Exhibit:	
Issues:	Labadie Electric Plant UWL
Witness:	Charles Norris
Sponsoring Party:	Intervenors Labadie Environmental Organization and Sierra Club
Type of Exhibit:	Rebuttal Testimony
Case No.:	EA-2012-0281
Date Testimony Prepared:	September 13, 2013

MISSOURI PUBLIC SERVICE COMMISSION

CASE NO. EA-2012-0281

CROSS- SURREBUTTAL TESTIMONY

OF

CHARLES H. NORRIS, P.G.

ON BEHALF OF

LABADIE ENVIRONMENTAL ORGANIZATION

AND

SIERRA CLUB

St. Louis, Missouri
September 13, 2013

CROSS-SURREBUTTAL TESTIMONY

OF

CHARLES H. NORRIS, P.G.

Case No. EA-2012-0281

Q. Please state your name and business address.

A. My name is Charles H. Norris and my business address is Geo-Hydro, Inc., 1928 East 14th Avenue, Denver, Colorado 80206.

Q. What is your position with Geo-Hydro Inc.?

A. I am its principal and its vice president, secretary, treasurer and CEO. I also am employed there as a professional geologist and as a hydrogeologist.

Q. What is your educational and professional licensing background?

A. I received my B.S. degree in Geology from the University of Illinois, and my M.S. degree in Geology from the University of Washington, where I was a National Science Foundation Fellow. I have completed all requirements for a Ph.D. in hydrogeology at the University of Illinois except for my dissertation. I am a licensed professional geologist in Missouri, Wisconsin, Wyoming, Indiana, Illinois, Kentucky, Virginia, Pennsylvania, and Utah, and a licensed environmental professional in Colorado.

Q. Describe your employment experience.

A. I began my career as a geologist in 1972 and have worked continuously in the field ever since. I spent the first 15 years in the petroleum industry working for petroleum producers such as Amoco International and Shell, and then as an industry consultant, owning my own company in the early 1980s. From 1987-1992, I was employed by the University of Illinois in the Laboratory for Supercomputing in Hydrogeology with a non-teaching faculty appointment. In 1996 I founded Geo-Hydro, Inc., where I have since worked as a geologist with specialization in physical, geochemical and environmental geology and hydrogeology. Geo-Hydro provides RI/FS & general site investigations, landfill services, and water resource development services. A copy of my CV is attached as Exhibit 1.

Q. Are you familiar with the disposal of coal combustion waste?

A. Yes. Over the last 20 years, I have worked extensively with landfills and coal ash, coal combustion waste management issues, and waste isolation, including landfill lining issues. During that time my firm's clients have included utilities needing assistance with the disposal of coal wastes and clean up of coal-waste contamination, a municipality reviewing proposals for coal ash landfills, and coal mining companies, in addition to citizen's groups like Intervenors LEO and the Sierra Club.

Q. Have you ever been qualified as an expert witness with regard to the disposal of coal ash from a coal-fired power plant?

A. Yes. I have testified as an expert at several administrative hearings in Indiana with regard to the disposal of coal ash from coal-fired power plants.

Q. Have you ever been qualified as an expert witness with regard to the hydrology, performance, and monitoring of landfills designed with composite liner systems?

A. Yes. I have qualified as an expert at several dozen siting hearings in Illinois in the fields of geology, hydrogeology, geochemistry as the apply to the hydrology, performance, and monitoring of municipal solid waste landfills with composite liners.

Q. What is the purpose of your Cross-Surrebuttal Testimony in this proceeding?

A. The purpose of my testimony is to respond to the Rebuttal Testimony of Staff witnesses John Cassidy and Claire Eubanks in this matter regarding the proposed expansion of Ameren's Labadie power plant in order to construct and operate a coal-combustion-waste-landfill. My testimony also responds to the Commission's Order of August 14, 2013 on pages 2 and 3 regarding the existence of "studies, reports, or other documents examining alternative sites, options, or possibilities" for the disposal of coal ash from the Labadie power plant.

Q. How is your testimony organized?

A. My testimony will cover four specific topics. The first topic is the economic feasibility of Ameren's proposed UWL at the Labadie site. The second describes Ameren's qualifications to operate the proposed UWL. The third relates to the public interest and the final topic discusses alternatives to the proposed UWL.

ECONOMIC FEASIBILITY OF PROPOSAL

Q. Mr. Cassidy's Rebuttal Testimony (p. 5) states that "Ameren Missouri has provided analysis and cost studies to Staff that indicates that the Company has sufficiently evaluated the necessary capital costs and ongoing operating costs associated with the proposed project." To the best of your knowledge, have you reviewed all of the documents submitted by Ameren in response to the Staff's Data Requests in this proceeding?

A. Yes.

Q. Has Ameren accounted for all of the capital and operating costs that will be associated with its proposed construction and operation of a utility waste landfill at the proposed Labadie site?

A. No.

Q. Please describe the nature of the costs for which Ameren has not accounted, and explain your basis for determining that such costs will likely be associated with the proposed Labadie landfill?

A. The documents provided by Ameren fail to identify capital and operating costs associated with at least three categories of activity. Not all costs associated with construction are included in the documents provided by Ameren. The costs associated with operations do not include all anticipatable and quantifiable expenses. And, the costs associated with closure and post closure activities do not reflect what will be needed.

Q. What costs related to construction are not included in the documents provided by Ameren?

A. Many of the construction materials necessary for the UWL will need to be imported because they are not available on-site. MPSC Staff identified that the clay soils needed for the compacted clay liner under the landfill and the ponds, as described in Ameren's Construction Permit Application (CPA) filed with the Missouri Department of Natural Resources, would be imported. Staff requested in DR 12 that the cost of transporting that clay from Ameren's Callaway facility be included. Although the detailed cost estimates provided in response to DR 12 indicate that the clays for the liner are from offsite, Ameren declined to include the cost of transporting the clay from the only known location because it may be able to find a contractor that would provide it from some other location. Whether the clays for the liner come from

Callaway or some other offsite location, there will be transportation costs and those are not presently in the construction costs.

Q. Other than the transportation costs for importing the clay soils for the liner for the UWL, are there other missing costs?

A. Yes, it appears so.

Q. What other costs appear to be missing?

A. As described in the CPA, there are insufficient available on-site soils of proper characteristics to construct the berms. Similarly, there are insufficient available on-site soils of proper characteristics to construct the platform beneath the waste disposal areas that are needed to lift the bottom of the landfill at least 2 feet above the natural water table. Some of those soil volumes will have to be imported from offsite as well. The detailed cost estimates provided in response to the DRs do not indicate that some of the general subgrade fill and berm soils will come from offsite, unlike line items for the liner clays. Further, the same price is indicated for all soils used for subgrade and berms, suggesting that the transportation costs of the offsite soils are not included in the costs provided to the MPSC.

Q. What costs related to operations are not included in the documents provided by Ameren?

A. The documents provided by Ameren do not include risk-adjusted costs associated with repairs to damage caused by known and quantifiable hazards specific to this site. These hazards include damage caused by flooding, damage caused by direct seismic impacts, and indirect seismic damage caused by subsequent earth movements such as liquefaction, subsidence, and slope failure.

Q. How should Ameren have accounted for those costs?

A. Floods and earthquakes occur with statistical patterns of magnitude and frequency, so the risk of a particular event is quantifiable. For a given event and a given design of a facility, the damage is predictable and so is the associated cost of the repair. If there is a defined risk of a particular event and a resulting cost of that event, there is an assignable risk-adjusted cost to the facility that should be included as part of repair and maintenance. Since different locations carry different risks and different repair costs, the risk-adjusted cost of statistical events such as earthquakes and floods should be included in costs of the proposed landfill. Without it, meaningful comparisons among potential sites with different levels of flood and earthquake risk cannot meaningfully be made.

Q. What costs related to closure and post-closure activities are not included in the documents provide by Ameren?

A. The costs that are not included are those likely to arise after the formal post-closure monitoring and maintenance period. Unlike municipal landfills, for which danger declines as a function of time due to biogenic decay, intact UWLs show little or no decline of toxicity with time; their inorganic contaminants persist indefinitely. The costs for risk-adjusted damage repair described above resulting from flood and seismic activities that occur after the UWL is closed are not among the costs shown in the documents provided. The costs do not include monitoring for and remediating any ground- and surface water contamination and fugitive utility waste after the post-closure period.

Q. Are there any other waste-related costs associated with the proposed UWL that are not included in the documents provided by with the CCN application?

A. Yes.

Q. And what are they?

A. Historical utility waste placement at the Labadie plant has produced a legacy of large volumes of utility wastes without containment that must be addressed and for which no plan and no associated budget is offered. The MPSC Staff recognized the significance of this legacy with DR 7 and DR 14.3, seeking an understanding of their ultimate fate. Ameren provided no answer beyond acknowledging there was no plan, no budget, and no action at this point beyond seeing what new regulations on the Federal level might entail. The response to DR 7 indicated a willingness by Ameren to simply leave these wastes in the existing ash ponds.

Q. How does the fate of the existing ash ponds impact the costs of the planned UWL?

A. It does so in at least two ways. First, unlined ash ponds pollute groundwater and, often, surface water. This contamination is demonstrated across the country where such facilities have been monitored. As documented elsewhere in my testimony, Ameren is well aware of this contamination at its own facilities in Missouri and in Illinois. Although Ameren has yet to report on any investigations for groundwater contamination associated with its existing ash ponds, such contamination would affect the same alluvial aquifer that underlies the planned UWL. The Detailed Site Investigation (DSI) for the UWL demonstrates that contamination from the existing ash ponds would migrate from the ponds to and across the area of the UWL. This requires a substantially more sophisticated, and therefore expensive, monitoring program than Ameren has proposed to demonstrate that the UWL is not contaminating groundwater.

Q. What is the second way the existing ash ponds impact the cost of the UWL?

A. The unlined ash ponds contain the same utility wastes as will be disposed of in the UWL. Contamination in the leachate of those ponds contains the same constituents as will leachate from the UWL. Groundwater contamination sourced from the utility wastes in the existing ash ponds would be indistinguishable from any leachate that was to escape the UWL. By interfering with the ability of Ameren to successfully monitor the UWL's performance, the existing ash ponds amplify the risks and costs of contamination and any subsequent remediation that becomes necessary. The documents provided by Ameren do not include these costs.

AMEREN'S QUALIFICATIONS TO OPERATE THE PROPOSED LABADIE UWL

Q. Do you agree with Ms. Eubanks' Rebuttal Testimony (p.4) that Ameren's experience thus far with the UWL at the Sioux power plant indicates that it is qualified to operate a UWL at Labadie?

A. No.

Q. Why not?

A. There is no information in the documents submitted in response to the DRs from the Staff that supports Ameren's ability to construct or operate a UWL. Most of the requests for information about the Sioux power plant were met with silence, whereas similar queries related to Rush Island or Meramec generated the requested information. In two responses that do include some Sioux information, the responses to DR 8 and DR 17, the answers regarding the approval and start of construction of a dry-waste storage cell, which would be analogous to the planned UWL at Labadie, are inconsistent on the time line. They are consistent, however, in stating that the cell is still under construction and won't start operations until sometime next year.

Q. Do you have concerns about Ameren's qualifications to operate the proposed Labadie UWL?

A. Yes.

Q. In summary, what are the bases for your concerns?

A. Ameren's current and past handling of coal ash at Labadie does not support its qualifications to operate the planned UWL. Ameren has not addressed the implications of potential, and likely, groundwater contamination from its historic management of utility wastes at Labadie migrating from its existing ash pond toward and under the proposed UWL. The groundwater monitoring plan proposed by Ameren in Appendix Q of its CPA for the Labadie landfill demonstrates it is not qualified to operate the proposed UWL. Finally, Ameren's departures from responsible management of utility wastes at Labadie are not limited to Labadie. Ameren has a record of environmental problems operating utility waste facilities, evidenced elsewhere in Missouri but perhaps best documented in Illinois.

Q. Please describe your concerns about Ameren's qualifications to operate the proposed Labadie UWL based on your knowledge of Ameren's current and past coal ash handling experience at the Labadie plant.

A. When Ameren began generation at the Labadie plant it began disposal of its utility wastes in the unlined ash pond located on or excavated into alluvial sediments in the floodplain of the Missouri River, adjacent to the plant. In the early 1970s, this configuration was a common approach. It is now understood that utility waste disposal in unlined ponds on alluvial floodplains was not a good idea. The utility wastes readily leach inorganic contaminants into infiltrating water and contaminate the potable water resource of the alluvial aquifer. While this problem is thoroughly documented today at dozens or hundreds of facilities across the country, it was first identified at multiple sites by the early 1990s. Ameren became aware of the problem at least at its Meramec plant by the late 1980s. There, monitoring data collected in 1988 document utility waste leachate penetrating not only into the alluvial sediments below and downgradient of the ash ponds, but reaching the bottom of the 80-100 ft thick alluvial aquifer. Appendix 1, CH2MHILL, 1997, Hydrogeologic Assessment of Potential Impacts of Meramec Ash Ponds on Local Groundwater and Surface Water, prepared for Union Electric. This document, including Appendix 1 thereof, is attached hereto as Exhibit 2.

Ameren apparently operated groundwater monitoring wells around the original Labadie ash pond subsequent to the documentation of groundwater contamination at Meramec, although no monitoring data has, to my knowledge, been made available. In response to DR 14, Ameren provided the June 1992 construction permit for the newer ash pond. Page two of the permit suggests that there existed in 1992 groundwater monitoring wells that would be sealed during construction of the new ash pond. Union Electric's April 1992 "Specification No. EC-2574 for Construction of New Ash Pond, Labadie Plant," a document not provided to MPSC Staff in response to DR 14, establishes there were monitoring wells and provides specifications for their abandonment as part of the construction. The Specification document also discusses in detail soils, depths of excavation, use and borrow of soils for berms and liner, and other design and construction details responsive to DR 14 but not produced by Ameren. The Specification document is attached hereto as Exhibit 3.

The 2011 NPDES permit reapplication provided in response to DR 14.2 discusses lateral leakage from the flanks of the original ash pond, which leakage was first acknowledged by Ameren in 1992 in an earlier NPDES permit reapplication. In the 1992 reapplication, the larger of the lateral leaks was estimated at 32 gallons per minute. In 1992 Ameren dismissed the leak as not significant enough to regulate, because the water seeped into the ground (i.e., became groundwater) and did not discharge as surface water. In the 2011 reapplication, the leak was characterized as having been remediated because the area of the leak and infiltration seepage had been covered with fill. Burying a seep does not remediate it; it merely hides it from sight. The ongoing leakage from this unlined ash pond could be causing significant groundwater contamination. Ameren has neither disclosed the results of the pre-1992 groundwater monitoring nor, to my knowledge, undertaken any monitoring to characterize the impact of the ash ponds on the groundwater at or leaving the plant site.

Q. Please describe your concerns about Ameren's qualifications to operate the proposed Labadie UWL based on the possibility that coal ash pollutants may have contaminated or may be migrating toward groundwater at the proposed Labadie UWL site.

A. As just discussed, coal ash disposed in unlined ponds discharges leachate from the pond bottoms vertically into underlying groundwater, especially when those ponds are located above or excavated into permeable soils such as alluvial sediment. There may also be leachate discharging laterally from an ash pond that infiltrates to groundwater, as occurs at Labadie, or discharges to surface water. The contamination from such discharges is observed with such frequency when monitored, it must be considered the norm or the expectation.

