	clay	undefined	undefined	1	0.11	undefined	undefined
4.075	13.4	1.9	0.03	0.00	0.54	clay	undefined	undefined	1	0.08	undefined	undefined
4.375	14.4	4.7	0.25	5.86	0.57	clay	undefined	undefined	2	0.24	undefined	undefined
4.675	15.3	2.5	0.18	7.17	0.60	organic soil	undefined	undefined	1	0.11	undefined	undefined
4.975	16.3	2.8	0.10	3.69	0.63	clay	undefined	undefined	1	0.13	undefined	undefined
5.275	17.3	1.4	0.02	1.44	0.66	organic soil	undefined	undefined	2	0.04	undefined	undefined
5.575	18.3	1.8	0.06	3.35	0.68	organic soil	undefined	undefined	1	0.07	undefined	undefined
5.875	19.3	15.4	0.17	1.67	0.71	silty sand to sandy silt	18	31	4	undefined	59.6	0.10
6.175	20.3	18.2	0.11	0.82	0.74	silty sand to sandy silt	22	32	4	undefined	50.4	0.09
6.475	21.2	38.4	0.59	4.03	0.77	silty sand to sandy silt	43	36	8	undefined	70.0	0.11

D_r - All sands (Jamiolkowski et al. 1985) ϕ' - Terzaghi, Peck, and Mesri (1996)

s_u: N_k = 17 CRR: M = 7.5 Robertson and Fear (1996)

** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPT-INT

APPENDIX D

PRELIMINARY COST ESTIMATE
FOR TRACK EMBANKMENT AND SUBGRADE

REITZ & JENS, Inc.
CONSULTING ENGINEERS

1055 Corporate Square Drive • St. Louis, Missouri 63132 • 314/993-4132
FAX 314/993-4177

MEMORANDUM

To: Tom Hollenkamp - Ameren Services
Bill Fleis - Design Nine, Inc.

Subject: Meramec Power Plant - New Rail Loop
Revised Cost Estimate

Date: November 16, 1999

Our April 9, 1999 memorandum outlined alternatives for constructing a suitable subgrade for the new rail loop over the existing ash ponds at Ameren/UE's Meramec Power Plant. Since that time we have performed additional field investigations of the subsurface materials, and had further discussions with the design team. Based on this additional information we have refined the scope of recommended subgrade preparation for the new rail loop. The details of our recommendations will be provided in a separate design memorandum which will be forwarded shortly.

The purpose of this memorandum is to provide an estimated cost to construct an adequate subgrade to the sub-ballast elevation. The estimated costs to install the ballast, ties and track will be provided separately by Design Nine. These additional improvements will raise the track a total of 24-inches above the finished subballast elevation. The subballast elevations were determined using verbal information provided to us by Design Nine on November 10, 1999. Drawings showing the general profile of the finished track and a typical subgrade cross-section are attached.

The quantities used in this cost estimate were developed by applying the typical cross-section to existing ground surface elevations from a recent aerial survey. The typical section will not work in all cases and assumptions had to be made in these areas to develop this estimate. Furthermore, the recommended typical section was developed using strength data and subgrade profiles from a limited number test holes along the proposed rail alignment. The section assumes the subgrade profile is relatively consistent along the proposed alignment, which is not necessarily the case. Prior to finalizing the recommended sections, additional test drilling is required in portions of the ash ponds which are presently inaccessible.

Cost Estimates/Unit Prices

With the an understanding of its preliminary nature, our estimate for improving the subgrade to the top of the sub-ballast in accordance with the attached typical section is $ 1.9 million. This estimate was based on removing, drying and replacing 60,000 CY of existing fly/bottom ash beneath the alignment; excavating, drying and placing an additional 40,000 CY of ash from another on-site location; importing 16,000 CY (28,000 tons) of MODOT Type 2 Aggregate for the embankment above existing grade; importing 10,000 CY (15,500 tons) of shot rock for embankment across the existing bottom ash pond; and purchasing and installing 24,000 SY of Mirafi HP570 geofabric across the bottom of the remove/replace section. Because of the unknowns that still exist, the estimate also includes a 25% contingency.

This estimate was developed by multiplying the estimated quantities by unit prices obtained from historical prices on other ash moving projects and in discussion with grading contractors familiar with the site. Based on this input, the following unit prices were used:

Excavate flyash & bottom ash:	$ 3.00/cubic yard
Dry and densify ash:	$ 5.00/cubic yard
Import/place and densify MODOT Type 2 Aggregate:	$ 15.00/ton*
Import/place and densify shot rock:	$ 15.00/ton**
Supply/Install Mirafi HP570 Geofabric:	$ 3.50/square yard

* Type 2 Aggregate averages 130 lbs/ft^3 when densified, 1 cubic yard = 1.75 tons
** Shot Rock averages 115 lbs/ft^3 when densified, 1 cubic yard = 1.55 tons

The construction cost estimates were developed by multiplying the quantities by the unit prices. As such, the construction cost estimates should be considered a rough approximation at this time and should be used only for planning purposes. The final construction costs will be influenced by many factors including the final layout and track elevation, additional subsurface information gathered in the future, time of year and sequencing of construction.

We trust this cost estimate is adequate at this time. If necessary, the estimate can be refined once additional subsurface investigation and the construction plans have been completed. If you have any questions, or need additional information in the interim, please contact us at your convenience.

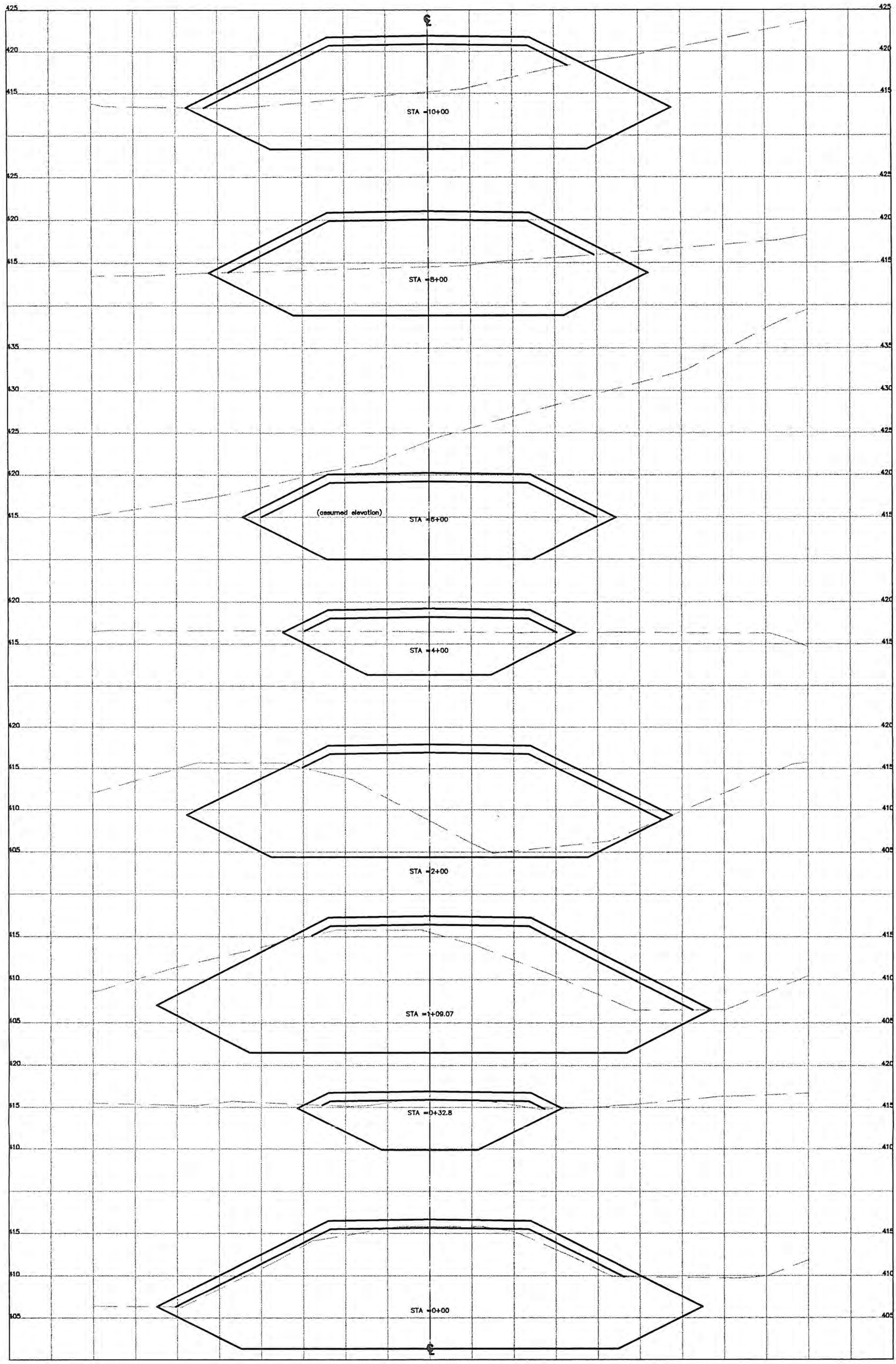
cc: W. Fleis/Design Nine

Ar-----n/UE
Meramec Power Plant - New Rail Loop
Earthwork Cost Estimate - Revised
Reitz & Jens, Inc.
November 16, 1999

Estimated costs to build subgrade to sub-ballast elevation based upon preliminary top of rail elevations provided by Design Nine on November 10, 1999

DESCRIPTION	UNITS	QUANTITY	UNIT PRICE	EXTENSION
EXCAVATE FLYASH	CY	100,000	$3.00	$300,000
DRY/COMPACT FLYASH	CY	100,000	$5.00	$500,000
IMPORT/PLACE SHOT ROCK	CY	10,000	$23.25	$232,500
IMPORT/PLACE MODOT #2	CY	16,000	$26.25	$420,000
SUPPLY/PLACE MIRAFI HP570 GEOFABRIC	SY	24,000	$3.50	$84,000
			SUBTOTAL	$1,536,500
			25% CONTINGENCY	$355,000
			ESTIMATED TOTAL	**$1,891,500**

* NOTE: Shot Rock is approx. 115 PCF, 1 CY = 1.55 tons
MODOT # 2 is approx 130 PCF, 1 CY = 1.75 tons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(assumed elevation)
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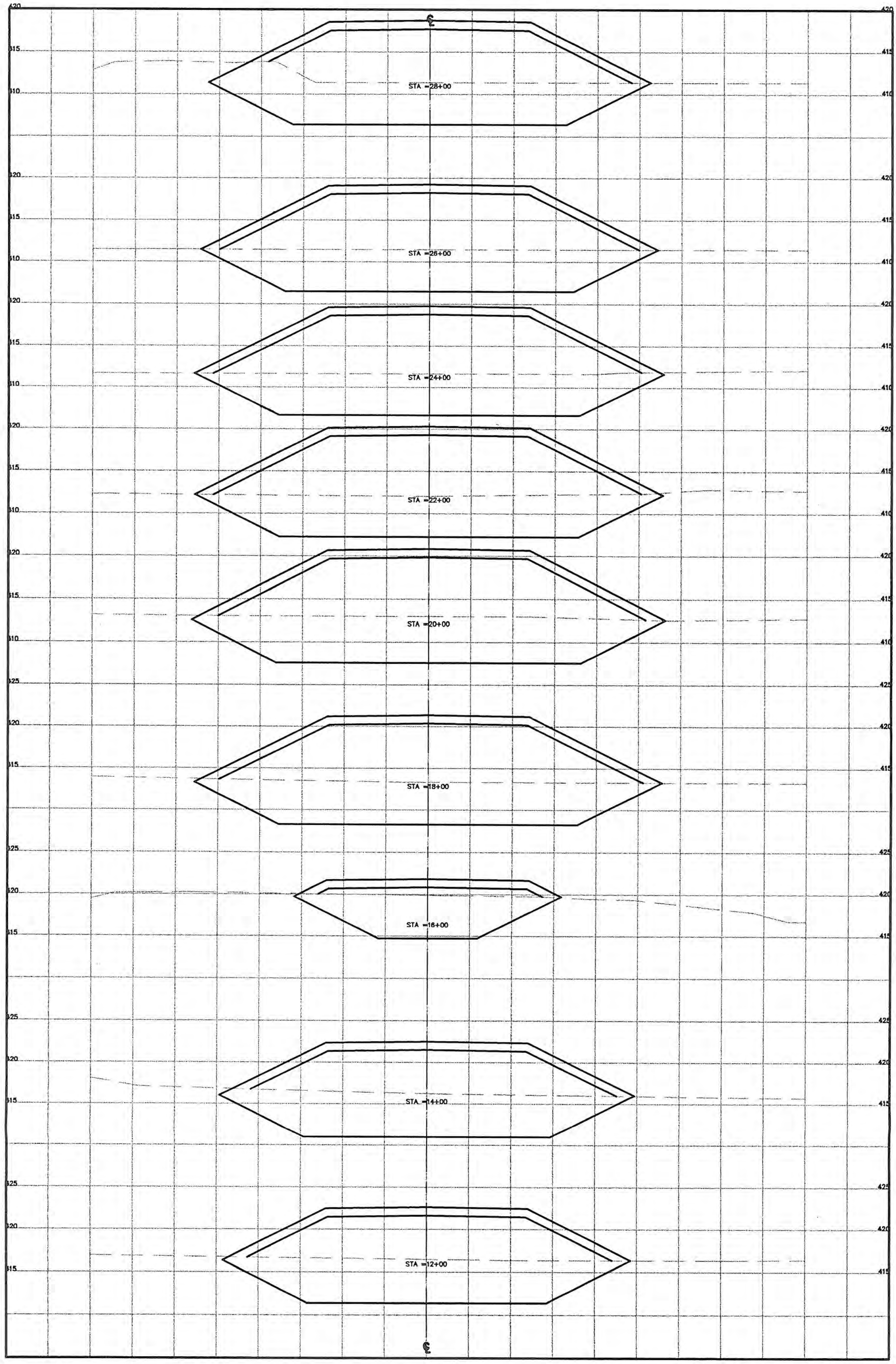
420
415
435
430
410
405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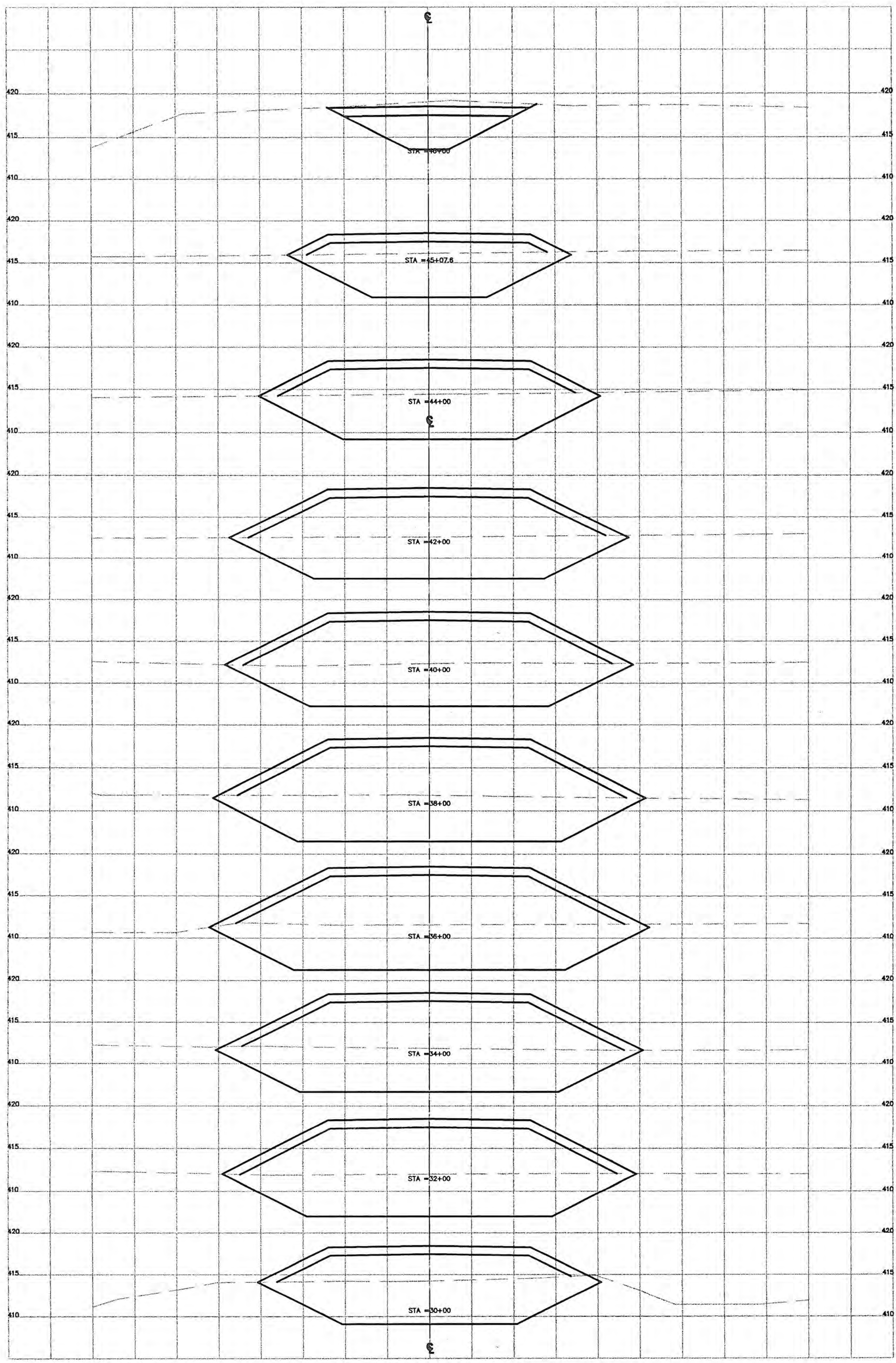
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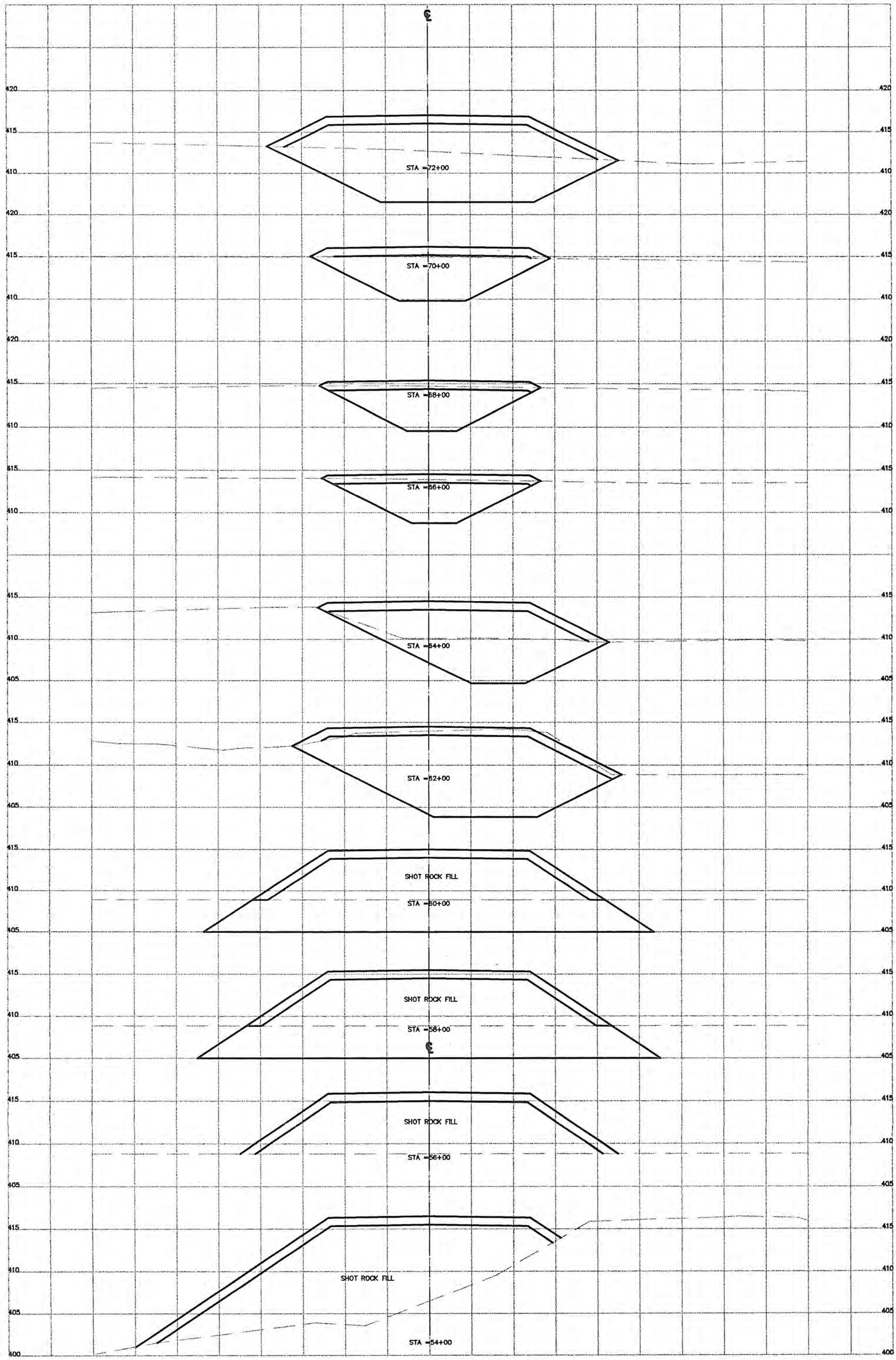
420
415
410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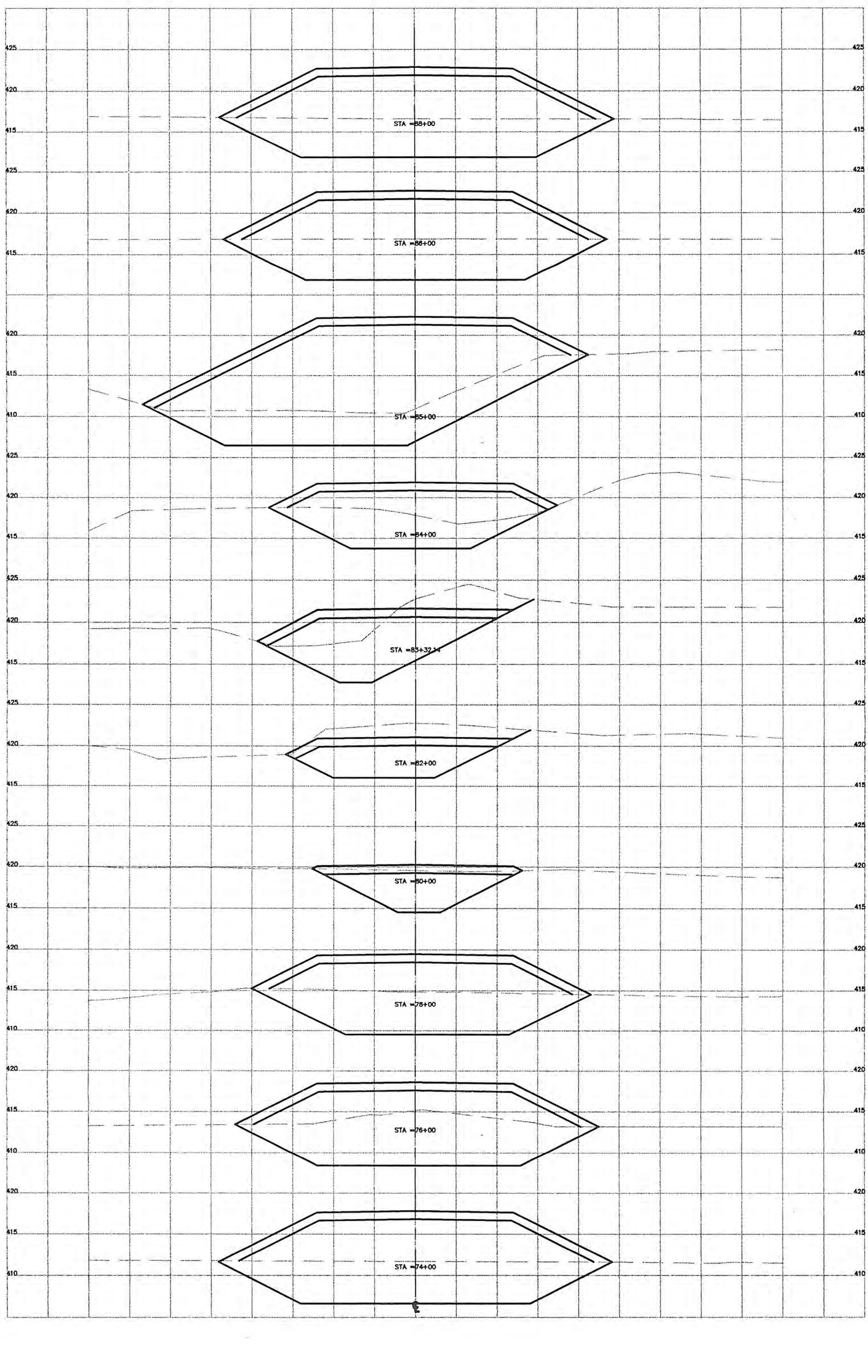
STA =54+00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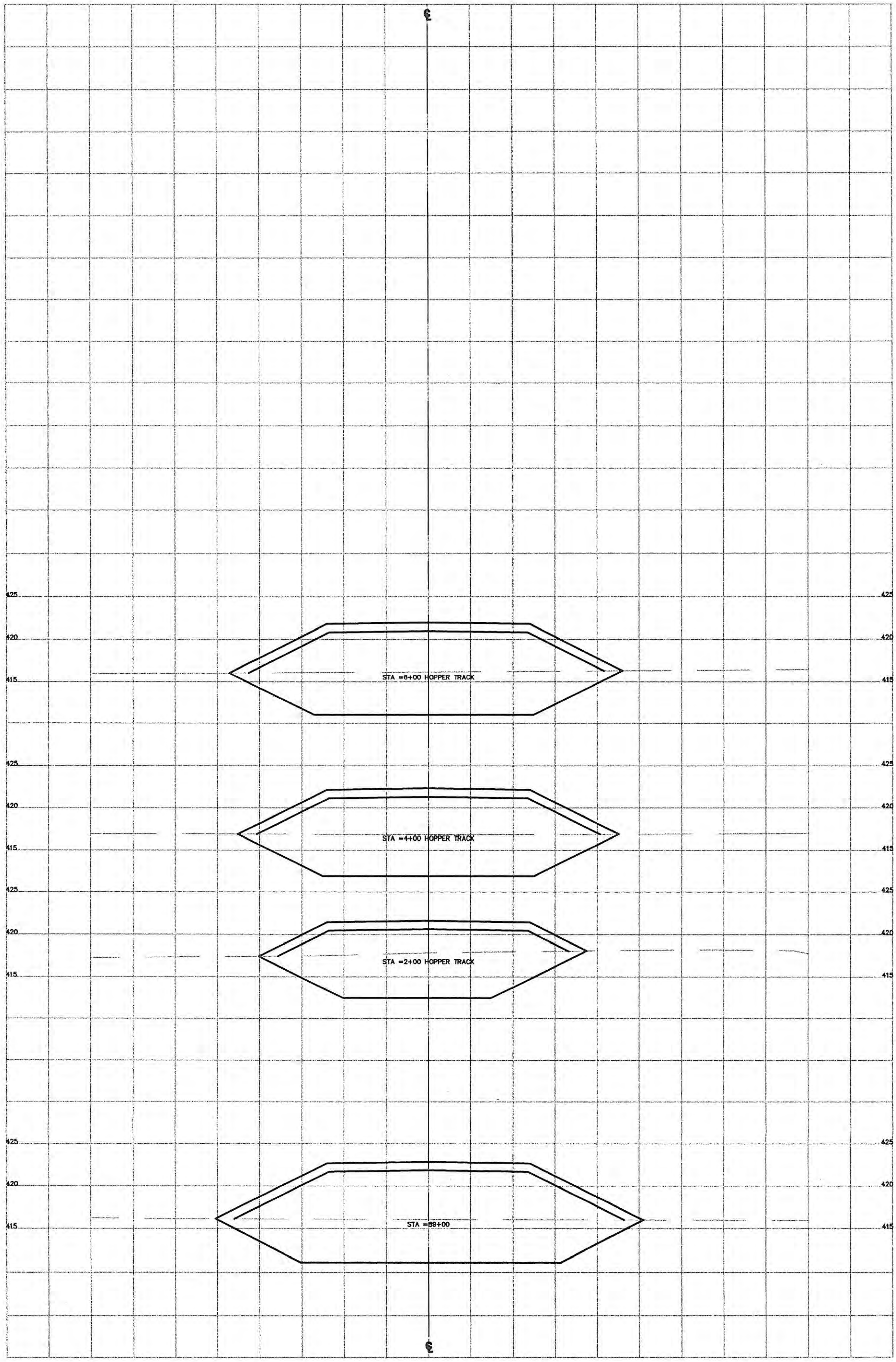

425
420
415
STA =6+00 HOPPER TRACK
425
420
415
STA =4+00 HOPPER TRACK
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420
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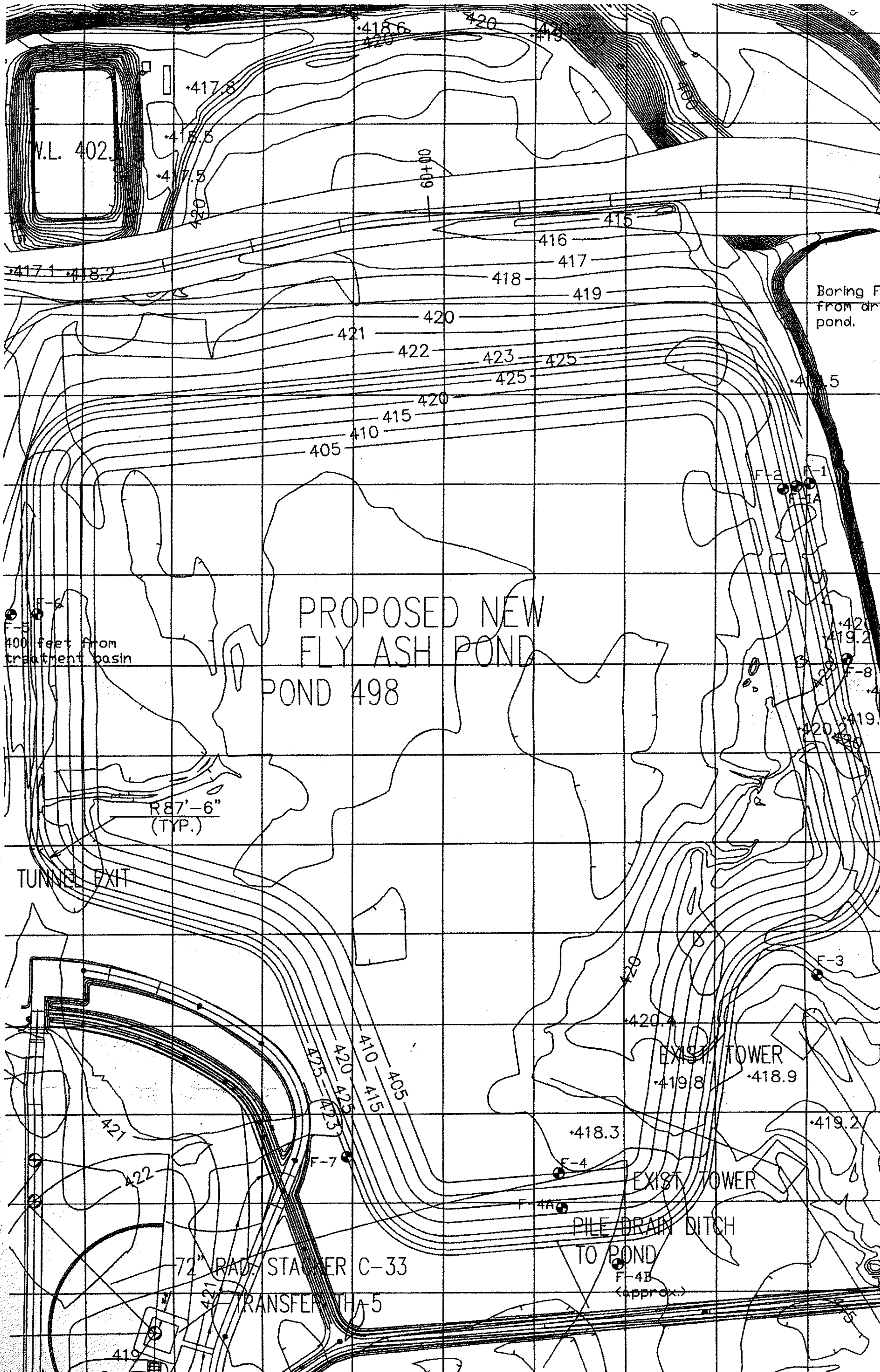
STA =2+00 HOPPER TRACK
425
420
415

Pond 498 Geotechnical Borings

2001


PROPOSED NEW
FLY ASH POND
POND 498
W.L. 402.
Boring F
from dr
pond.
F-1
F-1A
F-2
F-3
F-4
F-4A
F-4B
(approx.)
F-5
F-6
F-7
F-8
400 feet from
treatment basin
R87'-6"
(TYP.)
TUNNEL EXIT
EXIST. TOWER
EXIST. TOWER
PILE DRAIN DITCH
TO POND
72" RAD. STACKER C-33
TRANSFER TH-5
60+00

REITZ & JENS, INC.
CONSULTING ENGINEERS
1055 CORPORATE SQUARE DRIVE
ST. LOUIS MISSOURI 63132
(314) 993-4132

Boring No. F-1

SUBSURFACE EXPLORATION LOG

Sheet 1 of 1

Job No. ________ Job Title UE-Meramec - New Ash Pond Date 3-21-01

Depth (Elev) ft	Blows/6" (REC %) [RQD]	SYM	DESCRIPTION OF MATERIAL	Sample No.	Sample Typ	Sample Depth From	Sample Depth To	Casing Size	Casing Bl/12"	Remarks
5	8" 0-0-1		Fly Ash	1	SS	5'	6½'			
										7'
	8" 0-0-1		Brown silty clay	2	SS	7½'	9'			
										9½'
10	6" 0-1-2		Dark grey silty clay	3	SS	10'	11½'			
			Stopped Boring 11½'							
15										
20										

Boring No. ________

0-0-1
0-1-2

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SUBSURFACE EXPLORATION LOG

Boring No. F-2

Sheet 1 of 1

Date 3-21-01

Job No. ________ Job Title UE - Meramec - New Ash Pond

Depth (Elev) ft	Blows/6" (REC %) [RQD]	SYM	DESCRIPTION OF MATERIAL	Sample No.	Sample Typ	Sample Depth From	Sample Depth To	Casing Size	Casing Bl/12"	Remarks
5	18" 0-0-1		Fly Ash	1	SS	5'	6½'			
10	Rec. 19"		Fly Ash (Firm at Bottom)	2	ST	10'	12'			
15	18" 0-1-1		Fly Ash	3	SS	15'	16½'			
	18" 1-1-1		Fly Ash	4	SS	17½'	19'			
20	Rec. 24"		Fly Ash	5	ST	20'	22'			
	18" 0-2-2		Grey silty clay 23' Brown silty clay 23½'	6	SS	22½'	24'			
25	18" 0-1-2		Brown silty clay	7	SS	25'	26½'			
			Stopped at 26½'							

Hit Water while drilling at 22'
Water Level after Drilling = 12.2'
Set Screen 20' to 25'
Sand 15' to 25'
12' to 15' = Bentonite chips

Boring No. ____________

cut off 16" off 30' total
44" above Ground

REITZ & JENS, INC.
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1055 CORPORATE SQUARE DRIVE
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(314) 993-4132

15' - 15'
Between
F-1 & F-2

Boring No. ____

SUBSURFACE EXPLORATION LOG

Sheet ____ of ____

Job No. ____ Job Title UE - Meramec - New Ash Pond Date 3-21-01

Depth (Elev) ft	Blows/6" (REC %) [RQD]	PP	DESCRIPTION OF MATERIAL	Sample No.	Sample Typ	Sample Depth From	Sample Depth To	Casing Size	Casing Bl/12"	Remarks
5										
10	10" 0-1-1		Fly Ash	1	SS	10'	11½			
	18" 1-2-2		Fly Ash	2	SS	13'	14½'			
15	18" 0-1-1		Fly ash cinders 15½' to 16' Dark gray silty clay at 16' to 16½'	3	SS	15'	16½'			
	18" 1-1-1		Fly Ash & Soil Mixed 18½' to 19' Silty Clay	4	SS	17½'	19'			
20	24" Rec	1.25	Grey & Brown silty Clay	5	ST	20'	22'			
			Stopped Boring @ 22'							

Boring No. ____

Brotcke Drilling
636-343-3029
Don Houston - Driller

REITZ & JENS, INC.
CONSULTING ENGINEERS
1055 CORPORATE SQUARE DRIVE
ST. LOUIS MISSOURI 63132
(314) 993-4132

SUBSURFACE EXPLORATION LOG

Boring No. F-3
Sheet 1 of 1
Job No. ______ Job Title UE - Meramec - New Ash Pond Date 3-21-01

Depth (Elev) ft	Blows/6" (REC %) [RQD]	~~OVA~~ PP	DESCRIPTION OF MATERIAL	Sample No.	Sample Typ	Sample Depth From	Sample Depth To	Casing Size	Casing Bl/12"	Remarks
5	13" 1-3-7		Fly Ash	1	SS	5'	6½'			5
	15" 1-4-5		Fly Ash	2	SS	7½'	10'			
10	15" 0-1-2		Fly Ash	3	SS	10'	11½'			10
	21" Rec		Fly Ash - Hit rock at end - Bent tip of Tube	4	ST	12½	14½'			
15										15
	17" Rec	1.0	Dark grey clay at end of tube	5	ST	17½'	19½'			
20			Hole Dry while Drilling							20
			Total Depth 19½'							
										25

Boring No. ______

1-2-5

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1055 CORPORATE SQUARE DRIVE
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(314) 993-4132

SUBSURFACE EXPLORATION LOG

Boring No. F-4

Sheet ____ of ____

Job No. ______ Job Title UE-Meramec - New Ash Pond Date 3-23-01

Depth (Elev) ft	Blows/6" (REC %) [RQD]	PP	DESCRIPTION OF MATERIAL	Sample No.	Typ	Depth From	To	Casing Size	Bl/12"	Remarks
	13" 1-2-5	4.5*	Fly Ash	1	SS	2½'	4'			
5	18" 1-0-1	0	Fly Ash	2	SS	5'	6½'			
	18" 2-2-2	0 to 2.5	Fly Ash	3	SS	7½'	10'			
10	18" 0-0-1	0	Fly Ash	4	SS	10'	11½'			
			Total Depth = 11½'							
15			This is ? old Levee Road,							
20										
25										

Dry while Drilling & After

Boring No. ______

1-3-2

REITZ & JENS, INC.
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1055 CORPORATE SQUARE DRIVE
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(314) 993-4132

Boring No. E-4-A

SUBSURFACE EXPLORATION LOG

Sheet ______ of ______

Job No.________ Job Title UE - Meramec - New Ash Pond Date 3-23-01

Depth (Elev) ft	Blows/6" (REC %) [RQD]	PP	DESCRIPTION OF MATERIAL	Sample No.	Typ	Depth From	Depth To	Casing Size	Bl/12"	Remarks
	18" 1-3-2		Fly Ash	1	SS	2½'	4'			
5	18" 1-1-1		Fly Ash	2	SS	5'	6½'			
	18" Rod wt. 0-0-0		Fly Ash	3	SS	7½'	10'			
10	Rec. 19"	0	Fly Ash	4	ST	10'	12'			
	18" 0-0-2		Fly Ash	5	SS	12½'	14'			
15	Rec. 24"	0	Fly Ash - Sample almost Liquid -	6	ST	15'	17'			
	18" 0-1-1		Fly Ash	7	SS	17½'	19'			
20	Rec. 18"	0.5	Grey w/ some Brown HP Clay.	8	ST	20'	22'			
	1-3-4	1.75	Grey &/ Brown HP Clay	9	SS	22½'	24'			
25			Total Depth: 24'							
			Proposed End of Pond							

Hole Dry while Drilling

Boring No. ________

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1055 CORPORATE SQUARE DRIVE
ST. LOUIS MISSOURI 63132
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other old levee Rd. ?

