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Leachate Management and Final Cover Alternatives Analysis Report

Hutsonville Power Station
Unlined Ash Impoundment (Pond D) Closure
Hutsonville, IL

July 19, 2005

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LEACHATE MANAGEMENT AND FINAL COVER ALTERNATIVES ANALYSIS REPORT

HUTSONVILLE POWER STATION
UNLINED ASH IMPOUNDMENT (POND D) CLOSURE
HUTSONVILLE, IL

Project No: 1375

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EXECUTIVE SUMMARY

The Hutsonville Power Station in Crawford County Illinois is located on the west bank of the Wabash River approximately 1 mile north of Hutsonville, Illinois. Fly ash from this coal-fired power plant is collected by an electrostatic precipitator and has been sluiced to two ash impoundments.

Groundwater quality has been monitored at this facility since 1984. Concentrations of boron and sulfate, indicator parameters of coal ash leachate, exceed the Section 811.320 applicable background concentrations and Illinois Class I Groundwater Quality Standards at several shallow monitoring wells near an unlined impoundment, Pond D, which is no longer in service. Impacted groundwater is migrating east towards the Wabash River through shallow sediments, which are not utilized as a source of groundwater supply. Elevated concentrations were also noted in shallow monitoring wells along the south property boundary, suggesting potential for off-site migration; however, impacts have not been noted in water samples collected south of the impoundment.

There are five groundwater supply wells within ½ mile of the site, all finished in deep alluvial sand and gravel in the Wabash River valley. Two wells directly east of the unlined impoundment are used for potable and process plant water, and one well southwest and two wells southeast of the impoundment are used for irrigation water. Concentrations of boron and sulfate in samples collected from one on-site monitoring well were higher than 811.320 background concentrations, but lower than Class I groundwater quality standards. Six other monitoring wells screened in the deep alluvial aquifer on the Illinois side of the river show no evidence of impacts.

The primary objective of this alternatives analysis was to evaluate and make recommendations on leachate management, deep alluvial aquifer containment, and final cover alternatives for closure of the unlined ash impoundment (Pond D), based on technical and cost considerations. Alternatives analysis objectives, herein referenced as "Closure Objectives", were identified to protect human health and the environment for both the parameters of concern (POCs, identified in the Hydrogeologic Assessment) and to limit exposure pathways in accordance with applicable environmental standards. Site-specific considerations for establishing appropriate Closure Objectives for Pond D include proximity of the Wabash River to Pond D, hydrogeology and groundwater quality in the vicinity of Pond D, and the presence or absence of exposure pathways for identified POCs (groundwater, soil, and surface water). Based on a review of the regulations promulgated in 35 Illinois Administrative Code (IAC) Part 811 and 814 and site-specific considerations identified above, the following Closure Objectives were developed:

- Manage groundwater quality to meet the requirements of Section 811.320; and
- Construct a final cover system that meets the requirements of Part 811 or an adjusted standard approved by the Illinois Pollution Control Board (PCB).

Specific parameters for performing the alternatives analysis were developed on the basis of: 1) the results of the *1999 Hydrogeologic Assessment, the Groundwater Model Evaluation of Impoundment Closure Options* dated January 2000, and two supplemental investigations performed for this analysis; 2) groundwater flow and transport modeling for selected alternatives; and 3) considerations for pursuing adjusted standards through the Illinois PCB. Four final cover alternatives and four combinations of final cover and leachate management alternatives were carried through the groundwater transport modeling evaluation. Subsequent to the model analysis, four alternatives were selected for detailed analysis:

- Closure Alternative No. 1: Geosynthetic Final Cover with East and South Interceptor Drain/Trench and Groundwater Extraction from the Deep Alluvial Aquifer. This closure alternative adheres to the Section 811.314 requirements for a final cover system, and implements leachate collection along the east and south boundaries of Pond D and groundwater extraction in the deep alluvial aquifer to meet the requirements for meeting applicable groundwater quality standards at the edge of the "zone of attenuation" as defined in Section 811.320(c).

- Closure Alternative No. 2: Earthen Final Cover with South Interceptor Drain/Trench. This closure alternative balances lower cost with leachate collection and is designed to prevent off-site migration of groundwater to the south. Adjusted standards would be required to implement this closure alternative.

- Closure Alternative No. 3: Earthen Final Cover. This closure alternative represents the lowest cost alternative for closure of Pond D and would require adjusted standards to seek relief from several sections of Part 811 and Part 814.302(b)(1).