The groundwater flow direction at Labadie in the alluvial aquifer is from the existing ash ponds and toward and through the area of the proposed UWL. This flow direction was documented over the full course of the year for which water elevation data were collected for the DSI (Figures 18 through 29) and provided to the MPSC Staff in response to DR 2.2. Any contamination that leaks from the existing ponds is being transported toward and across the area of the planned UWL. The documented flow pattern is consistent across seasons and there is no reason to believe it has not existed for decades.

Although there is no ambiguity as to where contamination in groundwater would be flowing, there are no data indicating the concentrations of that contamination. Each of over 100 piezometers was visited monthly over a period of a year to collect data for the DSI, but there is not a single chemical analysis reported for any piezometer as part of that investigation. Documents from 1992, discussed above, indicate there were, for a period prior to 1992, groundwater monitoring wells east of the original Labadie ash pond. If there was water quality monitoring from those wells, it has not been made available.

Groundwater data regarding the existing plant site and the proposed UWL site are now expected to be collected, but will not be available before the Commission is expected to make its decision in this matter or before the MDNR is expected to make its decision regarding the Construction Permit Application. Based on a draft permit published in February 2013 and withdrawn in March 2013, MDNR is expected to include groundwater monitoring permits in a revised NPDES permit for the Labadie plant. The current permit expired in 1999. The draft provisions would not require Ameren to commence groundwater monitoring until 3 years after the revised permit is issued, or to submit monitoring data until 4 ½ years after the permit is issued.

The existence, location, and concentration of any contaminant plume passing under the UWL are not academic curiosities. They are material to the function of the UWL monitoring plan and, most importantly, the protection of the potable water resource of the alluvial aquifer on which the community relies. In my opinion, Ameren's plan to build a large new coal ash landfill before obtaining meaningful groundwater data regarding the existing plant and the proposed UWL site demonstrates that it is not qualified to operate the proposed UWL in a responsible manner.

Q. Please describe your concerns about Ameren's qualifications to operate the proposed Labadie UWL based on the adequacy of its plan to monitor groundwater at the proposed UWL site.

A. In addition to the concerns discussed above, there are issues related to the design of the groundwater monitoring program proposed by Ameren for the UWL. As the program is designed, it will unable to detect a breach or flaw in the liner system that allows leachate to leak into the alluvial aquifer. That inability to detect contamination is a fundamental characteristic of the monitoring plan that is independent of any preexisting or yet-to-arrive contaminant plume from the existing ash ponds. The danger of this monitoring plan is compound. It will not detect contamination if, or when, it occurs.

Q. Please describe your concerns about Ameren's qualifications to operate the proposed Labadie UWL based on documented groundwater contamination at Ameren's Illinois coal plants.

A. Ameren's Illinois subsidiaries/affiliates have developed an extensive list of coal ash disposal sites contaminating ground- and/or surface water. Persistent groundwater contamination at some of these sites has resulted in Violation Notices issued to Ameren by the Illinois Environmental Protection Agency (IEPA). In each of the four examples cited below, the notices of violation given in 2012 have been followed by Notices of Intent to Pursue Legal Action this year.

At the Grand Tower Generating Station in Grand Tower IL, IEPA issued a notice of violation in June 2012 for groundwater exceedences by multiple contaminants at 4 monitoring wells during years 2010-2012. The facility is an unlined ash pond put it service in 1951. The station is adjacent to the Mississippi River.

At Coffeen Generating Station in Montgomery County IL, the IEPA issued a notice of violation in June 2012 for groundwater exceedences by multiple contaminants at 3 monitoring wells during years 2010-2012. The facility uses an unlined ash pond put it service in 1979 and a lined landfill put in service in 2010. The station is adjacent to Coffeen Lake in south-central Illinois.

At the Meredosia Generating Station in Meredosia IL, IEPA issued a notice of violation June 2012 for groundwater exceedences by multiple contaminants at 4 monitoring wells over a period of 2010-2012. The facility uses an unlined fly ash pond put in service in 1968 and an unlined bottom ash pond put in service in 1972. The station is adjacent to the Illinois River.

At the Newton Generating Station in Newton IL, IEPA issued a notice of violation in June 2012 for groundwater exceedences by multiple contaminants at 3 monitoring wells over a period of 2010-2012. The facility has two unlined ash ponds put in service in 1977 and a lined landfill with cells put in service in 1997 and 2011. The station is adjacent to Newton Lake.

PUBLIC INTEREST

Q. Do you agree with Ms. Eubanks' statement in pre-filed Rebuttal Testimony (pp. 4-5) that Ameren's proposed Labadie UWL promotes the public interest?

A. No.

Q. Please explain.

A. The Labadie site carries risks of environmental and human health damage that can and should be avoided. As is discussed elsewhere in my testimony, choosing an alternative location can readily reduce the earthquake risk. It is even more transparent how to reduce the risk of damage by flooding; choose an alternative site outside the floodplain of one of Missouri's major rivers. Putting reactive wastes atop huge, unprotected shallow aquifers is not in the public interest. Utility wastes essential last forever. The engineered containment does not. If the utility waste is set on or in an alluvial aquifer, that aquifer will likely eventually be contaminated by it. Remediating the contamination of such an aquifer, if it can be done, will likely be far more expensive than using an alternative site.

Q. Ms. Eubanks states (p. 6) that the proposed UWL is an improvement over the existing ponds. She seems to acknowledge (p.7) that there currently are no closure requirements for the existing ash ponds at the Labadie power plant. Does Ameren's construction permit application for the proposed Labadie UWL indicate that Ameren plans to keep the existing ash ponds in operation or close them?

A. Ameren's CPA includes operations that clearly anticipate the existing ponds are expected to remain open, or at least the ash will remain in place. In addressing the potential episodic need for rapid placement of waste in new cells, particularly in response to uplift threats from imminent flooding before a new cell has sufficient fill, the CPA uses borrow from the existing ash ponds as an option. In another part of the CPA, the existing ash ponds, and their discharge to Outlet 002, are used for discharge of excess contact water that may under some circumstances exceed needs of the UWL.

In the response to DR 7, Ameren indicated it did not know what would happen to the ash in the existing ponds or the ponds themselves. Ameren stated that closure in place was an option that might prove viable. In that case, the ash ponds would not be active, but the ash would still remain at the site permanently.

Q. If the ash ponds are not closed, what risks might they pose both to Ameren and to its neighbors in the future?

A. The risks from the ash ponds in the future are what the risks are now; that they are, or will in the future, leak and contaminate ground- and or surface water. That risk will persist so long as the ash remains in the ponds.

Q. To what extent would the proposed UWL next to the Labadie power plant add to, rather than reduce, the risks posed by the existing ash ponds?

A. The risks associated with the proposed UWL are risks associated with seismic damage, up to and including catastrophic failure; damage related to flooding, up to and including failure of waste containment; and detected or undetected groundwater contamination resulting from failure of, or flaws in, the liner systems and/or leachate management. Each and all of these risks are attributable to the UWL and are additive to risks associated with the existing ash ponds.

Q. Ms. Eubanks states (p.7) that the liner for the proposed UWL "is based on future environmental regulations," referring (p. 6) to proposed regulations published by the United States Environmental Protection Agency (EPA) in June 2010. Are you familiar with the EPA's June 2010 proposed regulations that, when finalized, would constitute the first federal regulations governing coal ash disposal?

A. Yes.

Q. Does Ameren's proposed Labadie UWL comply with the requirement in EPA's proposed regulations that the base of a UWL's liner must be at least two feet above the upper limit of the natural water table?

Proposed new 40 CFR §257.60 Placement above the natural water table

> (a) New CCR landfills and new CCR surface impoundments and lateral expansions must be constructed with a base that is located a minimum of two feet above the upper limit of the natural water table.

> (b) For purposes of this section, natural water table means the natural level at which water stands in a shallow well open along its length and penetrating the surficial deposits just deeply enough to encounter standing water at the bottom. This level is uninfluenced by groundwater pumping or other engineered activities.

No, it does not.

Q. Based on your review of Ameren's most recent construction permit application submitted to the Department of Natural Resources in August 2013, what is Ameren proposing in terms of the separation, if any, between the base of the proposed UWL and the upper limit of the natural water table?

A. For the purposes of answering this question, I will accept the erroneous assumption of the DSI authors that the potential data of the DSI represent the elevation of the water table. The observed potentials on June 10, 2010 in the vicinity of the sumps for the proposed UWL were approximately 464.75. Appendix Z of the CPA projects the post-settlement elevation of the base of the liner under the sumps to be 462.2 feet. If the same settlement estimate is applied to the bottom of a cell as to the sump, 0.8 ft, the elevation of the bottom of the cell would be projected to be at an elevation of 465.2 ft.

For the upper limit of the natural water table as observed in 2010, the bottom of the liner in the sump area is about 2.55 ft below the water table. Alternatively expressed, the natural water table at the upper limit is about 0.55 ft above the HDPE liner. At the low point of the cell, the upper limit of the natural water table observed in 2010 is separated from the bottom of the liner by 0.45 ft.

Q. What costs could that design pose for Ameren that are not addressed in the documents submitted in this proceeding?

A. In order to bring the post-settlement separation of the liner bottom at the sumps from the upper limit of the natural water table recorded June 10, 2010, the fill platform upon which the UWL is to be built would need to be raised by about 4.5 feet. At a minimum, that change would require bringing significant additional off-site soils to the site.

NEED FOR LANDFILL AT LABADIE LOCATION/ALTERNATIVES

Q. Have you read and are you familiar with the Rebuttal Testimony of Staff Witness John Cassidy and Claire Eubanks?

A. Yes.

Q. In response to the question," Has the Company examined the costs associated with its proposed construction of an additional landfill to dispose of coal combustion residuals ("CCR's") on land adjacent to the current land occupied by the Labadie Energy Center in **comparison with other waste disposal options?" (Cassidy, p. 4), Mr. Cassidy testified, in part, "Ameren indicated to Staff in Response to Staff Data Request No. 2 that it had engaged the services of Reitz & Jens Consulting Engineers ("R&J") while in the planning stages of the Labadie Energy Center UWL project to review alternatives for disposal of CCR's produced at the Labadie Energy Center. R&J completed such a study for Ameren Missouri which examined 22 possible sites across the region." Based upon your review of the documents, are these correct summarizations of the Ameren response and submitted documents in response to Data Request 2?**

A. No.

Q. Why not?

A. Mr. Cassidy's response does not accurately reflect the contents of the attachments to DR 2, the relationships among the attachments, or the significance of the time line of their generation. As a result, the conclusions he draws from these documents further in this answer ("Therefore, according to the R&J study, the proposed Ameren Missouri owned UWL located adjacent to the Labadie Energy Center represents the lowest cost option for a UWL that is available to Ameren Missouri at this time.") is without support and is in error.

Q. Is Ms Eubanks' understanding of the documents submitted with the Ameren response to DR 2 similar to Mr. Cassidy's?

A. No, it appears to differ significantly?

Q. In what way does Ms Eubanks' understanding of the DR 2 documents differ?

A. Mr. Cassidy's testimony and conclusions are consistent with a perception that all of the documents submitted with DR 2 relate to cost considerations for siting the UWL on-site at Labadie. Ms Eubanks' testimony on the siting of the UWL at Labadie (pp. 7 and 8) clearly indicate she appreciated that some of the DR 2 documents are from technical studies and deal with technical issues and some are from financial or cost studies. Her conclusions reflect that understanding.

Q What information did DR 2 seek?

A. Staff DR 2 seeks verification and documentation that a company owned landfill on-site at Labadie Energy Center is "the best option which minimizes cost as well as environmental and land use impacts …"

Q. What documents were requested of Ameren and what documents were included in in Ameren's response to DR2?

A. DR 2 requested an explanation of the answer and copies of all documentation and studies relied upon by Ameren to reach its determination. In response, Ameren provided 5 documents: (1) a one-page spreadsheet generated by Ameren surveying dumping fees from 6 commercial landfills and hauling costs from two trucking firms, identified with the initials WEK and dated September 25, 2003; (2) an 11-page feasibility study done by Reitz & Jens, Inc., dated June 8, 2004; (3) a one-page spreadsheet and accompanying locations map documenting 22 "Sites Evaluated for possible Utility Waste Landfill" produced by Reitz & Jens, Inc., for AmerenUE Rush Island Plant, dated June 13, 2008; (4) an undated power point presentation by Reitz & Jens, Inc., for AmerenUE, presenting and evaluating the data from item (3); and (5) an email exchange between Paul Reitz of Reitz & Jens, Inc., and Doug Weible of FWI dated August 18, 2010, verifying a non-binding proposal of rates for disposing of Labadie ash at FWI's North Landfill.

Q. Do these documents support the conclusion that the proposed on-site UWL is the lowest cost option for the disposal of coal ash from the Labadie plant?

A. No. They do not.

Q. What does each of these documents show with respect to the cost of disposing on-site at Labadie?

A. The 2003/2004 documents indicate that an onsite landfill operated by Ameren may be a cheaper option than disposing of the coal ash generated by each of Ameren's four St. Louis area power plants when compared to disposal at a landfill operated by a third party. The 2010 tipping-fee shows that 3rd party rates have remained generally consistent since the 2003 survey and that waste transport by rail is substantially cheaper than that by truck.

Q. Do the documents provide any comparisons for the cost of disposing of Labadie utility wastes at Labadie with doing so at an alternative site?

A. No.

Q. Do you see any evidence that Ameren considered "22 possible sites across the region" as alternatives to the proposed Labadie site?

A. No. The evidence does not support this conclusion. The feasibility study identified waste hauling as a key cost factor in landfill disposal of ash. Had there been a search for alternatives to onsite disposal of Labadie ash, that search would logically have centered, at least approximately, on the Labadie Plant, with a bias westward toward less developed areas, more easily traveled roads, and presumably cheaper land. Yet each of the 22-matrix sites is across the St. Louis metropolitan area from Labadie, and the closest site on the matrix is 29 miles from Labadie. If only from the geography, it appears that the 22-site matrix was not an evaluation of options for a UWL at Labadie. The 22-site matrix was an initial, non-financial evaluation of sites in the vicinity of Rush Island to find location for a self-managed UWL for ash from Ameren's Rush Island and Meramec power plants.

Q. What did Ameren consider when looking for a site to dispose of the Rush Island and Meramec plant ash?

A. In addition to basic identification and geographic data, the layout of the 2008 22-site matrix indicates Ameren considered at each site's Strengths, Weaknesses, and Comments in the last three columns of the matrix. The most consistently cited weaknesses are floodplains, the need for berms, the unavailability of onsite clay, wetlands, and geology (i.e., karst). The most consistently cited strengths were proximity to the plant and geology (i.e., lack of karst).

Q. Using the criteria Ameren used on the 22-site matrix it considered for the Rush Island and Meramec ash, would the proposed Labadie site be a strong choice for UWL?

A. Based upon what were pluses and minuses in the site comparisons for Rush Island ash, Labadie would seemingly be an unlikely choice for a UWL. Other than its proximity to the Labadie Plant, there are only weaknesses. The Labadie site is on a floodplain, it is full of wetlands, it needs berms, it requires clay importation and it has bedrock geology beneath the alluvium that commonly exhibits karst features.

Q. What results did Ameren produce using the matrix to evaluate alternative locations for disposal of Rush Island and Meramec waste?