Boring No. F-4-B

SUBSURFACE EXPLORATION LOG

Sheet ______ of ______

Job No.________ Job Title UE - Meramec - New Ash Pond Date 3-23-01

Depth (Elev) ft	Blows/6" (REC %) [RQD]	SYM	DESCRIPTION OF MATERIAL	Sample No.	Sample Typ	Sample Depth From	Sample Depth To	Casing Size	Casing Bl/12"	Remarks
5	18" 1-1-1		Fly Ash	1	SS	5'	6½'			
10	18" 0-1-1		Fly Ash	2	SS	10'	11½'			
			Stopped at 10' Hole Dry while Drilling							
15										
20										

Boring No. __________

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Boring No. F-5

SUBSURFACE EXPLORATION LOG

Sheet ____ of ____

Job No. ____ Job Title UE - Meramec - New Ash Pond Date 3-21-01

Depth (Elev) ft	Blows/6" (REC %) (RQD)	SYM	DESCRIPTION OF MATERIAL	Sample No.	Sample Typ	Sample Depth From	Sample Depth To	Casing Size	Casing Bl/12"	Remarks
5	11" 1-1-2		5" Fly Ash 6" Brown silty Clay	1	SS	5'	6½'			
	14" 0-2-2		Grey clay & Brown silty clay w/ Vegetation	2	SS	7½'	9'			
10										
15	23" Rec		Brown silty clay	3	ST	15'	17'			
			Stopped Boring at 17'							
20										

Dry while Drilling
Dry after Drilling

Boring No. ____

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1055 CORPORATE SQUARE DRIVE
ST. LOUIS MISSOURI 63132
(314) 993-4132

SUBSURFACE EXPLORATION LOG

Boring No. E-6

Sheet ______ of ______

Job No.________ Job Title UE - Meramec - New Ash Pond Date 3-21-01

Depth (Elev) ft	Blows/6" (REC %) [RQD]	PP	DESCRIPTION OF MATERIAL	Sample No.	Typ	Depth From	To	Casing Size	Bl/12"	Remarks
5	3" 0-0-0		Grey silty clay & Fly Ash	1	SS	5'	6½'			
	18" 1-1-1		Fly Ash	2	SS	7½'	9'			
10	0-0-0		Fly Ash	3	SS	10'	11½'			
15	13"Rec		Fly Ash	4	ST	15'	17'			
	24"Rec	0.5	Grey Clay	5	ST	17½'	19½'			
20	0-2-2		Grey clay w/Some Veg.	6	SS	20'	21½'			
			Stopped at 21½'							

Dry while Drilling - Piez. - ~~25~~ 25' - 11" cut off

Boring No.

4.5' from top to ground Surface

5' Screen

10' Filter Sand

3' Bent. chips

REITZ & JENS, INC.
CONSULTING ENGINEERS
1055 CORPORATE SQUARE DRIVE
ST. LOUIS MISSOURI 63132
(314) 993-4132

SUBSURFACE EXPLORATION LOG

Boring No. F-7

Sheet ______ of ______

Job No. ________ Job Title UE - Meramec - New Ash Pond Date 3-23-01

Depth (Elev) ft	Blows/6" (REC %) [RQD]	~~SWR~~ PP	DESCRIPTION OF MATERIAL	Sample No.	Typ	Depth From	To	Casing Size	Bl/12"	Remarks
	18" 0-0-1		Fly Ash	1	SS	2½'	4'			
5										
	2-1-1		Fly Ash	2	SS	7½'	9'			
10	Rec. 24"		Fly Ash	3	ST	10'	12			
	18" 0-2-6		Fly Ash S-4 = Bottom 4" S-4A = Top =	4 1	SS	12½'	14'			
15	Rec. 20"		Fly Ash	5	ST	15'	17'			
	1-1-4		Fly Ash	6	SS	17½'	19'			
20	Rec. 24"		Fly Ash	7	ST	20'	22'			
	Rec 18" 0-1-1		Fly Ash	8	SS	22½	24'			
25	Rec. 24"	0.75	Brown & grey clay	9	ST	25'	27'			
			Stopped at 27'							

Hit Water while drilling at 15.0'
Water at 15.0' at end

Boring No. ____________

REITZ & JENS, INC.
CONSULTING ENGINEERS
1055 CORPORATE SQUARE DRIVE
ST. LOUIS MISSOURI 63132
(314) 993-4132

200' South of F-1

Boring No. F-8

SUBSURFACE EXPLORATION LOG

Sheet ____ of ____

Job No. ________ Job Title UE-Meramec - New Ash Pond Date 3-23-01

Depth (Elev) ft	Blows/6" (REC %) [RQD]	~~SUT~~ PP	DESCRIPTION OF MATERIAL	Sample No.	Sample Typ	Sample Depth From	Sample Depth To	Casing Size	Casing Bl/12"	Remarks
										Location 200' South of F-1
5	18" 1-0-1		Fly Ash	1	SS	5'	6½'			
	18" 0-0-1		Fly Ash	2	SS	7½'	9'			
10	5" 0-0-1	0.0	PP on soil = 0 Brown silty clay at 11' to 11½' - Soft	3	SS	10'	11½'			
		0.5	Brown & Grey HP clay	4	ST	12'	14'			
15	Rec 14"	2.25	Brown & grey HP Clay	5	ST	15'	17'			
20	Rec 22"	1.75	Brown w/some grey HP Clay	6	ST	20'	22'			
			Stopped at 22'							
25										

No water while Drilling or at end
Back filled w/C-Ash

Boring No. ________

2010 Ash Pond Stability Analysis Project

Geotechnical Borings

2010

Elevation Profile Survey Limits
Locations of Cross-sections and Borings

REITZ & JENS, INC.
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Figure 1

KEY TO BORING LOGS

Symbol	Description
KEY TO SOIL SYMBOLS	
	Crushed Limestone
	Miscellaneous FILL
	Medium to high plastic CLAY
	Low plastic Silty CLAY (CL)
MISCELLANEOUS SYMBOLS	
	Water table during drilling
●	Moisture content (%)
▲	N-value from Standard Penetration Test, ASTM D-1586 (blows/ft)
■	Shear strength from Pocket Penetrometer (tsf)
SOIL SAMPLERS	
	2-in. O.D. Split-Spoon
	3-in. O.D. Shelby Tube

Notes:

1. Details of the drilling and sampling program are presented in the general introduction of the report.

2. Stratification lines shown on the logs represent approximate soil boundaries; actual changes in strata may be gradual or occur between samples.

Figure 2-0

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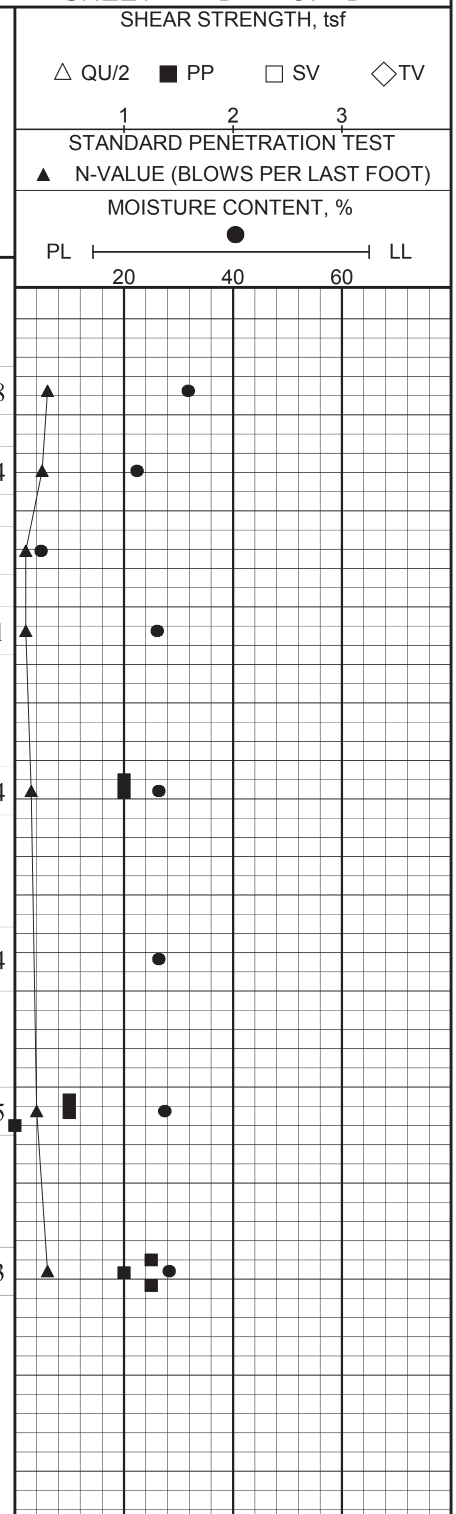
BORING LOG

PROJECT: Ash Pond Stability
Meramec Power Plant
CLIENT: Ameren Missouri

DATE DRILLED: 08-09-10

BORING NUMBER: PZ-1
LOCATION:
COORD. N 937323.42 E 864991.49
ELEVATION: 413.6 DATUM: NAVD88
FIGURE: 2-1 SHEET 1 OF 1

DEPTH (FEET)	ELEVATION	Water Table	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						FILL, gray with trace dark gray, firm, very silty clay to clayey silt, with trace limonite and fly ash		
					100		3-3-3	31.8
					100		1-2-3	22.4
6	408							
					6	Becoming very loose, and silty sand to sandy silt, gray, with fine sand, and trace fly ash and cinders	1-1-1	4.8
					100	Becoming soft, and silty clay to clayey silt, dark gray and brown, with fly ash	0-1-1	26.1
12	402							
					100	Becoming silty clay to very silty clay, with decayed roots and wood	1-1-2	26.4
						PZ-1, screened interval from 17' to 27'		
18	396							
					79	Becoming firm, silty clay, gray to brownish gray, with pockets of very silty clay and high plastic clay, and trace rock	96.8	26.4
24	390							
					100	Silty CLAY (CL), gray to brownish gray, firm, with trace lignite	1-2-2	27.5
30	384	▽			100	Becoming moderately plastic, and silty to slightly silty, with trace limonite and iron stains	1-2-4	28.3
						Boring terminated at 30'6"		
36	378							



THE STRATIFICATION LINES REPRESENT APPROXIMATE SOIL BOUNDARIES: ACTUAL STRATIFICATION MAY BE GRADUAL.

DRILLER: Terra Drill
METHOD: HSA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

WATER LEVELS: DURING DRILLING 29 FEET
____ BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ____ FEET

File:

REITZ & JENS, INC.
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BORING LOG

PROJECT: Ash Pond Stability
Meramec Power Plant
CLIENT: Ameren Missouri

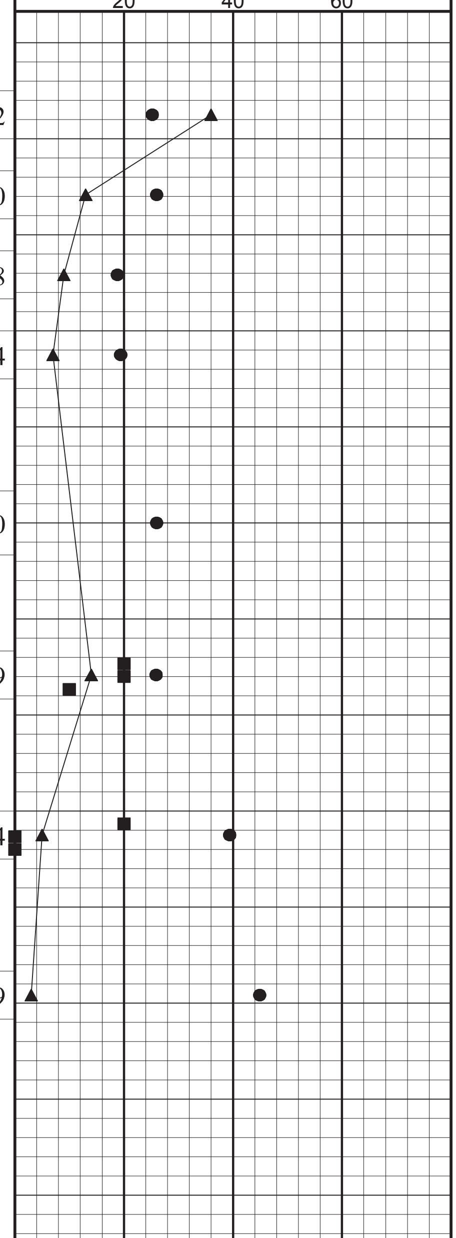
DATE DRILLED: 08-09-10

BORING NUMBER: B-2
LOCATION:
COORD. N 934544.23 E 864910.61
ELEVATION: 414.0 DATUM: NAVD88
FIGURE: 2-2 SHEET 1 OF 1

DEPTH (FEET)	ELEVATION	Water Table	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0	414					3" Crushed Aggregate Pavement		
					100	FILL, gray to dark gray, fly ash, dense	8-17-19	25.2
					100	Becoming medium dense, with bottom ash and trace fine sand	4-7-6	26.0
6	408				56	With some brown silty clay, and crushed limestone gravel up to 1" diameter	1-4-5	18.8
					100		1-3-4	19.4
12	402							
					83	Becoming high plastic clay, gray and dark gray, stiff, with trace organics	97.1	26.0
18	396				100	Becoming slightly silty, moderate to high plasticity, and dark gray-brown, with trace fine sand and crushed limestone	3-7-7	25.9
24	390	▽			100	Silty CLAY (CL-CH), grayish brown, firm, moist, moderate to high plasticity	1-2-3	39.4
30	384				100	Becoming gray and brownish gray, with decayed roots	0-1-2	44.9
						Boring terminated at 30'6"		
36	378							

THE STRATIFICATION LINES REPRESENT APPROXIMATE SOIL BOUNDARIES: ACTUAL STRATIFICATION MAY BE GRADUAL.

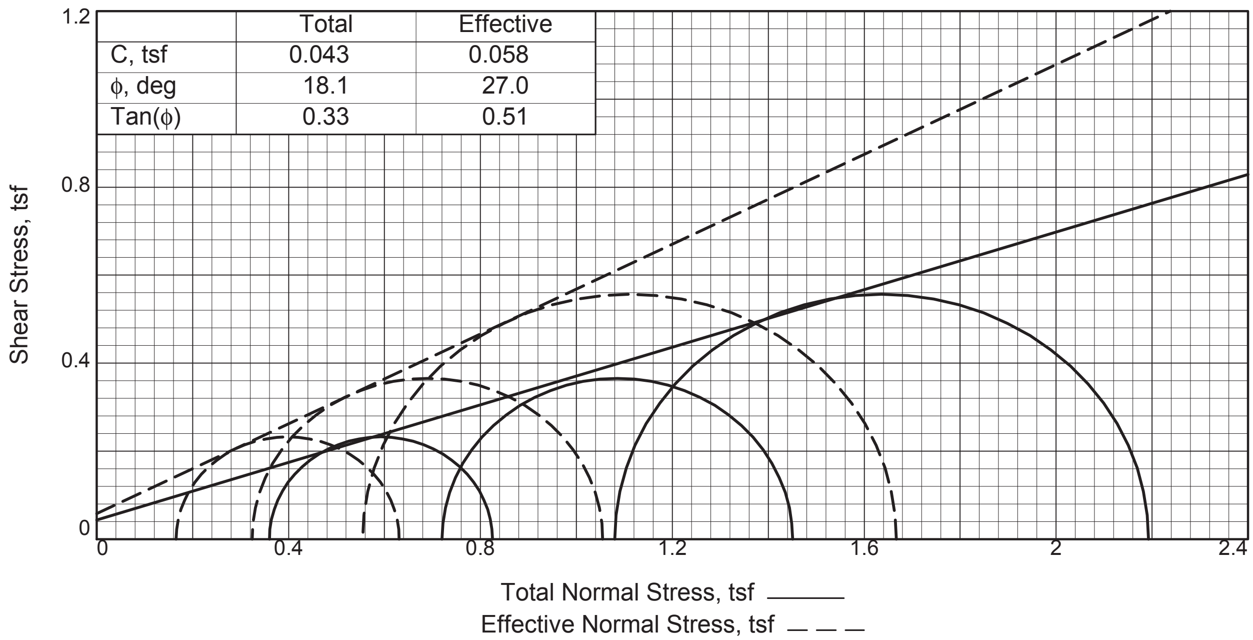
SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3
STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
MOISTURE CONTENT, %
PL ● LL
20 40 60

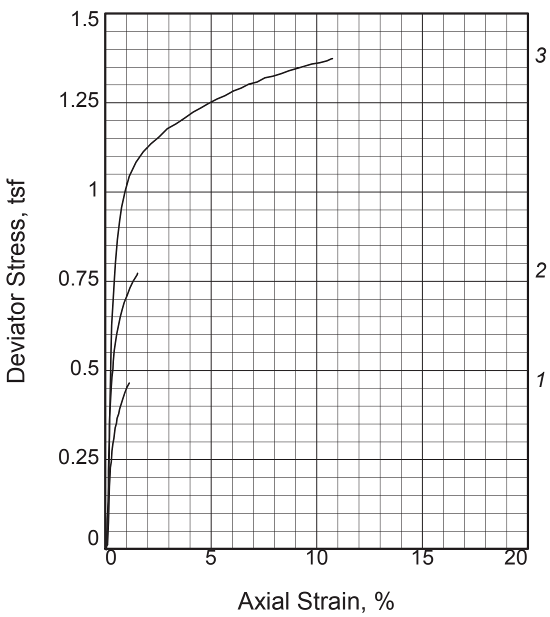


DRILLER: Terra Drill
METHOD: HSA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

WATER LEVELS: DURING DRILLING 24 FEET
____ BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ____ FEET

File:





	Sample No.	1	2	3
Initial	Water Content,	26.4	26.4	26.4
	Dry Density, pcf	96.8	96.8	96.8
	Saturation,	98.6	98.6	98.6
	Void Ratio	0.7098	0.7098	0.7098
	Diameter, in.	2.84	2.84	2.84
	Height, in.	5.81	5.81	5.81
At Test	Water Content,	26.0	25.4	25.1
	Dry Density, pcf	98.0	98.8	99.4
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.6878	0.6736	0.6647
	Diameter, in.	2.83	2.84	2.86
	Height, in.	5.78	5.70	5.60
	Strain rate, %/min.	0.01	0.01	0.01
	Back Pressure, tsf	3.96	4.32	5.04
	Cell Pressure, tsf	4.32	5.04	6.12
	Fail. Stress, tsf	0.46	0.73	1.11
	Total Pore Pr., tsf	4.15	4.72	5.57
	Ult. Stress, tsf			1.37
	Total Pore Pr., tsf			5.48
	$\bar{\sigma}_1$ Failure, tsf	0.63	1.05	1.67
	$\bar{\sigma}_3$ Failure, tsf	0.17	0.32	0.55

Type of Test:
CU with Pore Pressures

Sample Type: Shelby Tube

Description: Silty clay FILL (CL), grey and brownish grey, with pockets of very silty clay and high plastic clay, trace rock

Assumed Specific Gravity= 2.65

Remarks:

Figure 2-3

Client: Ameren Missouri

Project: Ash Pond Stability

Source of Sample: PZ-1 **Depth:** 19

Sample Number: ST-6

Proj. No.: 2010012488 **Date:** 8/9/10

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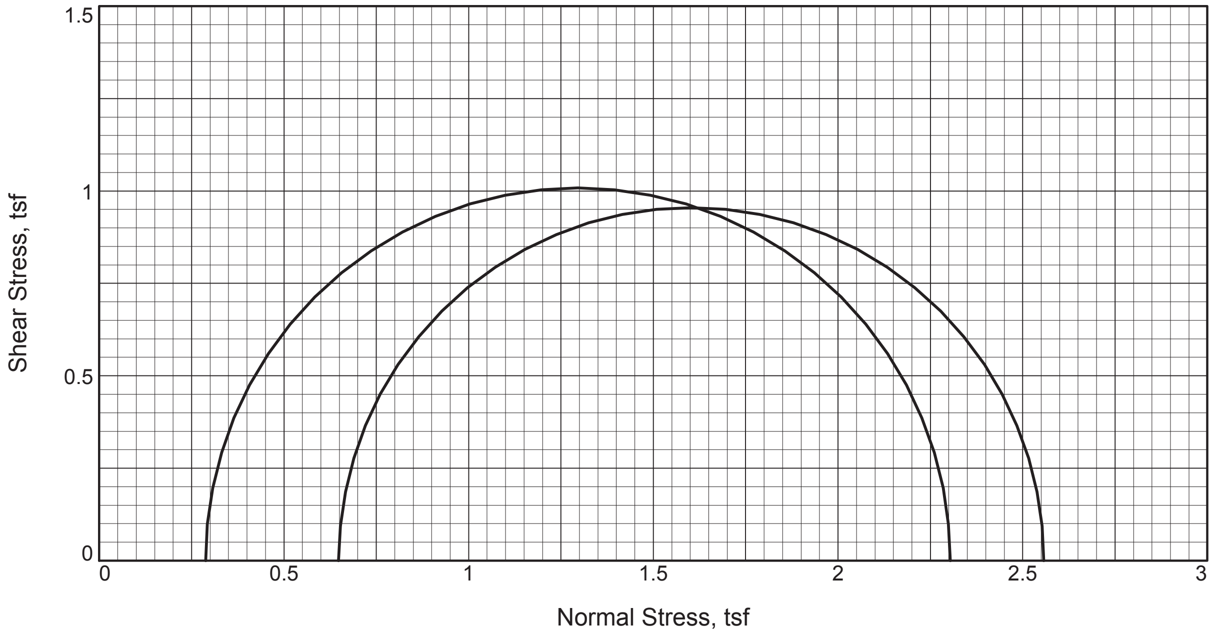
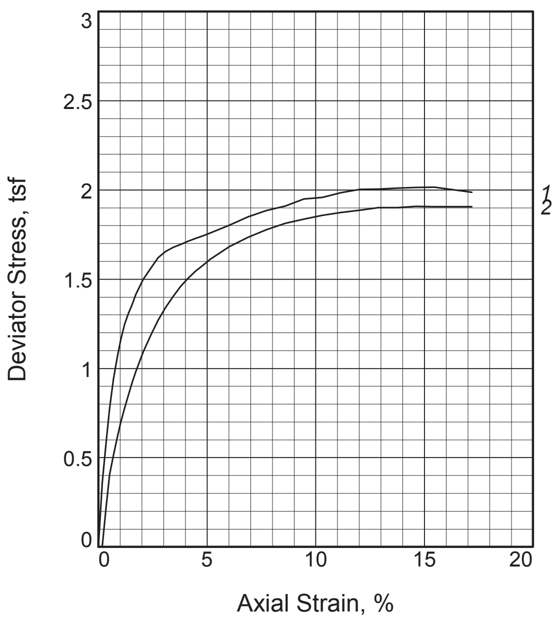
Tested By: K. Kocher **Checked By:** J. Bertel





Sample No.		1	2
Initial	Water Content,	23.5	26.9
	Dry Density, pcf	99.2	96.2
	Saturation,	91.7	97.6
	Void Ratio	0.6870	0.7385
	Diameter, in.	2.85	2.85
	Height, in.	5.82	5.82
At Test	Water Content,	23.5	26.9
	Dry Density, pcf	99.2	96.2
	Saturation,	91.7	97.6
	Void Ratio	0.6870	0.7385
	Diameter, in.	2.85	2.85
	Height, in.	5.82	5.82
Strain rate, %/min.		0.83	0.83
Back Pressure, tsf		0.00	0.00
Cell Pressure, tsf		0.29	0.65
Fail. Stress, tsf		2.02	1.91
Ult. Stress, tsf			
σ_1 Failure, tsf		2.30	2.56
σ_3 Failure, tsf		0.29	0.65

Type of Test:
Unconsolidated Undrained

Sample Type: Shelby Tube

Description: Clay Fill (CH), mottled gray and dark gray, with trace organics, high plasticity

Assumed Specific Gravity= 2.68

Remarks:

Client: Ameren Missouri

Project: Ash Pond Stability

Source of Sample: B-2 **Depth:** 14

Sample Number: ST-5

Proj. No.: 2010012488 **Date:** 08-11-10

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Figure 2-4

Tested By: J. David/J. Pruett **Checked By:** J. Bertel

LEGEND

Symbol Description

KEY TO SOIL SYMBOLS

Symbol	Description
	Organic Material
	Clay
	Silty Clay to Clay
	Clayey Silt to Silty Clay
	Sandy Silt to Clayey Silt
	Silty Sand to Sandy Silt
	Sand to Silty Sand
	Sand
	Gravelly Sand to Sand

	qc = Cone Tip Pressure, tons/sq. ft.
	fs = Skin Friction, tons/sq. ft.
	Rf = Friction ratio (fs/qc) in %
	u2 = Porewater Pressure, psi
	N60 = Calculated Equivalent N-value, blows/foot, (Standard Penetration Test)
	Su = Calculated Undrained Shear Strength, ksf
	Phi = Friction Angle, degrees

Notes:

1. Details of the drilling and sampling program are presented in the general introduction of the report.
2. Stratification lines shown on the log represent approximate soil boundaries; actual changes in strata may be gradual.

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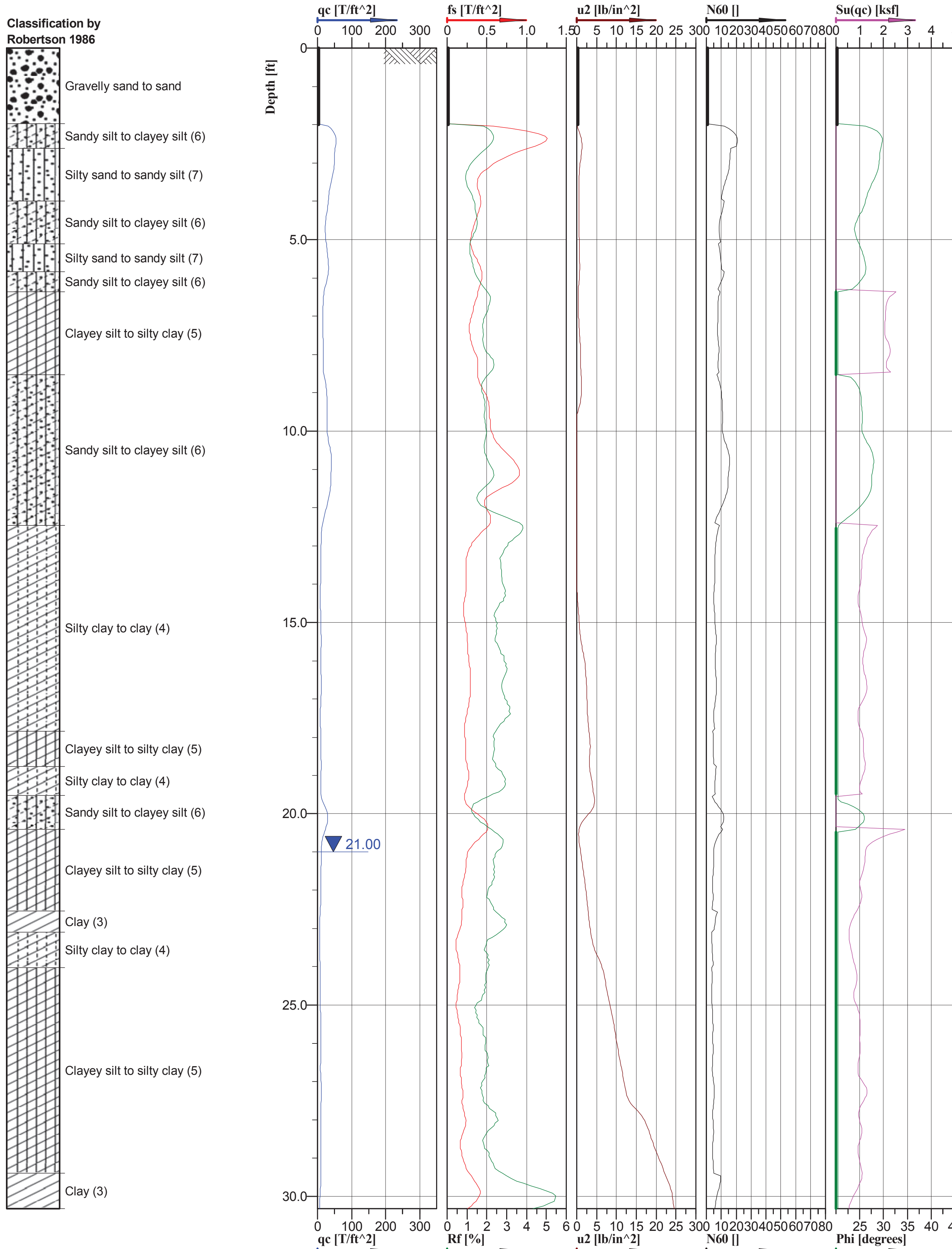
[1] Robertson et al. (1986) *Use of piezometer cone data.* Proceedings of the ASCE Specialty Conference: In Situ 86: Use of In Situ Tests in Geotechnical Engineering. ASCE 1986

[2] Lunne, T. Robertson, P.K. and Powell, J.J.M. (1997) Cone Penetration Testing in Geotechnical Practice, Published by Blackie Academic & Professional.

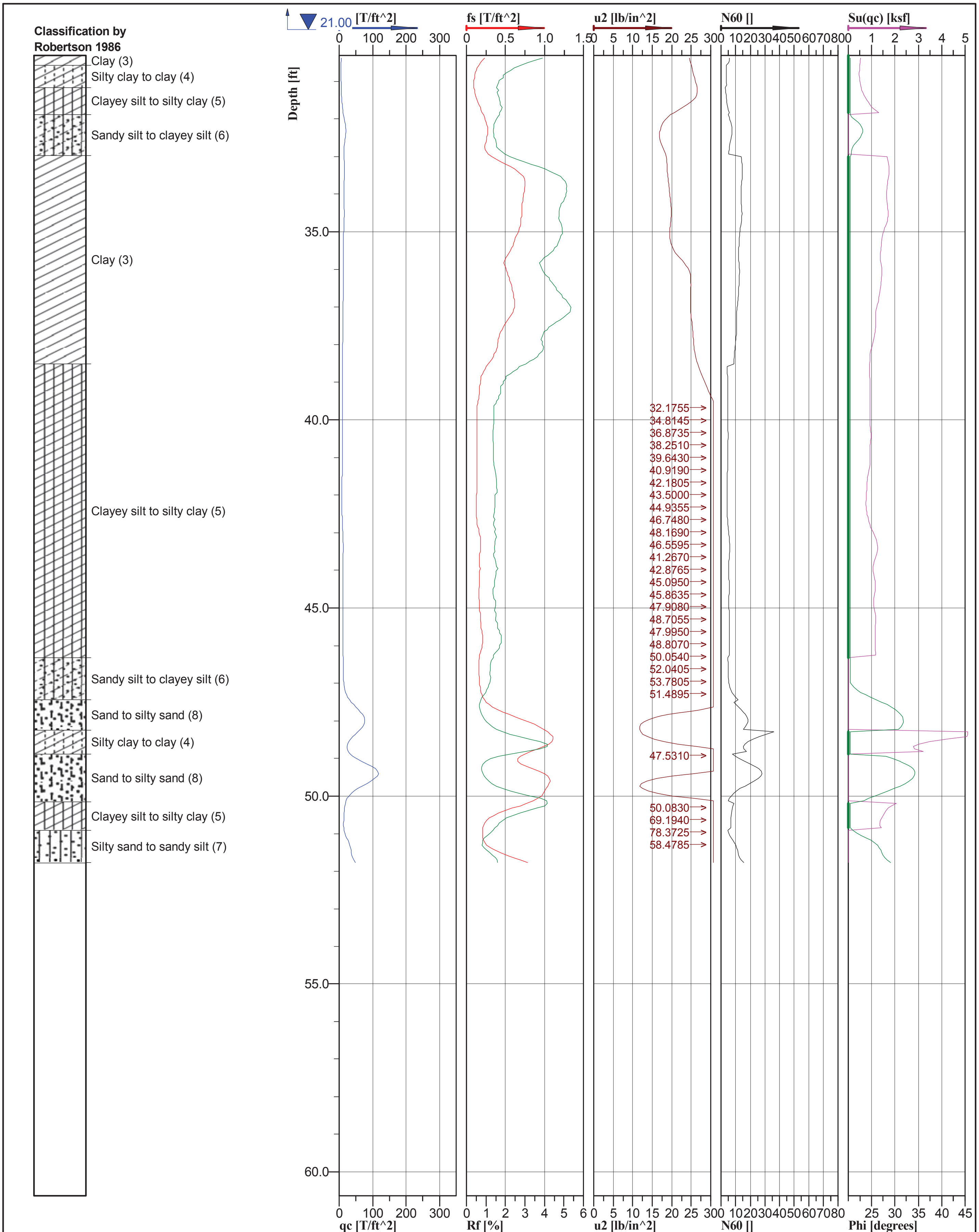
[3] Bowles, Joseph E. (1996) Foundation Analysis and Design. McGraw-Hill. 5^{th} ed. Page 180.