- Closure Alternative No. 4: Pozzolanic Fly Ash Final Cover. This closure alternative provides equivalent effectiveness to Closure Alternative No. 3 and has the added benefit of providing renewed capacity for the active (Pond A) fly ash impoundment. This alternative would require adjusted standards to seek relief from several sections of Part 811 and Part 814.302(b)(1) utilizing technology and construction techniques substantially similar to those promulgated in 35 IAC Part 816 (Alternative Standards for Coal Combustion Power Generating Facilities Waste Landfills).

Surface water management was considered for each of the selected alternatives. The optimal alternative routes surface water east toward the Wabash River and west toward a drainage collection pond.

Costs for each of the closure alternatives and the alternate final cover are summarized below:

- Closure Alternative No. 1 has the highest initial capital cost ($6.8 million) and highest operating and maintenance cost ($3.1 million over 30 years), based on 2003 dollars. Ease of implementation and performance are not concerns as the remedial components consisting of a geosynthetic cover, leachate collection via an interceptor drain/trench and groundwater extraction in the deep alluvial aquifer are demonstrated technologies that are widely available.

- Closure Alternative No. 2 provides significant cost savings versus Alternative No. 1 in up-front capital cost ($4.7 million) and a lower operating and maintenance cost ($1.1 million over 30 years). Predicted performance, effectiveness, and reliability along the south impoundment boundary are nearly equivalent to Closure Alternative No. 1.

- Closure Alternative No. 3 represents the lowest cost alternative with significant savings in up-front capital ($4.2 million) and low operating and maintenance cost ($0.2 million over 30 years). Groundwater transport modeling suggests that an earthen cover may provide performance and long term effectiveness along the south property boundary similar to Closure Alternatives No. 1 and 2.

- Closure Alternative No. 4 provides performance, reliability, and effectiveness equivalent to the final covers proposed for each alternative at a mid-range capital cost for final cover

($4.5 million) and with low long term operating and maintenance costs ($0.2 million over 30 years). An adjusted standard would be required to gain regulatory acceptance for the technology for construction of a pozzolanic fly ash cover; however, regulatory precedent exists for similar construction of final covers (35 IAC Part 816).

Each of the four alternatives is potentially appropriate for the site with similar performance and effectiveness, and reflects a range of approaches contingent on capital expenditure and varying approval of adjusted standards with the Illinois PCB. However, Closure Alternative No. 4, the Pozzolanic Fly Ash Cover, provides the best balance of capital expenditure and pursuit of adjusted standards for the following reasons:

- Groundwater transport modeling indicates that a pozzolanic fly ash final cover system will have similar performance and effectiveness as a cover system that meets the requirements of Section 811.314 (e.g., geosynthetic final cover).
- Groundwater transport modeling indicates that the pozzolanic fly ash final cover will achieve the Class I Groundwater Quality Standards along the south property boundary (MW-11R) within approximately 16 years, which compares favorably to the ten-year period predicted for Alternative No. 1. This alternative should satisfy long-term regulatory concerns with off-site migration.
- No leachate management is proposed along the east impoundment boundary. However, groundwater impacted by ash leachate discharges to the Wabash River and does not threaten any downgradient groundwater receptors. Based on this discussion, pursuit of an adjusted standard for the applicable groundwater quality standards along the east edge of the "zone of attenuation" is warranted.
- Regulatory precedent exists (35 IAC 816) for construction of a pozzolanic fly ash final cover system using substantially similar technology and construction techniques.
- Significant cost savings may be realized through construction of a pozzolanic fly ash final cover by providing additional capacity for fly ash in Pond A. Based on this discussion, pursuit of an adjusted standard for construction of a pozzolanic fly ash final cover is warranted.

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1 INTRODUCTION

1.1 Background

Ameren Energy Generating operates the Hutsonville Power Station in Crawford County Illinois (Figure 1-1). The power station is located on the west bank of the Wabash River, 1 mile north of the city of Hutsonville (SW ¼, Section 17, Township 8N, Range 11W). The coal fired power plant has been in operation since the 1940's. There are currently two units operating at the plant, completed in 1953 (unit 3) and 1954 (unit 4), with a combined generating capacity of 164 MW. Fly ash from the operating units is collected by an electrostatic precipitator and sluiced to a 12-acre lined ash impoundment (Pond A, Figure 1-2), which was constructed in 1984. Bottom ash is sluiced to a separate pond and eventually recycled. Sluice water from Pond A is routed through a 4.2-acre lined interim pond (Pond B, constructed in 2000) before discharge to the Wabash River via a NPDES permitted outfall #002 (IL0000175). Sluice water from the bottom ash pond is routed through a 1.7-acre drainage collection pond (Pond C, constructed in 2000) and Pond B before discharge to the Wabash River via the same outfall.