A. As reported in the undated power point presentation on the 22 sites on the matrix, 7 sites at four locations made the cut as potential UWL sites (page 6 of 23). Of these, two were at Rush Island itself and 5 sites at three locations were within 6.4 miles of Rush Island. However, another site, not from the 22-site matrix also made the cut -- Labadie Regional. Although no documents indicate how or when the decision was made, Labadie was clearly a "go", as a regional UWL, by the time of the power point presentation.

Q. Did Ameren evaluate the Labadie Regional site's strengths and weaknesses as it did the other 22 sites?

A. No, it does not appear on the 22-site matrix. In spite of its environmental, location and geologic weaknesses and in spite of it being 43 miles away (Response to DR 2.5), across an urban corridor, the Labadie Regional site was added to the short list of sites considered for disposal of Rush Island and Meramec waste. The 22-site matrix was not generated or used to decide whether Ameren would pursue onsite disposal at Labadie. Any comparisons were focused on whether or not disposal of Rush Island and Meramec ash at Labadie could be justified.

Q. Does Ameren claim to have considered "22 possible sites across the region" as alternatives to the proposed Labadie site? Schedule 3, at 1

A. No, it doesn't. Ameren's response to part 2 of DR 2 does, however, blur the distinctions among the purposes, activities, and timelines of the submitted documents and discrete events impacting or being impacted by the documents. Ameren's answer might create that perception only if one does not look closely enough. The 2003 tipping fee survey and the 2004 feasibility study considered whether or not it might make sense for Ameren to self-manage utility wastes as opposed to using a third-party's landfill, and if so, under what circumstances and settings would the choice make sense. The 2008 matrix comparison was a tool to evaluate potential sites around Rush Island for self-disposal of Rush Island ash and resulted from Ameren's previous decision to self-manage utility wastes. The expected Labadie Regional UWL was considered as one possibility for self-management of the Rush Island ash. The 2010 spot price check of one commercial alternative appears to have been motivated to test the impacts of reducing Labadie from a regional self-management UWL to one only serving the Labadie Plant, in the light of the Franklin County zoning decision.

Q. Could Ameren find alternative sites for the proposed Labadie landfill that were not in the floodplain?

A. Yes. Avoiding floodplains is straightforward and easily accomplished.

Q. Could Ameren find alternative sites for the proposed Labadie landfill that were not in a seismic impact zone?

A. Yes. In Missouri, as one moves west and further from the New Madrid seismic area, the severity and frequency of seismic events decline. Not far west of Franklin County, that risk has declined to the point that, while there may still be earthquakes, the activity falls below that defined as a seismic impact zone.

Q. Could Ameren find alternative sites for the proposed Labadie landfill that were along rail lines?

A. Yes, readily. The rail lines that bring PRB coal trains to Labadie return empty to the west and have available trunk routes cross Missouri outside the confines of major floodplains.

Q. Has your firm looked at places within a 166-mile distance of the Labadie site that are not in the floodplain, not in a seismic impact zone, not in karst or sinkhole-prone areas and located along rail transportation?

A. Yes, at a qualitative level. We have generated maps that composite GIS data from public and governmental data sets many and large areas that meet those criteria. We have not attempted to identify individual sites. I have attached three maps that show where those areas are located. The first, Exhibit 4, shows the seismic hazard map across Missouri. The second map, Exhibit 5, shows railroads and major rivers within 165 miles west of the Labadie site. The third map, Exhibit 6, shows railroads, faults, sinkholes and landslide potential within 165 miles west of the Labadie site.

Q. Does this conclude your Cross- Surrebuttal Testimony?

A Yes.

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

In the Matter of the Application of Union Electric Company d/b/a Ameren Missouri for Permission and Approval and a Certificate of Public Convenience and Necessity Authorizing it to Construct, Install, Own, Operate, Maintain and Otherwise Control and Manage A Utility Waste Landfill and Related Facilities at its Labadie Energy Center	)))))))	File No. EA-2012-0281

AFFIDAVIT OF CHARLES H. NORRIS, P.G.

STATE OF COLORADO)
) ss
CITY OF DENVER)

Charles H. Norris, being first duly sworn on his oath, states:

1. My name is Charles H. Norris. I work in Denver, Colorado and am employed by Geo-Hydro, Inc. as a professional geologist and a hydrogeologist.
2. Attached hereto and made a part hereof is my Cross-Surrebuttal Testimony on behalf of Intervenors Labadie Environmental Organization and Sierra Club. The testimony consists of 24 pages and has been prepared for introduction into evidence in the above-referenced matter.
3. I hereby swear and affirm that my answers contained in the attached testimony are true and correct to the best of my knowledge and belief.

Charles H. Norris

Subscribed and sworn to before me this 13 day of September, 2013.

Pamela Grey
Notary Public

My Commission expires: 9/15/15

PAMELA GREY NOTARY PUBLIC STATE OF COLORADO

My Commission Expires 09/15/2015

Charles H. Norris, P.G.

SUMMARY OF QUALIFICATIONS

Thirty plus years of professional experience in geology, hydrogeology and management in the applied and theoretical geosciences. Experience includes performance, oversight review, or management of site assessment; RI/FS; computer modeling of fluid flow, contaminant transport, and geochemistry (applications and code development); policy and rule making procedures; aquifer evaluation; resource development; and litigation support; nationwide and internationally.

PROFESSIONAL EXPERIENCE

Geo-Hydro, Inc., (1996-present), Principle, CEO
Hydro-Search, Inc., (1992-1996), Director of Hydrogeology
University Of Illinois at Champaign, (1987-1992), Research Associate; Manager, Industrial Consortium for Research and Education for the Laboratory for Supercomputing in Hydrogeology
Consulting Hydrogeologist/Geologist, Champaign, Illinois and Denver, Colorado, (1980-1992)
MGF Oil Corporation, (1985 - 1986), Manager Geological Engineering
Emerald Gas and Oil, (1980 - 1986), President and Owner
Petro-Lewis Corporation, (1980), District Geologist
Tenneco Oil Company, (1977-1980), Senior Geological Engineer
Amoco International Oil Company, (1975-1977), Senior Geologist
Shell Oil Company, (1972-1975), Exploration Geologist

PROFESSIONAL REGISTRATIONS, MEMBERSHIPS, AND AFFILIATIONS

Professional Geologist: Illinois (No. 196-001082), Indiana (No. 2100), Kentucky (No. KY-2470), Missouri (No. 2011012527), Pennsylvania (PG003994), Utah (No. 5532631-2250), Virginia (No. 2801 001834), Wisconsin (No. 924), Wyoming (No. 2989)
Registered Environmental Professional (#5350), State of Colorado, Petroleum Storage Tank Fund

National Ground Water Association
Colorado Groundwater Association (Vice President 1999, President 2000, Past-President 2001)

Phi Beta Kappa, Phi Kappa Phi, Sigma Xi

EDUCATION

B.S., Geology, University of Illinois, High Honors and Distinction in Geology, 1969
M.S., Geology, University of Washington, National Science Foundation Fellow, 1970
University of Illinois, all but dissertation completed for Ph. D., Hydrogeology, 1992

Select Project Experience

RI/FS and Site Investigations

- Manager for technical assistance through a Technical Assistance Program (TAP) grant from PRPs to local citizens' group. Assistance through grant to provide assessment and feedback on site work products as they are developed and implemented, explain the remediation processes and activities to the citizens, and serve as technical liaison between citizens and remediation team.

- Modeler and hydrogeologic consultant at industrial tank farm adjacent to the Chicago Sanitary and Ship Canal in northeastern Illinois. Assess hydrogeologic data, interpret aquifer testing, and model groundwater flow in soil and fractured carbonate bedrock in area of DNAPL accumulation as part of site characterization and voluntary remediation design.

- Manager and Hydrogeologist of groundwater investigation at an industrial dump site adjacent to the Illinois River in north Central Illinois. Investigated fate and transport of 3-4 decades of disposal of mixed, hazardous industrial wastes at a non-engineered floodplain dump site. Expert testimony and legal support. Pre-trial settlement provided for installation of monitoring system in lieu of site characterization.

- Manager of groundwater flow modeling performed as part of the groundwater characterization effort and as part of the preliminary remedial designs. The site is a Superfund site involving both organic and metals contaminants at a wood treating facility in an urban area in Alabama adjacent to a major commercial waterway.

- Manager of groundwater flow modeling performed as part of the groundwater characterization effort and as part of the 90% and final remedial designs. The site is a high profile Superfund site involving both organic and metals contaminants at a wood treating facility in Northern California.

- Technical Advisor assisting in the evaluation of aquifer properties and well performances for an extraction well field near Sacramento CA. A high volume pump and treat system for chlorinated solvents showed strong and anomalous decline in productivity. Detailed evaluation identified both possible causes and recommended operations changes to alleviate the problems.

- Technical Advisor assisting in the evaluation of aquifer properties and well performances for initial installation of a high volume extraction well field in Southern California. The chlorinated solvent plume associated with a Superfund site impacted a large area in a layered, heterogeneous groundwater basin managed intensively for public water supplies.

- Senior oversight and review in the evaluation of aquifer and soil properties, and the remediation of the soils contamination and groundwater impacts associated with compressor facilities of interstate gas transmission companies. Various projects and sites in western Colorado, Wyoming, and the Texas panhandle.

- Technical Advisor for the Remedial Investigation/Feasibility Study (RI/FS) of the Landfill Solids and Gases Operable Units at the Lowry Landfill CERCLA site located near Denver, Colorado. This project involves the characterization of the extent of potential contamination within the unsaturated zone adjacent to this high profile site. Work involves extensive coordination and interaction with multiple PRP groups as well as various regulatory agencies.

- Project Manager for independent oversight of a proposed low-level radioactive waste disposal site. Task was to develop technical and legal program for governmentally funded intervener's case as part of adjudicatory hearings on a high-profile, proposed disposal facility and involved identifying, retaining and educating legal staff, retaining a team of technical experts, negotiating fees, coordinating work product and presentations, providing liaison with citizen's groups, responding to press and integrating personal testimony on hydrogeology and modeling. Expert testimony and legal support.

Landfill Services

- Project Manager and Hydrogeologist for a geologic and hydrogeologic assessment of existing water quality and off-site migration from existing licensed landfill near Joliet IL. Work includes groundwater flow modeling of remedial alternatives and groundwater impact assessments of various alternatives for submittal to IEPA.

- Project Manager and Hydrogeologist for a geologic and hydrogeologic assessment for siting of a proposed expansion for a hazardous waste landfill in Peoria County, Illinois. Expert testimony and legal support. Review identified errors in application, unaddressed contamination on facility property, and inappropriate modeling design and implementation.

- Project Manager and Hydrogeologist for a geologic and hydrogeologic assessment for siting of a proposed regional landfill by expansion of local landfill in Ogle County, Illinois. Expert testimony and legal support. Review identified in errors application, unaddressed existing leakage, and potential risk to public water supply. (Three hearings)

- Project Manager and Hydrogeologist for a geologic and hydrogeologic assessment for siting of a proposed regional landfill by expansion of local landfill in Kankakee County, Illinois. Expert testimony and legal support. Review identified errors in application, unaddressed existing off-site leakage, and inappropriate modeling design and implementation. (Two hearings)

- Project Manager and Hydrogeologist for a geologic and hydrogeologic assessment of a proposed regional landfill in Will County, Illinois. Expert testimony and legal support. Research documented numerous errors in application which resulted in underestimation of infiltration rates and potential migration rates. Identified evidence of sub-karstic migration pathway from site to nearby stream.

- Project Manager and Hydrogeologist for a geologic and hydrogeologic assessment of a proposed regional landfill expansion at East Peoria, Illinois. Research documented current leakage from the existing landfill into the regional unconfined aquifer within the cone of depression of the municipal water supply wells. In part as a result of the evaluation, the proposed expansion has been abandoned. Expert testimony and legal support.

- Project Manager and Hydrogeologist for a geologic and hydrogeologic assessment of a proposed regional landfill at Ottawa, Illinois. Provided testimony at county hearings identifying and documenting site-specific conditions that invalidated part of the ground water evaluation testing, necessitating the need to re-evaluate the groundwater flow system and redesign the monitoring system. Expert testimony and legal support.

- Project Manager and Hydrogeologist for a geologic and hydrogeologic assessment of existing municipal landfills and a proposed landfill redesign and expansion at Salem, Illinois. Provided testimony at city hearings documenting existing landfill leakage and identifying site-specific conditions that complicate the design of a reliable monitoring system. Expert testimony and legal support.

- Project Manager and Hydrogeologist for site evaluations of the geology and hydrogeology of several proposed municipal landfills and a landfill expansion in Bartholomew County, Indiana. The review of the expansion demonstrated inadequate monitoring of the existing facility. One proposed site showed possible, current ground water usage from under the proposed facility and conditions that may preclude state-level site approval.

- Project Manager and Hydrogeologist serving in consultation to the Board of Wayne County, Illinois, regarding a proposed expansion to a regional landfill. Investigation and oversight established viability of the physical site and improvements that were needed in operating procedures and monitoring efforts. Expert testimony and legal support.

- Project Manager and Hydrogeologist for an assessment of an existing regional municipal landfill at Urbana, Illinois. Principle problems included ground water contamination, unplugged well(s) within the facility boundary that penetrated the aquifer serving public water supplies and a monitoring system inadequate to evaluate the contaminant migration. Results of the evaluation include an expanded system of monitoring wells, improved protocols for ground water sampling and revised statistical procedures to determine background water chemistries.

- Project Manager and Hydrogeologist for a site assessment of a proposed municipal landfill expansion in west central Indiana. Established feasibility of using the engineering and design features of the expansion to prevent contamination from the pre-existing non-engineered facility.

- Project Hydrogeologist for a site assessment of a proposed saturated-zone, regional balefill in central Illinois. Principal problems involved the evaluation of the hydrogeologic characteristics of the strip mine spoils within which excavation would occur, the blasted mine bottom upon which the liners would be built and the materials available for liner construction. Expert testimony and legal support.

- Project Manager and Hydrogeologist for a site assessment of a proposed municipal landfill expansion in Livingston County, Illinois. Principal problems involved the evaluation of the impact of shallow coal tunnel mining beneath the site and reaction of waste leachate with unusual clay mineralogy important to waste isolation at the site. Expert testimony.

- Technical Reviewer of site assessment and re-assessment of a proposed inter-governmental regional landfill in central Illinois. Verified unanticipated, politically unacceptable risks to major aquifer system serving public water supplies. Assisted in drafting of technical policy statement that permitted new siting efforts to proceed in the jurisdiction. Expert testimony.

WATER RESOURCE EVALUATION & DEVELOPMENT

- Manager for ground water modeling effort associated with the development of a high-volume ground-water supply and delivery project in Colorado. The effort included investigating and evaluating a previously used, court-accepted model, adapting and updating the model, and applying the model to assess the impacts of a proposed private ground-water diversion project that would be the largest in the United States. Ongoing effort includes subsequent review of alternative proposed model and further litigation support.

- Manager for review of an application for an expansion of a large long-wall mine in southeastern Ohio. The review identified extensive unrecognized mining-related impacts to water supplies from historic mining and identified hydrologic risks to a unique old-growth forest adjacent to the proposed expansion, and resulted in an appeal of the application. Expert testimony and legal support.