Figure 3-0



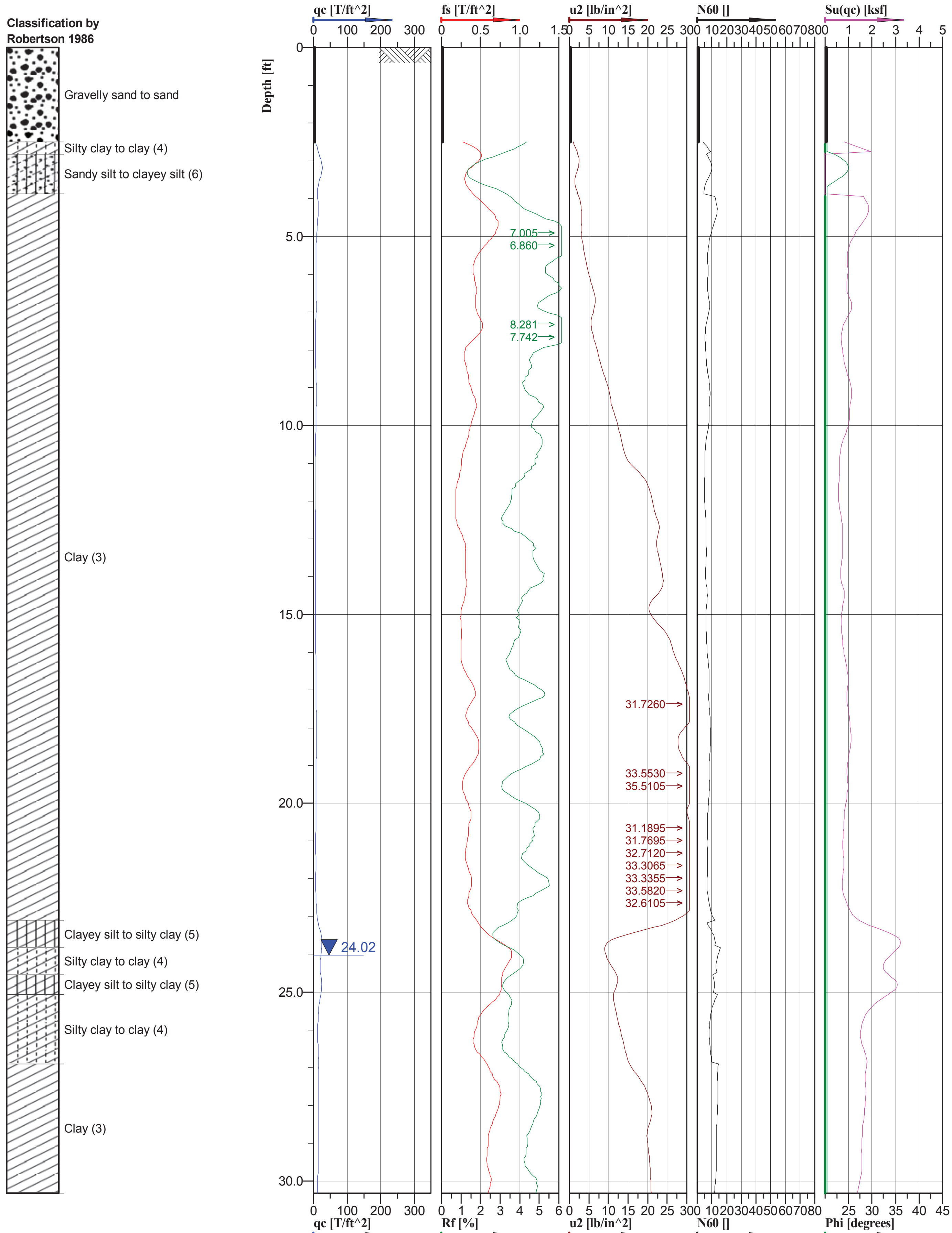
Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Meramec Power Plant	Position: X: 937555.35 ft, Y: 865357.78 ft	Ground level: 417.49	Test no: P-1
Project ID: 2010012488	Client: Ameren Missouri	Date: 10/7/2010	Scale: 1 : 42
Project: Ameren: Meramec Ash Pond Stability Analysis		Page: 1/2	Fig: 3-1
		File: Meramec P-1.cpd	



Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Meramec Power Plant	Position: X: 937555.35 ft, Y: 865357.78 ft	Ground level: 417.49	Test no: P-1
Project ID: 2010012488	Client: Ameren Missouri	Date: 10/7/2010	Scale: 1 : 42
Project: Ameren: Meramec Ash Pond Stability Analysis		Page: 2/2	Fig: 3-1
		File: Meramec P-1.cpd	



U2

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

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Location: Meramec Power Plant	Position: X: 936802.95 ft, Y: 864543.54 ft	Ground level: 414.57	Test no: P-2
Project ID: 2010012488	Client: Ameren Missouri	Date: 10/7/2010	Scale: 1 : 42
Project: Ameren: Meramec Ash Pond Stability Analysis		Page: 1/2	Fig: 3-2
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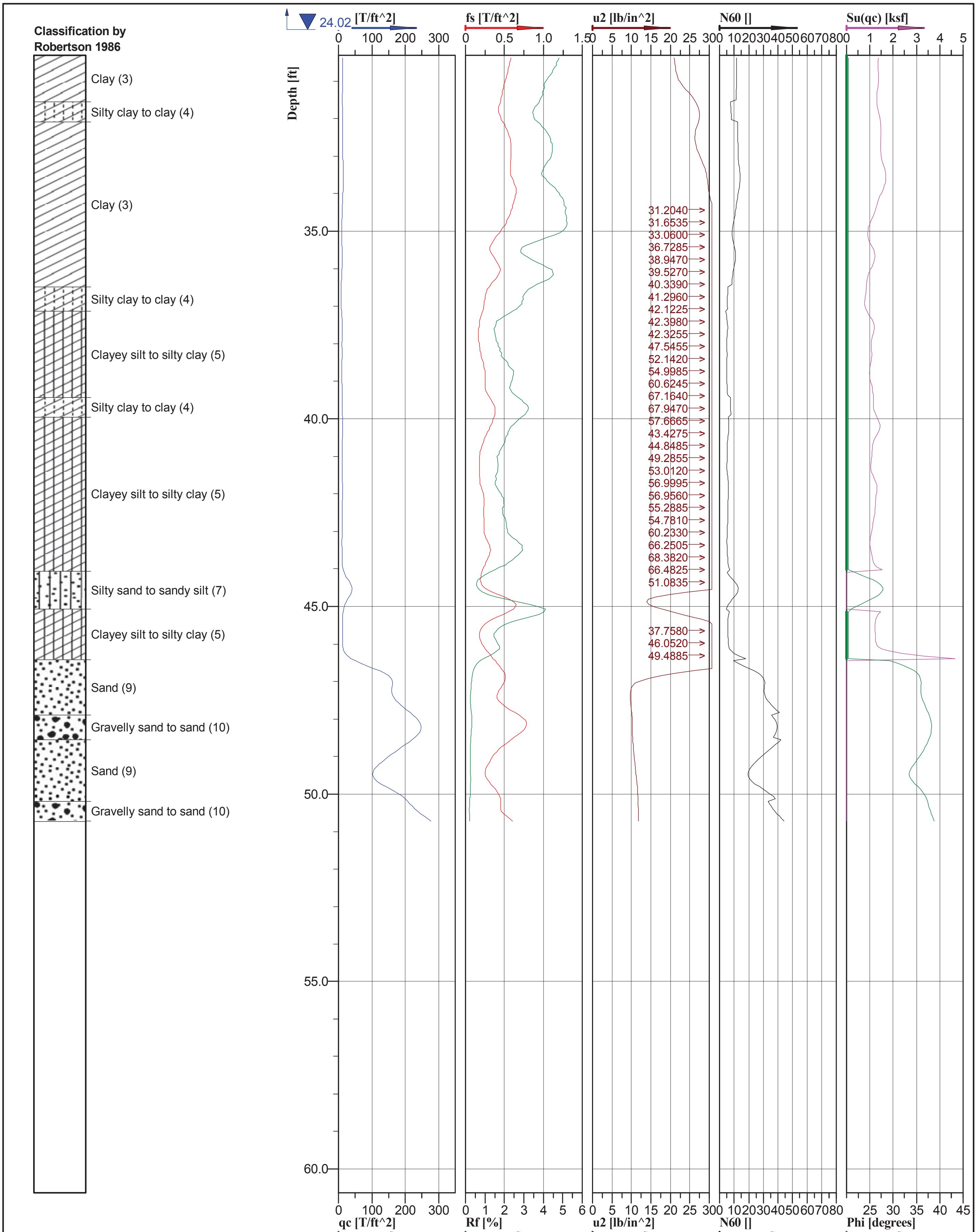

U2

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Meramec Power Plant	Position: X: 936802.95 ft, Y: 864543.54 ft	Ground level: 414.57	Test no: P-2
Project ID: 2010012488	Client: Ameren Missouri	Date: 10/7/2010	Scale: 1 : 42
Project: Ameren: Meramec Ash Pond Stability Analysis		Page: 2/2	Fig: 3-2
		File: Meramec P-2.cpd	

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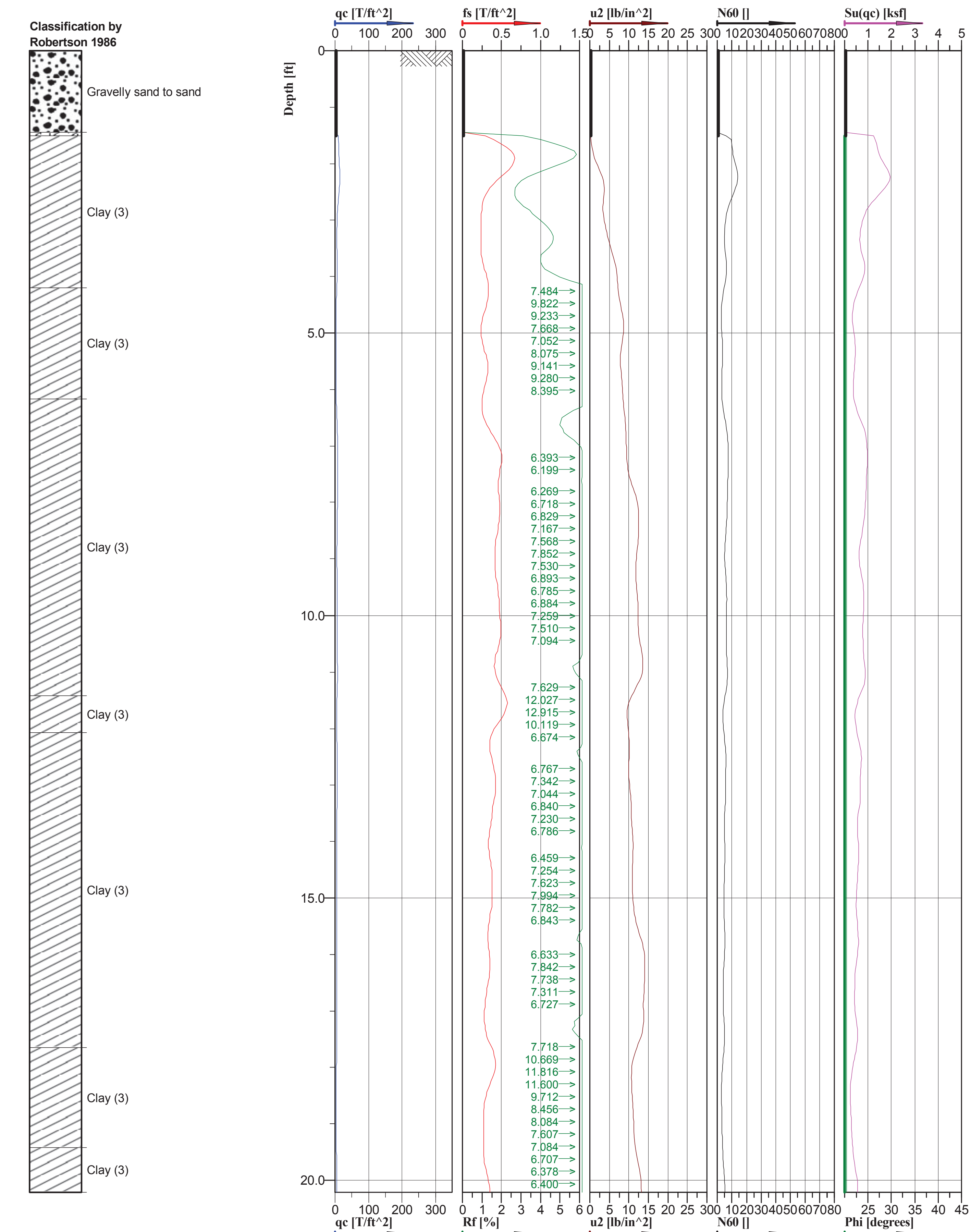

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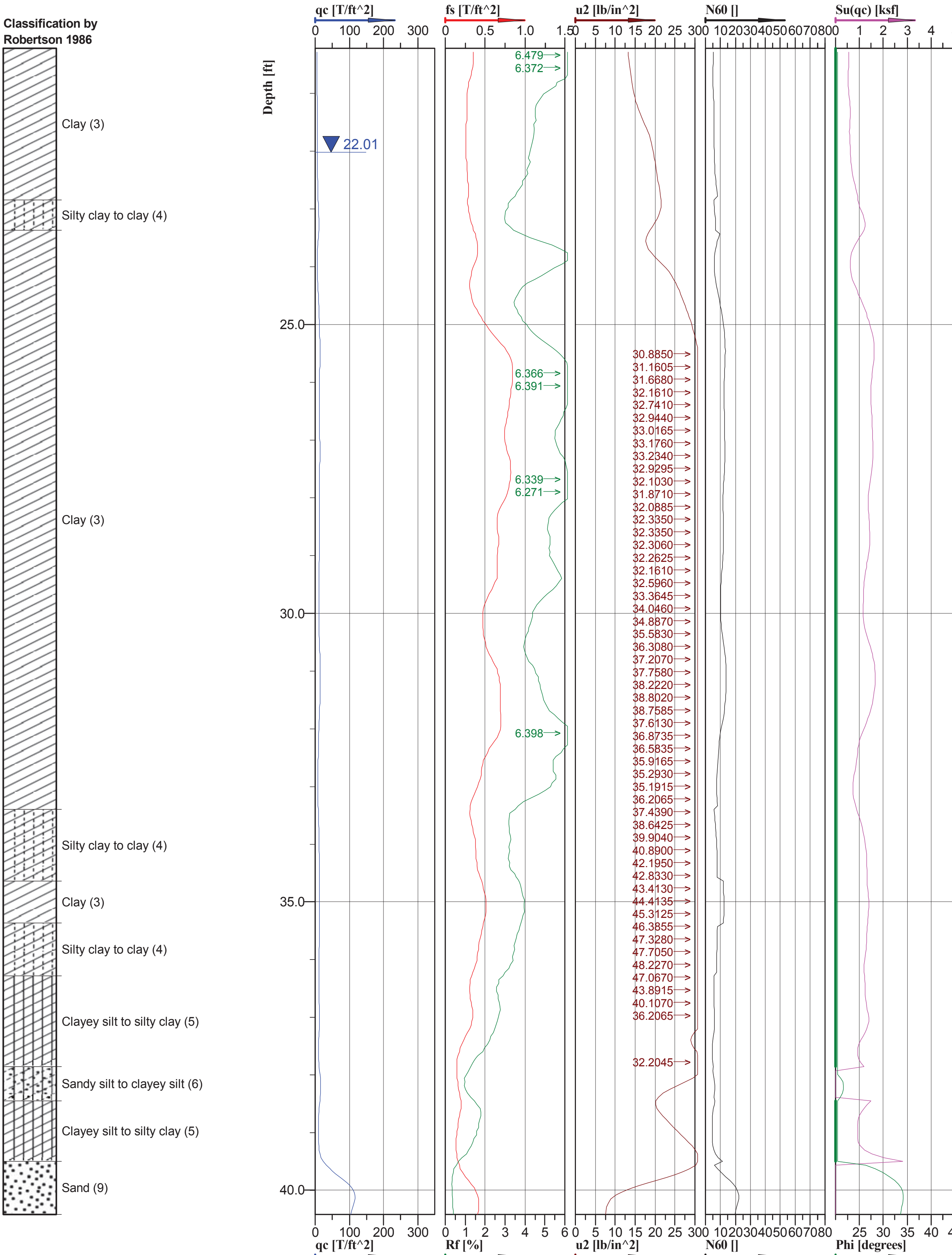
U2

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

22.01

Location: Meramec Power Plant	Position: X: 864515.12 ft, Y: 936305.48 ft	Ground level: 413.25	Test no: P-3
Project ID: 2010012488	Client: Ameren Missouri	Date: 10/7/2010	Scale: 1 : 28
Project: Ameren: Meramec Ash Pond Stability Analysis		Page: 1/3	Fig: 3-3
		File: Meramec PZ-2.cpd	



Location: Meramec Power Plant	Position: X: 864515.12 ft, Y: 936305.48 ft	Ground level: 413.25	Test no: P-3
Project ID: 2010012488	Client: Ameren Missouri	Date: 10/7/2010	Scale: 1 : 28
Project: Ameren: Meramec Ash Pond Stability Analysis		Page: 2/3	Fig: 3-3
		File: Meramec PZ-2.cpd	

U2

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

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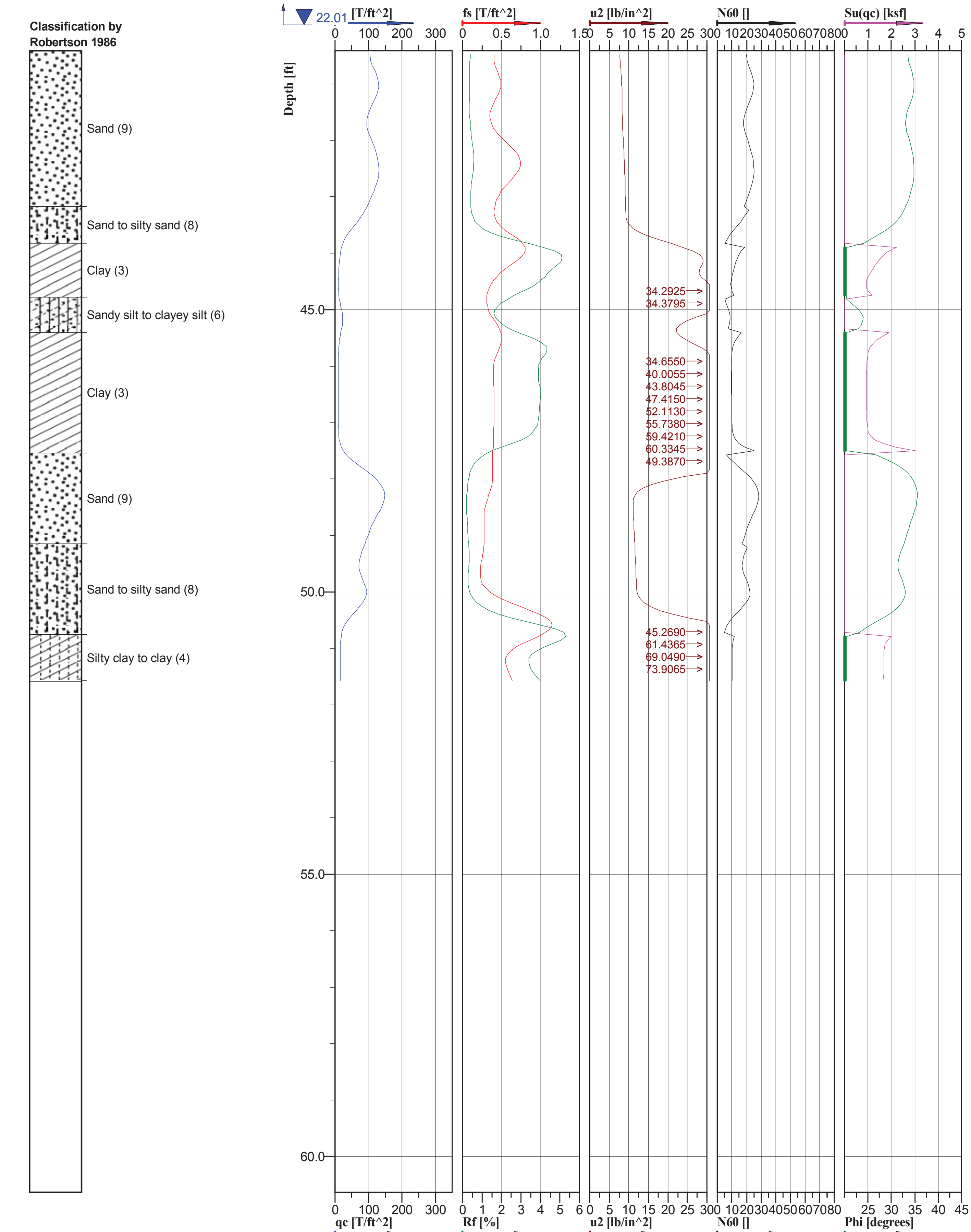
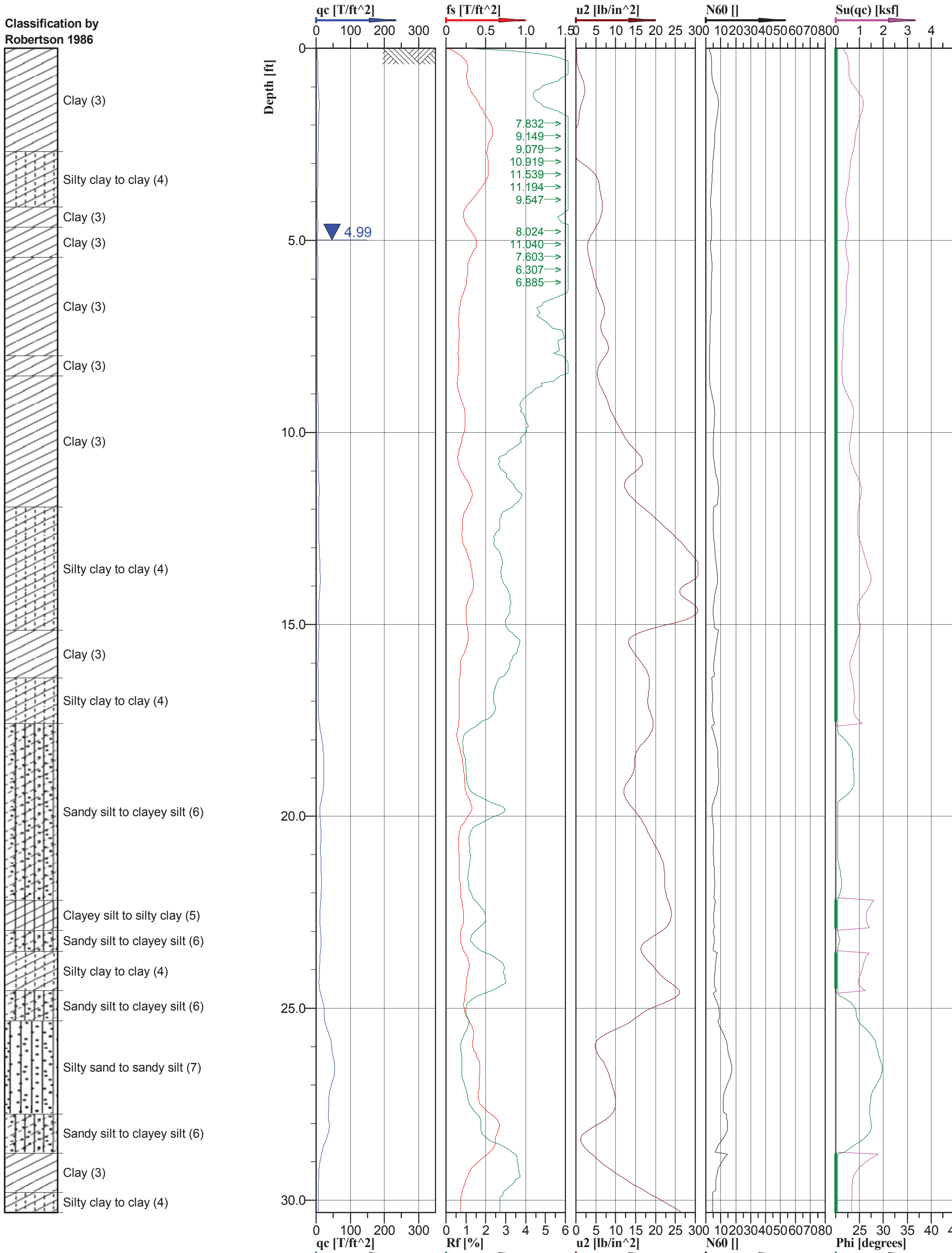


U2

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Meramec Power Plant	Position: X: 864515.12 ft, Y: 936305.48 ft	Ground level: 413.25	Test no: P-3
Project ID: 2010012488	Client: Ameren Missouri	Date: 10/7/2010	Scale: 1 : 28
Project: Ameren: Meramec Ash Pond Stability Analysis		Page: 3/3	Fig: 3-3
		File: Meramec PZ-2.cpd	



U2

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

REITZ & JENS, INC.
CONSULTING ENGINEERS

Location: Meramec Power Plant	Position: X: 864848.16 ft, Y: 934529.04 ft	Ground level: 394.26	Test no: P-4
Project ID: 2010012488	Client: Ameren Missouri	Date: 10/7/10	Scale: 1 : 42
Project: Ameren: Meramec Ash Pond Stability Analysis		Page: 1/2	Fig: 3-4
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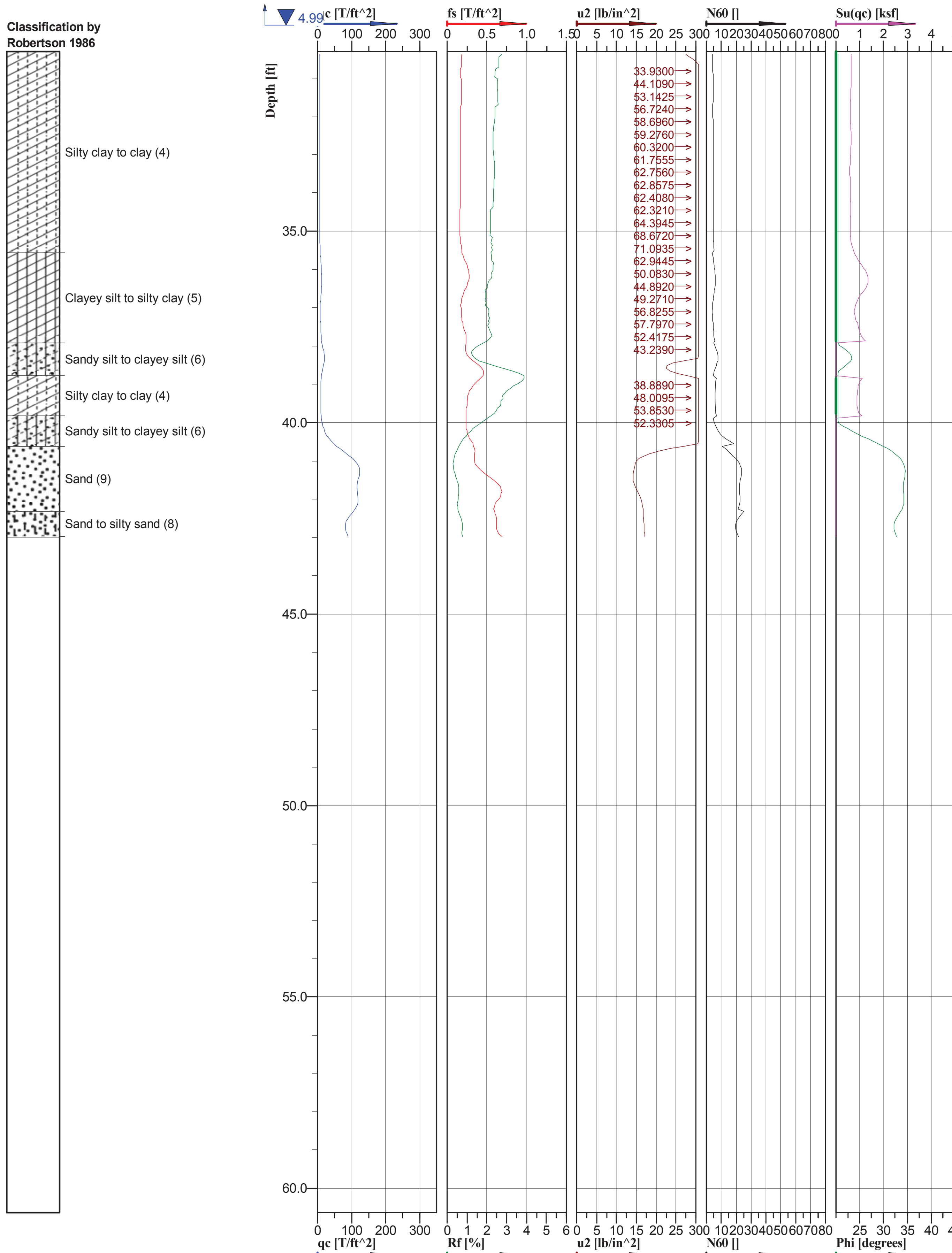
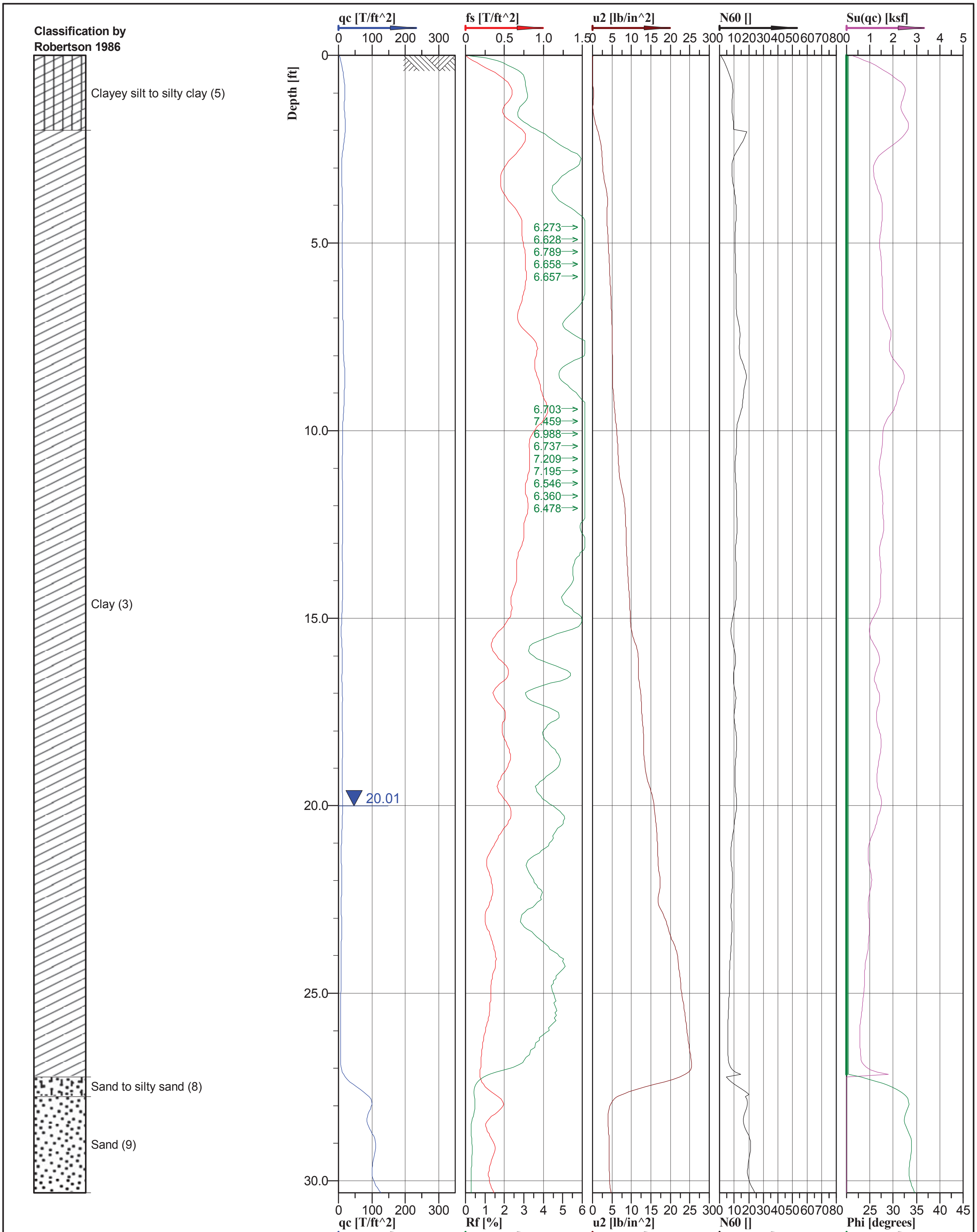
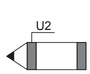


Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

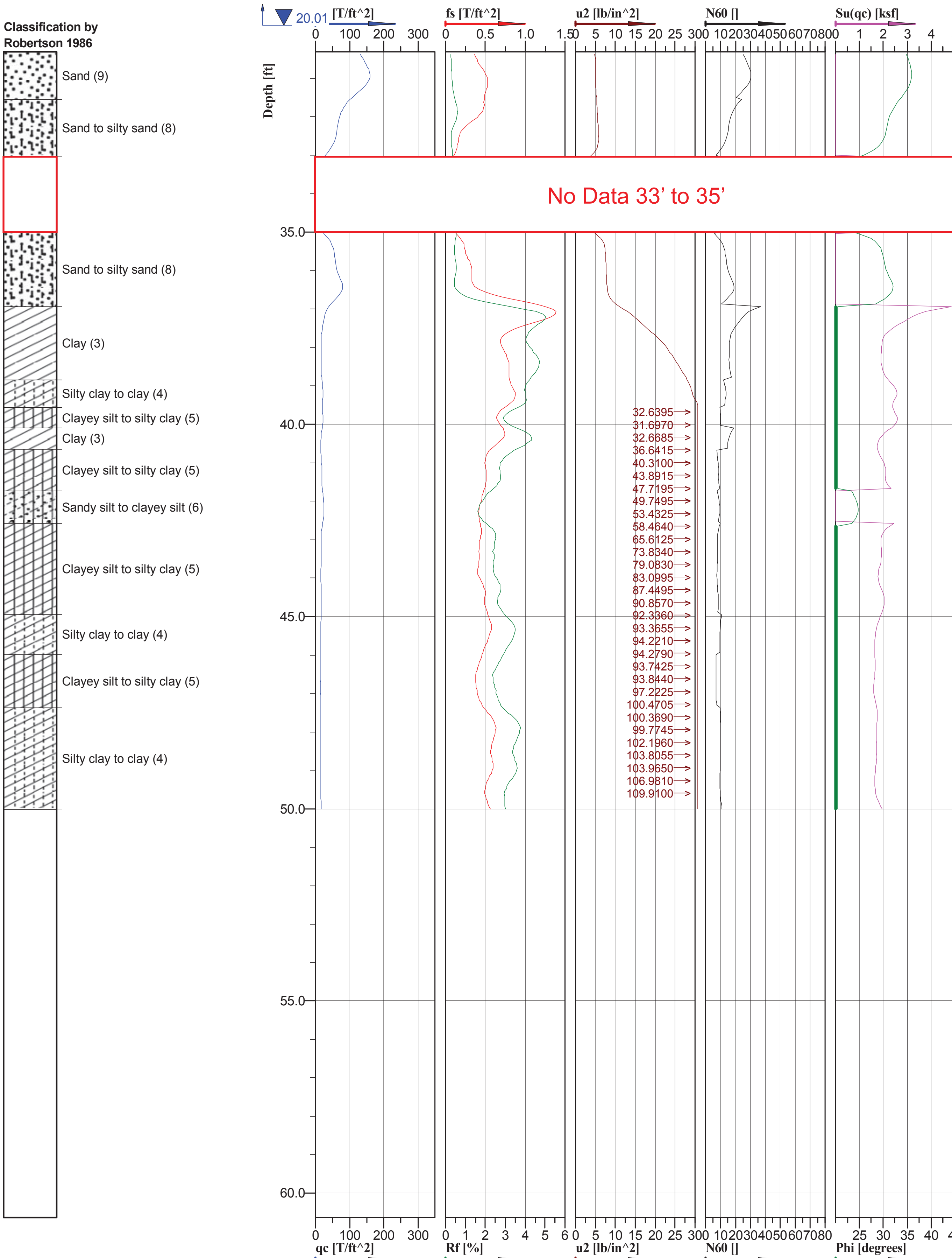
Location: Meramec Power Plant	Position: X: 864848.16 ft, Y: 934529.04 ft	Ground level: 394.26	Test no: P-4
Project ID: 2010012488	Client: Ameren Missouri	Date: 10/7/10	Scale: 1 : 42
Project: Ameren: Meramec Ash Pond Stability Analysis		Page: 2/2	Fig: 3-4
		File: Meramec P-4.cpd	





Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

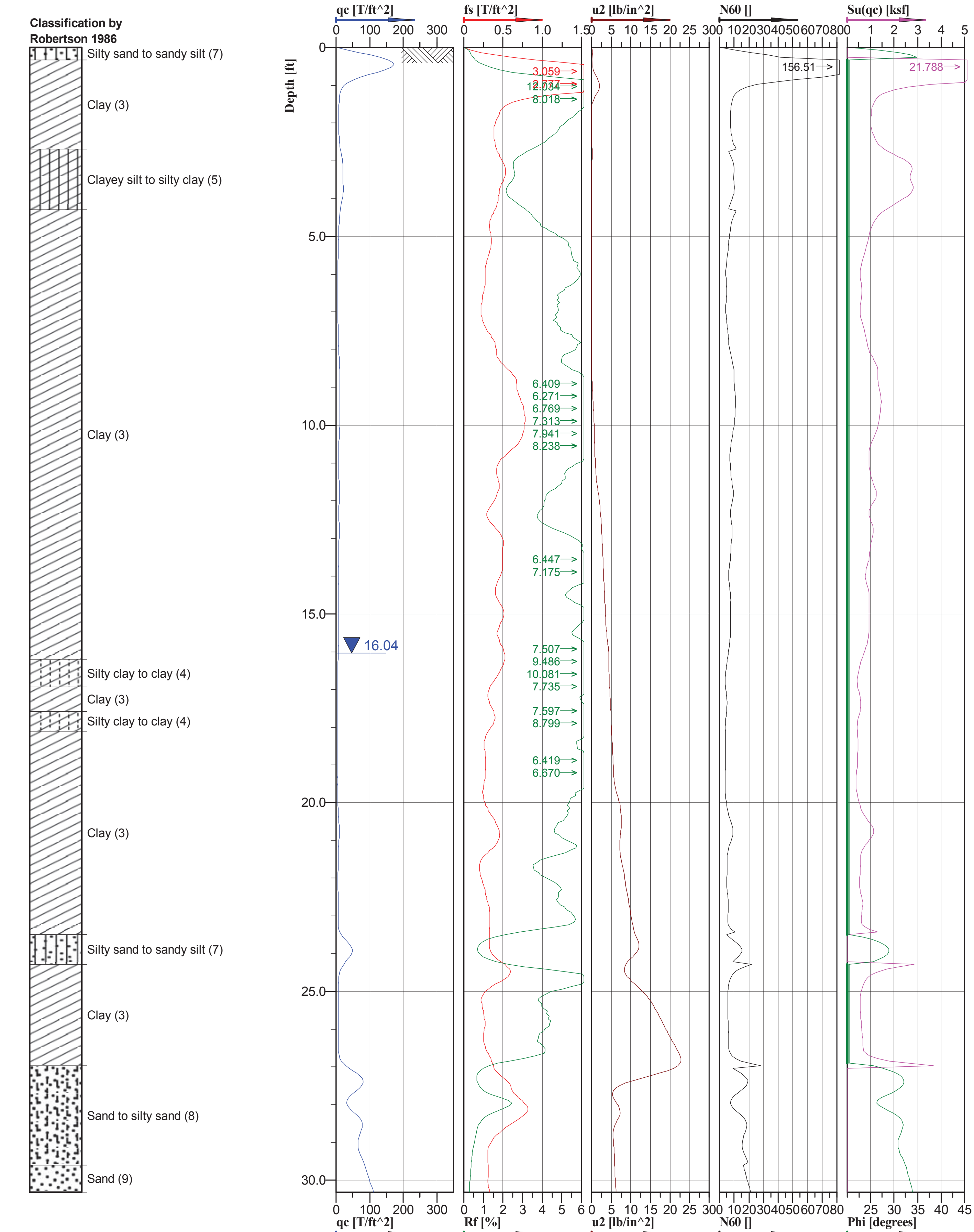
Location: Meramec Ash Ponds	Position: X: 864538.12 ft, Y: 936033.50 ft	Ground level: 398.00	Test no: P-5
Project ID: 2010012488	Client: Ameren Missouri	Date: 11/2/2010	Scale: 1 : 42
Project: Ameren: Ash Pond Stability Analyses		Page: 1/2	Fig: 3-5
No data 33' to 35'		File: meramec p-5.cpd	



U2

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Meramec Ash Ponds	Position: X: 864538.12 ft, Y: 936033.50 ft	Ground level: 398.00	Test no: P-5
Project ID: 2010012488	Client: Ameren Missouri	Date: 11/2/2010	Scale: 1 : 42
Project: Ameren: Ash Pond Stability Analyses		Page: 2/2	Fig: 3-5
No data 33' to 35'		File: meramec p-5.cpd	



Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Meramec Ash Ponds	Position: X: 864498.59 ft, Y: 936885.56 ft	Ground level: 396.69	Test no: P-6
Project ID: 2010012488	Client: Ameren Missouri	Date: 11/2/2010	Scale: 1 : 42
Project: Ameren: Ash Pond Stability Analyses		Page: 1/2	Fig: 3-6
		File: meramec p-6.cpd	