The site also has a 22-acre unlined ash impoundment (Pond D), which was constructed in 1968. This impoundment was the primary ash management unit prior to construction of Pond A in 1984, and was used as a secondary settling pond from 1984 through construction of Pond B in 2000. It has been inactive since 2000, although precipitation and flood backwater have accumulated in the impoundment at times, resulting in ponded conditions.

Groundwater quality has been monitored at this facility since 1984. Concentrations of boron and sulfate at several monitoring wells exceed the 35 Illinois Administrative Code (IAC) 811.320 groundwater quality standards (Section 811.320 applicable background concentrations) and the Illinois Class I groundwater quality standards. Boron and sulfate are indicator parameters for coal ash leachate. In response to these findings, Ameren Services contracted Science & Technology Management, Inc. (STMI) and Natural Resource Technology Inc. (NRT) to perform a Hydrogeologic Assessment that was completed in August 1999.

The Hydrogeologic Assessment identified a correlation between shallow groundwater quality (elevated boron and sulfate concentrations in groundwater) and potential leachate sources, namely the former ash laydown area (which was excavated prior to construction of Ponds B and C) and the unlined ash impoundment (Pond D). Boron and sulfate are migrating east towards the Wabash River; however, there are no groundwater supply wells in the shallow sediments between the unlined ash impoundment and the Wabash River.

There are four groundwater supply wells within ½ mile of the site, all finished in a deep alluvial sand and gravel aquifer in the Wabash River valley. Two wells are directly east of the unlined impoundment and are used for plant water, and two wells are southeast of the impoundment and used for irrigation water. Groundwater quality data from monitoring well MW-14, which is directly southeast of the unlined ash impoundment and is screened in the deep alluvial sand and gravel, indicates evidence of ash impoundment impacts in that aquifer, based on comparison to Section 811.320 applicable background concentrations. However, concentrations are lower than the Illinois Class I groundwater quality standards.

1.2 Investigation Time Line

1999	The *Hydrogeologic Assessment* report characterizes hydrogeology at the site and identifies Pond D and an ash laydown area as the sources of shallow groundwater quality impacts at the site. No evidence of groundwater impacts are found in the deep alluvial aquifer.
2000	A *Groundwater Model Evaluation of Impoundment Closure Options* concludes that dewatering of Pond D will reduce leachate loading to the Wabash river by more than 80 percent; however, no capping option will result in attainment of Class I groundwater quality standards due to continuing groundwater flow through ash deposited below the water table.
2000	Ash in the former ash laydown area is removed, Ponds B and C are constructed, and Pond D is permanently removed from service.
2001	A supplemental site investigation is performed for this alternatives assessment. Additional monitoring wells are installed in the deep alluvial aquifer. There is no evidence of ash impacts in the deep alluvial aquifer.
2002	Research is performed for an innovative approach to capping Pond D.
2003	The first draft of this *Alternatives Assessment* report and a petition for adjusted standards is completed. After a meeting and discussion of preliminary results, IEPA determines that a *Groundwater Impact Assessment* is required for the deep alluvial aquifer.
Spring 2004	After delays in obtaining site access on off-site private property, an investigation is performed to characterize hydrogeology in the deep alluvial aquifer.
2005	During a data review, it is determined that MW-14 has elevated boron and sulfate concentrations. In response to this finding, it is determined that the *Groundwater Impact Assessment* is no longer necessary, and a plan is developed to sample the off-site wells to determine whether or not groundwater impacts in the deep alluvial aquifer extend to the south; however, flood conditions on the Wabash river delay data collection. Work commences on completion of this *Alternatives Analysis.*

1.3 Alternatives Analysis Objectives and Approach

The primary objective of the alternatives analysis is to evaluate and make recommendations on leachate management and final cover alternatives for closure of the unlined ash impoundment (Pond D), based on technical and cost considerations. Alternatives analysis objectives, herein referenced as "Closure Objectives", were identified for protecting human health and the environment for both the parameters of concern (POCs, identified in the Hydrogeologic Assessment) and exposure pathways in accordance with applicable environmental standards. Site-specific considerations for establishing appropriate Closure Objectives for Pond D include proximity of the Wabash River to Pond D, hydrogeology and groundwater quality in the vicinity of Pond D, and the presence, or absence, of exposure pathways for identified POCs (groundwater, soil, and surface water).

Standards are promulgated for the design and operation of solid waste landfills under 35 Illinois Administrative Code (IAC) Parts 810 to 816. Based on a review of these regulations and on site-specific considerations, the following Closure Objectives were developed:

- Manage groundwater quality to meet the requirements of Section 811.320; and
- Construct a final cover system that meets the requirements of Part 811 or an adjusted standard approved by the Illinois Pollution Control Board (PCB).