- Manager for ground water modeling effort associated with the development of a surface reservoir designed for conjunctive use of ground and surface water to reduce peak ground water pumping demands in Denver metro area. The effort included investigating and evaluating a previously used, model, adapting and updating the model, and applying the model to assess the impacts of project on other water rights. Study is a component of the EIS.

- Project Manager for multi-company effort to model thermal loading of northern Nevada surface waters as a result of mine dewatering project. Successful liaison among technical staffs and regulators and modeling work for a high profile EIS resulted in approval of discharge permit.

- Project Hydrogeologist for the feasibility study of a small lake for a northern Illinois nursery, to be used for recreation, fishing and irrigation. Evaluated shallow and intermediate ground water and surface run-off, reviewed engineering design and directed ground and surface water sampling program to determine nutrient levels.

HYDROCHEMISTRY

- Principal Investigator for grant to research the geochemical implications of using alkaline addition as one means for preventing and/or remediating inorganic contamination resulting from acid mine/rock drainage. Empirical and modeling evidence showed conditions under which alkaline addition can cause or exacerbate contamination of some constituents of concern.

- Project Manager, hydrogeologist, geochemist for ongoing investigation of metals contamination of a trout stream in West Virginia. Impacts from natural and industrial sources , present and past, evaluated to segregate relative significance of various sources. Includes expert testimony and legal support.

- Project Geochemist and Hydrogeologist for evaluation and critique of modeling protocols used by USEPA for risk assessments performed as part of regulatory determinations for various solid wastes. Identified errors in methodology and input that had caused previous modeling to mischaracterize risks for settings with observed damage cases. Computer modeling.

- Geochemist and Hydrogeologist for evaluations of inorganic groundwater chemistry at an industrial RCRA site near Joplin MO. Federal lawsuit filed pursuant to PRP contribution and sources and timing of contamination. Was able to use geochemical interpretations to establish significant elements of aquifer characteristics and implications for contamination routes. Expert testimony.

- Project Hydrogeologist and Geochemist for evaluations of proposed coal combustion waste disposal as part of reclamation activities at surface coal mines in Southwestern Indiana. Ongoing efforts are targeted toward refining regulatory framework for disposal efforts, establishing effective characterization and monitoring programs and determining appropriate operation and engineering practices. Project involves extensive interdisciplinary effort and expert testimony.

- Project Geochemist for the investigation of the impacts of remediating acid mine drainage by installing bulkheads to flood exhausted mine working. Predictively modeled water chemistries in situ, within flooded mine, along flow paths and upon surface discharge. Assisted in preparation of testimony that resulted in permit approval for the San Juan County, Colorado project.

- Project Manager and Project Geochemist/Hydrogeologist for investigation of potential environmental impacts of disposal of coal combustion wastes (CCW) as part of a reclamation plan at a surface coal mine in northern New Mexico. Performed or directed geochemical, infiltration and flow modeling of the proposed project to identify optimum disposal methods and worst case impacts. Presentation to State resulted in approval of this precedent-setting project.

- Project Manager, Geochemist and Hydrogeologist for an investigation of a proposed disposal/construction project to build a central Illinois ski mountain from fly ash produced by a co-generating plant operated by a major food products manufacturer. The investigation involved overseeing an engineering review of project plans, a site investigation and evaluation, geochemical modeling of initial and final mineralogical composition of the mass and of the leachate chemistry and evolution and the impact on the hydrogeologic and structural integrity of the project. Expert testimony and legal support.

PETROLEUM INDUSTRY EXPERIENCE

- Project Manager for the environmental assessment of 82 Texas producing properties targeted for acquisition. Evaluations included site walk-overs, surface soil and liquid sampling, radiological monitoring and geoprobe sampling of soils and ground water. The assessments documented a multitude of impacts from both exempt and non-exempt wastes that, unrecognized, could have resulted in substantial financial exposure to the client.

- Project Geologist and Petrophysicist for an investigation of resource potential of coal bed methane in San Juan Basin of New Mexico and Colorado. Study focused on innovative log analysis techniques; formation water chemistries, production rates and disposal problems; well drilling, completion and re-completion practices; and detailed subsurface facies and structural mapping and stratigraphic correlation in shallow coal beds of Kirtland/Fruitland/Pictured Cliffs shoreline complex and relationships to overlying Tertiary sandstones.

- Developed a successful play in the Hunton and Mississippi Lime formations of northwest Oklahoma. The play recognized the secondary porosity systems of both formations (dolomitization and fracturing, respectively) and the genetic significance to each of the buried topography at the intervening unconformity.

- Managed a detailed reservoir study of a Cotton Valley gas field in east Texas that resulted in RRC approval of non-standard spacing based upon the recognition of secondary porosity and a dual-conductivity system that resulted from drape-induced fractures. The revised spacing both protected resource ownership and conserved the costs of infill drilling. Expert testimony and legal support.

- Project Geologist, Petrophysicist and Expert for various contested adjudicatory hearings apportioning oil and gas ownership. Cases involved primary recovery of both oil and gas and secondary recovery of oil. Accepted as expert (geology, hydrogeology, and/or geological engineering) in Oklahoma, Texas, and Wyoming.

ADDITIONAL PROFESSIONAL EXPERIENCE

- Invited presenter to National Research Council of the National Academy of Sciences, Committee on Mine Placement of Coal Combustion Wastes.

- Appointed member of a Quality Assurance Committee under the West Virginia Department of Environmental Protection. The committee, comprised of representatives of state and federal regulators, industry , and interveners, was charged with a year-long review of state mining applications and approval practices relative to mining under the state and federal surface mining laws.

- Invited presenter to National Research Council of the National Academy of Sciences, Subcommittee on Alternatives, Study on Coal Waste Impoundments.

- Project Manager and Hydrogeologist for the review of Proposed and Revised Proposed Criteria for the Siting of a Low Level Radioactive Waste Disposal Facility in Illinois. Evaluation was targeted toward both technical content and processes of selection. Testimony and written comments led to significant improvements and flexibility in the Criteria as finally published.

- Project Hydrogeologist testifying at hearings before the Illinois Pollution Control Board on regulatory language for the Illinois Ground Water Protection Act. Contributed major conceptual and specific language changes to the final promulgated rules for Ground Water Quality Standards and Regulations for Existing and New Activities with Setback Zones and Regulated Recharge Areas. Expert testimony and legal support.

- Project Hydrogeologist and Log Analyst for three applications to U.S. EPA for permits to continue deep well disposal of hazardous wastes in east central Illinois and southern Ohio. Project required evaluation of geophysical logging data to determine injection zone and confining layer properties, regional flow systems, chemical interactions of the waste stream with the native rock and the ability of the injection system to isolate the waste from the environment.

REPORTS, PRESENTATIONS, AND PUBLICATIONS

Norris, Charles H., 2005, "Water Quality Impacts from Remediation Acid Mine Drainage with Alkaline Addition", draft version released to National Research Council of the National Academy of Sciences, Committee on Mine Placement of Coal Combustion Wastes, Geo-Hydro, Inc., Denver CO, July 3, 2005

Norris, C. H., "notes from the front. . . Overview of three sites", invited paper before National Research Council of the National Academy of Sciences, Committee on Mine Placement of Coal Combustion Wastes, Evansville IN, March 2005.

Norris, Charles H., 2004, "Environmental Concerns and Impacts of Power Plant Waste Placement in Mines", Presented at Harrisburg PA, May 4-6, 2004. Published in Proceedings of State Regulation of Coal Combustion By-Product Placement at Mine Sites: A Technical Interactive Forum, Kimery C Vories and Anna Harrington, eds, by U. S. Department of Interior, Office of Surface Mining, Alton IL, and Coal Research Center, Southern Illinois University, Carbondale IL.

Norris, C. H., "Developing Reasonable Rules for Coal Combustion Waste Placement in Mines. Why? When? Where? How?", USEPA Contract 68-W-02-007, IEI Subcontract 7060-304, Invited paper at USEPA MRAM meeting, Rosslyn VA, September, 2003.

Norris, C. H., "So, You Think You're a Geologist? (F. Kafka to A. Liddell, In Wonderland)", Colorado Ground Waster Association Monthly Meeting,, Denver CO, September, 2002.

Norris, C. H., "Assessment of the Anker Energy Corporation proposal for mining and reclamation, Upshur County, West Virginia." Independent evaluation on behalf of Anker Energy Corporation and West Virginia Highlands Conservancy, July, 2002.

Norris, C. H., "Coal Combustion Waste: Coming soon to a neighborhood (and maybe a faucet) near you." Colorado Ground Waster Association Monthly Meeting,, Denver CO, May, 2001.

Norris, C. H., "Slurry-to-ashes, and ashes-to . . . A case of a coal company and citizens working together to evaluate alternatives." Invited paper before National Research Council of the National Academy of Sciences, Subcommittee on Alternatives, Study on Coal Waste Impoundments, St. Louis MO, June, 2001.

Norris, C.H., and C. E. Hubbard, "Use of MINTEQA2 and EPACMTP to Estimate Groundwater Pathway Risks from the Land Disposal of Metal-Bearing Wastes", for Environmental Technology Council, submitted as public comment to USEPA on regulatory determination for Fossil Fuel Combustion Wastes, May, 1999.

Norris, C.H., "Report on the Determination of Intermittent Streams and the Potential Impacts of Valley Fill on Area Drainages, Southern West Virginia", expert report for litigation prepared for Mountain State Justice, Inc, Charleston WV, March, 1999.

Norris, C.H., "Report on the Geology and Hydrogeology of the Caterpillar Levee Site with an Evaluation of Potential Pathways on- and off-site for the Movement of Solid and Hazardous Wastes", expert report for litigation prepared for Citizens for a Better Environment, Chicago IL, March, 1998.

Norris, C.H., "Dr Pepper, Biorhythms, and the Eight-Hour Pumping Test ", Colorado Ground Waster Association Annual Meeting, Golden CO, December, 1997.

Norris, C.H., "Characterizing Ash Composition and (vs.) Projecting Environmental Impact for Purposes of Permitting CCW Disposal ", Coal Combustion By-Products Associated with Coal Mining - Interactive Forum, Southern Illinois University at Carbondale, Carbondale IL, October, 1996.

Norris, C.H., "Geochemical Modeling". Co-instructor for Short Course on Hydrogeologic Issues Related to Mine Permitting, Reclamation and Closure, SME Annual Convention, Phoenix AZ; March, 1996.

Norris, C.H., An Improved Method for Middle Time Analysis of Slug and Bail Test. Unpublished. 1994.

Norris, C.H., "Evolution of the Landfill", presentation as part of a Telnet program, *Garbage Dilemma Educational Series*, sponsored by Illinois Farm Bureau and Cooperative Extension Service of the College of Agriculture, University of Illinois, Urbana, Illinois, April 20, 1992.

Norris, C.H., "Technical Analysis or Political Acceptability: The Domesticated Fowl or its Ovum", Solid Waste Management and Local Government Workshop, sponsored by Institute of Government and Public Affairs, University of Illinois, Urbana, Illinois, Jan-Apr, 1992.

Norris, C.H., Report on the Geology and Hydrogeology [of the] SWDA Proposed Landfill Site, Township 8 North, Range 6 East, Section 31, Bartholomew County, Indiana, for Central States Education Center, Champaign, Illinois, 1991.

Norris, C.H., Hydrogeology and Modeling of the Proposed Illinois Low Level Radioactive Waste Disposal Site at Martinsville, Illinois; testimony before the LLRW Siting Commission, October and November, 1991, Martinsville, Illinois.

Norris, C.H., Ground Water Quality Standards for the Illinois Ground Water Protection Act; testimony before Illinois Pollution Control Board, Chicago, Illinois; February, May, October and December, 1990; May, 1991.

Norris, C.H., Hearing on a Petition for a Special Use Permit for the Construction of a Ski Mountain in Oakley Township, Macon County, Illinois; testimony before the Macon County Zoning Board of Appeals; February 16, 1990.

Norris, C.H., Hearing on a Solid Waste Disposal Permit for the Siting of a Municipal Landfill for Streator, Illinois; testimony before the Livingston County Board; August 6, 1990.

Norris, C.H., In the matter of the Gallatin National Company Proposed Balefill, Fulton County, Illinois,

written comments to the Illinois Environmental Protection Agency, Springfield, Illinois, 1990.

Norris, C.H., 1990, Log Analysis of the Allied Chemical Corporation Waste Injection Well, Danville, Illinois, for Alberto Nieto, Champaign, Illinois.

Norris, C.H., 1989, Log Analysis of the Cabot Corporation Waste Disposal Wells, Tuscola, Illinois, for Alberto Nieto, Champaign, Illinois.

Norris, C.H., Regulations for Existing and New Activities Within Setback Zones and Regulated Recharge Areas for the Illinois Ground Water Protection Act; testimony before Illinois Pollution Control Board, Chicago, Illinois, June, 1989.

Norris, C.H., and C.M. Bethke, (Abstract) "Mathematical Models of Subsurface Processes in Sedimentary Basins", Conference on Mathematical and Computational Issues in Geophysical Fluid and Solid Mechanics, Society for Industrial and Applied Mathematics Annual Meeting, Houston, Texas, September 28 (invited paper), 1989.

Norris, C.H., "An Evaluation of the Geology and the Monitoring Well Data [at the] City of Urbana Regional Landfill", report submitted to the City of Urbana, Champaign County, Illinois, for Central States Education Center, Champaign, Illinois, 1989.

Norris, C.H., Gallatin National Proposed Balefill/Landfill [at] Fairview, Illinois; testimony before Fairview Town Council, Fairview, Illinois, November, 1988.

Norris, C.H., "Evaluation of the Hydrogeologic Factors Influencing Risk [at the] ISWDA Regional Landfill Site B", report submitted to the Inter-Governmental Solid Waste Disposal Association, Champaign County, Illinois, 1988.

Norris, C.H., and C.M. Bethke, "Status and Future Directions of Quantitative Flow Modeling in Sedimentary Basins", Workshop on Quantitative Dynamic Stratigraphy (QDS), Colorado School of Mines, Lost Valley Ranch, Colorado, February 14-18, 1988.

Hydrogeologic Assessment of Potential Impacts of Meramec Ash Ponds on Local Groundwater and Surface Water

CH2MHILL

Hydrogeologic Assessment of Potential Impacts of Meramec Ash Ponds on Local Groundwater and Surface Water

Prepared for

Union Electric Company,

Meramec Plant

Prepared by

CH2MHILL

December 16, 1997

STATE OF MISSOURI
THOMAS J. MILLER
RG 0465
REGISTERED GEOLOGIST

12/16/97

List of Figures and Tables

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1. INTRODUCTION

Union Electric (UE) is currently reviewing management options for the fly ash ponds at the UE Meramec Power Plant. As part of the review, UE has asked CH2M HILL to collate available site investigation data (see references) and perform a critical assessment of the local hydrogeological impacts, particularly to groundwater, potentially resulting from current and historic ash pond operations. The hydrogeological information will support UE in its ongoing dialogue with the Missouri Department of Natural Resources regarding future ash management strategies.

The analytical data compiled in the study was provided to CH2M HILL by UE; it represents the results of earlier investigations by other parties. The interpretations of site hydrogeology were based on this information, familiarity with the regional geology, and CH2M HILL's experience with similar environmental settings.

2. SITE GEOLOGY

2.1 Site Description

The UE Meramec Plant is located in the far southeast corner of St. Louis County near the confluence of the Meramec and Mississippi Rivers. The plant lies on flat floodplain land at an elevation of between 410-420 feet above Mean Sea Level (MSL), directly east of the Meramec River and west of the Mississippi River. The Meramec River enters the Mississippi River just downstream, to the south of the property. To the north and west of the site, the land is hilly and mostly wooded. Figure 1 shows the site location.