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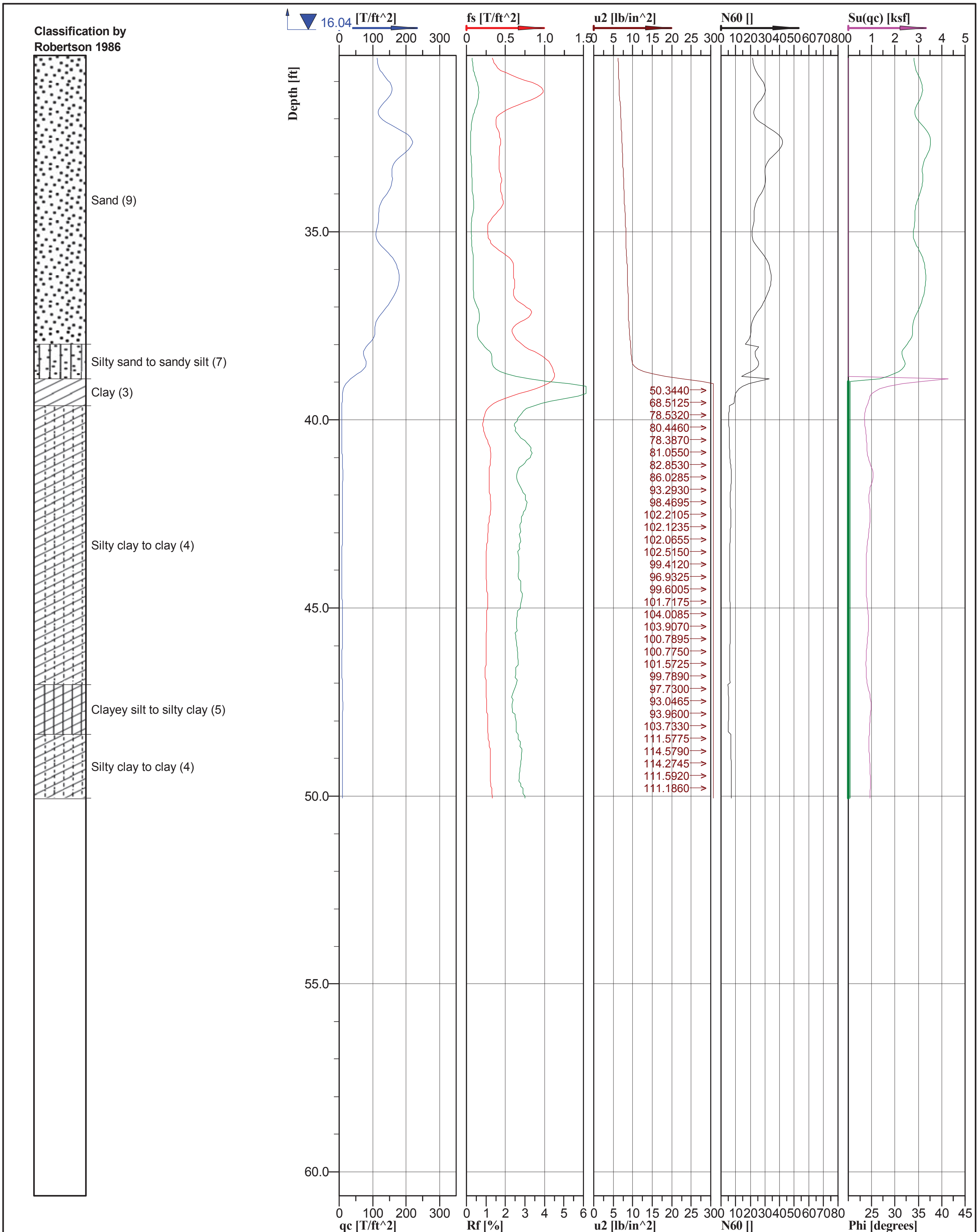

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U2

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Meramec Ash Ponds	Position: X: 864498.59 ft, Y: 936885.56 ft	Ground level: 396.69	Test no: P-6
Project ID: 2010012488	Client: Ameren Missouri	Date: 11/2/2010	Scale: 1 : 42
Project: Ameren: Ash Pond Stability Analyses		Page: 2/2	Fig: 3-6
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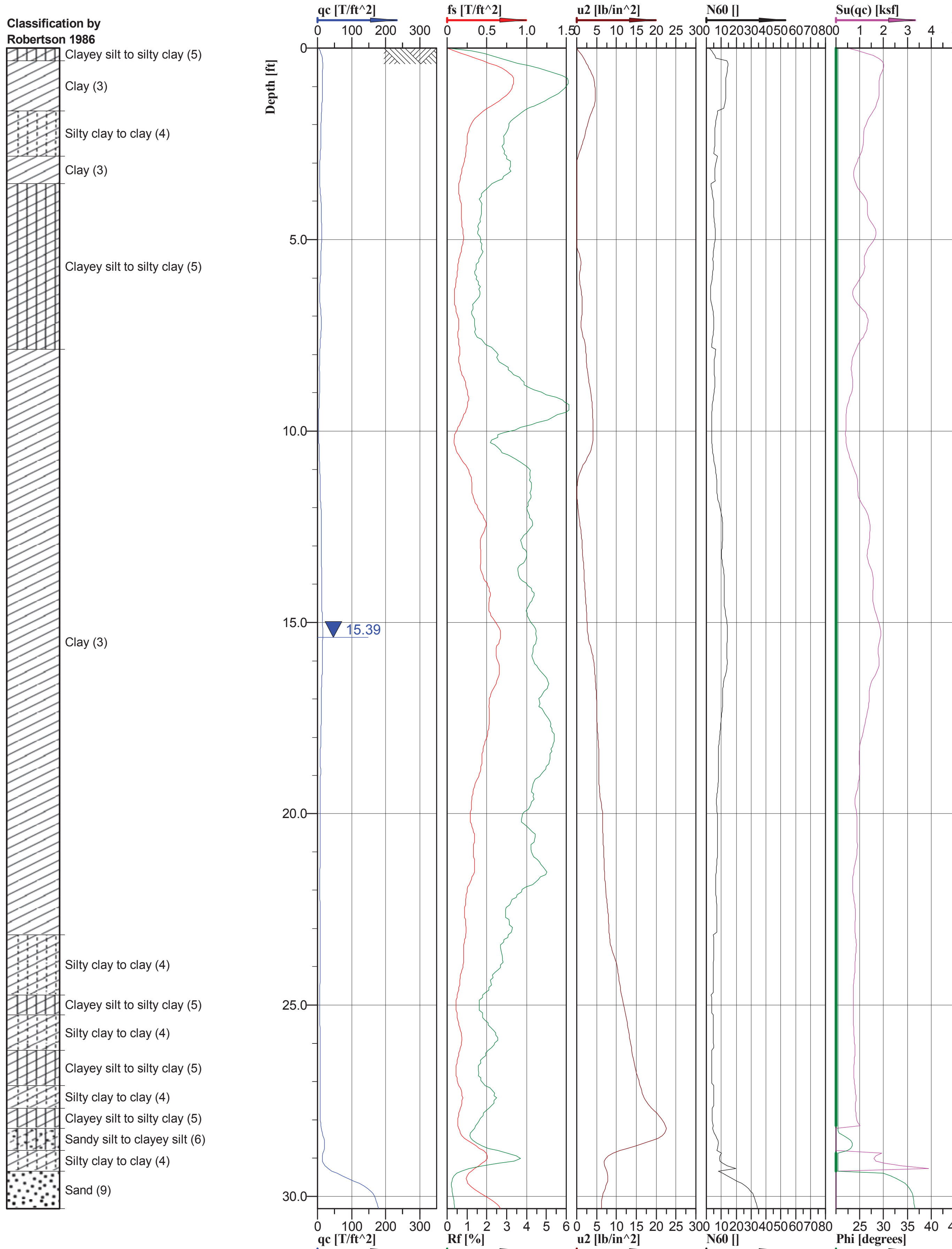

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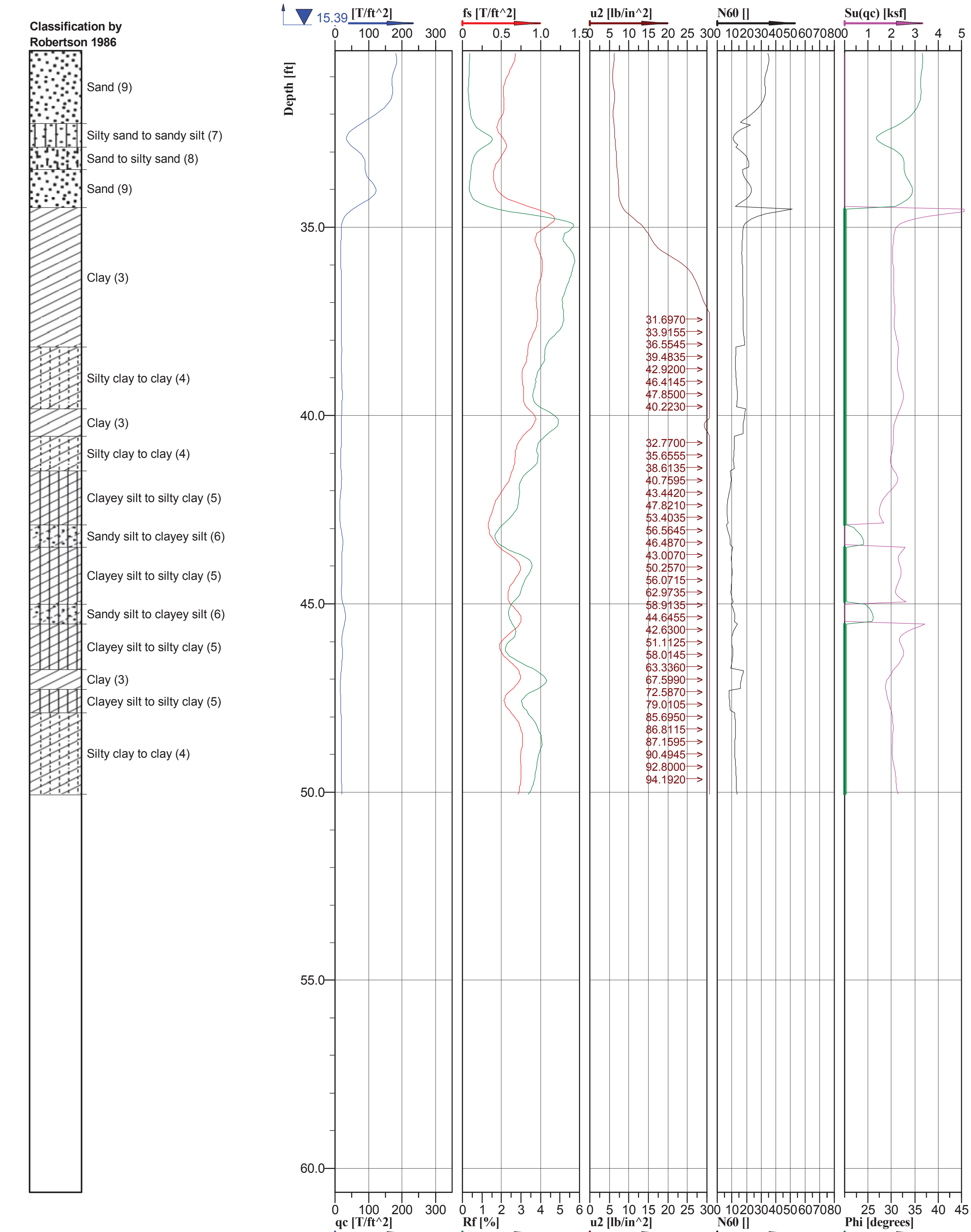
U2

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Meramec Ash Ponds	Position: X: 864861.25 ft, Y: 937323.69 ft	Ground level: 397.60	Test no: P-7
Project ID: 2010012488	Client: Ameren Missouri	Date: 11/2/2010	Scale: 1 : 42
Project: Ameren: Ash Pond Stability Analyses		Page: 1/2	Fig: 3-7
		File: meramec b-1.cpd	



U2

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Meramec Ash Ponds	Position: X: 864861.25 ft, Y: 937323.69 ft	Ground level: 397.60	Test no: P-7
Project ID: 2010012488	Client: Ameren Missouri	Date: 11/2/2010	Scale: 1 : 42
Project: Ameren: Ash Pond Stability Analyses		Page: 2/2	Fig: 3-7
		File: meramec b-1.cpd	

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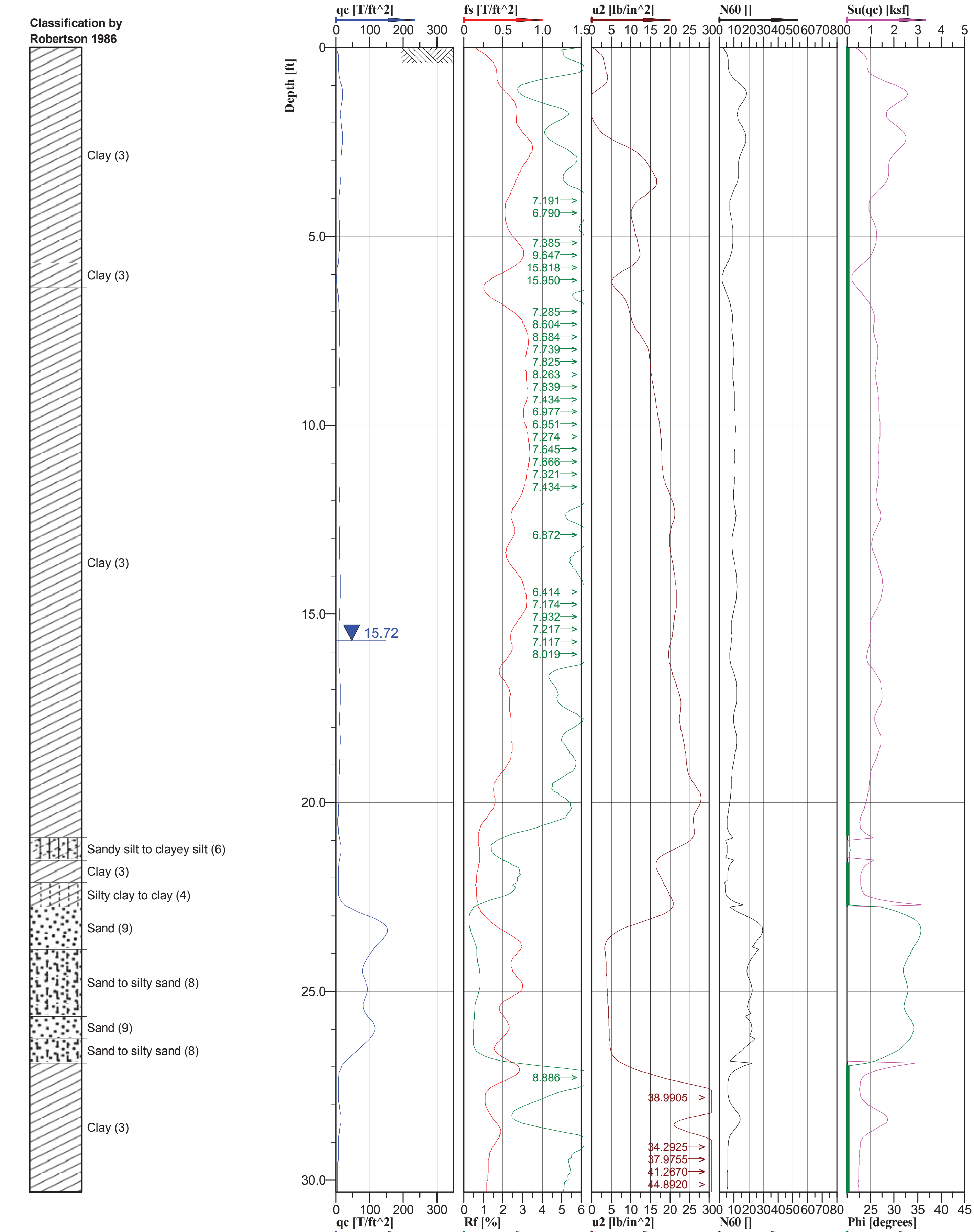
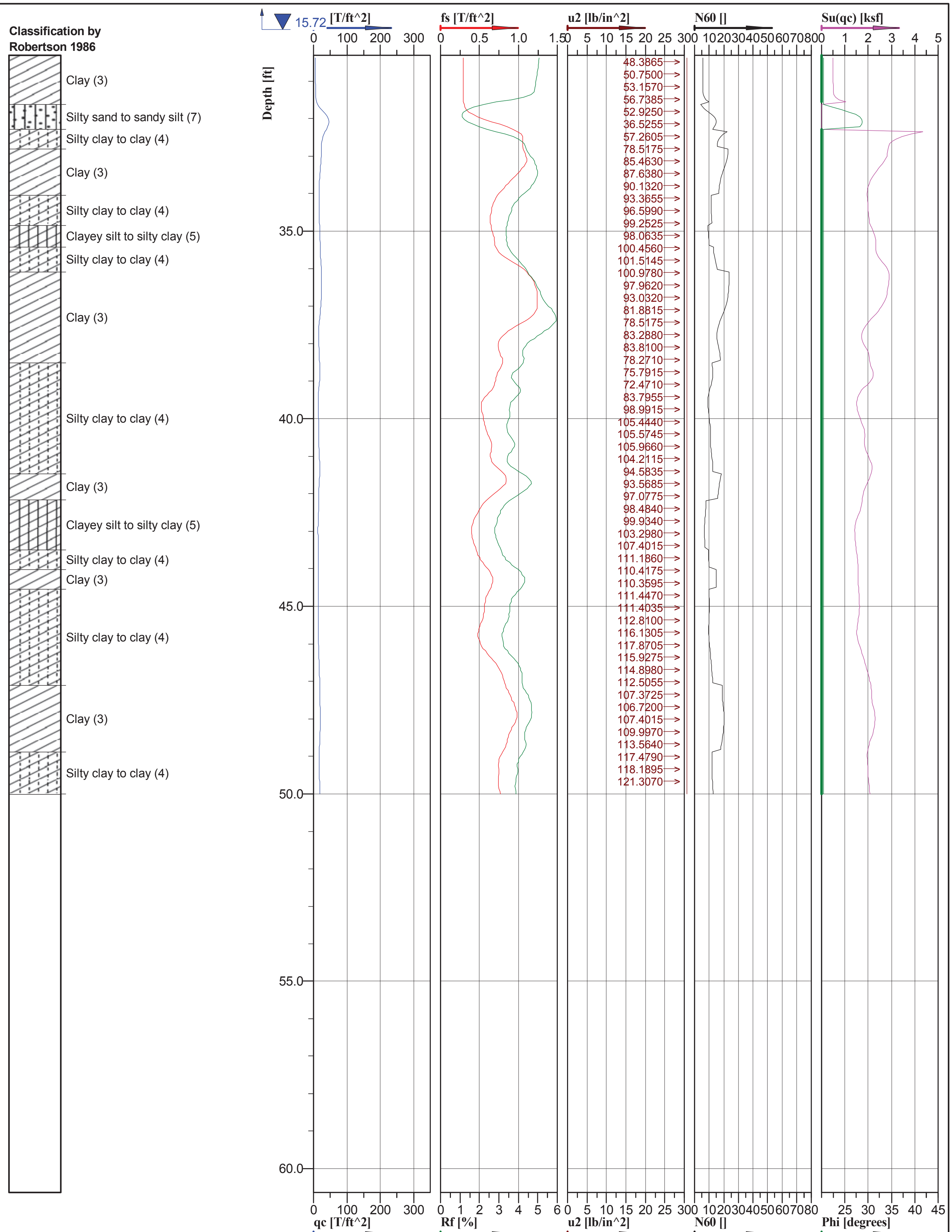
CONSULTING ENGINEERS



Location: Meramec Ash Ponds	Position: X: 864459.06 ft, Y: 936289.47 ft	Ground level: 398.00	Test no: P-8
Project ID: 2010012488	Client: Ameren Missouri	Date: 11/2/2010	Scale: 1 : 42
Project: Ameren: Ash Pond Stability Analyses		Page: 1/2	Fig: 3-8
		File: meramec b-2.cpd	



Reitz & Jens, Inc.
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Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Meramec Ash Ponds	Position: X: 864459.06 ft, Y: 936289.47 ft	Ground level: 398.00	Test no: P-8
Project ID: 2010012488	Client: Ameren Missouri	Date: 11/2/2010	Scale: 1 : 42
Project: Ameren: Ash Pond Stability Analyses		Page: 2/2	Fig: 3-8
		File: meramec b-2.cpd	

Drilled Boring #

Tentative Boring #

REITZ & JENS, INC.

0 250 500

SCALE FEET

N

Ameren Services: Meramec Closure
Boring Location Sketch

Figure 1

KEY TO BORING LOGS

Symbol	Description
	KEY TO SOIL SYMBOLS
	Crushed Limestone
	Miscellaneous FILL
	Low plastic Clayey SILT (ML)
	Medium to high plastic CLAY
	High plastic CLAY (CH)
	Low plastic CLAY (CL)
	Low plastic Silty CLAY/ Clayey SILT (CL-ML)
	Clayey SAND or Sandy CLAY (SC)
	Low plastic Silty CLAY (CL)
	Silty SAND (SM)
	Poorly-graded GRAVEL (GP)

Symbol	Description
	Poorly-graded SAND (SP)
	Inorganic, non-plastic SILT (ML)
	COAL
	Clayey Sandy SILT (ML)
	Clayey GRAVEL or Gravelly CLAY (GC)
	MISCELLANEOUS SYMBOLS
	Water table during drilling
	Delayed Reading of Water table
	Boring continues
●	Moisture content (%)
▲	N-value from Standard Penetration Test, ASTM D-1586 (blows/ft)
■	Shear strength from Pocket Penetrometer (tsf)

Symbol	Description
	SOIL SAMPLERS
	2-in. O.D. Split-Spoon
	3-in. O.D. Shelby Tube

Notes:

1. Borings were completed by Bulldog Drilling under a subcontract with Reitz & Jens. Borings were made with a CME 55LC track drill rig using 4.25-inch I.D. hollow-stem augers. The drill rig is equipped with an automatic standard penetration test (SPT) hammer. The energy efficiency of the automatic hammer was measured at 95.3% in August 2018.

2. The borings were staked in the field by Reitz & Jens using a handheld GPS as close to the proposed boring locations as access, overhead and underground utilities and obstacles would allow. The location and elevation of the ground surface at each boring was measured after drilling by CDI, Inc. of St. Louis, Missouri.

3. The borings were logged in the field by a Reitz & Jens' NICET certified soil technician based upon the recovered samples, cuttings and drilling characteristics. Samples were transported to Reitz & Jens' lab for testing. Field logs were revised, if needed, based upon laboratory classification and testing.

4. Stratification lines shown on the log represent approximate soil boundaries; actual changes in strata may be gradual or occur between samples.

Figure 2-0

REITZ & JENS, INC.
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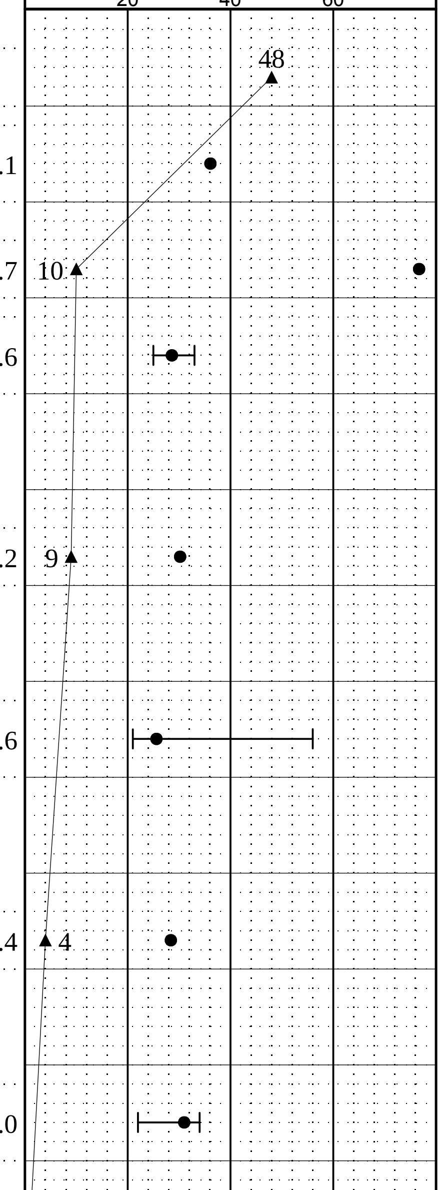
BORING LOG X-1

Ameren Meramec Ash Pond Closures
Meramec Energy Center
CLIENT: **Ameren**

LOCATION: N 937680.1 E 866182.2
ELEVATION: 414.09 DATUM: NAVD88
DATE DRILLED: 03-10-2021

DEPTH (FEET)	ELEVATION	WATER TABLE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) / BLOWS PER 6 INCHES / RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0				Crushed Rock (8-inches), 2-inch minus		
			100	Crushed Rock (22-inches), 1-inch minus	17-23-25	
	410		0	Bottom ASH, gray, tan and black, trace clay and rock fragments, very moist		36.1
5		▽	100	Becoming medium-dense and with fine sand	1-2-8	76.7
10	405		92	FILL: Clayey SILT (ML), gray, with lignite, crushed limestone pieces, trace bottom ash and fine roots, moist	96.1	28.6
15	400		100	CLAY (CL-CH), gray-brown, medium to high plastic, with lignite and limonite, very moist, stiff	1-3-6	30.2
20	395		88	Silty CLAY (CH), gray, high plastic, with lignite and limonite, moist, stiff	100.2	25.6
25	390	▼	100	Silty CLAY (CL), gray-brown, with lignite and limonite, moist, firm	2-2-2	28.4
30	385		100	Becoming soft	92.9	31.0

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3
▲ UNCORRECTED SPT N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (SILTS & CLAYS)
PL ├──┤ LL
20 40 60



DRILLER: Bulldog Drilling
METHOD: 4.25" HSA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 95.3
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 7 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 25 FEET AFTER 0 HOURS
AT ___ FEET AFTER ___ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

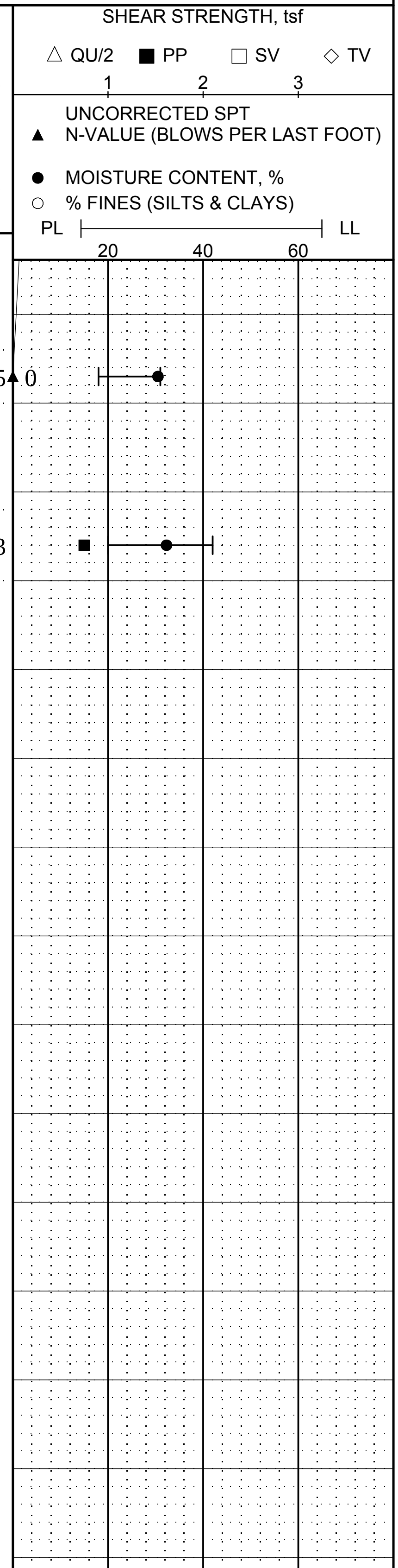
File: 2019012416

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG X-1

Ameren Meramec Ash Pond Closures

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
35	380				100	Clayey SILT (CL-ML), gray, very moist, very soft	0-0-0	30.5
40	375				17	Sandy CLAY (SC), gray, very moist	84.3	32.3
						Boring terminated at 40'-0" in Sandy CLAY.		
45	370							
50	365							
55	360							
60	355							
65	350							



File: 2019012416

BORING LOG X-2

REITZ & JENS, INC. CONSULTING ENGINEERS

Ameren Meramec Ash Pond Closures
Meramec Energy Center
CLIENT: **Ameren**

LOCATION: N 937564.9 E 8655689.9
ELEVATION: 417.34 DATUM: NAVD88
DATE DRILLED: 03-10-2021

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) / BLOWS PER 6 INCHES / RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT	UNCORRECTED SPT N-VALUE
0			Coal ASH, gray and black, with trace silt and organics, very moist, medium dense			
	415	100		4-3-4	35.3	7
		100	Becoming gray, with roots	63.2	52.6	
5						
	410	100	Becoming very soft, with trace organics	0-0-0	51.8	0
		0	Note: Pushed spoon for sample recovery		55.1	
10						
	405					
		100	Silty CLAY (CL), gray-brown, with lignite and limonite, moist, firm	0-1-2	27.3	3
15						
	400					
		88	Silty CLAY (CH), greenish-gray, high plastic, with lignite and limonite, moist, very stiff	103.1	24.3	
20						
	395					
		100	Sandy and Silty CLAY (CL), gray-brown, with lignite and limonite, very moist, stiff	2-2-4	31.4	6
25			Boring terminated at 25'-0" in CLAY.			
	390					
30						

SHEAR STRENGTH, tsf: △ QU/2 ■ PP □ SV ◇ TV (1, 2, 3)
▲ UNCORRECTED SPT N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (SILTS & CLAYS)
PL |—| LL (20, 40, 60)

DRILLER: Bulldog Drilling
METHOD: 4.25" HSA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 95.3
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 6 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 18 FEET AFTER 0 HOURS
AT ______ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2019012416

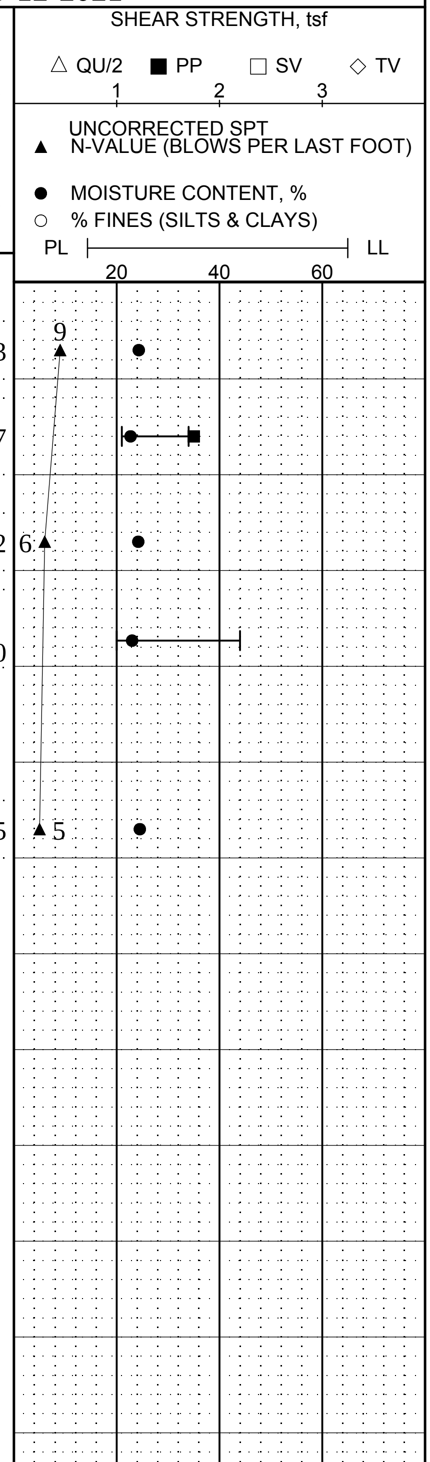
Reitz & Jens, Inc.
CONSULTING ENGINEERS

BORING LOG X-2A

Ameren Meramec Ash Pond Closures
Meramec Energy Center
CLIENT: **Ameren**

LOCATION: N E
ELEVATION: 418.84 DATUM: NAVD88
DATE DRILLED: 03-12-2021

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						Crushed Rock (10-inches)		
					100	FILL: Silty CLAY (CL-CH), brown, medium plasticity, with lignite and limonite, moist, stiff	2-3-6	24.3
	415				58	FILL: Silty CLAY (CL), brown and gray, with lignite, limonte, trace gravel and rock fragments, moist, stiff	104.0	22.7
5					100	With medium to high plastic clay inclusions	1-2-4	24.2
	410				83	Sandy SILT and SILT (SM), gray, with lignite and limonite, trace coarse gravel and horizontal seams of medium to high plasticity clay, organic odor, moist Note: Atterberg Limit conducted on horizontal clay seam.	103.7	23.0
10								
	405				100	Silty CLAY (CL-CH), gray-brown, medium to high plastic, with lignite and limonite, moist, firm	0-2-3	24.5
15						Boring terminated at 15'-0" in CLAY.		
	400							
20								
	395							
25								
	390							
30								



DRILLER: Bulldog Drilling
METHOD: 4.25" HSA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 95.3
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING DRY FEET
Y BORING DRY AT COMPLETION OF DRILLING
AT ______ FEET AFTER ____ HOURS
AT ______ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2019012416

REITZ & JENS, INC.
CONSULTING ENGINEERS

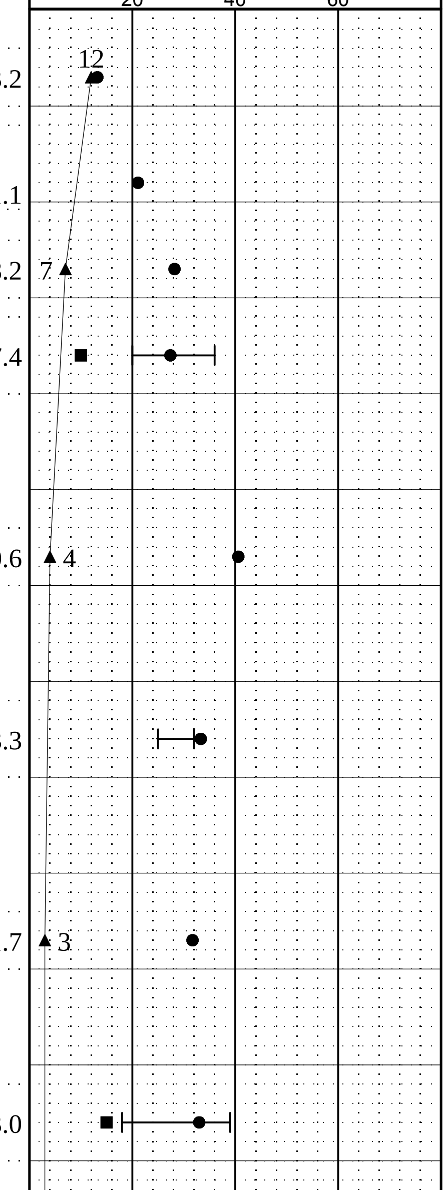
BORING LOG X-3

Ameren Meramec Ash Pond Closures
Meramec Energy Center
CLIENT: **Ameren**

LOCATION: N 937213.5 E 866147.7
ELEVATION: 419.12 DATUM: NAVD88
DATE DRILLED: 03-12-2021

SHEAR STRENGTH, tsf: △ QU/2 ■ PP □ SV ◇ TV (1, 2, 3)
▲ UNCORRECTED SPT N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (SILTS & CLAYS)
PL ├──┤ LL (20, 40, 60)

DEPTH (FEET)	ELEVATION	WATER TABLE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) / BLOWS PER 6 INCHES / RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0				Coal ASH, primarily bottom ash with fly ash		
			100	Becoming medium-dense	5-6-6	13.2
	415		88			
5				FILL: Sandy and Clayey SILT (SM), gray, with lignite, ash, roots, and trace clay, moist	106.6	21.1
			100	Silty CLAY or Clayey SILT (CL-ML), gray-brown, with lignite, moist, stiff	2-3-4	28.2
	410		92	Silty CLAY (CL), gray and brown, low plasticity	95.5	27.4
10						
	405		100	With organics, very moist, firm	0-2-2	40.6
15						
	400		50	Clayey SILT (ML), gray, very moist	90.0	33.3
20						
	395	▽	100	With limonite, trace wood pieces, loose	0-1-2	31.7
25						
	390		96	CLAY (CL), gray, lignite and limonite, trace fine-grained sand, with silt, very moist, firm	91.2	33.0
30						



DRILLER: Bulldog Drilling
METHOD: 4.25" HSA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 95.3
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 24 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ______ FEET AFTER ____ HOURS
AT ______ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2019012416

Figure 2-4 Sheet 1 of 2

BORING LOG X-3

REITZ & JENS, INC.
CONSULTING ENGINEERS

Ameren Meramec Ash Pond Closures

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT	SHEAR STRENGTH, tsf / UNCORRECTED SPT N-VALUE (BLOWS PER LAST FOOT)
35	385				100	Sandy SILT (SM), with clay seams, moist, loose	0-1-2	28.5	▲ 3
40	380				100	Silty CLAY (CL), gray, lignite, very moist	91.3	32.6	
45	375				100	Without lignite, becoming very soft	0-0-0	33.1	▲ 0
50	370				63	Trace fine gravelly rock fragment	80.0	46.1	
						Boring terminated at 50'-0" in Silty CLAY.			
55	365								
60	360								
65	355								

Legend: △ QU/2 ■ PP □ SV ◇ TV (1, 2, 3); ▲ UNCORRECTED SPT N-VALUE (BLOWS PER LAST FOOT); ● MOISTURE CONTENT, %; ○ % FINES (SILTS & CLAYS); PL ├──┤ LL (20, 40, 60)