Specific parameters for performing the alternatives analysis were developed on the basis of: 1) the results of the 1999 *Hydrogeologic Assessment*, the *Groundwater Model Evaluation of Impoundment Closure Options* dated January 2000, and supplemental investigations performed for this analysis (Section 2); 2) additional groundwater flow and transport modeling of alternatives (Section 4); and 3) considerations for pursuing adjusted standards through the Illinois PCB. The range of technological applications considered included conventional and innovative alternatives.

Tables 3-1, 3-2, 3-3, 4-1, 4-2, 5-1, and 5-2 summarize the findings of this alternatives analysis, which are described in Sections 3, 4, and 5. This alternatives analysis process was developed to meet the substantive regulatory requirements of 35 IAC Part 811 and is divided into four major stages as follows:

- <u>Initial Screening</u>: This stage consisted of three steps. First, site specific Closure Objectives were established to address parameters of concern and exposure pathways (Section 3.1). Second, closure alternatives to meet these objectives were divided into three categories: 1) leachate management alternatives; 2) final cover alternatives; and 3) surface water management alternatives. Third, these alternatives were initially screened on the basis of construction / implementation feasibility, effectiveness, and cost (Table

3-1). Alternative specific rough cost estimates were developed at this stage (Appendix B).

- Groundwater Transport Modeling and Secondary Effectiveness Evaluation: The closure alternatives that met the initial screening criteria were combined into model scenarios for prediction of their effects on groundwater quality using a calibrated groundwater flow and transport model (Table 4-1). These results were used to reduce the number of alternatives that would be subject to the next step of detailed analysis (Table 4-2).

- Assemble Alternatives for Detailed Analysis: Specific closure alternatives that met the secondary effectiveness screening criteria were evaluated with respect to meeting the Closure Objectives, regulatory acceptance, and relative cost (Section 5.1). From these alternatives, four were selected that represented a range of closure alternatives on the basis of the following criteria: 1) an alternative that meets the requirements of 35 IAC Parts 811 and 814; 2) an alternative that meets the "effectiveness criteria" (Section 4.2.3) with adjusted standards and includes leachate collection; 3) an alternative that represents the lowest cost alternative and meets the "effectiveness criteria" (Section 4.2.3) with adjusted standards and no leachate collection; and, 4) an alternative that meets the "effectiveness criteria" (Section 4.2.3) with adjusted standards and meets the "intent" of 35 IAC Part 811 and 814 through utilization of technology and construction techniques substantially similar to those promulgated in 35 IAC Part 816 (Alternative Standards for Coal Combustion Power Generating Facilities Waste Landfills).

- Detailed Analysis: The four final closure alternatives were further evaluated in terms of total cost (Table 5-1) and in general accordance with the criteria listed in Table 5-2 to develop a final recommendation for the site. These criteria include the degree to which the proposed remedy is protective of human health and the environment, short and long term effectiveness, ease of implementation, performance, reliability, potential impacts, time-frame for completion, cost, and institutional requirements required for regulatory acceptance.

2 SUMMARY OF SITE CONDITIONS

Hydrogeology and groundwater quality were thoroughly characterized in the Hydrogeologic Assessment report. Additional field investigation was performed for this project to upgrade the monitoring well system surrounding Pond D, characterize the deep alluvial aquifer, and to collect detailed information specific to the alternatives assessment.

2.1 Supplemental On-Site Investigation: October 2001

The first supplemental site investigation was performed from October 1 to 4, 2001. The scope of work included: 1) advancement of six soil borings (SB-101 through SB-106); 2) installation of one additional monitoring well (MW-14) and one temporary monitoring well (TW); and 3) abandonment of monitoring well MW-11 and replacement with MW-11R. In addition, hydraulic conductivity tests were performed on selected new and existing monitoring wells.

2.1.1 Advancement of Soil Borings

An all-terrain drill rig equipped with 4 ¼-inch hollow-stem augers was used to perform all soil borings, direct push sampling, and monitoring well installations at the site. A total of nine soil borings were advanced at the site, two of which were converted into permanent monitoring wells (MW-11R and MW-14) and one that was converted into a temporary monitoring well (TW). Soil borings SB-101 through SB-103 were advanced to better characterize the type and extent of geologic materials surrounding Pond D. Soil borings SB-104 through SB-106 were advanced north of the ash impoundment to find a suitable location for a background monitoring well within the deep alluvial sand and gravel. The latter borings were drilled in the only accessible locations that were not downgradient of the ash impoundments. However, shallow bedrock was encountered at all three locations, and a natural coal seam was encountered at SB-106, indicating that the Wabash River was over the west side of the valley in this area. As a result, an upgradient well could not be installed within the deep sand and gravel of the valley.