The ash ponds are situated south of the power plant and cover about 110 acres. The fly ash has been stored onsite in unlined ponds for over 40 years. The site subsurface was initially described during pre-construction geotechnical investigations conducted by Stone and Webster Engineering Company in 1949. The boring logs from the investigation were reviewed as part of this study.

In addition, ash pond 489 has been investigated several times in the past and provides a valuable model for the current study. It is the southernmost ash pond and represents the downgradient boundary of the facility. Two abandoned and three active groundwater monitoring wells are installed along the lower edges of the pond parallel to the two rivers. Two background monitoring wells are located east and north of the ash pond area. Also, CH2M HILL has been monitoring groundwater levels at ash pond 490 as part of an alternative closure cap feasibility study. Data from both sites are used in this study.

Figure 2 shows the site plan and monitoring well locations. It also shows the W-E section line used to depict the conceptual site model.

FIGURE 1

SITE LOCATION MAP

UNION ELECTRIC MERAMEC PLANT
ST. LOUIS CO., MISSOURI

CH2M HILL

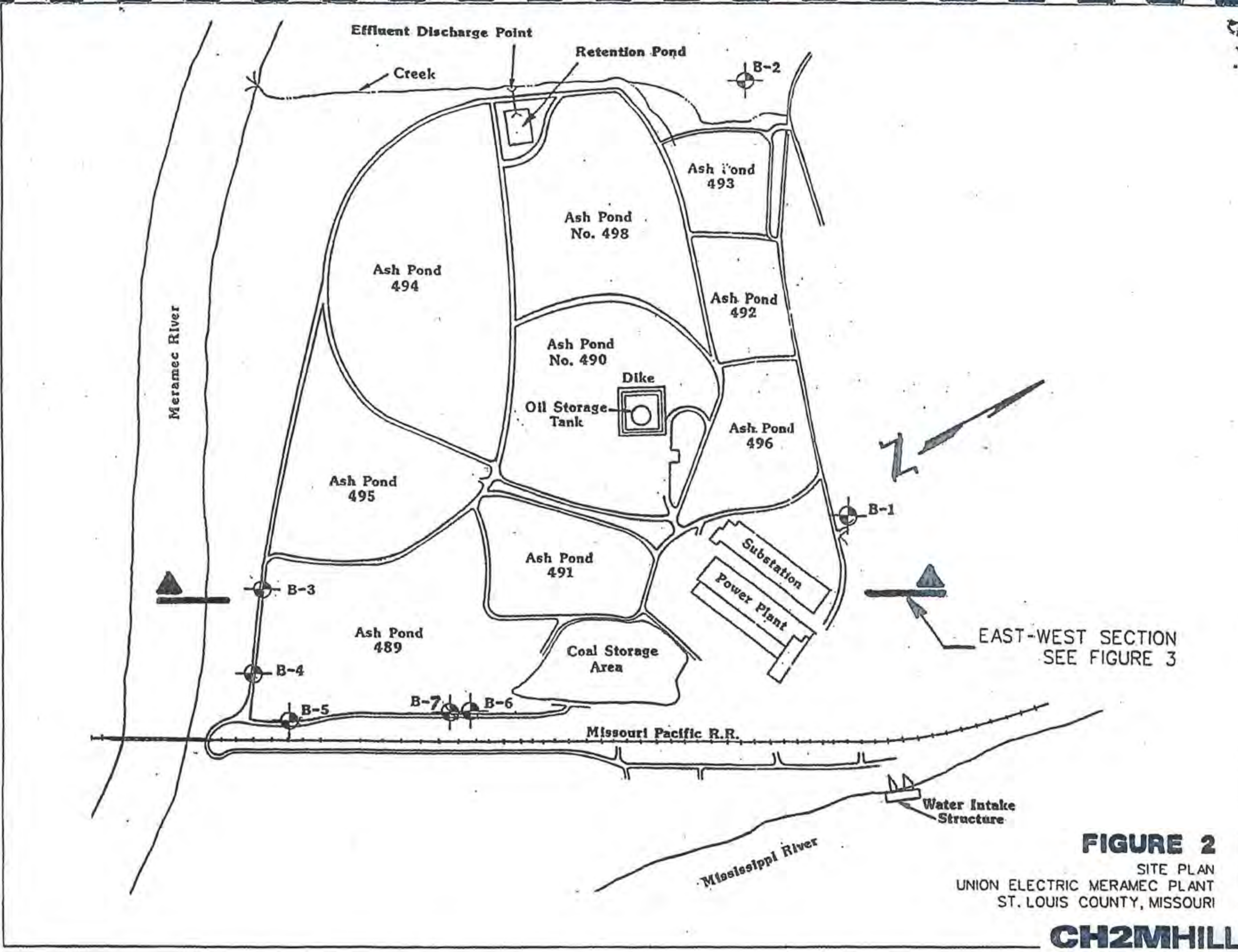


FIGURE 2

SITE PLAN
UNION ELECTRIC MERAMEC PLANT
ST. LOUIS COUNTY, MISSOURI

CH2MHILL

Exhibit 300 p 42

2.2 Surface and Subsurface Soils

The present site grade is as much as 20 feet above the original ground surface that is indicated by historic engineering drawings (Stone and Webster, 1949). As part of the plant construction project, the original grade was increased by using imported silty clay fill. Reportedly, the ash ponds were made by excavating onsite silts and clays and using the material as construction fill beneath the plant and also for the ash pond berms. In general, the site soils under the fill materials are typical floodplain deposits, comprising interbedded clay, silt, sand, and gravel. The alluvium tends to become coarser-grained with increasing depth and proximity to the river channels. These varied sedimentary deposits were excavated to about 10 feet below original grade to form the ash ponds. The pond bottoms were apparently several feet above the average elevation of the water table.

Details of the soil stratigraphy at pond 489 are provided by the drilling logs of the monitoring wells, particularly wells MW4, MW5, and MW6 (Woodward-Clyde Consultants, 1988). Subsurface information for the remainder of the site was obtained from geotechnical logs completed during the original geotechnical site investigation prior to plant construction (Stone and Webster, 1949). A conceptual site model has been developed using this information and is shown in Figure 3 as a generalized W-E cross-section.

As shown in Figure 3, the site stratigraphy changes eastward from the Meramec River. The west part of the site near the river is underlain primarily by silts and sands. In contrast, sands are poorly represented in the east, and fine silts and clay underlie this part of the property. A thick sequence of silts east of the plant suggests a former deeply-incised alluvial valley. In general, pond ash fill or construction fill extends about 20 to 25 feet below the current site grade (nominally 420 ft. MSL). The fill is underlain by alluvial clayey silt and fine silty sand deposits typically 20 to 40 feet thick (except at the east edge of the site where fine material extends almost to bedrock). As depth increases, the sands in the west part of the site become coarser-grained and gravelly, with less fines. About 90 feet below grade (approximately 320 ft. MSL) a very stiff, blue-gray, high plastic clay is encountered. The clay is estimated to be about 5 to 10 feet thick in the west but increases to 60 to 70 feet thick at locations beneath the plant. Limestone bedrock is present at depths of about 105-115 feet. A coarse sand and gravel bed, up to 10 feet thick, exists between the limestone and the gray clay. The sand and gravel also contains limestone and shale fragments and may represent a highly weathered bedrock surface.

2.3 Bedrock

According to geotechnical reports for the site (Shannon and Wilson, 1979), the limestone beneath the alluvium and clay belongs to the Warsaw formation of the Meramecian series and is upper Mississippian in age. The formation comprises shales and fine-grained shaley limestones, and is fossiliferous. The numerous boring logs from the pre-construction investigation confirm the presence of shale and limestone bedrock beneath the site.

The bedrock surface slopes gently to the southeast although the regional dip is typically to the northeast. This is because, structurally, the site lies within a lithographic trough or syncline (Missouri Geological Survey, 1974). Synclines can often act as traps for mineralized groundwater, a situation that is discussed further in section 3.2.2 below.

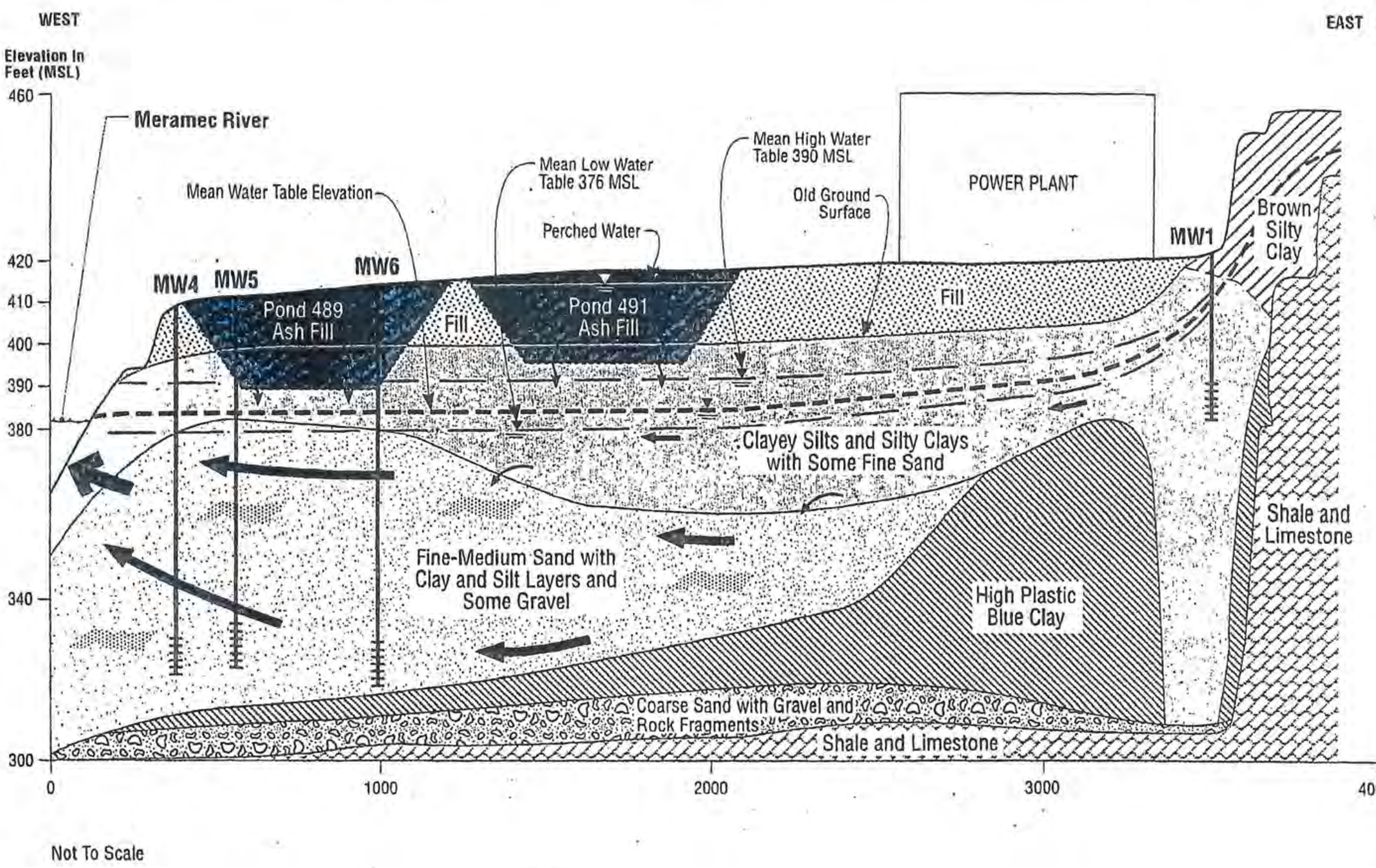


FIGURE 3
Conceptual Site Model
Union Electric Meramec Plant, St. Louis County, MO

E143874.SR.ZZ Cross-Section 12-3-97 mj

CH2MHILL

3. SITE HYDROLOGY

3.1 Surface Water

The Meramec and Mississippi Rivers are the dominant surface water features near the UE site. The Mississippi River controls the flow of the Meramec River causing the latter to back-up during flood stage. The mean discharge of the Mississippi River is 188, 300 cubic feet per second (cfs); the mean discharge of the Meramec River is 3,244 cfs. The averages are based on river years 1933 to 1996 (USGS, 1996). Typically, the river stage ranges between elevations of 376 ft. MSL to 390 ft. MSL (U.S. Army Corps of Engineers). The nearest river gage is at Water's Point, 2 miles downriver on the Mississippi. The mean river stage here is 380.8 ft. MSL (averaged between 1900 and 1994). According to the US Army Corps of Engineers (personal communication with R.J. Dieckmann, St. Louis District) the Mississippi River gradient, locally, is about one-half foot per mile. Therefore, the mean river stage at the UE plant is about 382 ft. MSL (several feet below the ash ponds).

In addition, a small creek north of the site runs west into the Meramec River. The creek receives water from the retention pond located north of ash pond 498. Rainwater that does not infiltrate surface soils in the area of the ash ponds will pass offsite via the retention pond and creek.

3.2 Groundwater

3.2.1 Alluvial Aquifers

Site-specific groundwater information was obtained from five monitoring wells installed in January, 1988 and from shallow piezometers installed in pond 490. Depth to groundwater in the area of ash pond 489 is indicated by monitoring wells MW4, MW5, and MW6. These wells are between 90 feet and 101 feet deep with screened intervals near the base of the alluvium. Wells MW1 and MW2 are hydraulically upgradient of the ash pond and are 41 feet and 56 feet deep, respectively. Over the past several years, UE has monitored the depth to water in the five wells and also recorded the corresponding Mississippi River stage. This data is provided in Appendix 1 and summarized in Table 4 below.

Data show that the water levels in the downgradient wells MW4, MW5, and MW6 closely reflect the recorded river stage. The groundwater depth in MW1, however, is typically about 30 feet higher than the ash pond wells; at MW2, the depth to water is some 20 feet higher than the ash pond wells. Also, the response of water levels in MW1 and MW2 to changes in river stage is less apparent. These differences can be accounted for by considering the relative distances of the wells from the rivers and the accompanying changes in lithology. Wells MW1 and MW2 are located several thousand feet away from the rivers, on the edge of the floodplain and near the base of the adjacent hills. In addition, they are completed to shallower depths in finer-grained, less transmissive sediments and as a result tend to respond more slowly to elevation changes in the local water table.

3.2.2 Bedrock Aquifers

There is little detailed information about the bedrock aquifers directly beneath the site. A previous geotechnical investigation by Shannon and Wilson (1979) collected 10-feet long, rock core samples from five borings located near the power plant. However, no monitoring wells were installed in bedrock.

Groundwater aquifers in the St. Louis region have been described and classified by the Missouri Geological Survey in a 1974 report. According to the survey, the Mississippian bedrock underlying southeastern St. Louis County yields groundwater with high dissolved solids content and rich in sodium-chloride. The mineralized water is believed to represent saline connate water trapped by the synclinal structure that runs through the site. Natural flushing of groundwater occurs slowly in synclinal areas and tends to result in water resources of poor quality. The report concludes that bedrock aquifers in the region of the site are "not favorable" for well development because of poor yields and concentrations of dissolved solids and sodium chloride that often exceed relevant drinking water standards.