File: 2019012416

REITZ & JENS, INC.
CONSULTING ENGINEERS

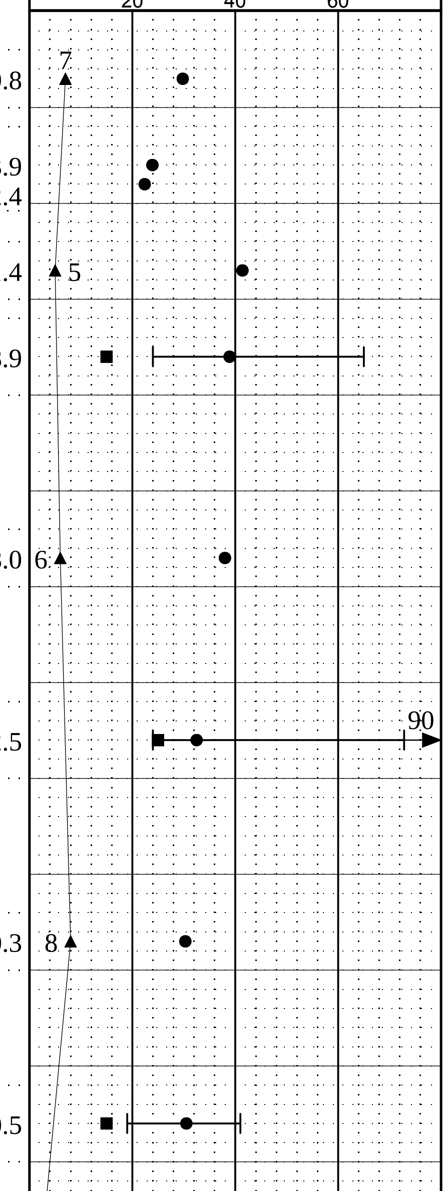
BORING LOG X-4

Ameren Meramec Ash Pond Closures
Meramec Energy Center
CLIENT: **Ameren**

LOCATION: N 937206.2 E 866477.7
ELEVATION: 414.61 DATUM: NAVD88
DATE DRILLED: 03-11-2021

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0					100	Coal ASH, gray-black, primarily bottom ash with some fly ash, moist, medium dense	3-4-3	29.8
5	410				100	FILL: Silty CLAY (CL-CH), greenish-gray, medium to high plastic, with trace roots, moist	102.0 95.2	23.9 22.4
					100	Coal ASH, black, with clayey silt, fine gravel and trace fine roots With trace gray silty clay and fine gravel.	4-3-2	41.4
10	405				83	Becoming mostly high plastic clay with bottom ash, organics and coal pieces, very moist, firm	80.9	38.9
						CLAY (CH), gray and brown, high plasticity, with trace sand		
15	400				100	Becoming dark gray, brown, and black, stiff	1-3-3	38.0
20	395				71		91.0	32.5
25	390				100	CLAY (CL-CH), dark gray and brown, medium to high plastic, with limonite, trace sand and organics, very moist, stiff	2-4-4	30.3
30	385	▽			79	Silty CLAY (CL), brown, with lignite and limonite, very moist, firm	92.4	30.5

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3
▲ UNCORRECTED SPT N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (SILTS & CLAYS)
PL LL
20 40 60



DRILLER: Bulldog Drilling
METHOD: 4.25" HSA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 95.3
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 28 FEET
U BORING DRY AT COMPLETION OF DRILLING
AT ______ FEET AFTER ____ HOURS
AT ______ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2019012416

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG X-4

Ameren Meramec Ash Pond Closures

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT	N-VALUE
35	380				100	Becoming clayey silt or silty clay, brown and gray, and soft	0-0-1	30.9	1
40	375				0	Becoming gray silty clay and clayey silt Note: Pushed spoon for sample recovery		30.7	
45	370				100	GRAVEL (GP), fine gravel with coarse to fine sand, medium dense	2-4-5		9
50	365				44	SAND (SP), fine to coarse sand, with medium gravel, medium dense	6-8-8		16
						Boring terminated at 50'-0" in SAND.			
55	360								
60	355								
65	350								

SHEAR STRENGTH, tsf

△ QU/2 ■ PP □ SV ◇ TV

1 2 3

▲ UNCORRECTED SPT N-VALUE (BLOWS PER LAST FOOT)

● MOISTURE CONTENT, %

○ % FINES (SILTS & CLAYS)

PL LL

20 40 60

File: 2019012416

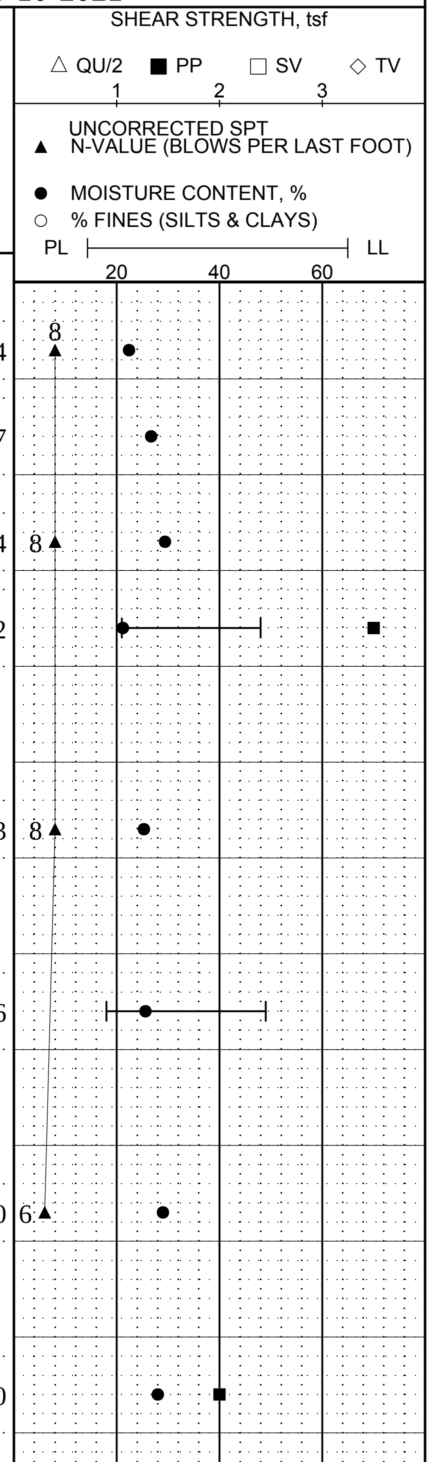
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG X-5

Ameren Meramec Ash Pond Closures
Meramec Energy Center
CLIENT: **Ameren**

LOCATION: N 937566.4 **E** 865958.0
ELEVATION: 414.40 DATUM: NAVD88
DATE DRILLED: 03-10-2021

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) / BLOWS PER 6 INCHES / RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0		100	FILL: Silty CLAY (CL), brown, with bottom ash and coal pieces, moist, stiff	3-4-4	22.4
			Coal ASH, black and gray, with bottom and fly ash		
	410	67	With trace decaying wood, moist	81.9	26.7
5		78	Silty CLAY (CL-CH), gray, medium to high plastic, with lignite and limonite, trace ash and rock fragments, moist, stiff	2-3-5	29.4
	405	75	Becoming greenish-gray, with trace roots, organic odor	107.2	21.2
10					
	400	100	Becoming gray-brown, with trace silt	1-3-5	25.3
15					
	395	54	Becoming silty with trace fine roots	100.2	25.6
20					
	390	100		1-2-4	29.0
25					
	385	100	Becoming brown with clayey sand and sandy clay lenses	97.1	28.0
30			Boring terminated at 30'-0" in CLAY.		



DRILLER: Bulldog Drilling
METHOD: 4.25" HSA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 95.3
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 28 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 28 FEET AFTER 0 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2019012416

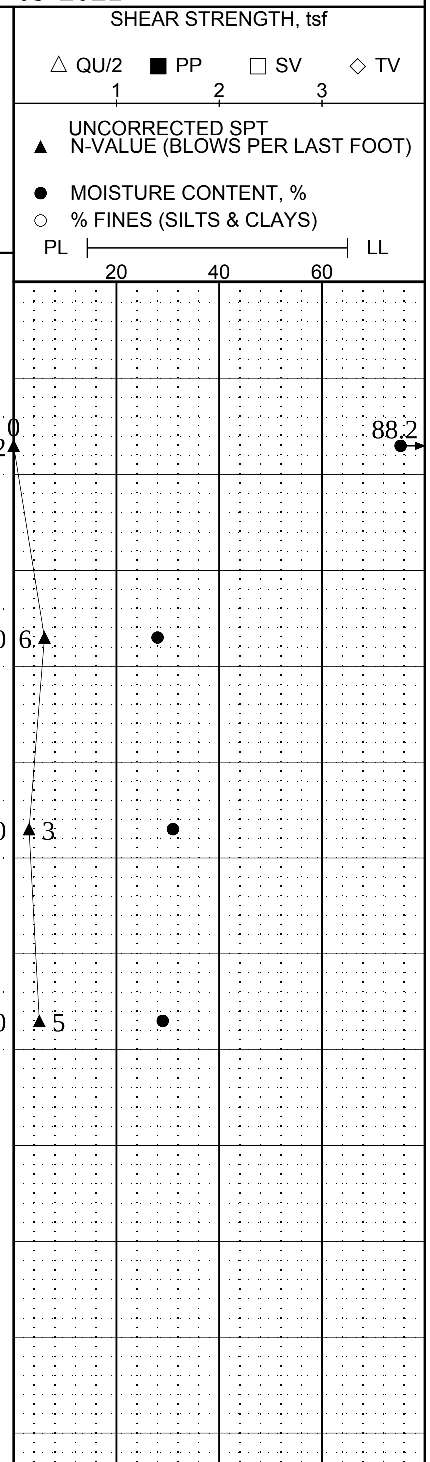
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG X-7

Ameren Meramec Ash Pond Closures
Meramec Energy Center
CLIENT: **Ameren**

LOCATION: N 937657.2 E 866328.1
ELEVATION: 410.00 DATUM: NAVD88
DATE DRILLED: 03-09-2021

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0	410					Coal ASH, dark gray, primarily fly ash		
		▽ (3.5)			22	Becoming very loose and wet	0-0-0	88.2
5	405							
					100	Note: Augers charged with water before SS-2.	1-3-3	28.0
10	400					SILT (ML), gray, with fine-grained sand, very moist, loose		
15	395				100	Becoming sandy and clayey	0-1-2	31.0
					100	Silty CLAY (CL-CH), brown and gray, medium to high plastic, with lignite and limonite, moist, firm	1-3-2	29.0
20	390					Boring terminated at 20'-0" in CLAY.		
25	385							
30	380							



DRILLER: Bulldog Drilling
METHOD: 4.25" HSA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 95.3
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 3.5 FEET
U BORING DRY AT COMPLETION OF DRILLING
AT ______ FEET AFTER ____ HOURS
AT ______ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT ___ FEET

File: 2019012416

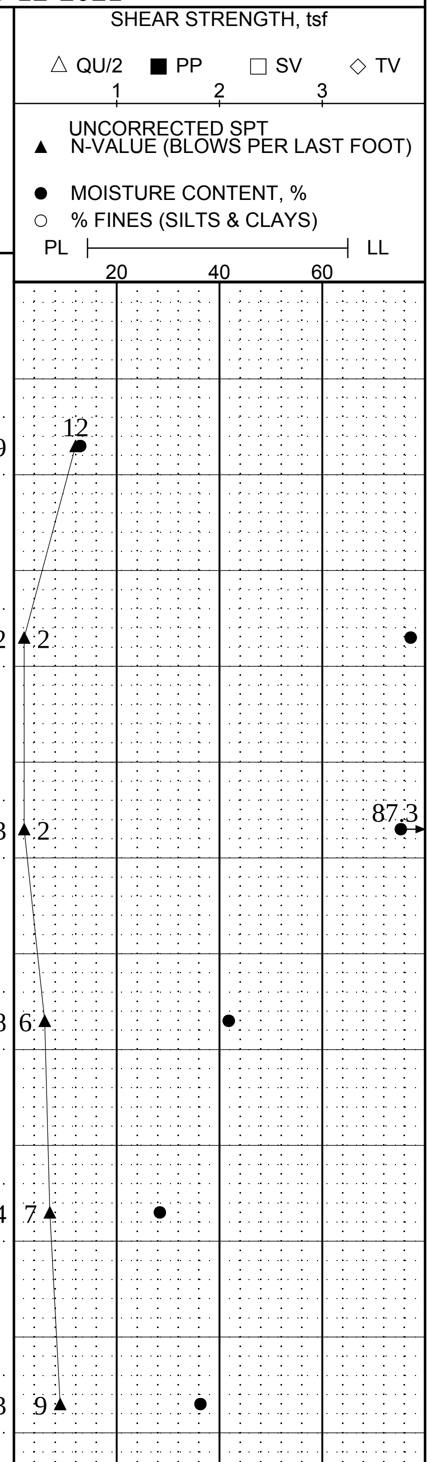
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG X-8

Ameren Meramec Ash Pond Closures
Meramec Energy Center
CLIENT: **Ameren**

LOCATION: N 936880.3 E 866508.2
ELEVATION: 418.92 DATUM: NAVD88
DATE DRILLED: 03-12-2021

DEPTH (FEET)	ELEVATION	WATER TABLE	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) / BLOWS PER 6 INCHES / RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT	UNCORRECTED SPT N-VALUE (BLOWS PER LAST FOOT)
0					Coal ASH, dark gray, primarily bottom ash			
5	415		SPT	100	Becoming medium-dense, with fine roots	2-6-6	12.9	12
10	410		SPT	100	Becoming very loose	1-1-1	77.2	2
15	405	▽	SPT	100		1-1-1	87.3	2
19	400		SPT	100	CLAY (CL-CH), gray, with limonite, medium to high plastic, very moist, stiff	1-2-4	41.8	6
24	395		SPT	100	CLAY (CH), gray, limonite, high plastic, moist, stiff	1-2-5	28.4	7
29	390		SPT	100		2-4-5	36.3	9
30					Boring terminated at 30'-0" in CLAY.			



DRILLER: Bulldog Drilling
METHOD: 4.25" HSA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 95.3
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 14 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ______ FEET AFTER ____ HOURS
AT ______ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2019012416

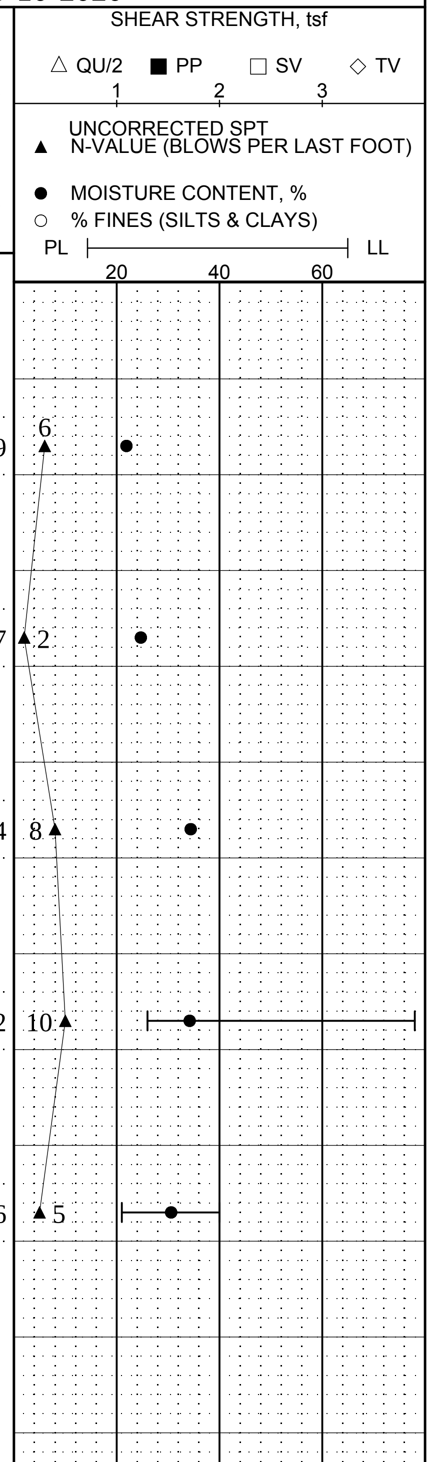
Reitz & Jens, Inc.
CONSULTING ENGINEERS

BORING LOG X-9

Ameren Meramec Ash Pond Closures
Meramec Energy Center
CLIENT: **Ameren**

LOCATION: N 937237.2 E 866257.3
ELEVATION: 412.84 DATUM: NAVD88
DATE DRILLED: 03-10-2020

DEPTH (FEET)	ELEVATION	WATER TABLE	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) / BLOWS PER 6 INCHES / RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0					FILL: Silty CLAY (CL), gray-brown, with trace ash and organics, moist, stiff		
	410						
5			SPT	89		3-3-3	21.9
	405						
10			SPT	22	FILL: Clayey and Sandy SILT (SM), gray, with ash, moist, very loose	0-1-1	24.7
	400						
15			SPT	100	Silty CLAY (CL-CH), gray-brown, medium to high plastic, with lignite and limonite, very moist, stiff	1-3-5	34.4
	395						
20			SPT	100	Becoming high plastic, very stiff	2-4-6	34.2
	390	▽					
25			SPT	100	Becoming firm and with low plasticity	1-2-3	30.6
					Boring terminated at 25'-0" in CLAY.		
	385						
30							



DRILLER: Bulldog Drilling
METHOD: 4.25" HSA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 95.3
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 23 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 23 FEET AFTER 0 HOURS
AT ______ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2019012416

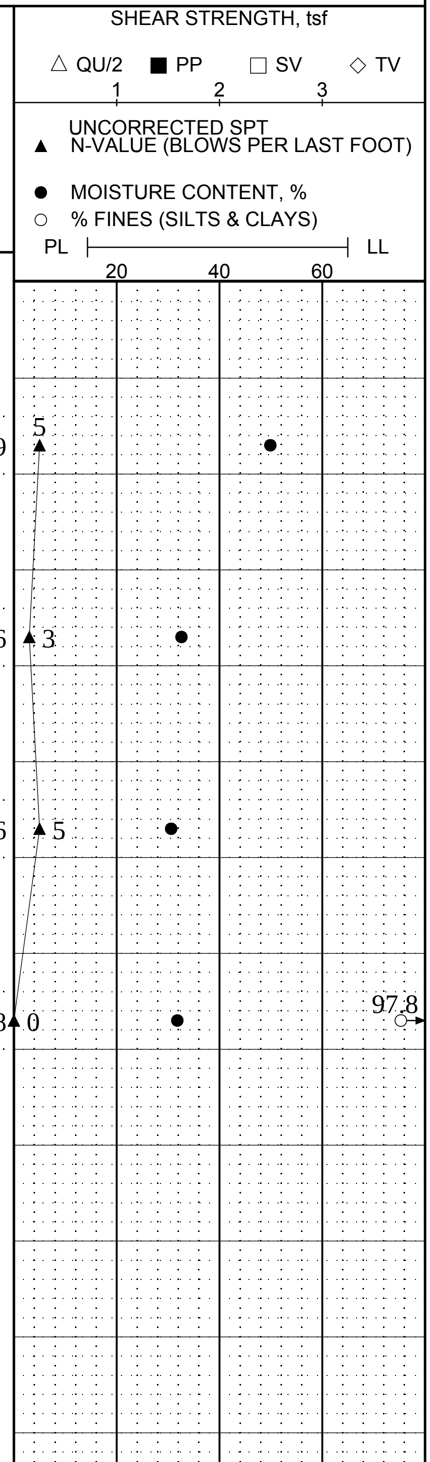
BORING LOG X-10

REITZ & JENS, INC.
CONSULTING ENGINEERS

Ameren Meramec Ash Pond Closures
Meramec Energy Center
CLIENT: **Ameren**

LOCATION: N 936025.2 E 866810.4
ELEVATION: 411.53 DATUM:
DATE DRILLED: 03-09-2021

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0			Coal ASH, black and tan, primarily bottom ash with fly ash, very moist		
	410				
		100	Becoming loose	5-2-3	49.9
5	405				
		100	Note: Switched to mud rotary at 8.5 feet. Becoming greenish-gray fly ash	3-1-2	32.6
10			CLAY (CH), green-gray, high plastic		
	400		Note: Stiff drilling at 12 feet.		
		100	With limonite and fine sand, firm	0-2-3	30.6
15	395		Silty CLAY (CL), brown, lignite and limonite, very moist, very soft		
		100	Becoming silty and sandy clay	0-0-0	31.8
20			Boring terminated at 20'-0" in Silty CLAY.		
	390				
25	385				
30					



DRILLER: Bulldog Drilling
METHOD: 4.25" HSA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 95.3
LOGGED BY: J. Pruett

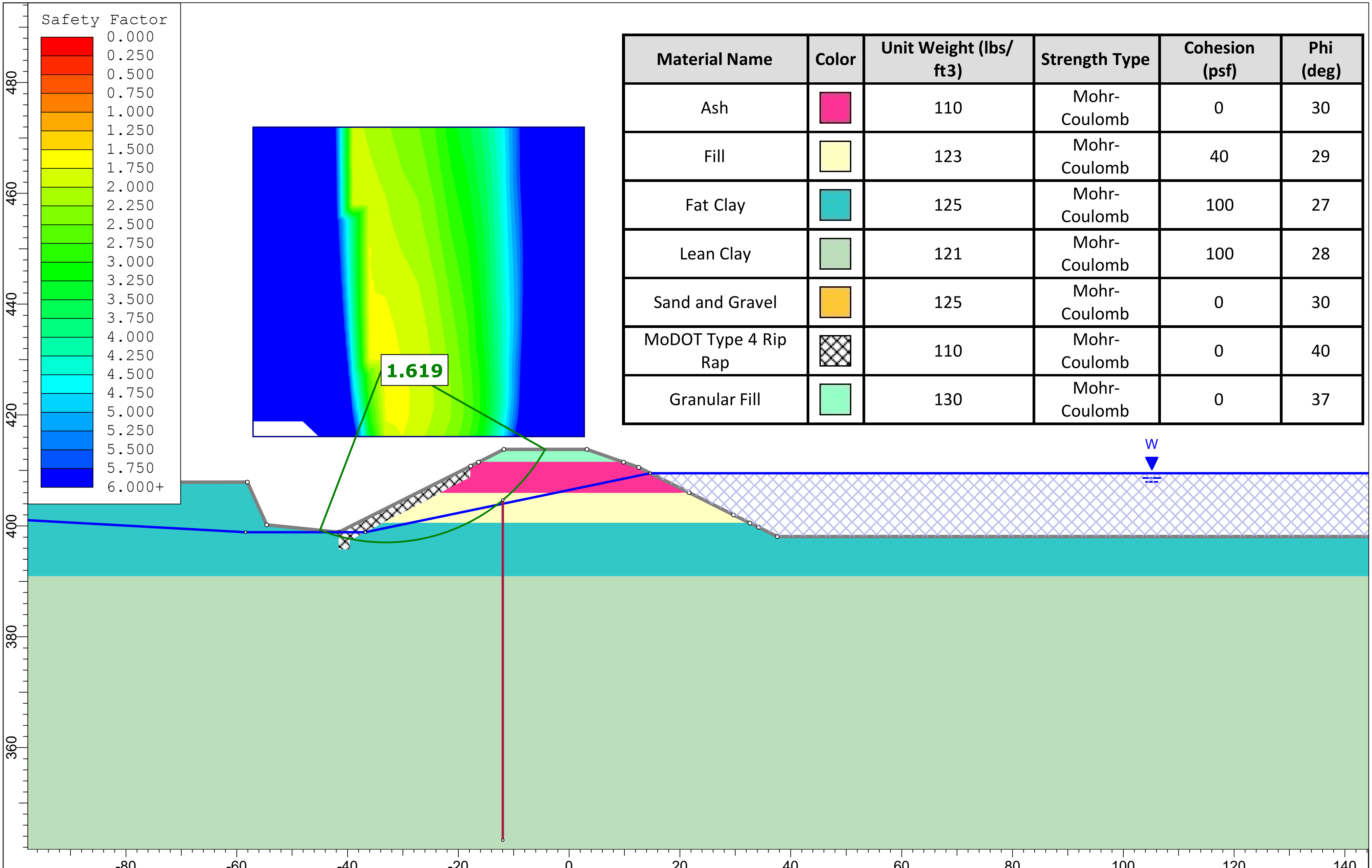
STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 1 FEET
U BORING DRY AT COMPLETION OF DRILLING
AT ______ FEET AFTER ____ HOURS
AT ______ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2019012416

APPENDIX II

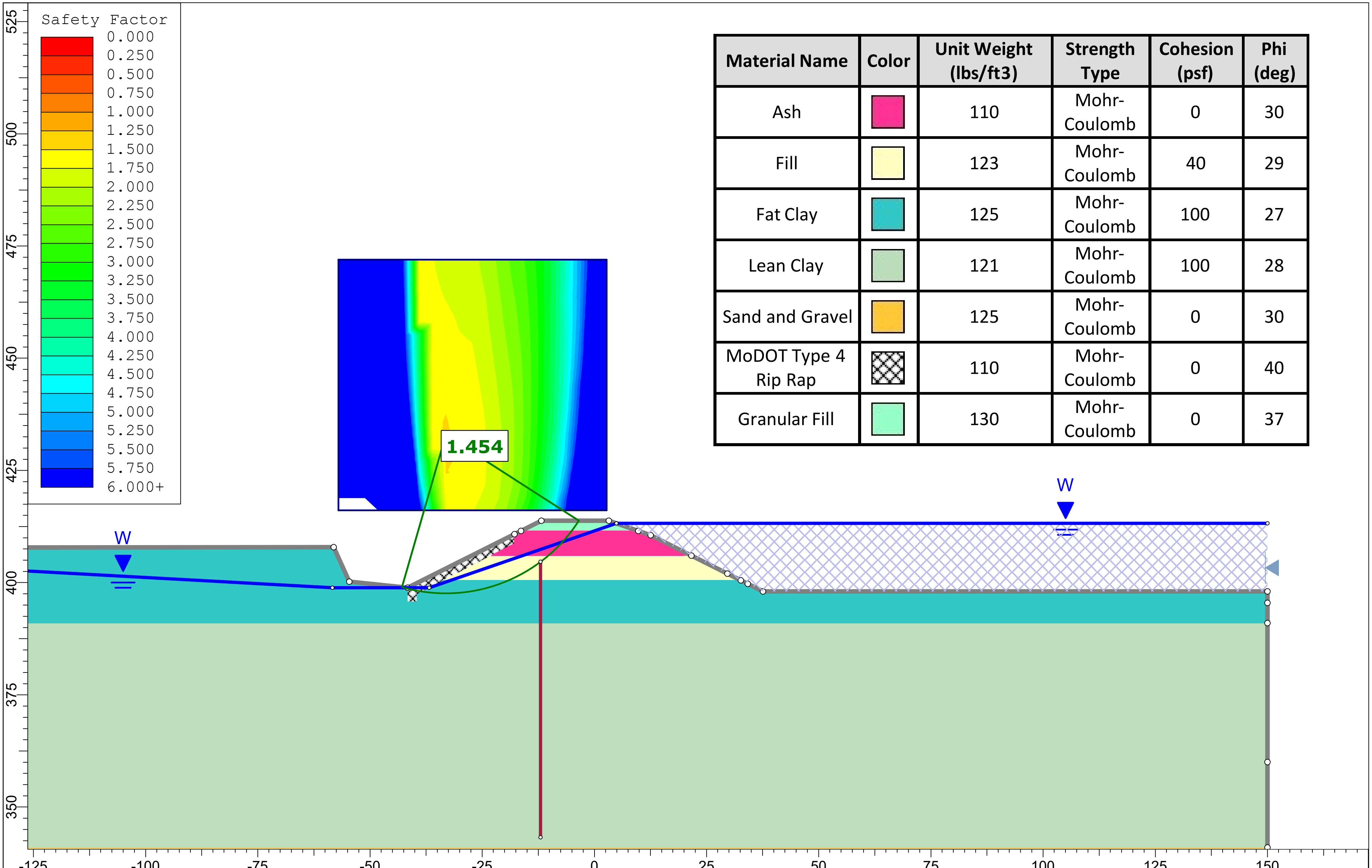
GRAPHICAL RESULTS OF SLOPE STABILITY ANALYSES



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Ash		110	Mohr-Coulomb	0	30
Fill		123	Mohr-Coulomb	40	29
Fat Clay		125	Mohr-Coulomb	100	27
Lean Clay		121	Mohr-Coulomb	100	28
Sand and Gravel		125	Mohr-Coulomb	0	30
MoDOT Type 4 Rip Rap		110	Mohr-Coulomb	0	40
Granular Fill		130	Mohr-Coulomb	0	37

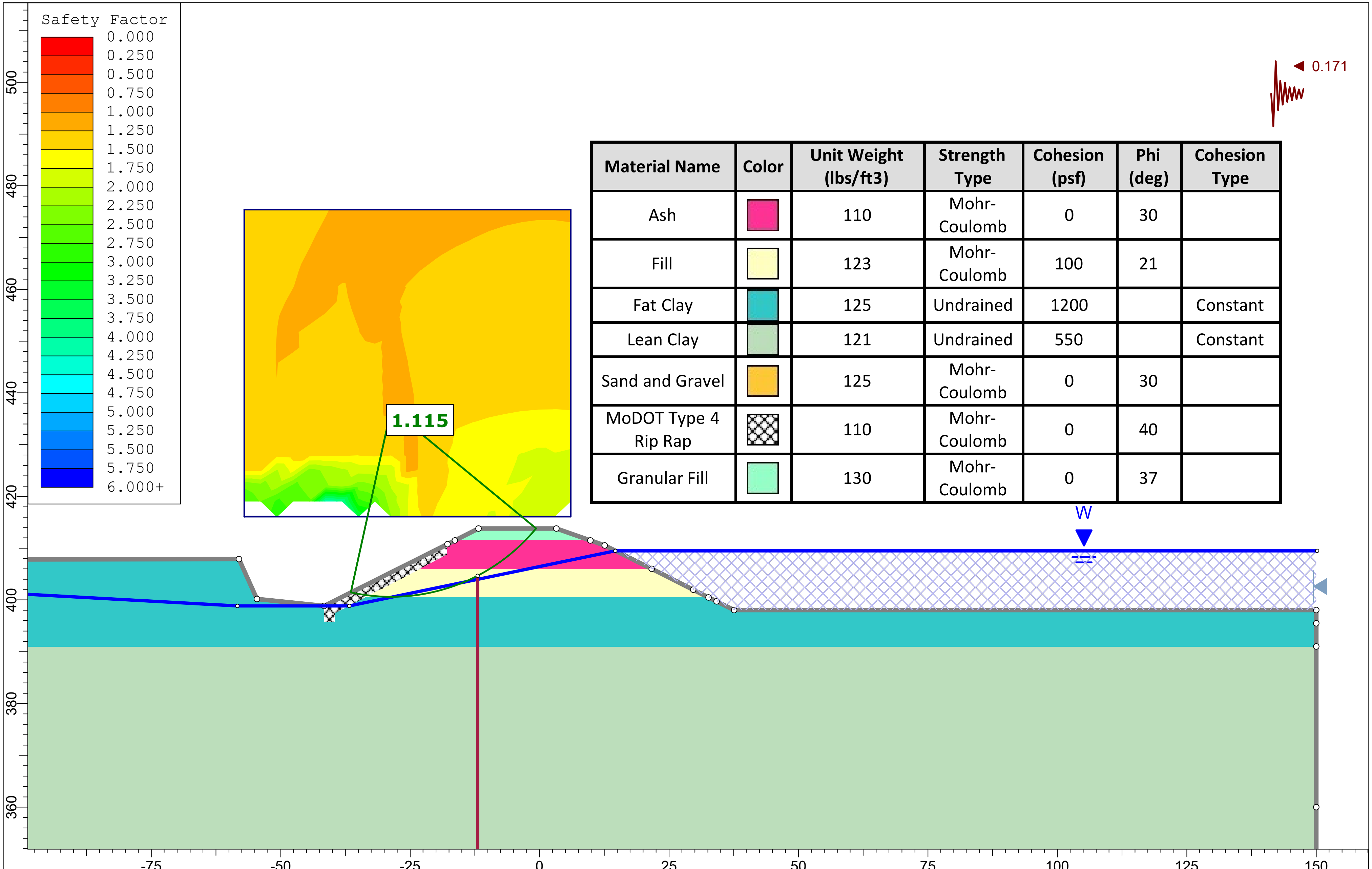
Project Name: Periodic Safety Factor Assessment		Client: Ameren - Meramec Energy Center
Section Location: Section 6 - Pond 493		Load Case: Static, long-term, maximum storage pool

Project Number: 2020012463	Analysis By: J. Bertel	Checked By: L. Sutton	Figure:



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Ash		110	Mohr-Coulomb	0	30
Fill		123	Mohr-Coulomb	40	29
Fat Clay		125	Mohr-Coulomb	100	27
Lean Clay		121	Mohr-Coulomb	100	28
Sand and Gravel		125	Mohr-Coulomb	0	30
MoDOT Type 4 Rip Rap		110	Mohr-Coulomb	0	40
Granular Fill		130	Mohr-Coulomb	0	37

Project Name: Periodic Safety Factor Assessment		Client: Ameren - Meramec Energy Center	
Section Location: Section 6 - Pond 493		Load Case: Static, long-term, maximum surcharge pool	
Project Number: 2020012463	Analysis By: J. Bertel	Checked By: L. Sutton	Figure:



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type
Ash		110	Mohr-Coulomb	0	30	
Fill		123	Mohr-Coulomb	100	21	
Fat Clay		125	Undrained	1200		Constant
Lean Clay		121	Undrained	550		Constant
Sand and Gravel		125	Mohr-Coulomb	0	30	
MoDOT Type 4 Rip Rap		110	Mohr-Coulomb	0	40	
Granular Fill		130	Mohr-Coulomb	0	37	

Project Name: Periodic Safety Factor Assessment

Client: Ameren - Meramec Energy Center

Section Location: Section 6 - Pond 493

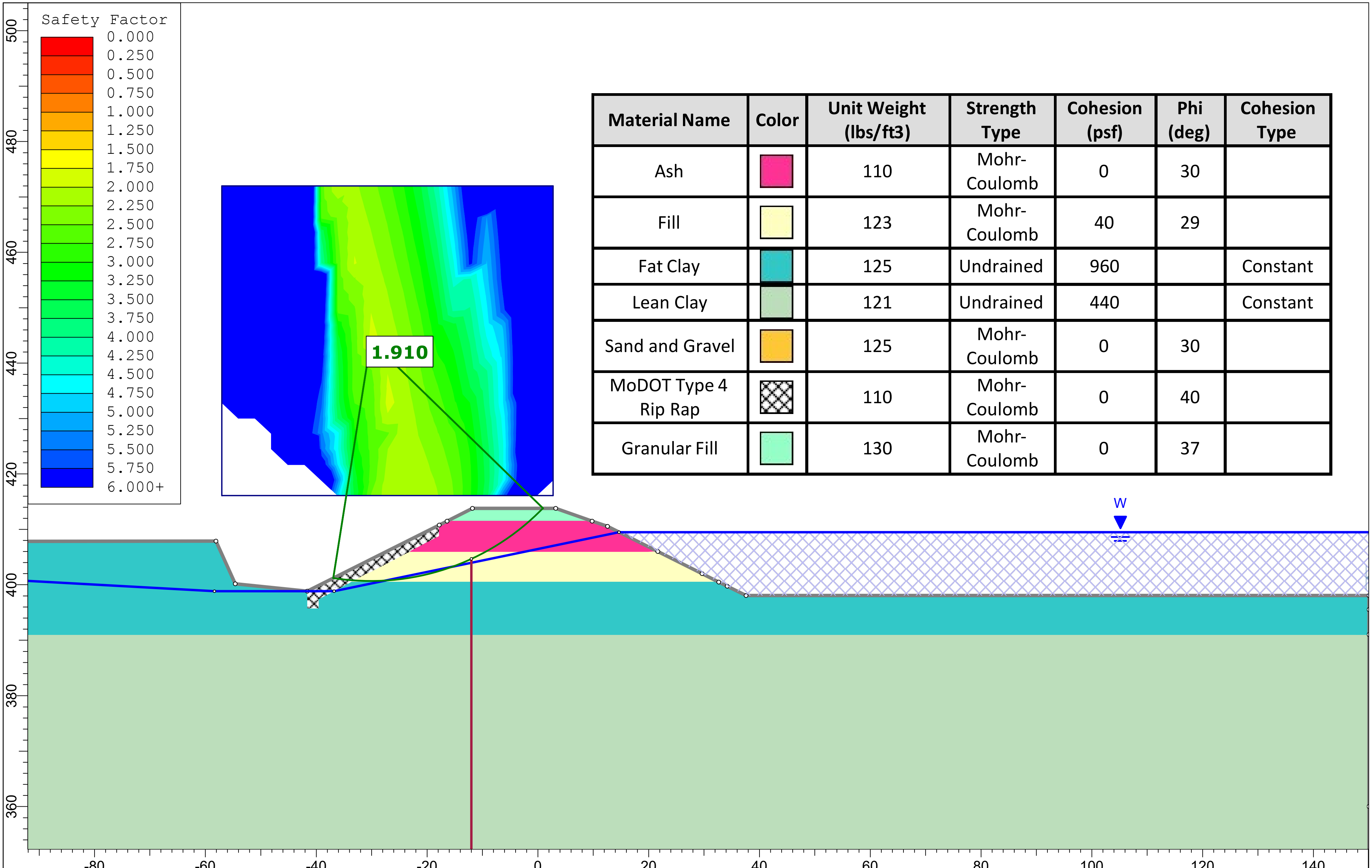
Load Case: Seismic

Project Number: 2020012463

Analysis By: J. Bertel

Checked By: L. Sutton

Figure:



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type
Ash		110	Mohr-Coulomb	0	30	
Fill		123	Mohr-Coulomb	40	29	
Fat Clay		125	Undrained	960		Constant
Lean Clay		121	Undrained	440		Constant
Sand and Gravel		125	Mohr-Coulomb	0	30	
MoDOT Type 4 Rip Rap		110	Mohr-Coulomb	0	40	
Granular Fill		130	Mohr-Coulomb	0	37	

Project Name: Periodic Safety Factor Assessment

Client: Ameren - Meramec Energy Center

Section Location: Section 6 - Pond 493

Load Case: Liquefaction

Project Number: 2020012463

Analysis By: J. Bertel

Checked By: L. Sutton

Figure:

APPENDIX E

HYDROLOGY AND HYDRAULICS

AMEREN MISSOURI MERAMEC ENERGY CENTER
EVALUATION OF CCR UNITS
40 CFR PART 257
ST. LOUIS COUNTY, MISSOURI

APPENDIX E: INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN §257.82

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AMEREN MISSOURI MERAMEC ENERGY CENTER
EVALUATION OF CCR UNITS
ST. LOUIS COUNTY, MISSOURI

APPENDIX E: INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN §257.82

1.0 INTRODUCTION

The Meramec Energy Center is located at the southernmost point in St. Louis County, Missouri at the confluence of the Mississippi and Meramec Rivers, approximately 2.8 miles southeast of the City of Arnold. The Meramec Energy Center has ten surface impoundments used for managing coal combustion residuals (CCR) within an approximate 138-acre area. They are designated as Ponds 489, 490, 491, 492, 493, 494, 495, 496, 498, and Inactive Pond 498. Ponds 489, 490, 491, 494, 495 and Inactive Pond 498 no longer receive CCR and are inactive. Pond 498 was closed in accordance with the CCR Rule in 2021. The remaining active CCR surface impoundments are Ponds 492, 493 and 496. Stormwater, and discharge from the active ponds is routed to the Retention Pond prior to discharge through an NPDES permitted outfall. A map showing the location of the surface impoundments and the Retention Pond is attached as Figure 1.

1.1 Purpose

40 CFR §257.82 requires the owner or operator of an existing CCR surface impoundment to prepare periodic inflow design flood control system plans for the CCR unit. The plan should document how the inflow design flood control system has been designed, constructed, operated and maintained to meet the requirements of §257.82. The section specifies that the inflow design flood control system must adequately manage flow into the CCR unit during and following the peak discharge of the inflow design flood and must manage flow from the CCR unit to collect and control the peak discharge resulting from the inflow design flood. Because the existing CCR surface impoundments at the Meramec Energy Center are classified as Low Hazard Potential dams, 40 CFR §257.82 requires that the 100-Year flood is used as the design flood in this analysis.

The inflow design flood control system plan has been developed for the active Meramec Energy Center surface impoundments, which include MCPA, MCPB and MCPC . MCPA, MCPB and MCPC are hydraulically interconnected to form the “Bottom Ash Pond”.

2.0 MCPA, MCPB AND MCPC

2.1 Pertinent Data

MCPA, MCPB and MCPC were brought online in the 1950s and are collectively referred to as the "Bottom Ash Pond". The ponds receive flow from the plant combined drained sump (CDS), bottom ash sluice flow and stormwater runoff from Ponds 490 & 491, the conveyor and coal pile area, portions of closed Pond 498 and the Switchyard. Flow is conveyed south to north through MCPC to MCPA and then to MCPB. MCPA and MCPC are separated by an interior berm, with the level in MCPA controlled by two culverts through the interior berm which are fitted with a knife gate. The level in MCPB is primarily controlled by an 18-inch diameter carbon steel pipe with an upturned pipe riser that discharges into the Retention Pond serving as the principal spillway. The pipe alignment is shown in Figure 2. MCPB also has a secondary, or emergency, spillway in the form of a 24-inch diameter corrugated metal pipe that discharges into a 6-foot-wide flat bottom ditch with 2H:1V sides that ultimately discharges into the Retention Pond. Plans of this spillway are shown in Figure 3.

The O&M Manual for the Meramec Ash Pond Embankment lists the MCPB's normal pool elevation at 409.5 feet. A normal pool elevation has not been established for MCPA and MCPC because these are flow through ponds that discharge into MCPB. A 2015 profile survey, confirmed with 2019 aerial survey data, measured the low point of the top of the embankment in MCPB at elevation 413.2 feet. Ameren has estimated the volume of CCR impounded in MCPA, MCPB and MCPC at about 312,000 cubic yards. Based on the 2019 topographic survey there is approximately 229,000 cubic yards of storage capacity remaining in the bottom ash pond. Table 1 includes pertinent hydrologic and hydraulic data regarding MCPA, MCPB and MCPC.

Table 1 – MCPA, MCPB and MCPC hydrologic and hydraulic data

CCR Unit	Normal Pool Elev. (feet)	Normal Pool Water Surface Area (acres)	Max. Pool Elev. (feet)	Max. Pool Water Surface Area (acres)	Total Watershed Area (acres)	Sluice Flow (cfs)
MCPB	409.5	5.1	413.2	6.9	64.0	1.14
MCPA & MCPC	410.3	6.0	415.3	8.0	57.3	1.14

2.2 Hydrologic and Hydraulic Analysis

Hydrologic and hydraulic analysis of the bottom ash pond was completed to confirm the adequacy of the current inflow design flood control system. The system was modeled using Hydraflow Hydrographs by Autodesk, Inc. Version 2021. The 24-hour, 100-year precipitation event was taken from Bulletin 71, Rainfall Frequency Atlas of the Midwest (Huff and Angel, 1992). The total rainfall over the 24-hour period was 7.21 inches. The flow from sluicing ash into the pond was estimated to be 1.14 cfs based on outfall discharge data provided by Ameren. The maximum pump capacity for the CDS is approximately 11.9 cfs. The maximum storm flow to the CDS is 8.4 cfs. This flow was routed through the CDS assuming it receives stormwater runoff from the plant and parking area, excluding the visitor parking area. The Area-Capacity Curve for MCPA and MCPC, and MCPB is shown as Figures 4 and 5.

Flow from the CDS is discharged into the south end of MCPC and flows north to MCPA. The flow then passes through the culvert in the interior berm and discharges into MCPB. Modeling showed the peak water levels in MCPA and MCPC during the 100-year, 24-hour would reach elevation 412.85 feet and return to within 0.1 feet of the normal pool elevation of 410.3 feet within 127 hours. The maximum outflow into MCPB was modelled at 28.2 cfs and occurred 18.1 hours after the start of the storm event. The peak water level in MCPB would reach elevation 411.74 feet 21.7 hours after the start of the storm. The peak discharge from MCPB during this storm was estimated at 26.2 cfs.

MCPB was also modelled during the 100-year event assuming that the principal spillway was not functioning (routing step named "Lake 493 Out - 24 only"). Assuming an initial pool elevation of 409.5 feet or the maximum pool level elevation, MCPB would reach el. 412.05 during the 100-year flood event with a non-functioning principal spillway pipe. This analysis suggests that the inflow design flood control system for MCPA, MCPB and MCPC adequately manages flow into this CCR unit during and following 100-Year flood as required by §257.82 with or without a functioning primary spillway.

A summary of the modelling performed for MCPA, MCPB and MCPC is included in Appendix A.

2.3 Inflow Design Flood Control System Plan

The modelling shows that provided MCPB, and MCPA and MCPB are operated with normal pool elevations of 409.5 and 410.3, respectively, the current inflow flood control system has adequate capacity to handle the 100-Year design flood. Since the condition of the pipe that creates the primary spillway pipes could not be assessed, an additional model was developed that assumed that only the secondary spillway was functional. This model determined that the peak water level during the 100-Year flood event would rise to elevation 412.05 feet, or approximately 1.2 feet below the low point on the crest of MCPB. Although the principal spillway is not necessary to control the 100-year flood event, it should be maintained in functional condition to maintain the normal pool elevation.

The area capacity curve is based on 2011 topographic data. This analysis assumes that the quantity of CCR in MCPA, MCPB and MCPC is similar to that determined by the 2011 survey. Additional CCR disposal in this pond will reduce the available storage. As a result, a topographic survey should be completed for the interior of MCPA, MCPB and MCPC to confirm the necessary storage is available.

The following Table 2 presents operational limits for MCPA, MCPB and MCPC.

Table 2 – MCPA, MCPB and MCPC operating limits

CCR Unit	Normal Pool Elevation (feet)	Maximum Surcharge Pool Elevation (feet)
MCPB	409.5	412.05
MCPA and MCPC	410.3	412.85

If pool levels exceed the maximum surcharge pool elevation, Ameren must conduct a special inspection to evaluate the condition of the primary spillway pipe and determine if sluice flow should be temporarily suspended. If the pool levels are elevated due to a malfunctioning spillway pipe, procedures should be implemented to restore the functionality of the primary spillway and alternative discharge methods (e.g. pumps, siphons, etc.) must be implemented to lower the pool level.

3.0 MCPD

MCPD has been dewatered and is currently being closed. Closure of MCPD was designed so that water is not permanently impounded within the impoundment embankment. The interior of MCPD has been graded and capped to route stormwater via overland flow to designated outfalls. An inflow design flood control system plan is longer applicable or necessary for MCPD.

3.0 CONCLUSIONS

The initial inflow design flood control system has been evaluated for MCPA, MCPB and MCPC at the Meramec Energy Center. The inflow control system for these ponds can adequately handle and discharge the 100-Year design flood event. The following summarizes the conclusions of this report, and outlines recommendations for surveillance and operation of each CCR unit.

- The MCPB normal pool elevation should be maintained no higher than elevation 409.5 feet to maintain a maximum surcharge pool at elevation 412.05 feet.
- MCPA and MCPB normal pool elevation should be maintained no higher than elevation 410.3 feet to maintain a maximum surcharge pool at elevation 412.85 feet.
- If the water levels exceed the maximum surcharge pool elevations, special inspections of the primary spillways should be completed, and temporary measures should be implemented to prevent the water from overtopping the Pond embankments until the primary spillways are functioning as designed.
- Before completing additional evaluations of the Periodic Inflow Design Flood Control System Plan, topographic surveys should be completed on the interior of all active ponds to confirm the necessary water storage is available.
- Staff gage readings should be recorded during weekly inspections to confirm the assumed normal pool elevations.

4.0 REFERENCES

Ameren Missouri. (2011). "Operation and Maintenance Manual; Meramec Ash Pond Embankment, St. Louis, Missouri, St. Louis County." Dam Safety and Hydro Engineering, St. Louis, Missouri.

Environmental Protection Agency. (2015). "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities; Final Rule." 40 CFR Parts 257 and 261., Vol. 80, No. 74.

Huff, F.A. and J.R. Angel. (1992). "Rainfall Frequency Atlas of the Midwest." Bulletin 71, Midwestern Climate Center and Illinois State Water Survey.

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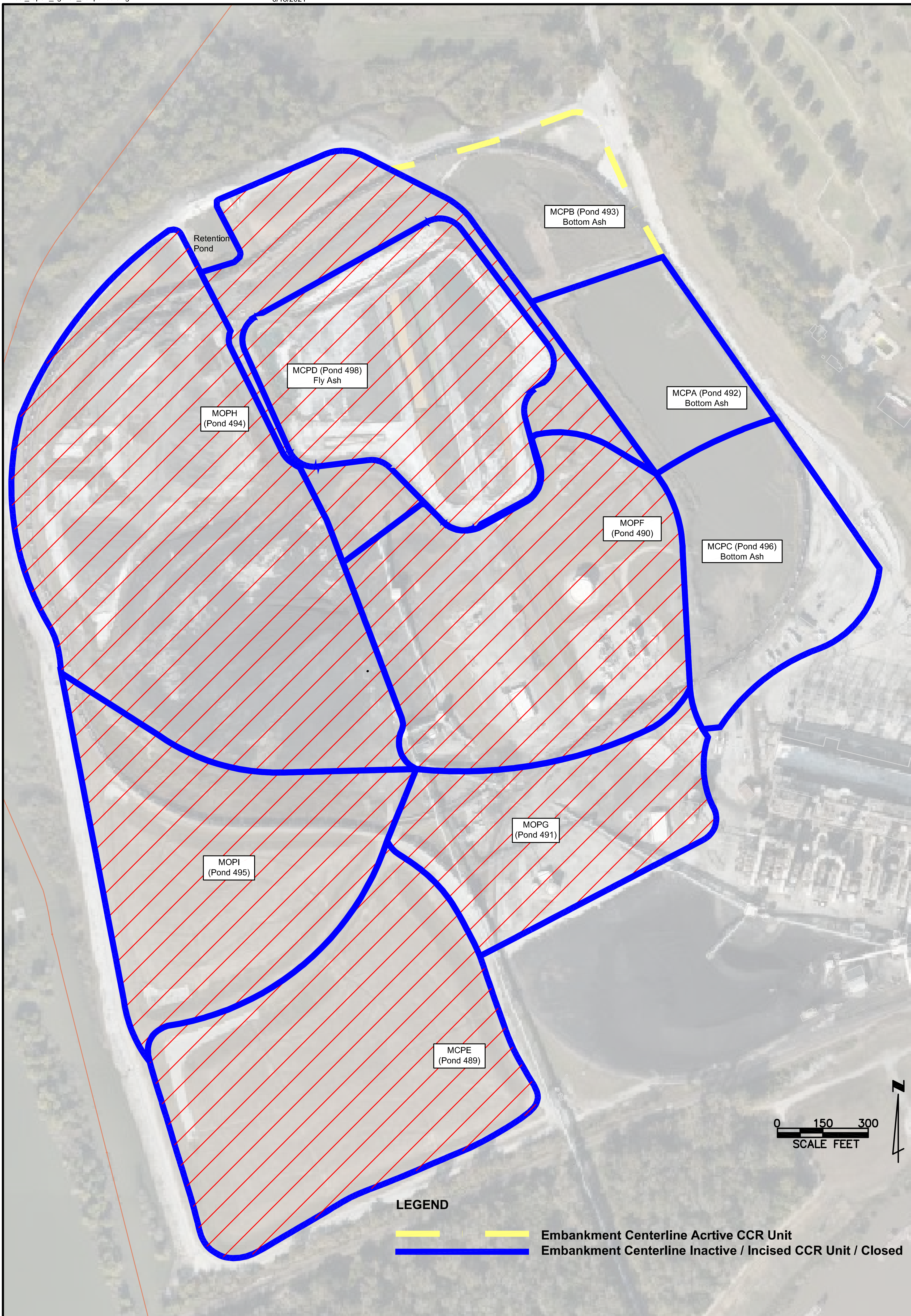
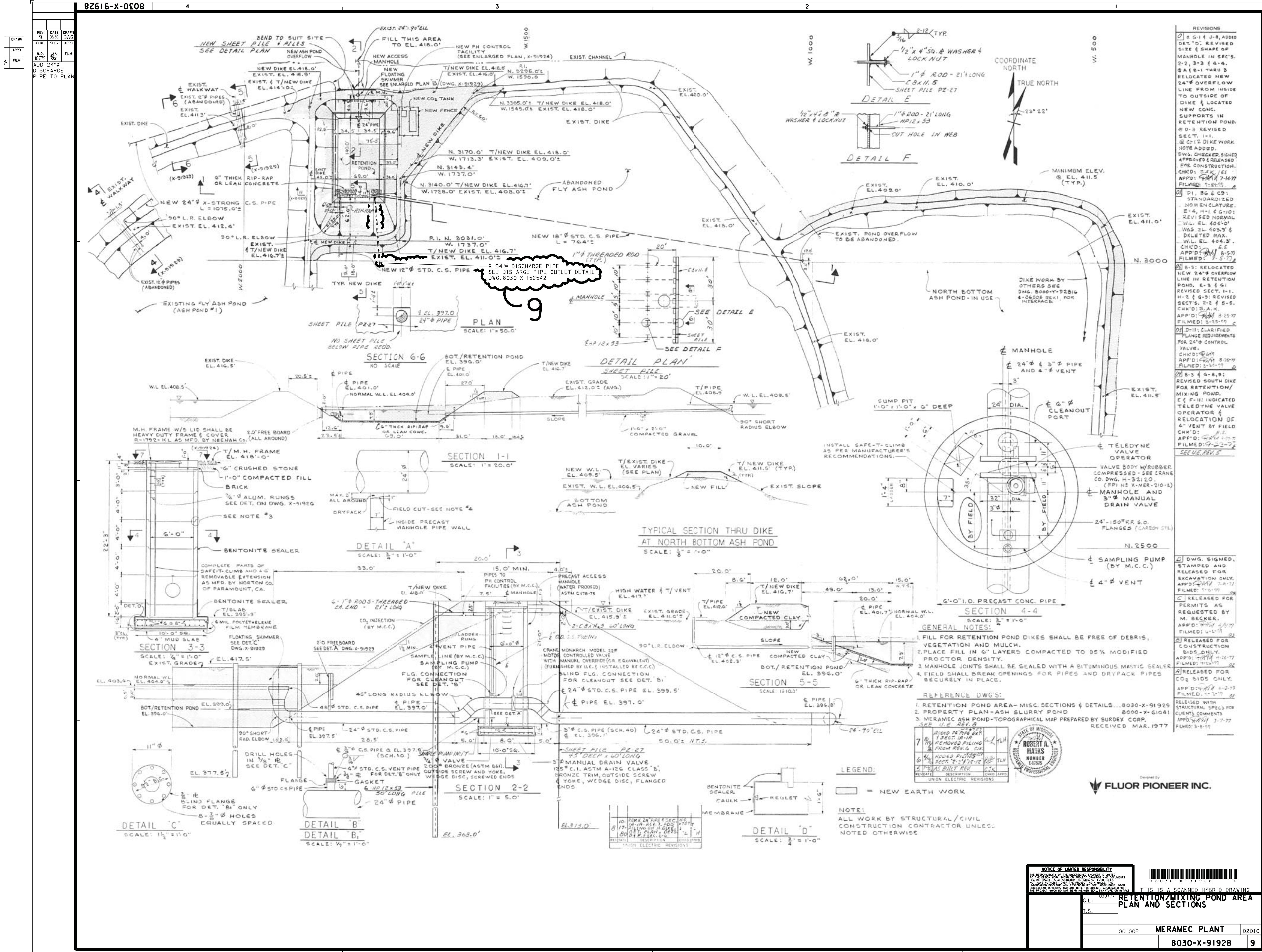


FIGURE 1	MERAMEC ENERGY CENTER ASH PONDS	Ameren Missouri 3700 S. Lindbergh St. Louis, MO 63127	Designed J.D.B. Checked J.L.F. Drawn E.J.K. Issued 9/13/2021	REITZ & JENS, INC. CONSULTING ENGINEERS 1055 CORPORATE SQUARE DRIVE ST. LOUIS MISSOURI 63132 (314) 993-4132 PROFESSIONAL ENGINEERING CORP., LICENSE #000215

Figure 8



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SCALE RATIO 1:1

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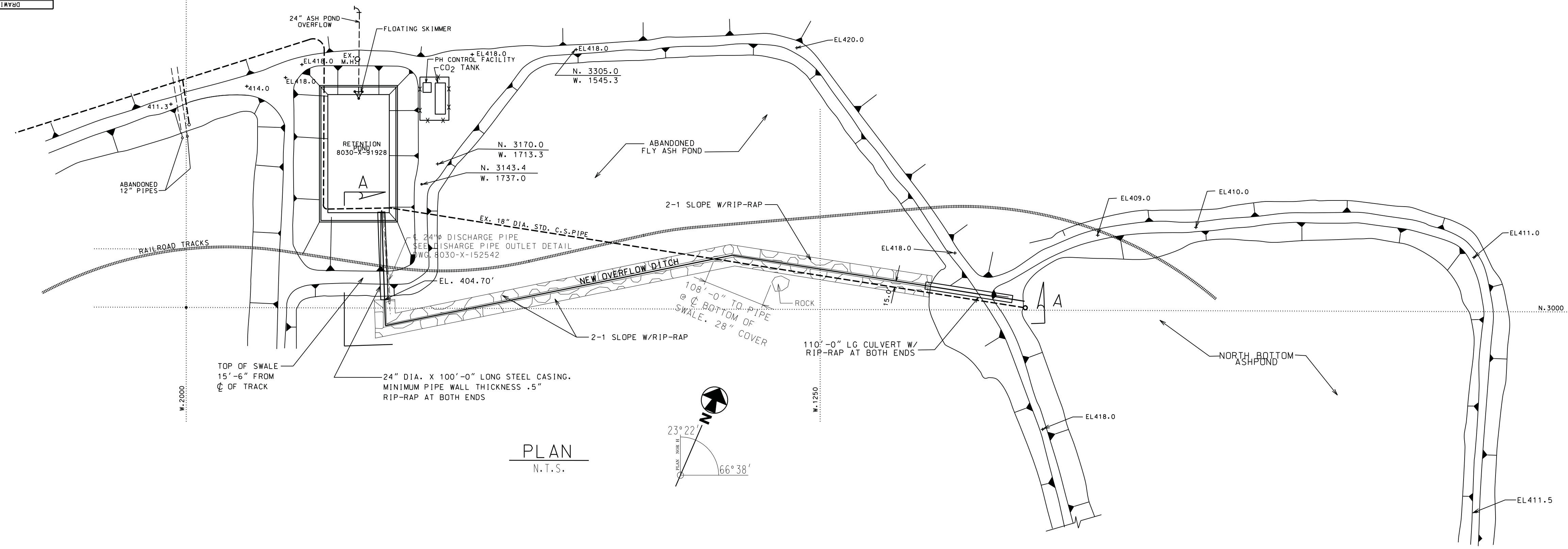
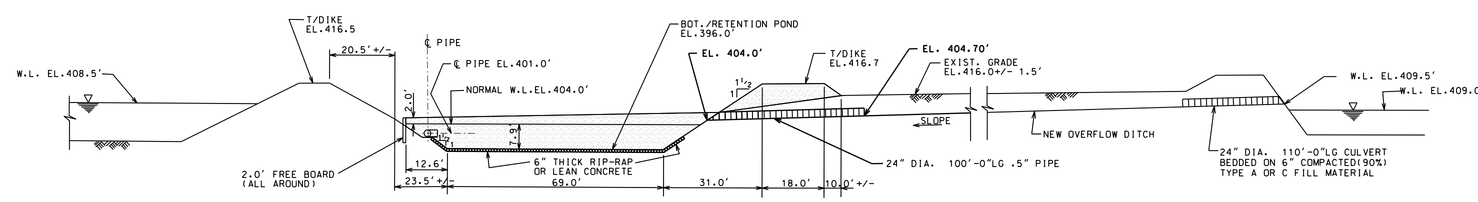
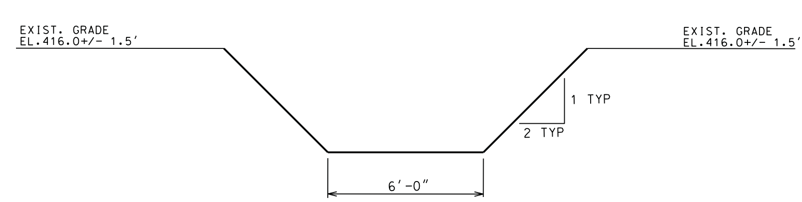
Figure 9



PLAN
N.T.S.



SECTION A-A
N.T.S.



TYPICAL SECTION THRU OVERFLOW DITCH
N.T.S.

NOTES:

1. INSTALL TYPE 2 RIP-RAP AT ALL CULVERTS AND CASING ENDS. PREDOMINANT ROCK SIZE OF 6 INCHES. MAXIMUM ROCK SIZE OF 10INCHES AND A GRADATION SUCH THAT NO MORE THAN 15% WILL BE LESS THAN 3 INCHES.

AS BUILT

MARK UP DRAWING NO.: ---------------- REV.: ---
SHEET NO. ---

DRAWING RECORD

REV.	DATE	PROJECT NO.	AMEREN SUPV ENGR	DRAFTING DRFTR	DRAFTING CHK'D	DRAFTING SUPV	ENGR APPROVAL AMEREN	ENGR APPROVAL OTHER	DESCRIPTION
000	08-28-12	J017N	-	MSB	MSB	KAJ	MRB	-	FIRST ISSUE PER MR-2012-MDM-0011 & JR109893
001	10-04-12	J017N		MSB	MSB	KAJ			REMOVED 24" PIPE/REPLACED WITH OVERFLOW DRAINAGE DITCH AND CULVERTS
									MR-2012-WO-DOCREQ-0033 JR109893
002	05-08-13	J017N		DLF	RBM	KAJ	RBM		AS BUILT PER JR109893; INSTALL NEW OVERFLOW DITCH

SCALE 1"=100'
UNIT NO. -
DWG. SIZE 34X44
SUB CLASS -

PIPING PLAN & DETAILS
ASH POND OVERFLOW DRAIN
TO RETENTION POND

SITE: MERAMEC ENERGY CENTER

Ameren MISSOURI

DRAWING NO.: MR-DWG-PIPE-000021 REV.: 002
SHEET NO. 001

MR-DWG-PIPE-000021 002 SHEET NO. 001

Ameren Missouri: Meramec Energy Center
POND 493
AREA-CAPACITY CURVE

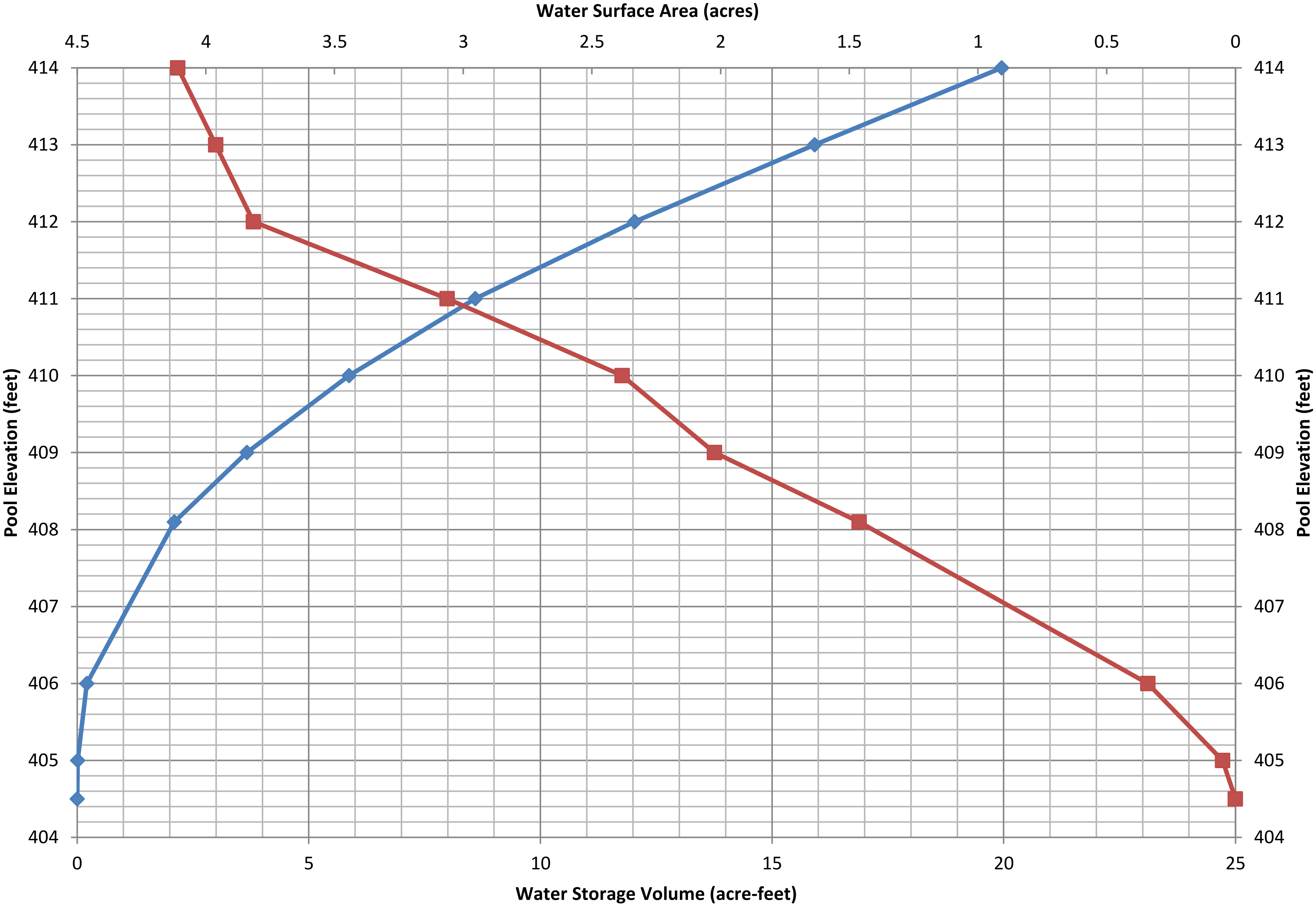


Figure 4

Ameren Missouri: Meramec Energy Center
POND 492 & 496
AREA-CAPACITY CURVE

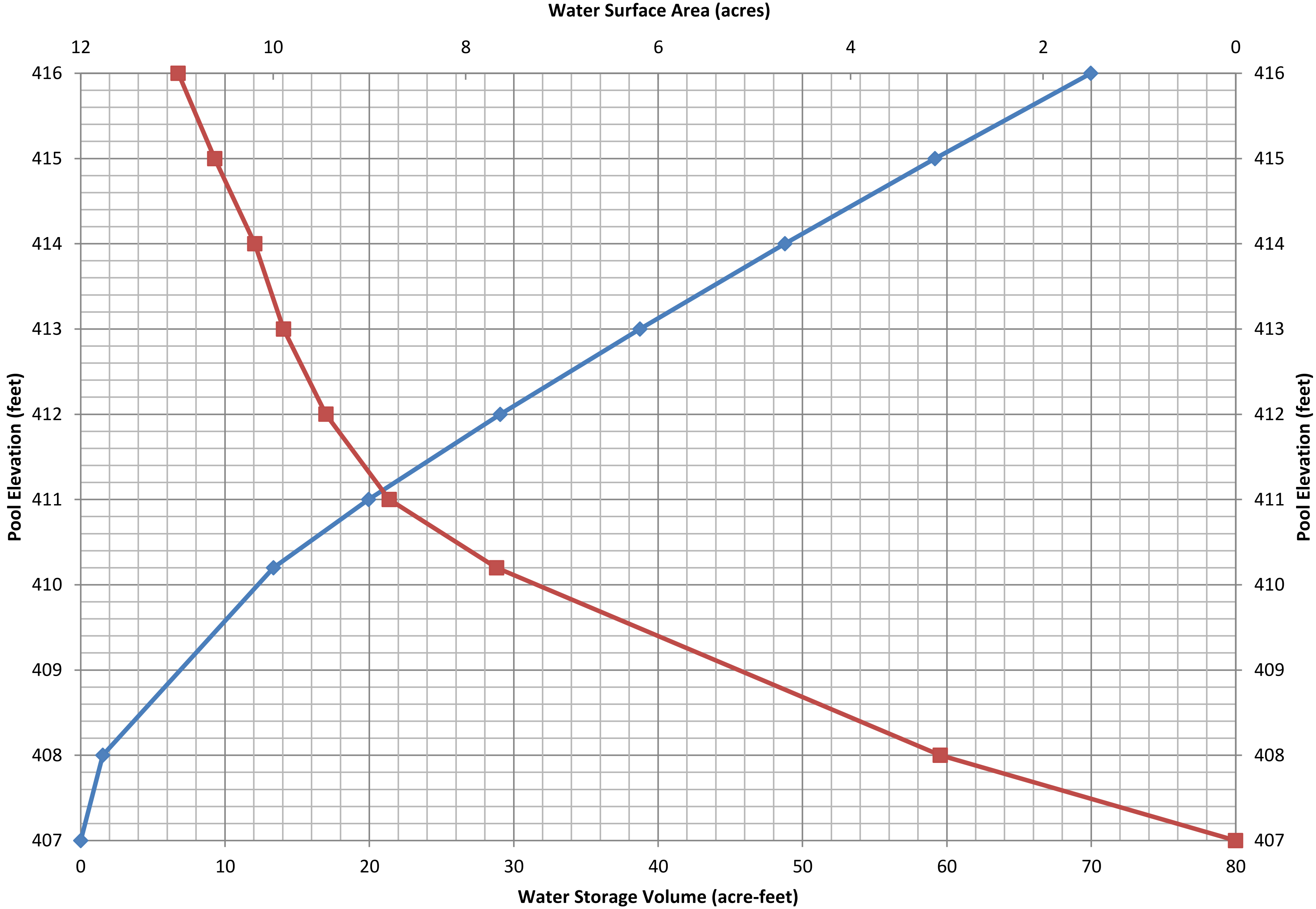


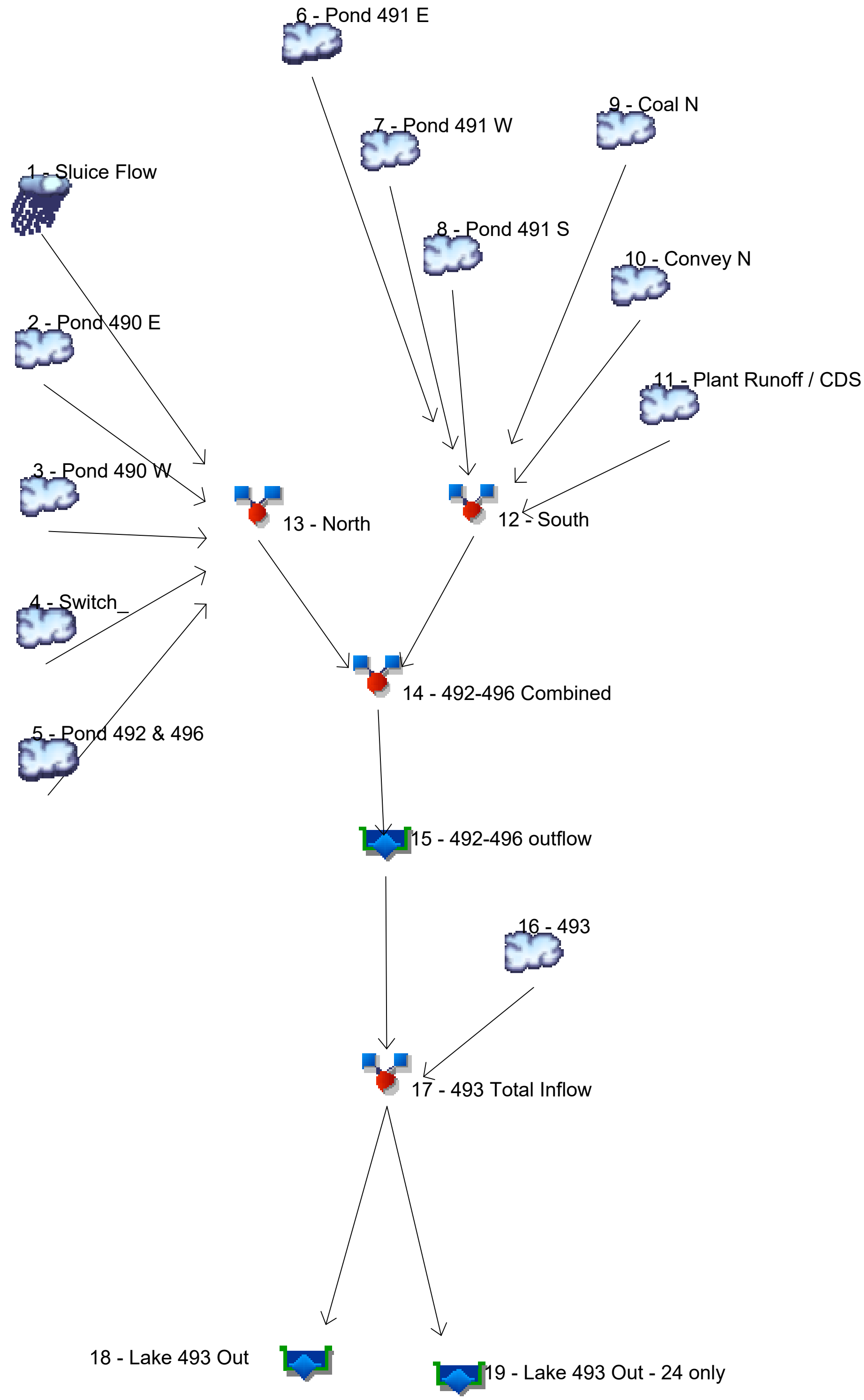
Figure 5

APPENDIX I

HYDROLOGIC AND HYDRAULIC MODEL SUMMARIES

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021



Project: BA_2021.gpw	Thursday, 09 / 2 / 2021

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Manual	1.140	3	0	49,453	------	------	------	Sluice Flow
2	SCS Runoff	9.062	3	936	239,142	------	------	------	Pond 490 E
3	SCS Runoff	5.423	3	936	144,598	------	------	------	Pond 490 W
4	SCS Runoff	9.496	3	936	279,324	------	------	------	Switch_
5	SCS Runoff	20.30	3	936	582,162	------	------	------	Pond 492 & 496
6	SCS Runoff	3.488	3	936	97,701	------	------	------	Pond 491 E
7	SCS Runoff	1.730	3	936	49,287	------	------	------	Pond 491 W
8	SCS Runoff	1.884	3	936	52,758	------	------	------	Pond 491 S
9	SCS Runoff	5.492	3	936	140,422	------	------	------	Coal N
10	SCS Runoff	0.547	3	936	14,977	------	------	------	Convey N
11	SCS Runoff	8.402	3	936	270,359	------	------	------	Plant Runoff / CDS
12	Combine	21.54	3	936	625,505	6, 7, 8, 9, 10, 11	------	------	South
13	Combine	44.28	3	936	1,294,679	1, 2, 3, 4, 5,	------	------	North
14	Combine	65.83	3	936	1,920,184	12, 13	------	------	492-496 Combined
15	Reservoir	28.21	3	1089	1,896,817	14	412.85	1,004,916	492-496 outflow
16	SCS Runoff	6.169	3	936	183,020	------	------	------	493
17	Combine	31.79	3	1014	2,079,836	15, 16	------	------	493 Total Inflow
18	Reservoir	26.25	3	1302	2,068,221	17	411.74	325,439	Lake 493 Out
19	Reservoir	18.46	3	1524	2,033,869	17	412.05	812,715	Lake 493 Out - 24 only

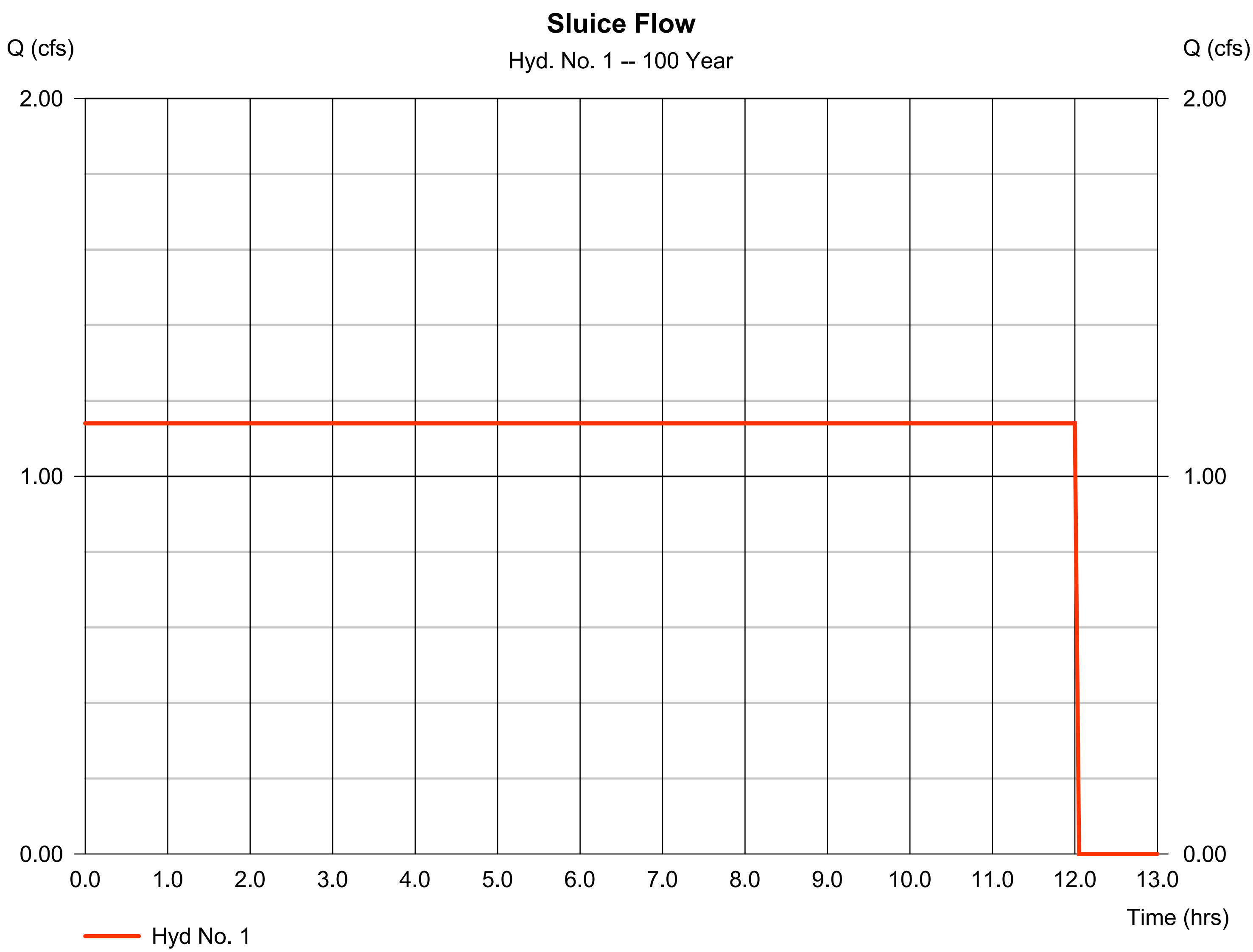
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 09 / 2 / 2021