3.2.3 Drinking Water Aquifers

The UE Meramec site does not overlie any currently-used drinking water aquifers. Neither the alluvial aquifer nor the bedrock aquifer beneath and downgradient of the site are used for drinking water. St. Louis County Water withdraws its supply directly from the Meramec, Missouri, or Mississippi Rivers at locations upgradient of the site (personal communication, St. Louis County Water Co.). A search of records for wells within one mile of the UE facility was performed by contacting the MDNR, Division of Geology and Land Survey. Locally, there are no groundwater extraction wells downgradient from the site, between the facility and either the Meramec or Mississippi Rivers. The nearest state-registered wells are located west of the Meramec River, along Highway 61. Future use of the bedrock aquifers is not considered a likelihood, all but precluded by the intrinsically saline quality of the groundwaters and the abundant availability of surface water.

3.3 Hydrogeologic Parameters

Detailed laboratory analyses of the hydrogeological properties of the site sediments and bedrock are not readily available. Nonetheless, some general characteristics of the site stratigraphy can be interpreted to help describe groundwater movement. Figure 3 is a W-E cross-section of the plant location that depicts the position of the water table across the site. Perched water table conditions are present in several of the ash ponds, as indicated by piezometers in the pond 490 tree plot and water levels observed recently in pond 491.

The hydraulic gradient at the site slopes south and east toward the adjacent major rivers. The situation is implied by the large (~ 30 feet) difference in head between the groundwater levels measured at wells MW1 and MW2, and those measured at wells MW4, MW5, and MW6. The downgradient wells are about 3,000 feet from MW1. Groundwater flow is thus toward the rivers at an approximate average hydraulic gradient of 0.01 ft/ft. However, the number and distribution of wells onsite do not provide adequate information to describe in three dimensions the water-table surface of the alluvial aquifer, or the potentiometric surface of the uppermost underlying bedrock aquifer.

The hydraulic conductivity of the ash deposits and the underlying sediments has not been analyzed but can be reasonably estimated from details of the soil stratigraphy. CH2M HILL has tested coal fly ash at other similar sites and determined the hydraulic conductivity to range between about 10^{-5} and 10^{-6} cm/s, values that correspond to silt. Coarser sands and gravels have hydraulic conductivities several orders-of-magnitude higher than finer silts and clays, from 10^{-1} to 10^{-3} cm/s.

Referring to Figure 3, it is apparent that the upper sediments are generally less permeable than the sediments below. This means that the groundwater flux in the ash, silts and silty sands will be significantly less than in the sands and gravels. Nonetheless, both sedimentary horizons will tend to be at least twice as permeable as the underlying shaley limestone. Hydraulic conductivity is also direction-dependent. In the absence of vertical cracks, average horizontal conductivity is typically several orders-of-magnitude larger than vertical conductivity, especially in interbedded alluvial deposits. Table 1 shows the relationship of sedimentary grain size to hydraulic conductivity (Freeze and Cherry, 1979).

3.4 Aquifer Sequence and Relationship

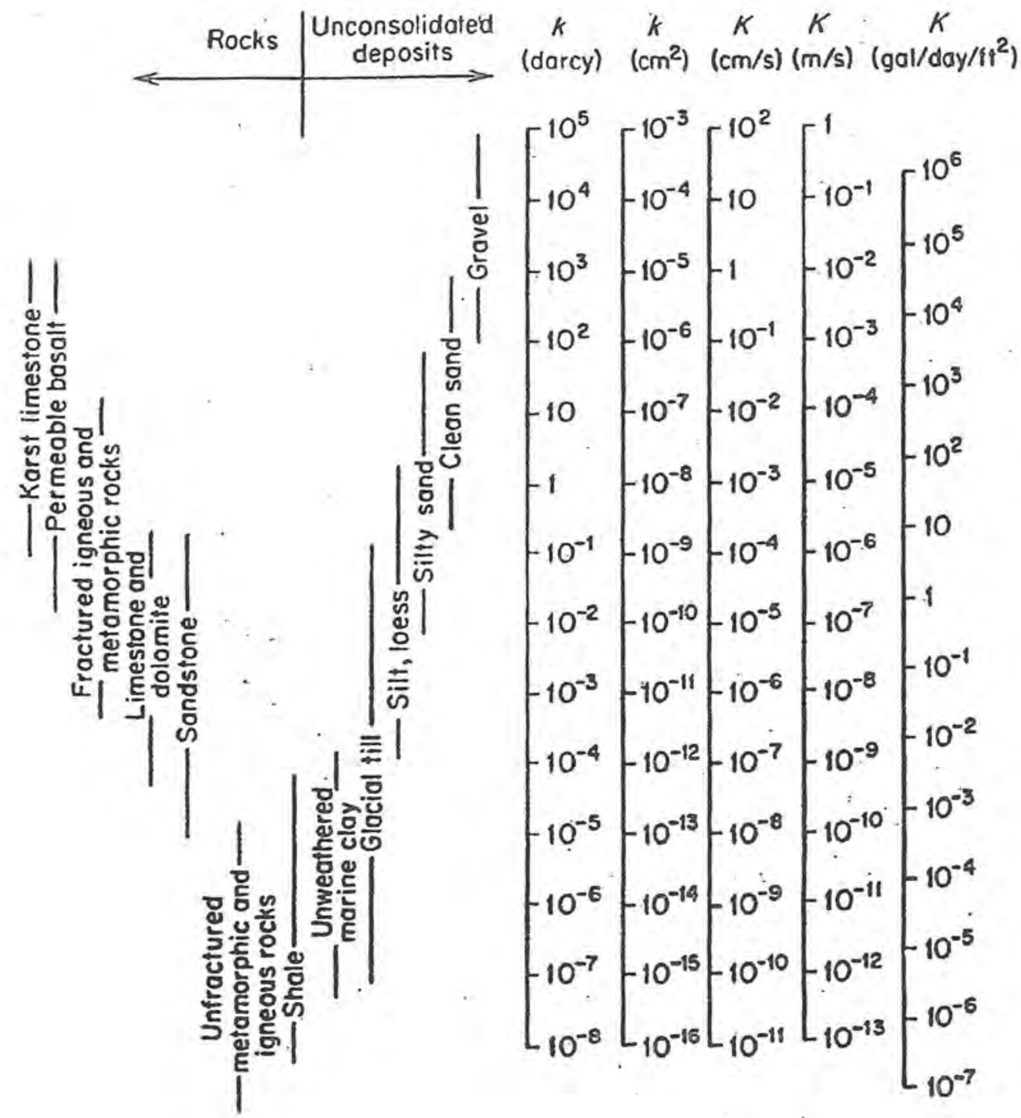
Figure 3 is a schematic representation of a vertical cross-section west-to-east through the site. The ground surface is at an elevation of between 410 feet MSL and 420 feet MSL. The ponded fly-ash is estimated to be 25-feet thick and lies on top of several feet of fine-grained clayey silts, silts, and fine silty sands. Beneath the west part of the site, the fine-grained sediments quickly grade into coarser sands and gravels. At about an elevation of 320 ft. MSL, a 5 to 10 feet thick layer of hard blue clay occurs, underlain by a nominal 10-feet thick bed of coarse sand, gravel, and rock fragments. The sand and gravel rest on top of shaley limestone bedrock at an approximate elevation of 305 ft. MSL. The east part of the site is predominantly underlain by fine-grained sediments. The sand and gravel zone appears to pinch out below the plant and is not recorded in logs for borings east of the plant.

The water table is shown corresponding to the mean elevation of 382 ft. MSL but can rise during high water to levels within the ash pond deposits. Based on data recorded by the U.S. Army Corps of Engineers 2 miles south of the facility, the mean high water stage at the site is approximately eight feet above normal (i.e. ~ 390 ft. MSL), and the mean low water stage is about six feet below normal (i.e. ~376 ft. MSL).

Under normal or low flow river stages, groundwater from the site flows to the rivers. The rivers act as boundary conditions for the alluvial groundwater onsite, preventing the groundwater from discharging elsewhere locally. Under flood conditions, the rivers act as groundwater divides, containing the site groundwater until the hydraulic gradient toward the river is restored as floodwater recedes. The specific interaction between the ash pond deposits and the alluvial groundwater is discussed below.

TABLE 1

Common Range of Values of Hydraulic Conductivity



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4. ASH POND EFFECTS ON GROUNDWATER

4.1 Ash - Groundwater Hydraulic Relationship

Under average river conditions, the water table at the site is several feet below the ash pond bottoms. However, perched water conditions often occur within the ponds when the inflow of water from the plant or rainfall exceeds the infiltration capacity of the ponds and the discharge from the retention basin.

Because of the low permeability of the fly ash, the vertical flux of water moving through the ash under gravity is significantly less than the horizontal flux of groundwater through the alluvium, particularly the upper sand and gravel zone. In addition, the interbedded nature of alluvial deposits exerts a strong anisotropy on the flow system causing horizontal conductivity to be orders-of-magnitude larger than vertical conductivity (Freeze and Cherry, 1979). In other words, relatively small quantities of slowly percolating water from the ash ponds will be influenced by the larger volume and predominantly horizontal component of groundwater flow in the upper sands and gravels, and will thus preferentially move laterally toward the rivers not vertically toward the underlying bedrock.

4.2 Ash Composition

As mentioned above, the ash ponds at the Meramec facility have been in existence for over 40 years. The ash from pond 489 was sampled and analyzed by UE in 1994 to determine its composition and to assess the leaching potential of the various chemical constituents of the ash. The samples were composited from three pond horizons: lower, middle, and upper.

The ash sample results were compared to background soil samples from two facility locations and also to average values determined for typical Missouri soils by the Geochemical Survey of Missouri (as referenced by UE in its September 22, 1994 report to the MDNR). Calcium (Ca), sodium (Na), arsenic (As), and boron (B), were found in the composite ash samples at levels above twice the site background concentration. Table 2 shows the composition of the fly-ash and local background soil samples as represented by the total soils analysis data.

Two standard leaching tests were performed on the ash samples: U.S. EPA Method 1311 Toxicity Characteristic Leaching Procedure (TCLP); and ASTM Method D-3987. The former test uses a buffered organic acid solution (pH 4.98) as the extraction fluid. The ASTM method uses neutral-pH water as the extraction fluid. Table 3 presents the results of the TCLP and ASTM leaching tests.

Onsite and background TCLP results for barium (Ba), cadmium (Cd), manganese (Mn), and lead (Pb) were above state surface water and groundwater standards. Onsite and background TCLP results for arsenic (As), mercury (Hg), and selenium (Se) exceeded state surface water standards.

TABLE 2
Total Soils Analysis

Parameters:	Total analysis, without extraction, of:					
	Pond 489 Ash Composites:				On-site Soils:	
	Lower	Middle	Upper	Mean	River Bank	Bluff Base
Conventional -						
Calcium	19,890	18,450	10,970	16,437	4,130	1,860
Iron	16,610	10,590	10,530	12,577	21,300	8,299
Magnesium	1,877	1,511	1,449	1,612	3,138	1,902
Sodium	623	366	776	588	79.4	71.3
Toxic metals -						
Arsenic	51	19	103	58	13	7
Barium	221.2	204.2	219.1	214.8	427.2	125.2
Boron	573.1	663.9	276.7	504.6	89.9	46.8
Cadmium	2.74	2.72	2.03	2.50	2.26	1.11
Chromium	39.04	36.48	32.80	36.11	18.87	13.37
Cobalt	10.8	7.5	11.1	9.8	14.8	9.2
Copper	32.75	20.68	42.30	31.91	34.16	9.90
Manganese	212.3	205.0	152.0	189.8	809.3	518.0
Mercury	<2	<2	<2	<2	<2	<2
Lead	44	23	78	48	239	18
Selenium	<1	<1	<1	<1	<1	<1
Silver	0.152	0.091	0.241	0.161	0.213	0.052
Zinc	164.7	156.5	154.1	158.4	133.9	49.7

All units are ug/g (ppm)

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TABLE 3

TCLP and ASTM Analysis of Ash

Parameters:		TCLP extract analysis of:						ASTM extract analysis of:							
		Pond 489 Ash Composites:				On-site Soils:		Pond 489 Ash Composites:				On-site Soils		Off-Site Soils	
		Lower	Middle	Upper	Mean	River Bank	Bluff Base	Lower	Middle	Upper	Mean	River Bank	Bluff Base	N.Tele. Road	S.Tele. Road
Conventional -															
Ammonia								0.05	0.01	0.6	0.22	0.05	0.03	0.13	0.23
Calcium	Run 1	790	910	514	738	105	47.4	46	44.6	30.5	40.36667	6.4	0.9	0.7	3.5
	Run 2	660	810	350	607	61	39.4	58.8	57.4	31.8	49.33333	7.3	1.7		
Chemical Oxygen Demand								2	3	71	25	17	16	40	65
Chloride								0.8	1.3	1.2	1.1	0.8	0.8	1.3	2.3
Flouride								0.2	0.2	0.8	0.4	0.3	0.3	0.23	0.35
Iron	Run 1	0.04	0.04	0.06	0.046667	0.21	0.08	0.02	<0.02	0.04	0.03	2.58	1.73	2.4	2.9
	Run 2	0.04	0.05	0.03	0.04	0.04	0.06	0.04	0.02	<0.02	0.027	3.96	4.3		
Magnesium	Run 1	13.4	10	12	11.8	23	9	0.57	0.53	1.5	0.866667	2.35	0.47	0.47	2
	Run 2	10.9	8	10.1	9.666667	16.4	8	0.7	0.5	1.4	0.866667	3	1		
Nitrate/nitrite Nitrogen								0.02	0.01	0.05	0.026667	0.5	0.07	0.03	0.11
pH								10.24	10.35	9.48	10.02333	8.74	8.72	5.44	6.57
Specific Conductance								298	291	227	272	85.3	26.9	47	60
Sodium								1.83	1.5	2.04	1.79	5.62	3.24		
Sulfate								92	72	68	77	28	20	26	24
Total Dissolved Solids								248	231	186	222	134	67	123	170
Total Phosphate								<0.01	0.01	0.09	0.04	0.02	0.02	0.19	0.23
Toxic metals -															
Arsenic	Run 1	0.010	0.008	0.012	0.010	0.005	0.005	0.056	0.015	0.180	0.084	0.002	0.004	<.005	<.005
	Run 2	0.015	0.016	0.042	0.024	0.013	0.014	0.033	0.015	0.085	0.044	0.006	0.005		
Barium	Run 1	4	3	7	5	16	11	0.02	0.02	0.03	0.023333	1.33	0.57	0.53	0.66
	Run 2	1	2	5	3	4	5	0.19	0.21	0.12	0.173333	0.89	0.57		
Boron	Run 1							6.06	6.24	4.07	5.456667	0.27	<0.2	0.15	0.13
	Run 2														
Cadmium	Run 1	0.04	0.04	0.04	0.04	0.03	0.02	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<.005	<.005
	Run 2	0.006	0.004	0.009	0.006	0.006	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002		
Chromium	Run 1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.005	0.004	0.006	0.005	0.003	0.002	<.005	<.005
	Run 2	0.049	0.075	0.009	<0.05	0.002	0.002	0.005	0.007	0.005	0.006	0.014	0.013		
Cobalt	Run 1							<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<.05	<.05
	Run 2														
Copper	Run 1	0.02	0.03	0.02	0.023333	0.01	0.01	0.002	<0.001	0.002	0.002	0.008	0.006	0.005	0.013
	Run 2	0.009	0.007	0.020	0.012	0.012	0.010	0.002	0.002	0.002	0.002	0.009	0.007		
Manganese	Run 1	1.8	1.2	2.1	1.7	1.5	0.5	<0.001	<0.001	0.002	0.002	0.020	0.022	0.010	0.040
	Run 2	1.2	0.68	1.5	1.126667	1.4	0.82	<0.001	<0.001	<0.001	<0.001	0.035	0.071		
Mercury	Run 1	0.0001	0.0001	0.0002	0.0001	0.0002	0.0004	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<.001	<.001
	Run 2	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
Lead	Run 1	0.4	0.33	0.27	0.333333	0.33	0.27	<0.001	<0.001	<0.001	<0.001	0.012	0.003	<.005	0.016
	Run 2	<0.01	<0.01	<0.01	<0.01	0.054	<0.01	<0.01	<0.01	<0.01	<0.01	0.031	<0.01		
Selenium	Run 1	0.017	0.013	0.019	0.016	0.007	0.004	0.002	<0.001	0.028	0.015	0.002	0.004	<.005	<.005
	Run 2	0.005	0.011	0.014	0.010	0.004	0.005	<0.001	<0.001	0.040	0.014	<0.001	<0.001		
Silver	Run 1	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<.005	<.005
	Run 2	0.006	0.009	0.004	0.006333	0.003	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
Zinc	Run 1	0.2	0.36	0.1	0.22	0.3	0.23	0.02	0.01	0.01	0.013333	0.11	0.06	0.04	0.04
	Run 2	0.2	0.14	0.4	0.246667	0.94	0.88	0.02	0.02	0.02	0.02	0.06	0.05		

All units for extractable analysis are mg/l, except pH (std units) and Specific Conductance (umhos/cm)

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Additionally, as you requested, we have included copies of the form C and water balance diagram recently submitted with our operating permit reapplication. As identified in the previously submitted engineering report, the only significant impact of this construction project on the existing ash pond discharge, Outfall 002, is expected to be a reduction in flyash slurry water (approximately 60-80%) and a subsequent reduction in the discharge flow at the outfall of approximately 30-40%.