Hyd. No. 1

Sluice Flow

Hydrograph type	= Manual	Peak discharge	= 1.140 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.00 hrs
Time interval	= 3 min	Hyd. volume	= 49,453 cuft



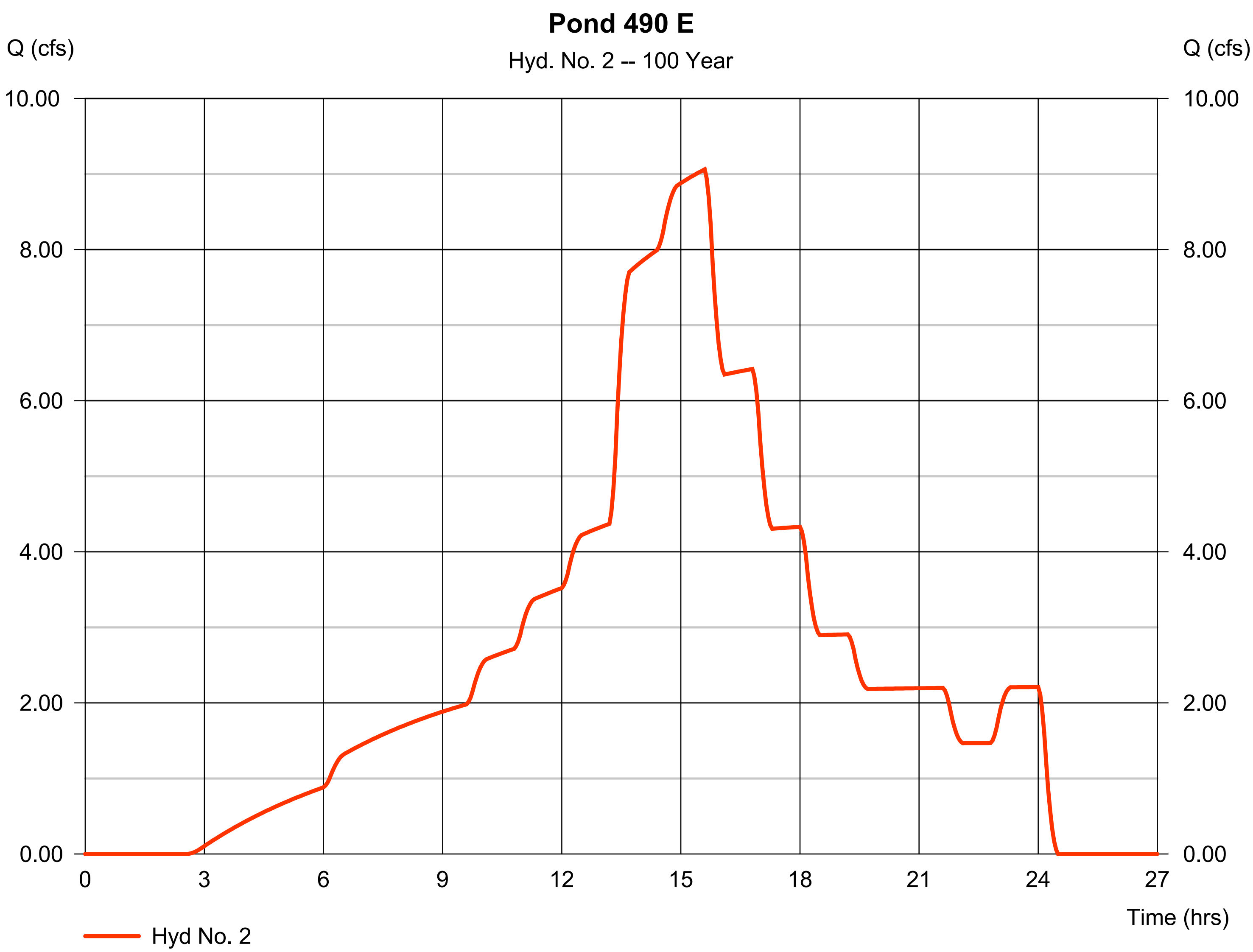
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 09 / 2 / 2021

Hyd. No. 2

Pond 490 E

Hydrograph type	= SCS Runoff	Peak discharge	= 9.062 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.60 hrs
Time interval	= 3 min	Hyd. volume	= 239,142 cuft
Drainage area	= 12.600 ac	Curve number	= 81.7
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 18.00 min
Total precip.	= 7.20 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484



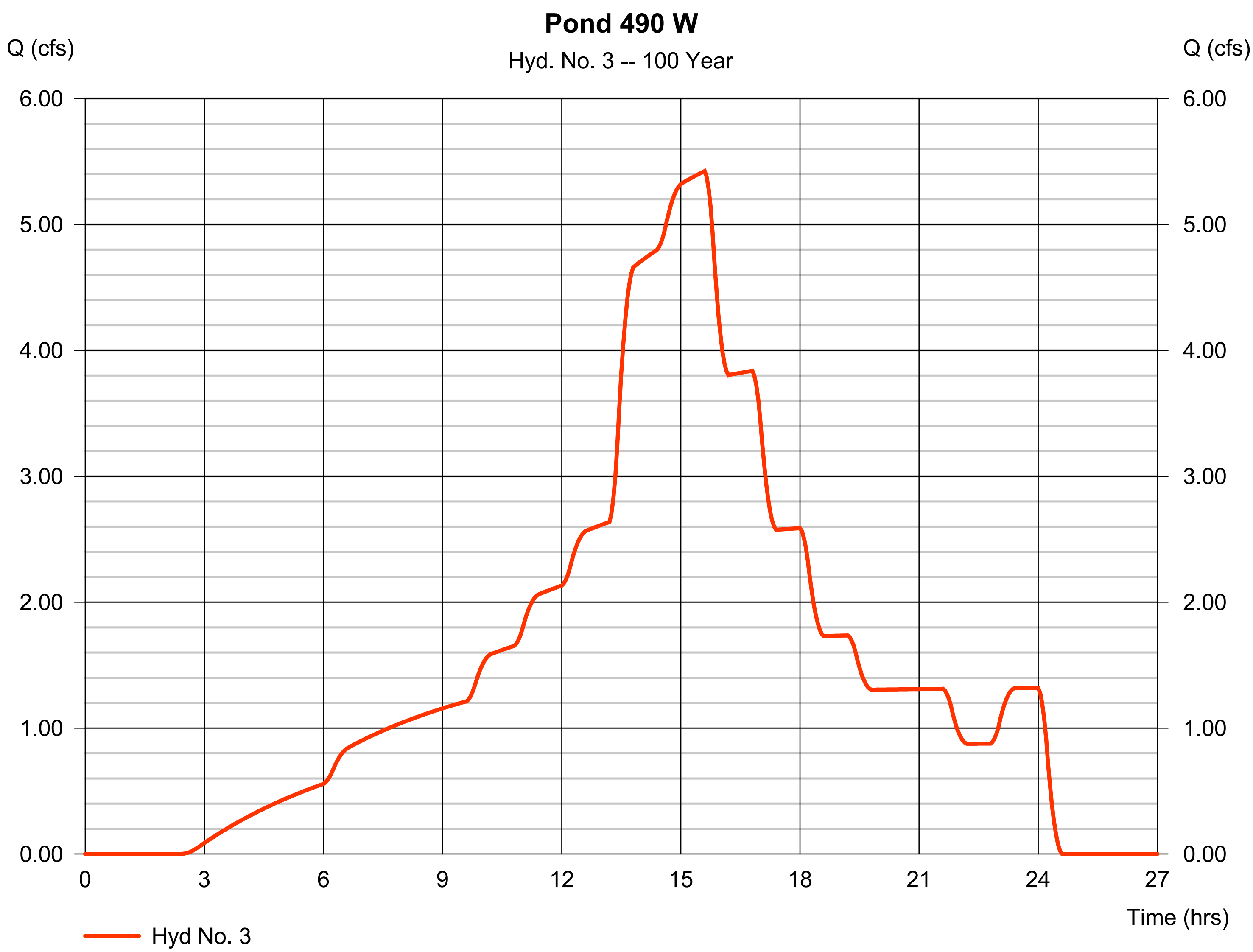
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 09 / 2 / 2021

Hyd. No. 3

Pond 490 W

Hydrograph type	= SCS Runoff	Peak discharge	= 5.423 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.60 hrs
Time interval	= 3 min	Hyd. volume	= 144,598 cuft
Drainage area	= 7.900 ac	Curve number	= 82.6
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 24.00 min
Total precip.	= 7.20 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484



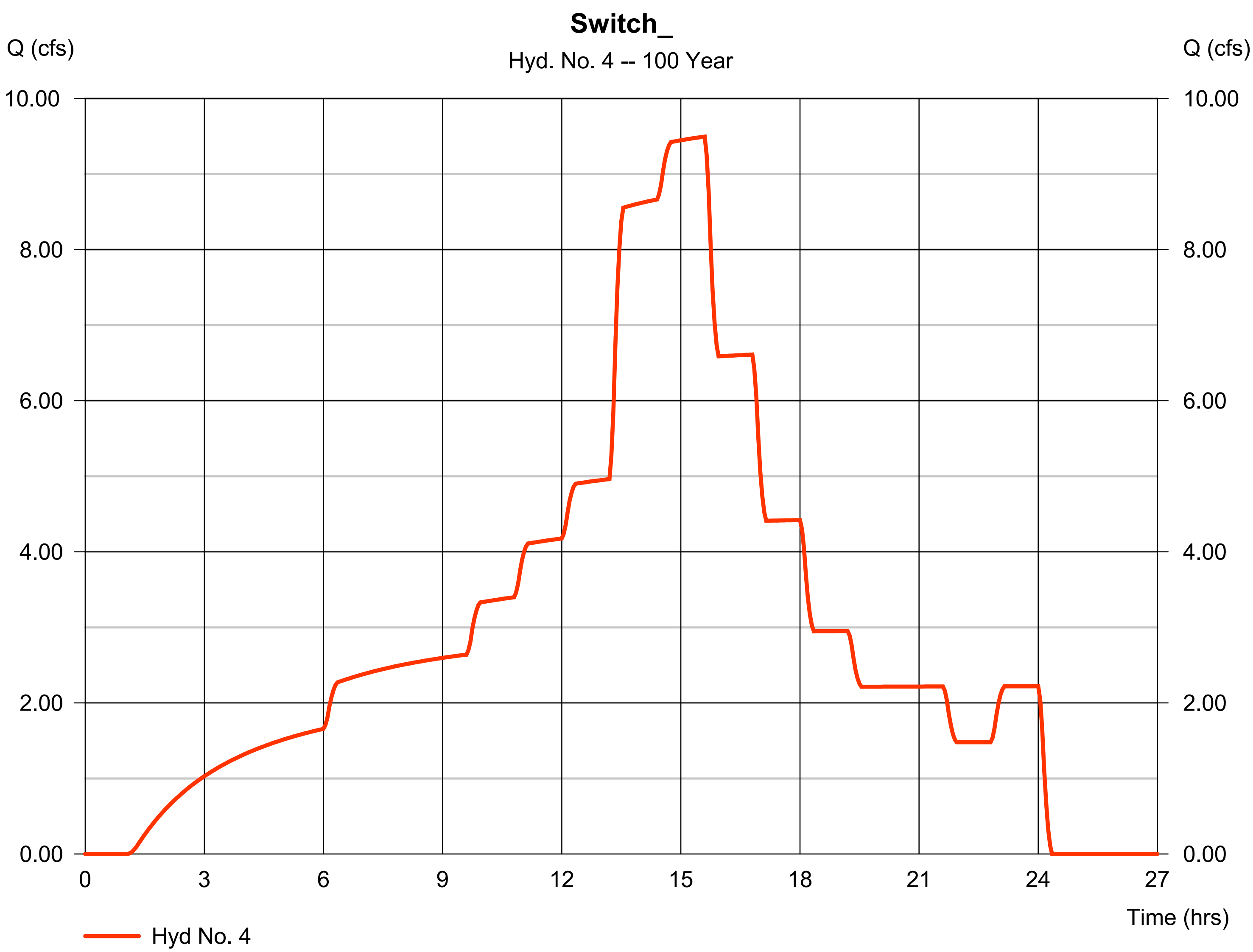
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 09 / 2 / 2021

Hyd. No. 4

Switch_

Hydrograph type	= SCS Runoff	Peak discharge	= 9.496 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.60 hrs
Time interval	= 3 min	Hyd. volume	= 279,324 cuft
Drainage area	= 12.400 ac	Curve number	= 91.6
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 13.00 min
Total precip.	= 7.20 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 09 / 2 / 2021

Hyd. No. 5

Pond 492 & 496

Hydrograph type	= SCS Runoff	Peak discharge	= 20.30 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.60 hrs
Time interval	= 3 min	Hyd. volume	= 582,162 cuft
Drainage area	= 27.490 ac	Curve number	= 89.2
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 36.00 min
Total precip.	= 7.20 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484

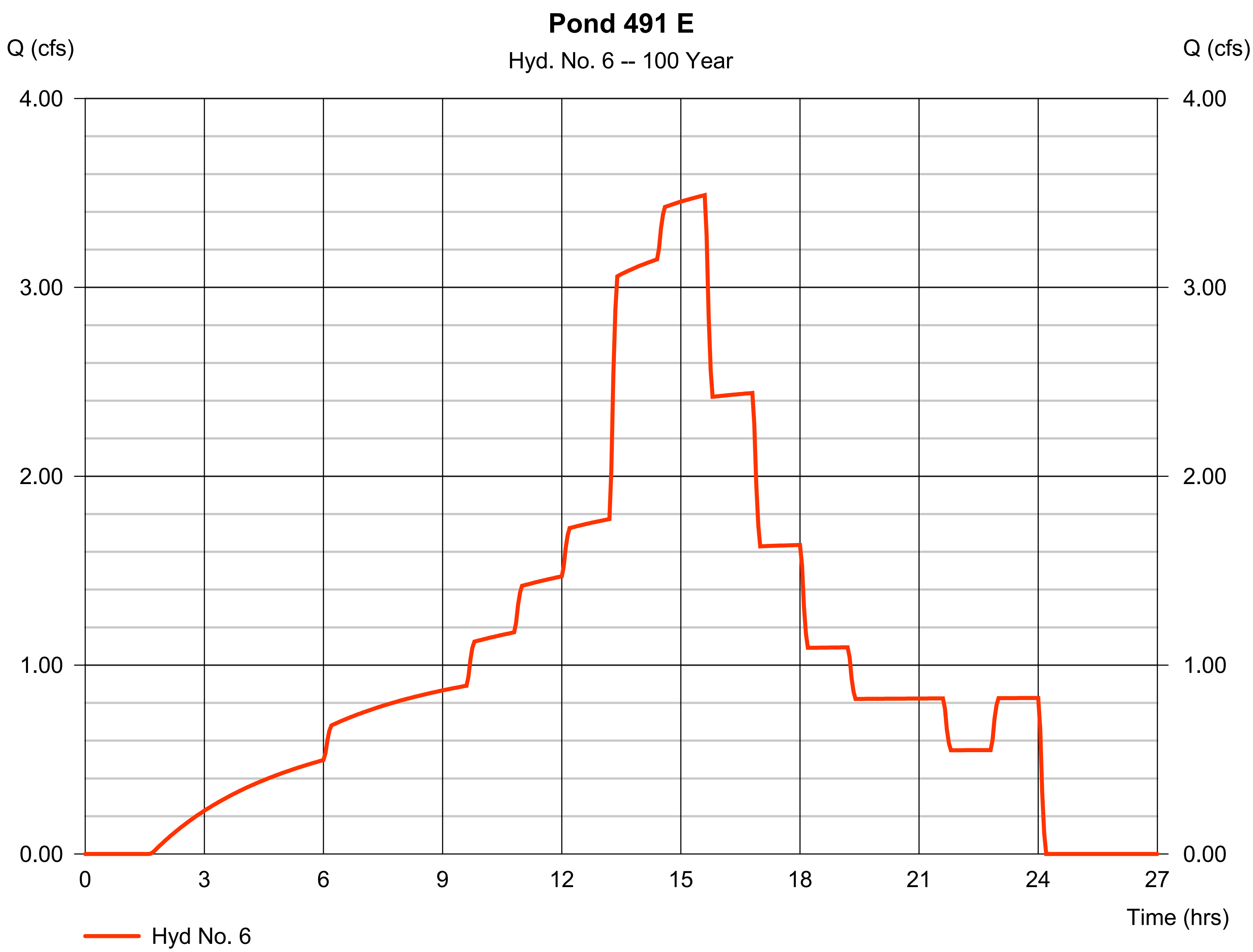
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 09 / 2 / 2021

Hyd. No. 6

Pond 491 E

Hydrograph type	= SCS Runoff	Peak discharge	= 3.488 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.60 hrs
Time interval	= 3 min	Hyd. volume	= 97,701 cuft
Drainage area	= 5.000 ac	Curve number	= 87.6
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 7.20 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484



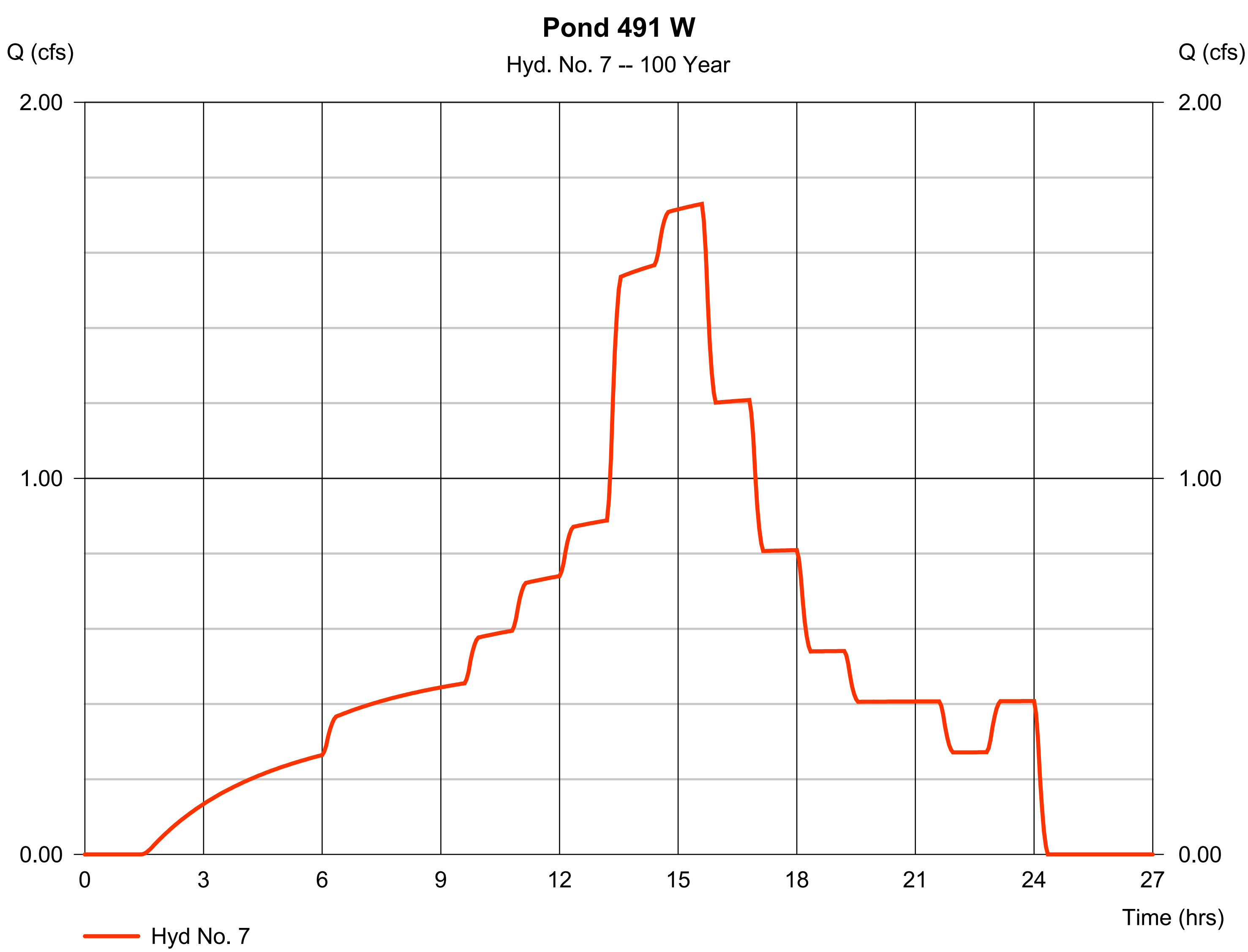
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 09 / 2 / 2021

Hyd. No. 7

Pond 491 W

Hydrograph type	= SCS Runoff	Peak discharge	= 1.730 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.60 hrs
Time interval	= 3 min	Hyd. volume	= 49,287 cuft
Drainage area	= 2.300 ac	Curve number	= 89
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 11.00 min
Total precip.	= 7.20 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484



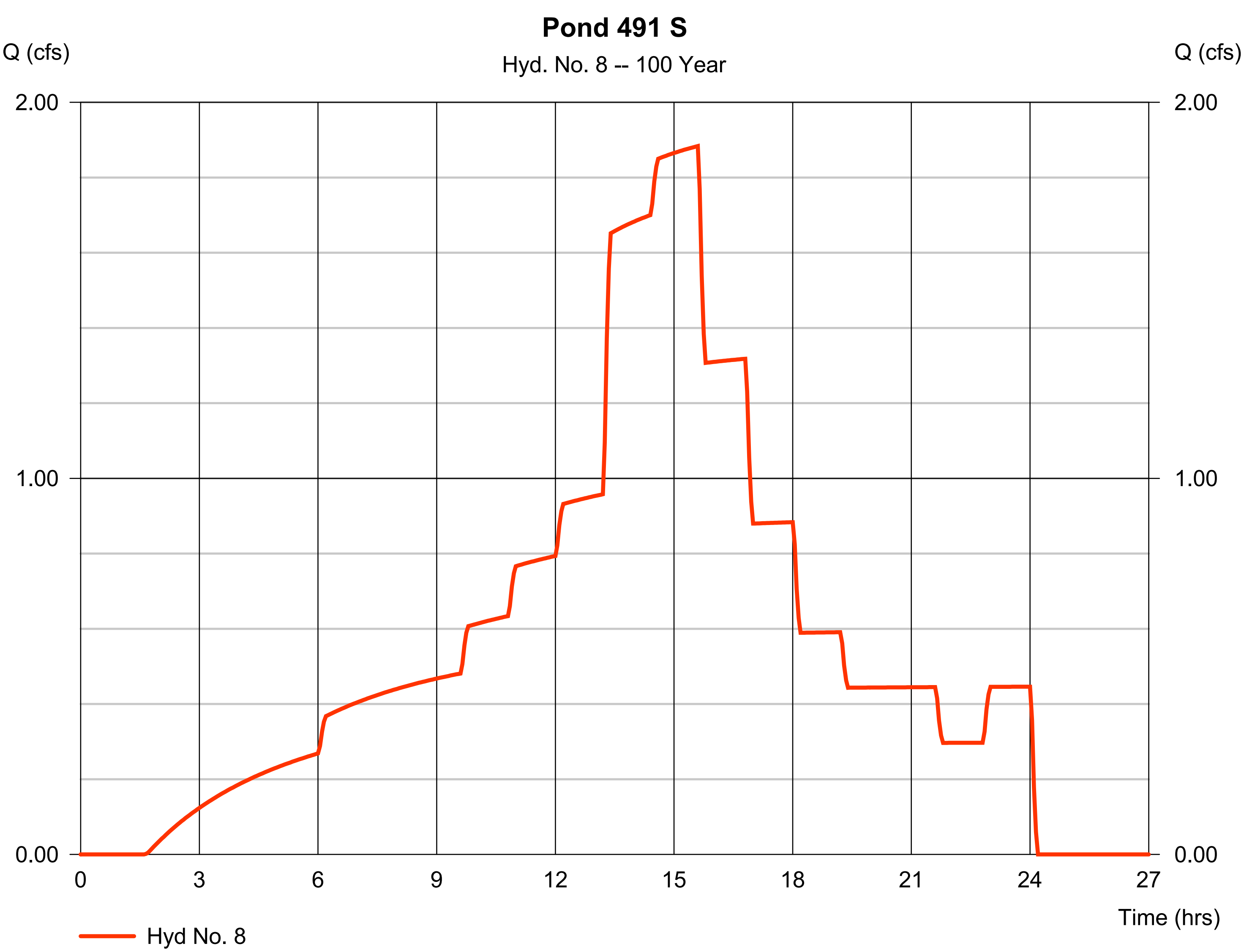
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 09 / 2 / 2021

Hyd. No. 8

Pond 491 S

Hydrograph type	= SCS Runoff	Peak discharge	= 1.884 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.60 hrs
Time interval	= 3 min	Hyd. volume	= 52,758 cuft
Drainage area	= 2.700 ac	Curve number	= 87.6
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 9.00 min
Total precip.	= 7.20 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484



Hydrograph Report

Hyd. No. 9

Coal N

Hydrograph type	= SCS Runoff	Peak discharge	= 5.492 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.60 hrs
Time interval	= 3 min	Hyd. volume	= 140,422 cuft
Drainage area	= 8.500 ac	Curve number	= 78.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 24.00 min
Total precip.	= 7.20 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484

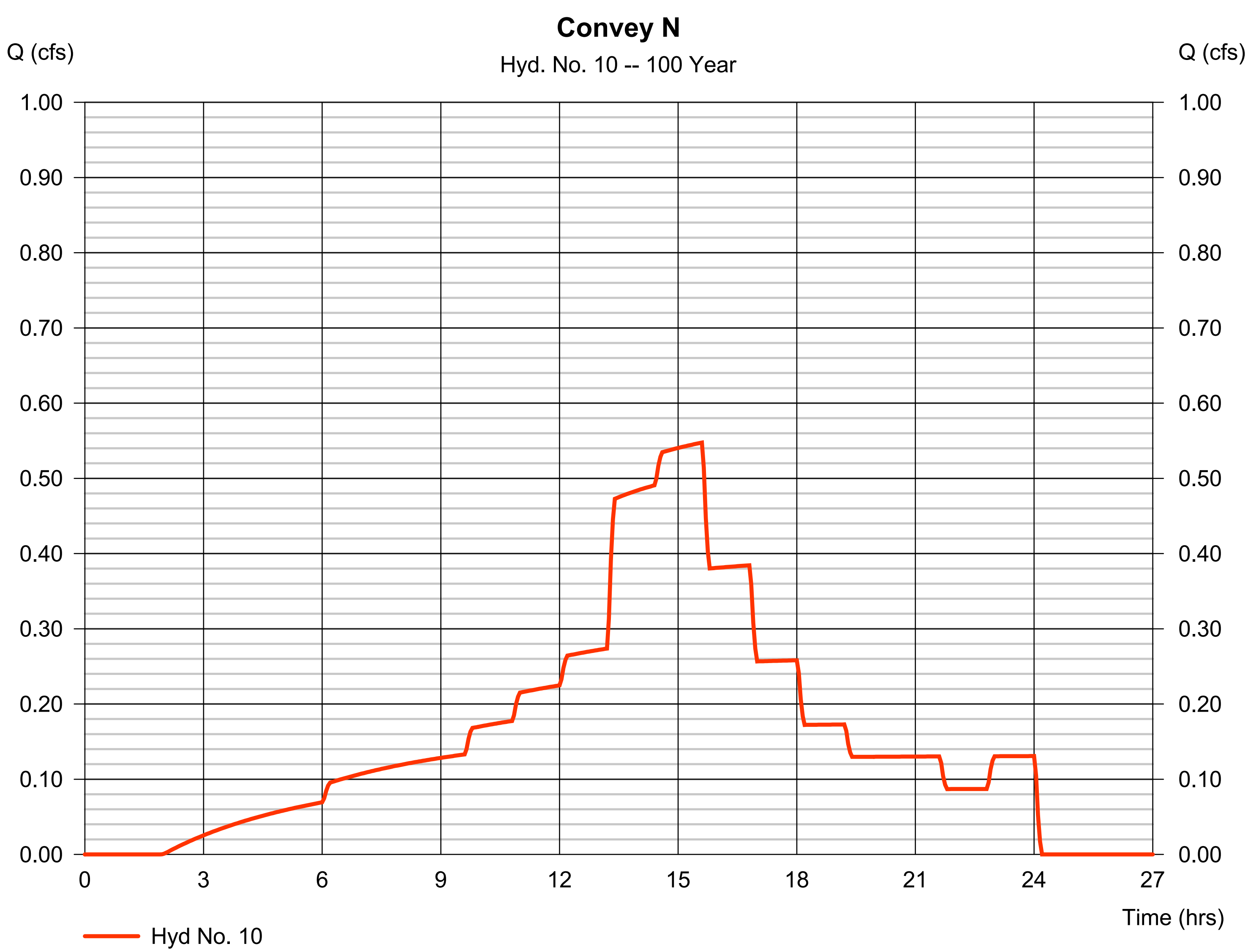
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 09 / 2 / 2021

Hyd. No. 10

Convey N

Hydrograph type	= SCS Runoff	Peak discharge	= 0.547 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.60 hrs
Time interval	= 3 min	Hyd. volume	= 14,977 cuft
Drainage area	= 0.800 ac	Curve number	= 85.5
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 9.00 min
Total precip.	= 7.20 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484



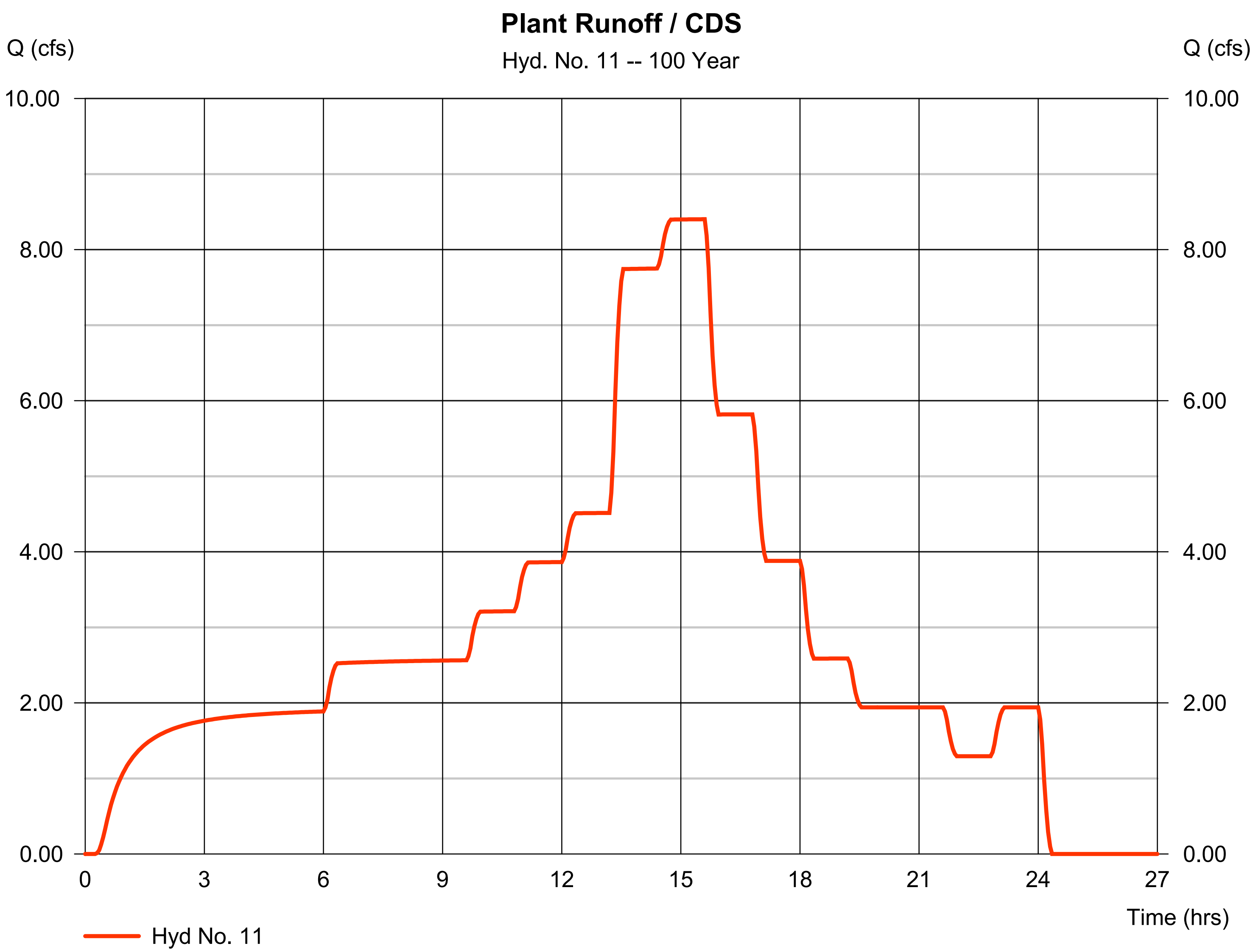
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 09 / 2 / 2021

Hyd. No. 11

Plant Runoff / CDS

Hydrograph type	= SCS Runoff	Peak discharge	= 8.402 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.60 hrs
Time interval	= 3 min	Hyd. volume	= 270,359 cuft
Drainage area	= 10.700 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.00 min
Total precip.	= 7.20 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484



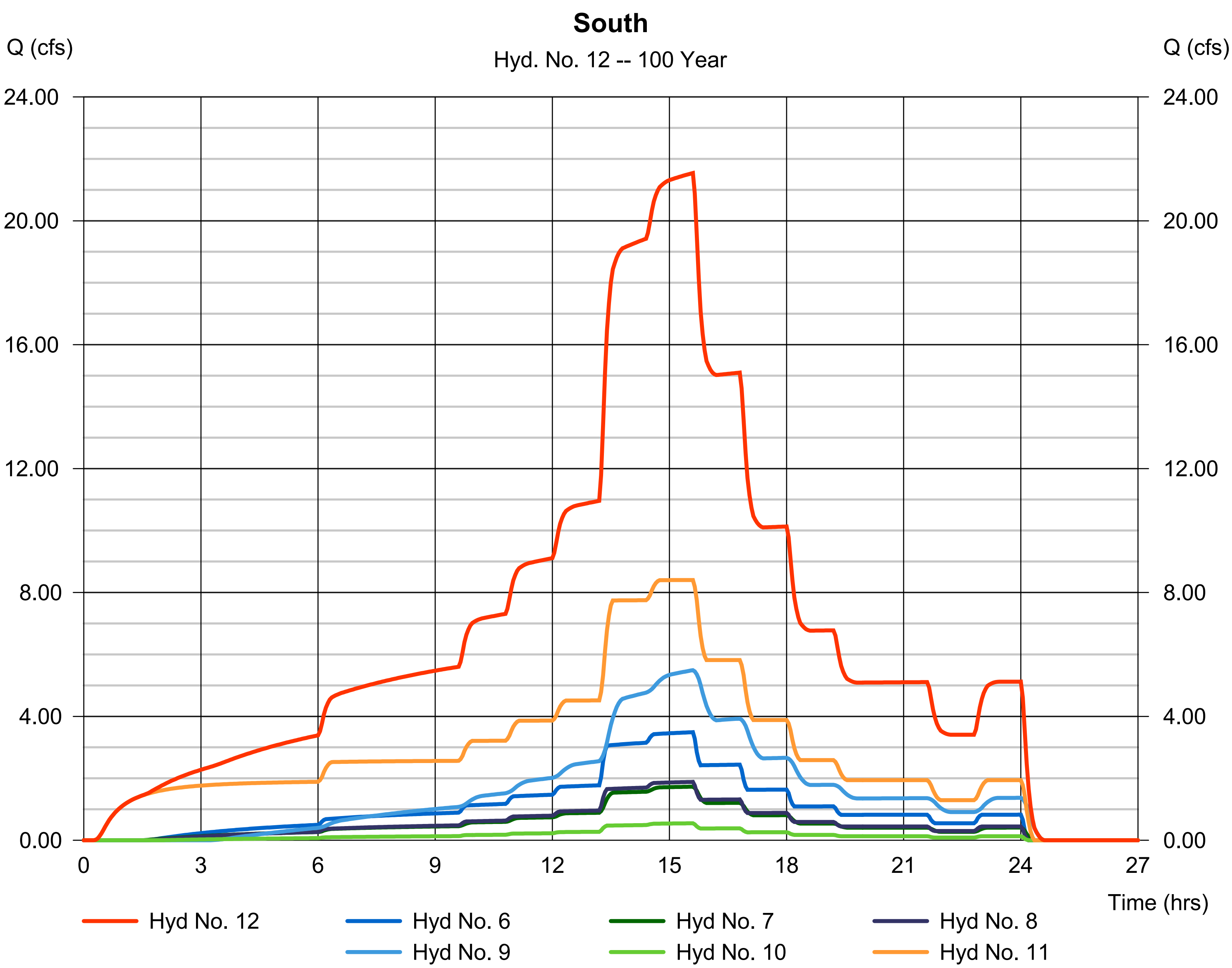
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 09 / 2 / 2021

Hyd. No. 12

South

Hydrograph type	= Combine	Peak discharge	= 21.54 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.60 hrs
Time interval	= 3 min	Hyd. volume	= 625,505 cuft
Inflow hyds.	= 6, 7, 8, 9, 10, 11	Contrib. drain. area	= 30.000 ac



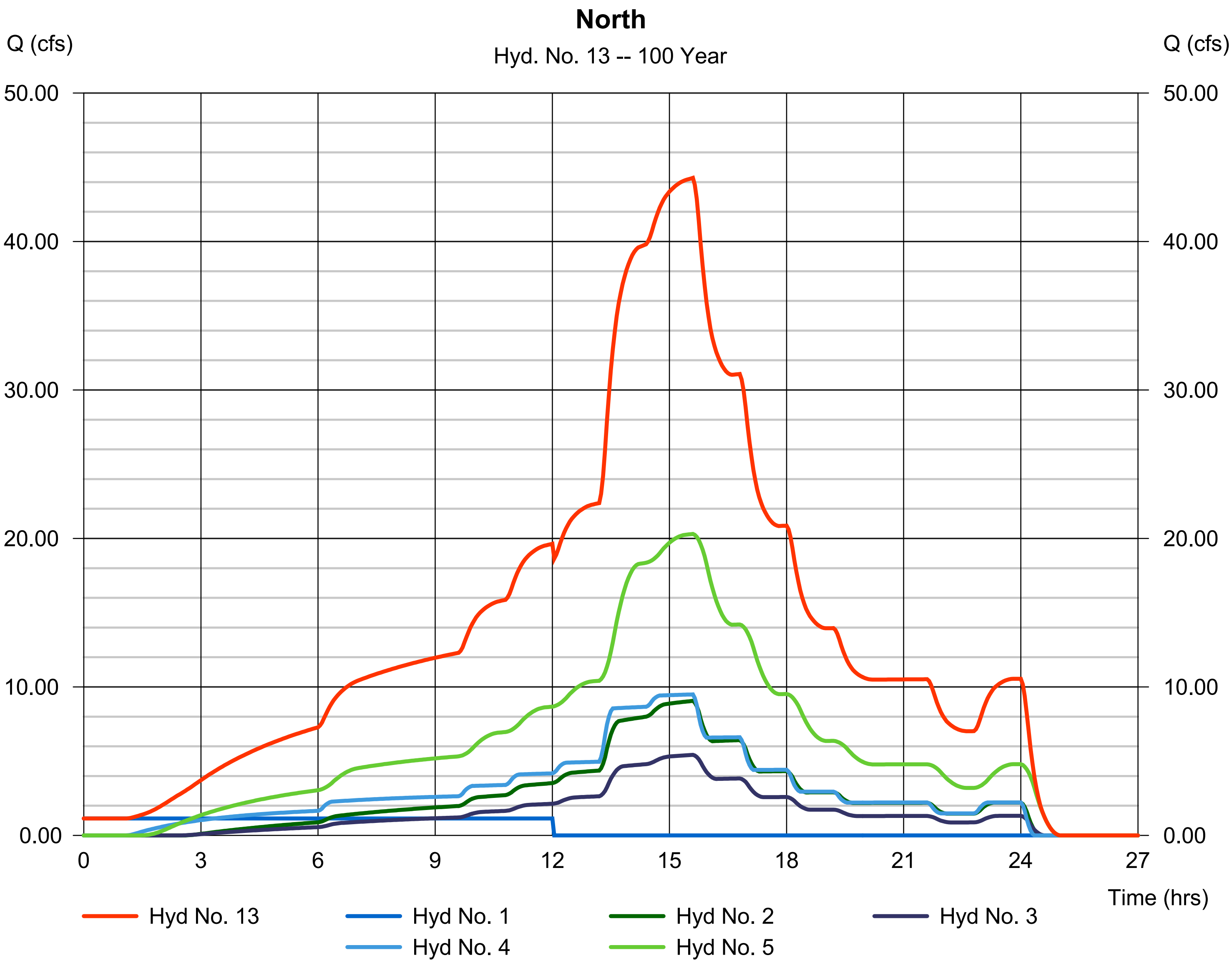
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 09 / 2 / 2021

Hyd. No. 13

North

Hydrograph type	= Combine	Peak discharge	= 44.28 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.60 hrs
Time interval	= 3 min	Hyd. volume	= 1,294,679 cuft
Inflow hyds.	= 1, 2, 3, 4, 5	Contrib. drain. area	= 60.390 ac



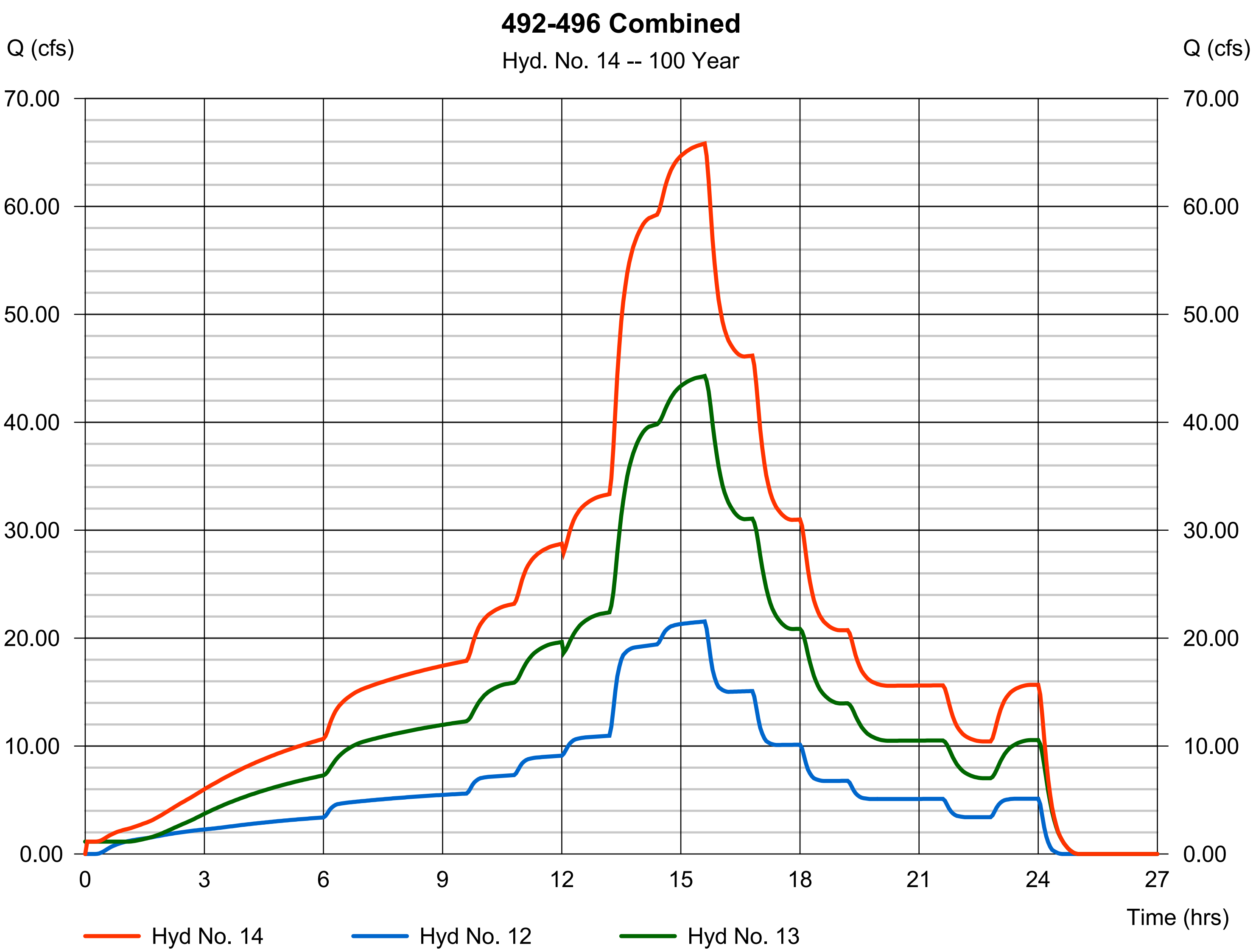
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 09 / 2 / 2021

Hyd. No. 14

492-496 Combined

Hydrograph type	= Combine	Peak discharge	= 65.83 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.60 hrs
Time interval	= 3 min	Hyd. volume	= 1,920,184 cuft
Inflow hyds.	= 12, 13	Contrib. drain. area	= 0.000 ac



Hydrograph Report

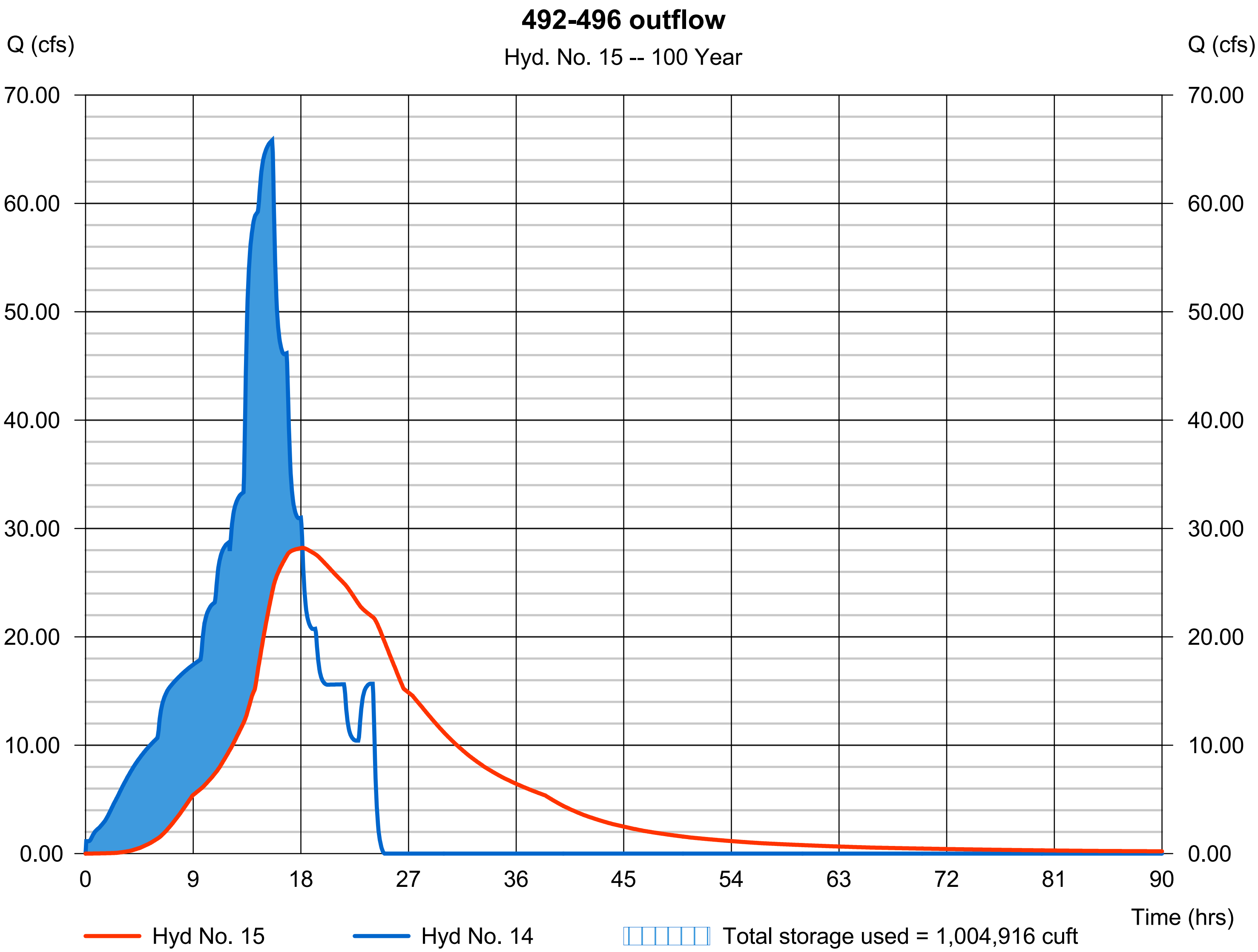
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 09 / 2 / 2021

Hyd. No. 15

492-496 outflow

Hydrograph type	= Reservoir	Peak discharge	= 28.21 cfs
Storm frequency	= 100 yrs	Time to peak	= 18.15 hrs
Time interval	= 3 min	Hyd. volume	= 1,896,817 cuft
Inflow hyd. No.	= 14 - 492-496 Combined	Max. Elevation	= 412.85 ft
Reservoir name	= 492-496 outlet	Max. Storage	= 1,004,916 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 09 / 2 / 2021

Pond No. 2 - 492-496 outlet

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 410.30 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	410.30	334,432	0	0
0.70	411.00	383,084	250,913	250,913
1.70	412.00	411,650	397,242	648,155
2.70	413.00	430,877	421,185	1,069,339
3.70	414.00	443,960	437,359	1,506,698
4.70	415.00	462,022	452,915	1,959,613
5.70	416.00	478,601	470,241	2,429,854

Culvert / Orifice Structures

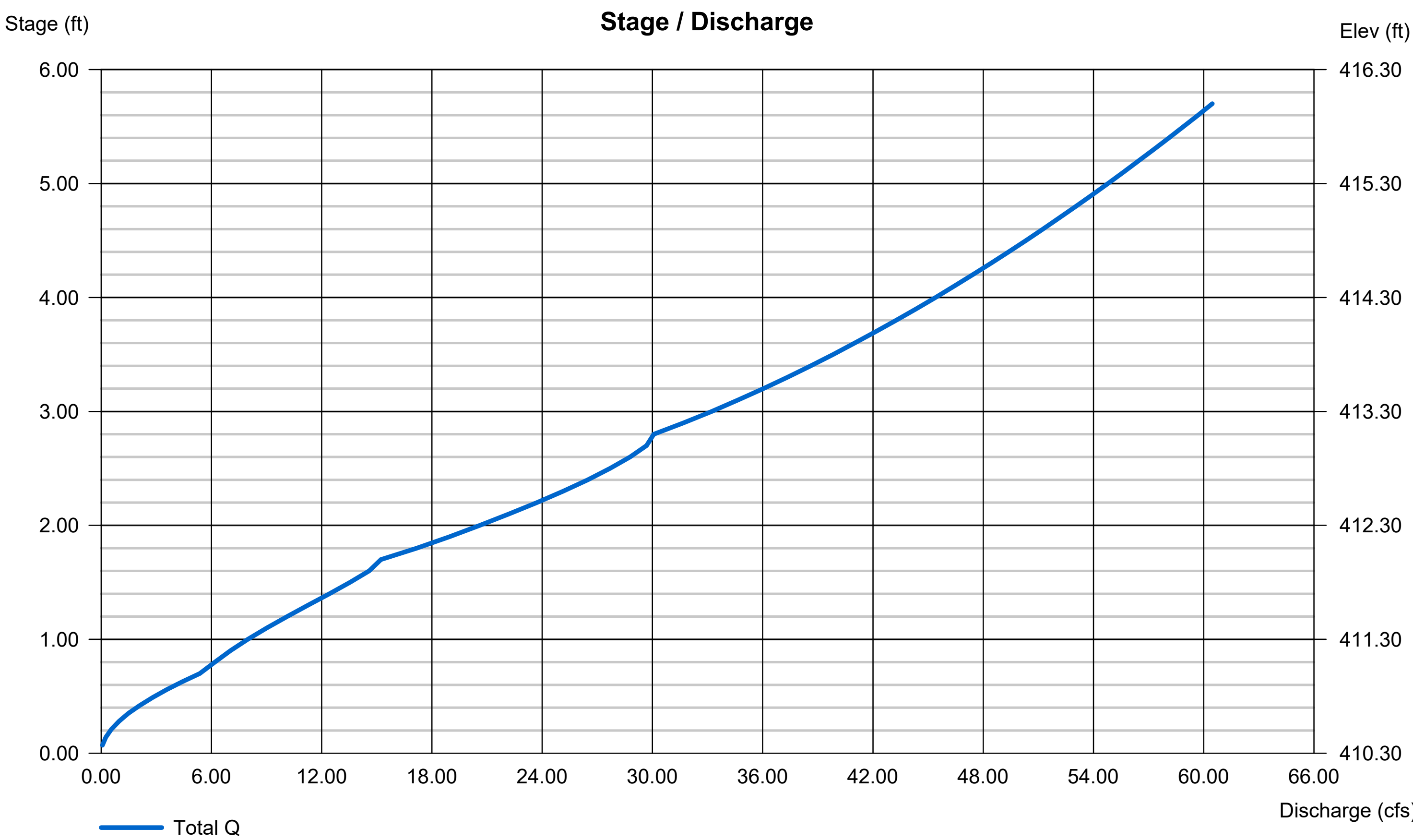
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	Inactive	24.00	24.00	0.00
Span (in)	= 0.00	24.00	24.00	0.00
No. Barrels	= 0	1	1	0
Invert El. (ft)	= 0.00	410.30	411.40	0.00
Length (ft)	= 0.00	100.00	100.00	0.00
Slope (%)	= 0.00	0.50	0.50	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.00	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Contour)
TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



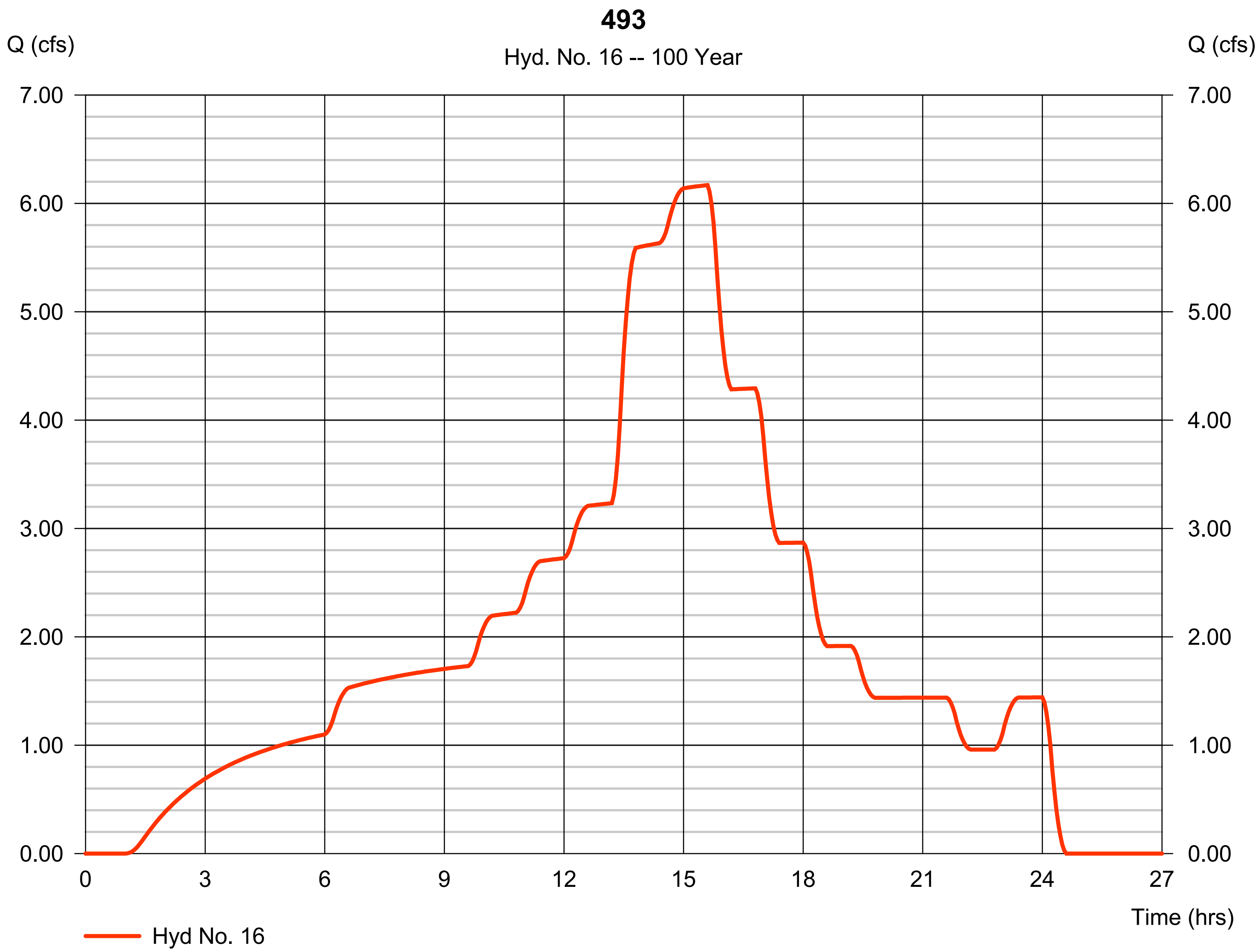
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 09 / 2 / 2021

Hyd. No. 16

493

Hydrograph type	= SCS Runoff	Peak discharge	= 6.169 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.60 hrs
Time interval	= 3 min	Hyd. volume	= 183,020 cuft
Drainage area	= 8.240 ac	Curve number	= 92.2
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 22.00 min
Total precip.	= 7.20 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484



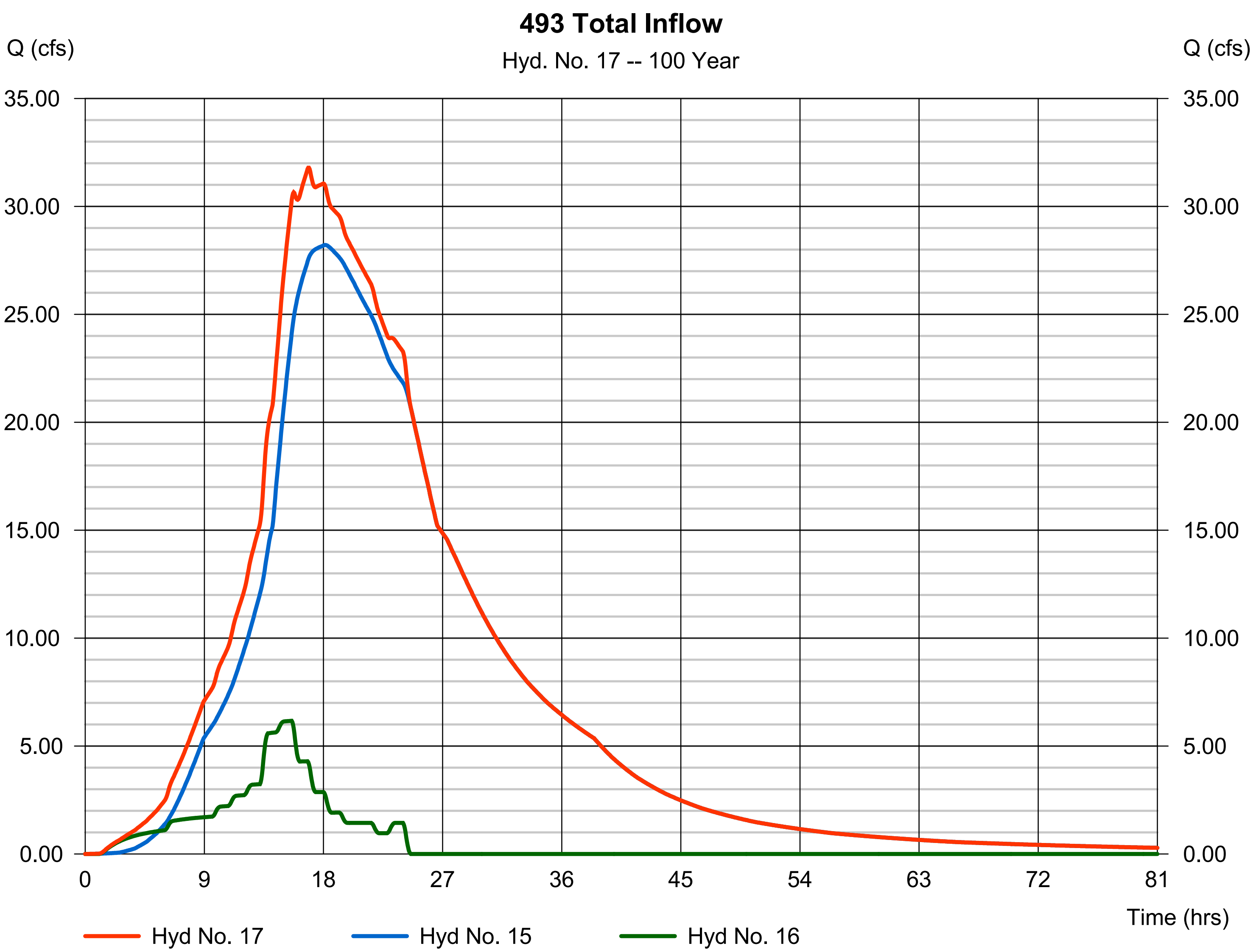
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 09 / 2 / 2021

Hyd. No. 17

493 Total Inflow

Hydrograph type	= Combine	Peak discharge	= 31.79 cfs
Storm frequency	= 100 yrs	Time to peak	= 16.90 hrs
Time interval	= 3 min	Hyd. volume	= 2,079,836 cuft
Inflow hyds.	= 15, 16	Contrib. drain. area	= 8.240 ac



Hydrograph Report

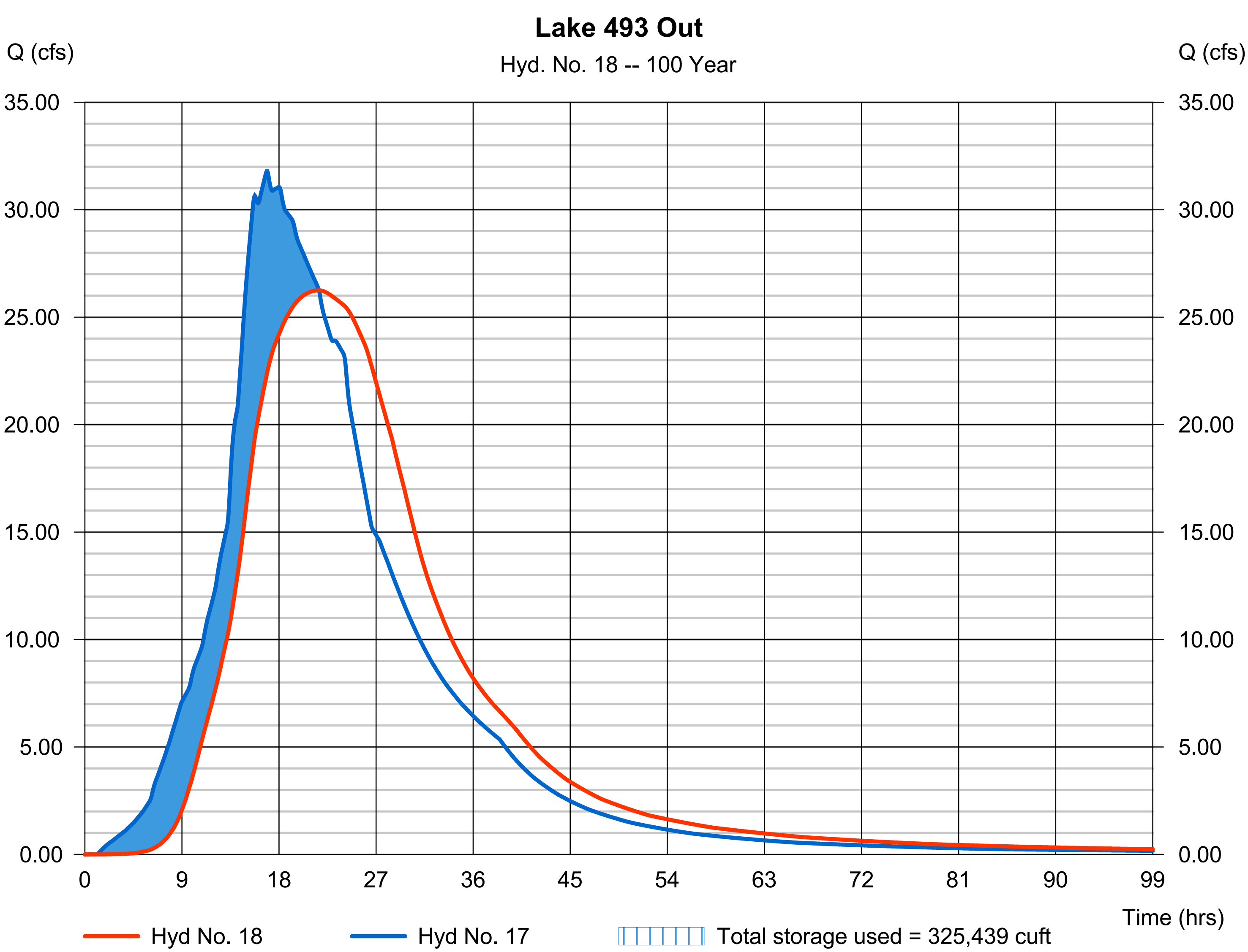
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 09 / 2 / 2021

Hyd. No. 18

Lake 493 Out

Hydrograph type	= Reservoir	Peak discharge	= 26.25 cfs
Storm frequency	= 100 yrs	Time to peak	= 21.70 hrs
Time interval	= 3 min	Hyd. volume	= 2,068,221 cuft
Inflow hyd. No.	= 17 - 493 Total Inflow	Max. Elevation	= 411.74 ft
Reservoir name	= Lake 493	Max. Storage	= 325,439 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 09 / 2 / 2021

Pond No. 4 - Lake 493

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 409.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	409.00	88,149	0	0
1.00	410.00	103,776	95,847	95,847
2.00	411.00	133,412	118,272	214,119
3.00	412.00	166,166	149,475	363,594
4.00	413.00	172,589	169,351	532,944
5.00	414.00	178,990	175,762	708,707
6.00	415.00	189,714	184,308	893,014

Culvert / Orifice Structures

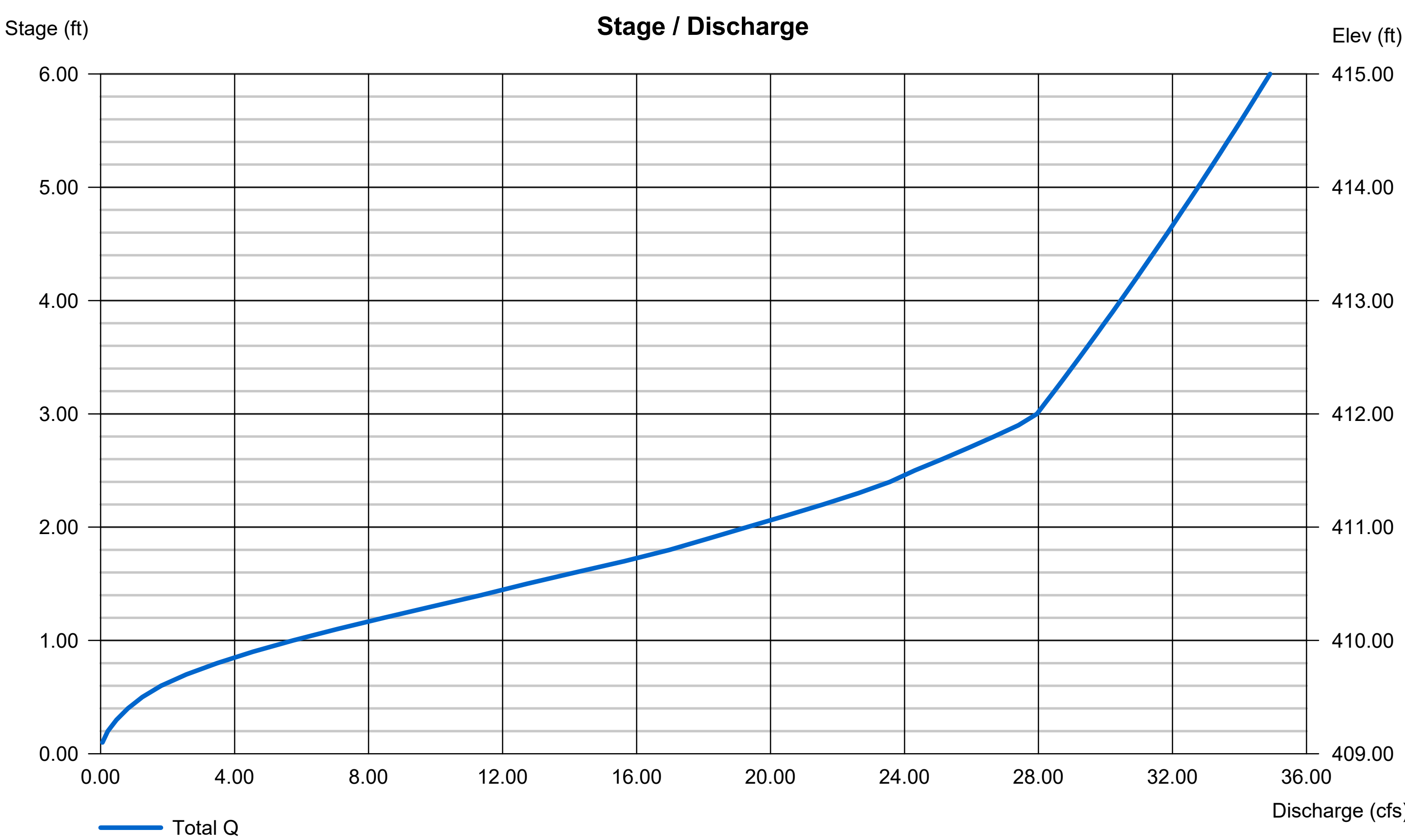
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	Inactive	18.00	24.00	0.00
Span (in)	= 0.00	18.00	24.00	0.00
No. Barrels	= 0	1	1	0
Invert El. (ft)	= 0.00	409.00	409.50	0.00
Length (ft)	= 0.00	650.00	650.00	0.00
Slope (%)	= 0.00	0.70	0.70	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.00	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Contour)
TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Hydrograph Report

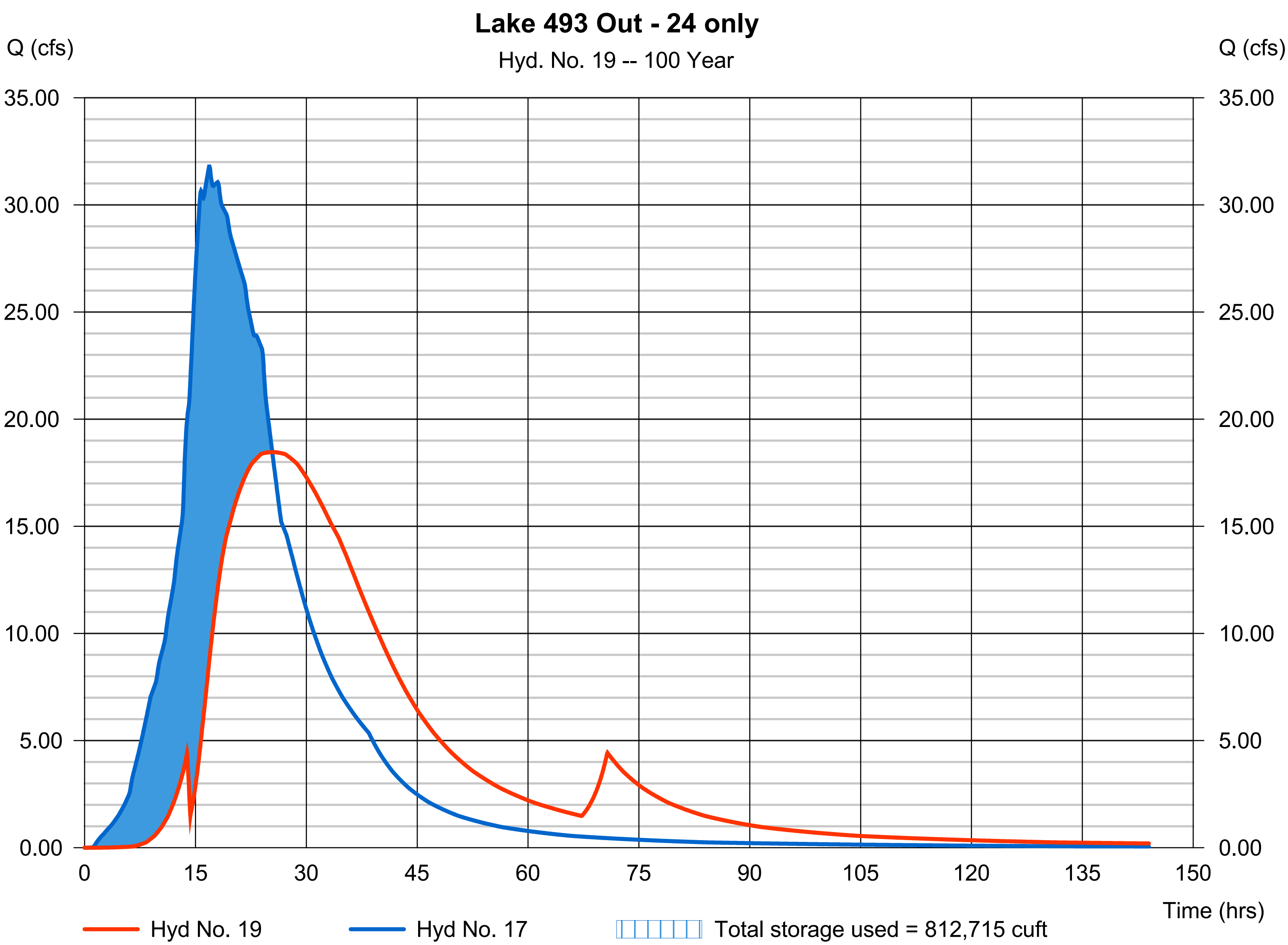
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 — Thursday, 09 / 2 / 2021

Hyd. No. 19

Lake 493 Out - 24 only

Hydrograph type	= Reservoir	Peak discharge	= 18.46 cfs
Storm frequency	= 100 yrs	Time to peak	= 25.40 hrs
Time interval	= 3 min	Hyd. volume	= 2,033,869 cuft
Inflow hyd. No.	= 17 - 493 Total Inflow	Max. Elevation	= 412.05 ft
Reservoir name	= Lake 493 24 only	Max. Storage	= 812,715 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Thursday, 09 / 2 / 2021

Pond No. 6 - Lake 493 24 only

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 409.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	409.50	266,413	0	0
1.00	410.00	266,413	266,386	266,386
2.00	411.00	266,413	266,386	532,773
3.00	412.00	266,413	266,386	799,159
4.00	413.00	266,413	266,387	1,065,546
5.00	414.00	266,413	266,386	1,331,932
6.00	415.00	266,413	266,386	1,598,318

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	Inactive	24.00	0.00	0.00
Span (in)	= 0.00	24.00	0.00	0.00
No. Barrels	= 0	1	1	0
Invert El. (ft)	= 0.00	409.50	0.00	0.00
Length (ft)	= 0.00	650.00	0.00	0.00
Slope (%)	= 0.00	0.70	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.00	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Contour)
TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Discharge