Also, we have forwarded our soil investigation report and the final specification to DGLS. We have previously submitted our Land Disturbance Permit application for this project in our letter dated February 28, 1992.

As we noted in our December 30, 1991, letter, the construction phase of this project is still being planned for June 1992. We recognize this is a tight timetable. Although we believe the package to be complete, we are prepared to respond promptly to any questions you may have to help expedite the approval process.

If you have any questions or require further information, please contact Mr. Garrett Kramer of my staff at (314) 554-4581.

Thank you for your attention to this matter.

Very truly yours,

T. E. Siedhoff

T. E. Siedhoff
Manager
Environmental Services

GSK/ems

cc: R. H. Hentges (DNR-HQ)

SPECIFICATION NO. EC-2574

FOR

CONSTRUCTION OF NEW ASH POND

LABADIE PLANT

UNION ELECTRIC COMPANY

Engineering & Construction

Rev. No.	Date	Revisions	By	Approvals	
1	4/23/92	Initial Issue	CWR	CWR	4/23/92

I N D E X

SECTION 1A - SUPPLEMENTAL GENERAL CONDITIONS

1.0 GENERAL

This section of the specification is intended to clarify and supplement the General Conditions of Contract. Specific duties set forth herein are not meant to constitute an exclusive list of requirements but are intended to complement requirements of the General Conditions of Contract. The enumeration of "Contract Documents" in the first paragraph of Section II of the General Conditions of Contract is expanded to include these Supplemental General Conditions.

The work under this Contract shall include the furnishing of all materials, labor, equipment, tools, protection and incidental items necessary to complete in an acceptable manner and ready for use each portion of the work described in the Contract Documents.

2.0 INTENT OF SPECIFICATIONS AND DRAWINGS

The Contract Documents are complementary and any work called for by any part thereof shall be executed as part of the Contract in the same manner as if called for in all parts. Therefore, all work that may be called for in the specifications and not shown on the drawings, or shown on the drawings but not called for in the specifications, shall be executed and furnished by the Contractor as if described in both of these documents. Should any work or materials be required which is not denoted in the drawings, specification, or other Contract Documents either directly or indirectly, but which are necessary for the proper carrying out of the intent thereof, the Contractor is to understand the same to be implied and required, and shall perform all work and furnish all materials as fully as if they were particularly described.

3.0 ALTERNATE MATERIAL

These Contract Documents may contain items of material for which a certain manufacturer or type is specifically designated. The Contractor's proposal shall be based on furnishing only that specified type or manufacturer for that item of material. Consideration will be given to other manufacturer's material items only if included in the Contractor's original proposal as an alternate to the specification together with the corresponding increase or decrease in the Contractor's base price.

The Company reserves the right to accept or reject any such alternate items of material which may be offered. Approval or rejection of such items of material will be given within a reasonable period of time after award of the Contract and submittal of necessary details.

4.0 STANDARDS

The quality of workmanship, clearances, protection of workers, etc., shall be governed by applicable laws, ordinances and regulations of authorities having jurisdiction as well as applicable sections of standards as set up by the following organizations:

American Concrete Institute (ACI)
American Institute of Steel Construction (AISC)
American National Standards Institute (ANSI)
American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRE)
American Society of Mechanical Engineers (ASME)
American Society for Testing & Materials (ASTM)
Institute of Electrical and Electronic Engineers (IEEE)
National Electrical Code (NEC)
National Electrical Manufacturer's Association (NEMA)
National Electrical Safety Code (NESC)
National Fire Protection Association (NFPA)
Occupational Safety and Health Administration (OSHA)

5.0 PERMITS

The Company will be responsible for any building permits required by duly constituted authorities. The Contractor shall be responsible for obtaining all other permits, including any necessary for moving equipment over the city or county streets and state highways.

The Contractor shall comply with all laws, ordinances, rules and regulations of governmental authorities affecting the conduct of the proposed work. Before the completion of the contract, the Contractor shall furnish to the Company any and all certificates of approval resulting from required inspections.

6.0 BENCH MARKS

One bench mark with its assigned elevation will be furnished on the site by the Company. The Contractor shall furnish all field layouts and shall be responsible for the use of proper field dimensions and elevations. All such work shall be subject to approval by the Construction Supervisor at his discretion.

7.0 INSPECTION OF SITE

Before submitting a proposal, the Contractor should visit the site and become thoroughly familiar with existing conditions to which his work is in any way related and become fully informed as to the extent and character of the work required.

No consideration will be granted for any misunderstanding of the materials to be furnished or the work to be done, it being understood that the submission of a proposal is an agreement to all conditions referred to in the Contract Documents including those indicated on the drawings and specifications.

8.0 DRAWINGS, DETAILS & INSTRUCTIONS PROVIDED BY CONTRACTOR

The Contractor shall submit to the Company, with such promptness as to cause no delay in the performance of the work, copies of shop drawings, equipment details, installation, operating, and maintenance instructions, wiring diagrams, parts lists, etc., as required below. No purchasing, fabrication, erection processing or shipping of the aforementioned material or equipment may begin until the drawings or details have been reviewed by the Engineer.

The Contractor shall submit five (5) copies of the above information, four (4) of which the Company will retain for its permanent file. One copy will be returned.

These submittals will be reviewed and approved for general design features only. Approval will not relieve the Contractor of responsibility for proper dimensions, quantities, accuracy, fit, adequacy of details, and coordination with other trades. Deviations from Contract Documents are not approved unless specifically requested in writing by Contractor and approved in writing by the Company.

Should field changes be required, such changes shall be promptly documented by the Contractor and submitted to the Company in the form of as-built drawings as required above.

9.0 TESTING OF MATERIALS, ETC.

The Contractor shall furnish free of charge any samples necessary for testing. The Company will pay for routine tests performed on concrete or masonry. The Contractor will pay for all others.

The Contractor, when called upon, will furnish to the Company three (3) copies of test reports, literature, etc., pertaining to material used or to be used by him or his subcontractor in this work.

10.0 LABOR CONDITIONS

Contractor shall comply with and shall cooperate with the Company in enforcing jobsite conditions which directly affect the performance of the work including but not limited to starting and quitting time, smoking regulations, check-in and check-out procedures, job safety regulations and daily clean-up. Contractor shall enforce the following work rules:

A. Workmen shall be at their place of work at the starting time and shall remain at their place of work until the quitting time.

B. There shall be no limit on production by workmen nor restrictions on the full use of tools or equipment. There shall be no restriction, other than may be required by safety regulations, on the number of men assigned to any crew or to any service.

C. Slowdowns, standby crews and featherbedding practices will not be tolerated.

D. If a steward is included in the labor force, he shall be a qualified workman performing work on his craft and shall exercise no supervisory functions. There shall be no non-working stewards.

E. There shall be no illegal strikes, work stoppages or lockouts.

F. When a local union does not furnish qualified workmen within 48 hours (Saturdays, Sundays and holidays excluded), the Contractor shall be free to obtain workmen from any source.

G. It is agreed that overtime is undesirable and not in the best interests of the industry or the craftsmen. Therefore, except in unusual circumstances, overtime will not be worked. Where unusual circumstances demand overtime, such overtime will be kept to a minimum. Under no circumstances will regularly scheduled overtime (5 ten hour days, etc.) be considered.

The Contractor shall assure that its Subcontractors of all tiers shall comply with the provisions herein set forth.

11.0 SUPERINTENDENCE

The Contractor shall keep on the work at all times during its progress, a competent superintendent and any necessary assistants.

The Contractor shall employ craft foreman who have passed a qualified foreman's training program when such training is offered by the foreman's respective craft. Contractor shall provide certificates of completion of said training to the Construction Supervisor before foreman starts on job.

12.0 PERFORMANCE REQUIREMENTS

The Work shall be performed by Contractor at the times stated and in accordance with the provisions of these Contract Documents.

All overtime worked at the discretion of the Contractor must be approved in writing by the Company and all costs will accrue to Contractor's account. The Company reserves the right to require Contractor to perform overtime work at Company's written direction.

13.0 WORK LIMITATIONS

Care must be exercised at all times to maintain safe clearance and safe working practices, both for equipment and personnel, in order to avoid injury or service interruption. All job personnel must be made thoroughly acquainted with hazards involved. It shall be the Contractor's responsibility, working with the Construction Supervisor, to make this condition clear to all Contractor's personnel.

The Contractor shall at all times perform his work to conform with the Company's safety practices and operating procedures. Should an outage of Company equipment be required during the course of the work, the Contractor shall obtain all outages and releases in accordance with the Company's Workman's Protection Assurance Procedures. The appropriate procedure, based on the Operating Manual for the Union Electric System, is included as an appendix to this specification.

High voltage may be present on circuits or equipment at the site during construction period. The Contractor shall at all times perform his work to conform with the Company's safety practices and operating procedures as mentioned above.

No explosives may be used without written permission from the Company.

Any additional work limitations are set forth in an appendix and become a part of this specification.

14.0 DELIVERY AND STORAGE

The Contractor shall provide suitable facilities and shall store all materials supplied by him. Storage of the material and equipment on the jobsite areas shall be as designated by the Construction Supervisor and so located that it will not interfere with the Company's personnel or operations.

Materials provided by the Company will be stored in a suitable location by the Company if received prior to the Contractor's presence at the site. Any materials received thereafter will be unloaded and stored by the Contractor. The Contractor shall be responsible for inspecting and hauling all materials from point of storage to the job site unless otherwise stated in specification.

It shall be the Contractor's responsibility to perform inventory and ascertain that all materials are on hand as required. He shall notify the Company's Construction Supervisor at once of any material shortages or damage to allow replacement without delaying the progress of the work. After acceptance of equipment or material, Contractor will be responsible for loss or damage.

After completion of the work the Contractor shall inventory and haul all excess material, furnished by the Company, to designated Company storage location(s), and shall restore all construction storage areas to a reasonably satisfactory condition as directed by the Construction Supervisor.

15.0 PROTECTION OF WORK AND PROPERTY

The Contractor shall:

A. Be responsible for repairing any damage to any building, walkway, etc., arising in connection with the work performed. For damage due to causes beyond the reasonable control of the Contractor, any of the subcontractors or any of the Contractor's or subcontractor's officers, agents, servants, or employees, the Company will reimburse the Contractor for such expense of repairing the damage.

B. Bear the responsibility for repairing and/or replacing any equipment or materials damaged by the Contractor.

C. Maintain adequate protection for his work and materials at all times to prevent damage from Company operating activities.

D. Post warning signs adjacent to all work areas indicating the hazards created by the construction in progress.

E. Provide necessary temporary lighting, wiring, globes, guard lights, barricades or any other items required by regulations, standards or laws established for public protection and safety or to facilitate the work.

The adequacy of all safeguards is the responsibility of the Contractor. The Construction Supervisor may order additional safeguards, signs, coverings, etc., when he deems it necessary.

16.0 SECURITY

The Contractor shall be responsible for providing a level of security that will ensure control, accountability, and protection to the work area, tools, materials and equipment involved in the execution of this contract.

17.0 REMOVALS AND PREPARATORY WORK

The Contractor shall cooperate with the Construction Supervisor in scheduling removal work so as to cause a minimum disruption to Company's personnel or operations.

The Contractor shall provide protective enclosures, covers, water stops, etc., necessary to prevent water damage to existing building areas during construction.

Materials removed from existing facilities become the property of the Contractor unless otherwise specified elsewhere in the Specification or on the drawings and shall be promptly removed from the site. The Construction Supervisor will designate areas where the removed items retained by the Company shall be stored. All retained materials shall be neatly stored and protected from the elements as necessary to prevent damage.

18.0 CUTTING, PATCHING, ETC.

The Contractor shall do all cutting, fitting, or patching that may be necessary to make the several parts come together properly and fit to receive the work of other Contractors.

19.0 TEMPORARY HEAT

The Contractor shall provide temporary heat as necessary to protect all work materials against damage from dampness and cold to the satisfaction of the Construction Supervisor.

20.0 CLEAN-UP

The Contractor shall maintain good housekeeping while performing the work. Upon completion of the work, the Contractor shall remove all excess material and debris and leave the area in a condition satisfactory to the Construction Supervisor.

21.0 OWNER APPROVAL OF PROCEDURE, ETC.

The procedures, methods, and materials agreed to in the Contract Documents shall not be deviated from without consent of the Company.

The Company reserves the right of approval over all procedures, methods, and materials to be employed by the Contractor for this work.

22.0 INSPECTION, REJECTION OF MATERIALS AND WORKMANSHIP

The Contractor shall, at its own expense, provide safe and necessary facilities and all samples, documents, drawings and lists necessary for complete inspection of the work. If Contractor covers all or any portion of the work prior to any required inspection or test by the Company, the cost of any necessary uncovering and replacing shall be borne by Contractor. Neither the failure to make such inspection nor to discover defective workmanship, materials or equipment nor approval of or payment to Contractor for such work, materials or equipment shall prejudice the rights of the Company thereafter to correct or reject the same as hereinafter provided.

23.0 EXTENSION OF TIME-CONTRACTOR'S WAIVER OF DAMAGES FOR DELAY

If Contractor's performance of the Work be delayed by any condition beyond the control and without the fault or negligence of Contractor and which was not foreseeable by Contractor at the time this contract was entered into, Contractor shall, within seven (7) days of the commencement of any such delay give to the Company written notice thereof and of the anticipated results thereof. Within seven (7) days of the termination of any such delay, Contractor shall file a written notice with the Company specifying the actual duration of the delay. Failure to give either of the above notices shall be sufficient ground for denial of an extension of time. If the Company determines that the delay was beyond the control and without the fault or negligence of Contractor and not foreseeable by Contractor at the time this contract was entered into, the Company shall determine the duration of the delay and shall extend the time of performance of this contract thereby.

Contractor shall not be entitled to, and hereby expressly waives recovery of any damages suffered by reason of the delays contemplated by this Paragraph 23 and extension of time shall constitute Contractor's sole remedy for such delays.

24.0 ACCOUNTING

The Contractor shall furnish complete accounting information and cooperate with the Company's accounting practice.

25.0 FINAL ACCEPTANCE BY OWNER

As soon as practicable after completion of all the work, full inspection and/or tests will be made by the Company. When such inspection and/or tests have proved that the work is in accordance with the requirements of this contract, the Manager of Construction shall notify Contractor in writing of final acceptance of the work. Use of the work by the Company and/or another contractor does not constitute acceptance.

SECTION 1B - SUMMARY OF WORK

1.0 INTRODUCTION

The intent of this specification is to provide the services of a Contractor and certain items of material necessary to construct a new ash pond complete with a liner at the Labadie power plant located outside of Labadie, Missouri.

This Contractor will work in close harmony with other Contractors or Union Electric personnel who may be employed at this site. In the event of differences of opinion regarding scheduling of work, the decision of the company will be final and binding.

2.0 DESCRIPTION OF WORK

The scope of work shall consist of procuring, delivering, receiving, unloading at the worksite, storing, and installing all materials and other items necessary to perform the work as described below:

A. Site Clearing: Clear the pond area and fill areas of all trees, plants, debris, and other items as required to permit grading of the site as detailed on the drawings. Cleared vegetation and debris shall be in disposed of accordance with Section 02200 of the specification.

B. Grading:

* Remove approximately the top 6" of topsoil, vegetation, etc. Stockpile topsoil and stockpile.

* Excavate the soil from within pond basin, construct the new ash pond 27'-6 high dikes (south and west side of the pond) and the 3'-0 high berms (north side of the pond) by placing and compacting the excavated material in accordance with Section 02200 of the specification. The elevation of the top of the liner in the southwest corner adjacent to the pumping station shall be 460.0.

* The cleared existing slopes on the north and west side of the pond shall receive 6" of compacted clean soil to cover all rocks, tree roots, grass, etc. This soil shall be compacted with a drum

roller to provide a smooth surface for placement of synthetic liner.

* Finish grade the pond bottom to provide a constant slope from all parts of the pond down to the pumping station (elev 460.0). Final compaction of the pond bottom shall be performed with a drum type roller to provide a smooth surface for placement of synthetic liner.

* Spread and compact the stockpiled topsoil over the top and outside face of the new dikes and on all surfaces of the new 3'-0 high berms.

C. Erosion Protection: Provide and install a continuous line of straw bales along property lines and other erosion prone areas, if required for erosion control during construction.

D. Pumping Structure: Construct the pumping structure as detailed in the drawings. This structure will house submersible pumps which will be used to pump excess water from the new pond to the existing pond.

E. Liner Installation: Provide and install a 40 mil High Density Polyethylene (HDPE) pond liner over the entire pond bottom and a 60 mil HDPE liner over the inside face of all surrounding dikes. The liner shall be installed in accordance to the manufacturers specifications including quality control testing as specified in the approved manufacturer's QC manual.

F. Seeding: Preparation of the seed bed, fertilization, seeding, and mulching of the top and outside face of the new dikes and all surfaces of the 3'-0 high berms. Water and maintain seeded areas for six weeks from date of seeding.

3.0 COMPANY AND MANUFACTURER'S DRAWINGS

3.1 Provided By Union Electric

The following drawings are intended to indicate the scope of the work to be done and details necessary for the installation of items set forth in this specification, and are part of this specification. These drawings in general are to scale, but figures shall always be followed and drawings are not to be scaled. In case of errors or discrepancies, the Engineer shall be consulted for the adjustment of all complication arising therefrom. The Engineer's decisions shall be final.

The Contractor shall field verify the dimensions as noted and shall give due consideration to the areas where field fitting and adjustments will be required in congested areas as noted on the drawings.

U.E. Drawing No.	Rev. No.	Drawing Title/Description
8500-X-126563	2	Property - Plan New Ash Pond
8500-X-124893	0	Property - Plan Proposed Ash Pond
8500-X-124136	1	Property Plan New Roadway & Ash Pond
8500-X-124829	0	Ash Silo/Truck Loop Site And Grading Plan
8500-X-124830	0	Ash Silo/Truck Loop Profile And Details

3.2 Provided by the Contractor

The contractor shall submit to the Company, with such promptness as to cause no delay in the performance of the work, 5 copies of shop drawing, product data sheets, etc., as required by this specification. No purchasing, fabrication, erection, processing, or shipping of the aforementioned materials may begin until the required documentation has been reviewed by the Engineer.

Samples and data required to be submitted to Union Electric shall be forwarded to :

Union Electric Company
J. W. Rinke - Manager, Construction
P.O. Box 149, Mail Code 450
St. Louis, MO 63166

Approval samples and data sheets shall be reviewed and returned to the Contractor within ten working days after receipt. Approval is for general design features only and will not relieve the Contractor of responsibility for proper quantities, adequacy of details, and coordination with other trades. Deviation from contract Documents are not approved unless specifically requested in writing by the Contractor and approved in writing by the Company.

Should field changes be required, such changes shall be promptly documented by the Contractor and submitted to the Company in the form of as-built drawings.

4.0 MATERIALS AND EQUIPMENT SUPPLIED BY THE COMPANY

The materials and equipment that are to be furnished by the Company are listed in the schedule below:

NONE

5.0 MATERIALS AND EQUIPMENT FURNISHED BY THE CONTRACTOR

All materials, equipment, tools, and any incidental items (except those specifically stated above) necessary to complete each portion of the work described herein and/or shown on the drawings shall be furnished by the Contractor.

6.0 UTILITIES, FACILITIES, AND MISCELLANEOUS

The following utilities, facilities, etc., shall be provided as indicated.

	Item	Provided By
A.	Telephone Service for Use of Construction Forces	Contractor
B.	Sanitary Facilities	Contractor
C.	Drinking Water	Contractor
D.	Construction Water	Contractor
E.	Electric Service	Contractor

7.0 SCHEDULE

The Contractor shall be required to furnish the Company with a complete schedule of the Work to be performed under this contract broken down by activity. The schedule shall include a listing of the Contractor's estimate of mandays required for each activity by craft. The schedule shall be included as part of bid package presented by the Contractor.

The schedule shall comply with the dates and guidelines listed below:

A. The required finish date of this contract is **November 1, 1992.**

D. The level of detail in each schedule shall be sufficient to permit the Company to monitor the Contractor's performance relative to the specified guidelines. The activities should be depicted in such a manner that precedent relationships between activities are shown.

E. The Contractor shall furnish update reports at two (2) week intervals until the work is completed. These reports shall indicate by activity the scheduled % of completion as shown on the original schedule, the actual % completion as of the date of the report, and the number of mandays expended on the project to date.

If at any time during this Contract, when the Contractor's actual progress, in the opinion of the Company, is such that the completion dates of the work will not be met, the Contractor shall participate in a re-evaluation of the remaining work.

If, as a result of this re-evaluation of the remaining work, it is determined by the Company that the completion date will not be met, the Company retains the right to direct the Contractor to accelerate the construction program. It shall be the responsibility of the Contractor to initiate and comply with such corrective action as required or directed.

At the time of the award of this contract, scheduling requirements will be discussed in detail by all interested parties.

SECTION 02200

SITE PREPARATION AND EARTHWORK

PART 1 - GENERAL

A. SUMMARY

This Section includes all excavating, trenching, filling, embankment construction, backfilling, compacting, grading and all related items necessary to complete the work indicated or specified.

B. REFERENCES

1. Applicable Standards

a. American Society For Testing and Materials (ASTM):

(1) C88 - Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.

(2) D698 - Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-Pound (2.49 kg) Rammer and 12-Inch (304.8 mm) Drop.

(3) D1241 - Materials for Soil-Aggregate Subbase, Base and Surface Courses.

(4) D4253 - Maximum Index Density of Soils Using a Vibratory Table.

(5) D4254 - Minimum Index Density of Soils and Calculation of Relative Density.

b. Occupational Safety and Health Administration (OSHA):

(1) Part 1926 - Safety and Health Regulations for Construction.

C. SUBMITTALS

1. Submit as specified in DIVISION 1.

2. Where selecting an option for excavations, trenching and shoring design from "OSHA Part 1926," which requires design by a Registered Professional Engineer, submit (for information only and not for Engineer approval) copies of design calculations and notes for sloping, benching, support systems, shield systems, and other protective systems approved by the Registered Professional Engineer obtained by Contractor.

PART 2 - PRODUCTS

A. MATERIALS ENCOUNTERED

1. Materials suitable for use in embankment and fill include material that is free of debris, roots, organic matter, frozen matter and which is free of stone having any dimension greater than 2 inches in areas requiring a high degree of compaction, or 4 inches in other embankment and fill areas.

    a. Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands generally exclusive of clayey and silty material--materials which are free-draining and for which impact compaction will not produce a well-defined moisture-density relationship curve and for which the maximum density by impact methods will generally be less than by vibratory methods.

    b. Cohesive materials include silts and clays generally exclusive of sands and gravel--materials for which impact compaction will produce a well-defined moisture-density relationship curve.

2. Materials unsuitable for use in embankment and fill include all material that contains debris, roots, organic matter, frozen matter, stone (with any dimension greater than 2 inches in areas requiring a high degree of compaction or 4 inches in other embankment and fill areas), or other materials that are determined by Engineer as too wet or otherwise unsuitable for providing a stable subgrade or stable foundation for structures.

3. All materials encountered, regardless of type, character, composition and condition thereof shall be unclassified. Rock encountered shall be handled at no additional cost to Owner.

4. Waste material includes excess usable materials and materials unsuitable for use in the Work.

5. Borrow materials shall be obtained from areas shown on the plans.

B. GRANULAR MATERIAL

1. Granular bedding material except for use with High Molecular Weight -High Density Polyethylene (HDPE) pipe shall be crushed stone or gravel indicating a loss of not more than 15 percent after 5 cycles when tested for soundness with sodium sulfate as described in ASTM C88. Granular bedding material shall conform to ISSRBC SECTION 704 -"COURSE AGGREGATE," gradation No. CA 11.

Percent Passing	Sieve Size
100	3/4-inch
60-100	1/2-inch
0-5	No. 4

2. Granular bedding material for HDPE pipe shall be clean natural sand conforming to ISSRBC SECTION 703 - "FINE AGGREGATES."

C. EMBANKMENT AND FILL MATERIAL

1. Material shall be free of roots or other organic matter, refuse, ashes, cinders, frozen earth or other unsuitable material.

2. Use for embankment suitable material sufficiently friable to provide a dense mass free of voids and capable of satisfactory compaction.

3. Do not use material containing gravel, stones, or shale particles greater in dimension than one-half the depth of the layer to be compacted.

4. Moisture content shall be that required to obtain specified compaction of the soil.

5. Perform any wetting or drying of the material as required to (obtain the specified density when compacted.

D. TRENCH STABILIZATION MATERIAL

Granular material as specified or conform to ASTM D1241, Gradation A or B, well-graded, with not more than 10 percent passing No. 200 sieve.

PART 3 - EXECUTION

A. SITE PREPARATION

1. Clearing, Grubbing and Demolition

   a. Perform only in areas where earthwork or other construction operations are to be performed.

   b. Protect tops, trunks, and roots of existing trees which are to remain on the site.

   c. Clear areas and dispose of other trees, brush and vegetation before starting construction.

   d. Remove tree stumps and roots larger than 3 inches in diameter and backfill resulting excavations with approved material.

   e. Remove existing construction to limits indicated or as required to accommodate new construction.

   f. Dispose of debris by burning on the site as directed and in a manner acceptable to Construction Supervisor.

2. Stripping: Remove topsoil from areas within limits of excavation, trenching and borrow and areas designated to receive embankment, and compacted fill as follows:

   a. Scrape areas clean of all brush, grass weeds, roots and other material.

   b. Strip to depth of approximately 6 inches or to a sufficient depth to remove excessive roots in heavy vegetation or brush areas and as required to segregate topsoil.

   c. Stockpile topsoil in areas where it will not interfere with construction operations or existing facilities. Stockpiled topsoil shall be reasonably free of subsoil, debris and stones larger than 2 inches in diameter.

   d. Remove waste from the site or dispose of on site as directed by Engineer.

B. EXCAVATION AND TRENCHING

1. Sheeting and Bracing:

   a. Use when required by the specifications or drawings and where resulting slopes from excavation or trenching might endanger in-place structures or utilities.

b. Provide materials on site prior to start of excavation. Adjust spacing and arrangement as required by conditions encountered.

c. Remove sheeting and bracing as backfill progresses. Fill voids left after withdrawal with sand or other approved material.

2. Explosives: Blasting will not be permitted.

3. Excavation for Structures:

   a. Excavate area adequate to permit efficient erection and removal of forms.

   b. Trim to neat lines where details call for concrete to be deposited against earth.

   c. Excavate by hand in areas where space and access will not permit use of machines.

   d. Notify Engineer immediately when excavation has reached the depth indicated.

   e. Restore bottom of excavation to proper elevation with concrete or compacted granular material in areas overexcavated.

4. Trenching for Underground Utilities:

   a. Side Walls:

      (1) Make vertical or sloped within specified trench width limitations below a plane 12 inches above top of pipe.

      (2) Make vertical or sloped (stepped) as required for stability, above a plane 12 inches above top of pipe.

      (3) Excavate without undercutting.

   b. Trench Depth:

      (1) Excavate to depth sufficient to provide the minimum bedding requirements for the pipe being placed.

      (2) Do not exceed that indicated where conditions of bottom are satisfactory.

      (3) Increase depth as necessary to remove unsuitable supporting materials.

c. Trench Bottom:

(1) Protect and maintain when suitable natural materials are encountered.

(2) Remove rock fragments and materials disturbed during excavation or raveled from trench walls.

(3) Restore to proper subgrade with trench stabilization material when overexcavated. Payment shall conform to the unit price stipulated in the BID FORM for authorized replacement of unsuitable materials. Correct at no additional cost to Owner when trench is overexcavated without authority or to stabilize bottom rendered unsuitable through negligence or improper operations.

d. Trench Width:

(1) Excavate trench to a width which will permit satisfactory jointing of the pipe and thorough tamping of bedding.

(2) Do not exceed following trench widths:

(a) Below a plane 12 inches above top of pipe.

Nominal Pipe Size	Trench Width	
	Minimum	Maximum
Less than 24 inches	Pipe od + 1 foot	Pipe od + 2 feet 24
inches and larger	Pipe od + 2 feet	Pipe od + 3 feet

(b) Above plane defined in (a), no maximum limit.

(c) Maximum trench width limitations shall apply in all areas more than 3 feet from manhole or structure walls.

(d) Maximum width shall be as near the minimum specified as can be controlled by construction equipment and methods utilized.