Geologic materials at all soil borings were logged every 2½ feet using a 2-inch diameter by 2-foot long split-barrel sampler. The soil borings were advanced to bedrock, to design depth, or adjusted in the field as necessary ranging from 9 feet to 39 ½ feet below ground surface (Table 2-1). Upon completion of sampling, all soil borings were backfilled with bentonite chips and hydrated, or converted into monitoring wells (Appendix A-1).

During advancement of soil borings SB-102, MW-14, and TW, a hydro-punch discrete water sampler was used to collect groundwater samples at targeted depths (Table 2-1). The purpose of the discrete water sampling was to determine the geologic formation(s) where ash leachate was most prevalent and better assess the feasibility of leachate collection surrounding Pond D. Discrete samples were designed to target groundwater 1) in the shallow silty alluvial sediments, 2) immediately below the silt interface at the top of the deep alluvial sand, and 3) at depth in the deep alluvial sand (a minimum of 10 feet below the silty alluvium). This analysis showed decreasing concentrations with depth; however, interpretation of results was uncertain due to potential vertical migration within the borehole.

2.1.2 Installation / Abandonment of Monitoring Wells

Monitoring well MW-14 was installed to support the creation of a groundwater monitoring network surrounding Pond D. The screen of MW-14 is designed to monitor the deep alluvial sand and gravel aquifer immediately underlying the shallow alluvial silt and clay unit. The temporary monitoring well (TW) was installed to provide additional data for characterization of the deep alluvial aquifer. The screen of TW monitors the deep sand and gravel aquifer at a depth of nine feet below the silt and clay unit.

Monitoring well MW-11R was installed to replace monitoring well MW-11, which was yielding anomalous results. Monitoring well MW-11R was screened in unlithified materials atop shallow bedrock.

All of the wells were constructed with 2-inch inner diameter (I.D.), schedule 40 PVC pipe, flush-threaded to a 5 foot (MW-14 and TW) or 10 foot (MW-11R) long section of 0.010-inch, factory slotted PVC well screen (Tables 2-2 and 2-3). From bottom to top the monitoring wells were completed with: 1) filter pack consisting of uniform silica (#5) sand to at least one foot above the well screen; 2) one-half to two feet of fine (#7) sand; and 3) a minimum of two feet of hydrated bentonite chips to near ground surface (Appendix A-2). All of the monitoring wells were finished with stick-up style, locking steel well protective casings, surrounded by a set of steel bumper posts.

Following well completion, all wells were developed to remove sediment and restore groundwater flow surrounding the well.

2.1.3 Hydraulic Testing

Single well recovery tests were performed on newly installed wells and wells that were not previously tested. Wells MW-1, MW-14, MW-11R, and TW were tested. Well MW-8 could not be tested due to slow recovery after groundwater sampling. Data were collected using an In-Situ Hermit™ datalogger and pressure transducers. Pressure transducers and disposable bailers were placed in the wells, and time was allowed for groundwater to reach equilibrium. After groundwater had returned to static water level, the transducers were linked to the datalogger and set to begin. A slug of water was removed using a disposable bailer with approximately 0.037 ft^3 of displacement for wells MW-1 and MW-11R. Two disposable bailers (0.074 ft^3 of displacement) were joined together and used to remove the slug at well MW-14, and three bailers (0.11 ft^3 of displacement) were used at TW due to the static head of the water table and the screened formation. Test duration was about 25 minutes, or until water had returned to static level. Upon test completion, the data were downloaded and processed using the Aqtesolv software.

Data were interpreted using the Bower-Rice (1976) method (Table 2-4, Appendix A-3). Slug test results from wells MW-14 and MW-11R could not be interpreted due to an equipment malfunction.

2.2 Supplemental Off-Site Investigation: April and May 2004

The supplemental off-site investigation was performed from April 26 to May 13, 2004. The scope of work included: 1) installation of seven temporary monitoring wells (TW-115S through TW-120);
2) deployment of downhole dataloggers for continuous groundwater elevation observations in TW-115S, TW-115D, and TW-118; 3) performance of single well recovery (slug) tests on new wells to characterize aquifer characteristics near the monitoring points; 4) survey of all new wells; and 5) collection of groundwater elevation data at all new and existing wells. In addition, pumpage data for the two plant water wells was collected and analyzed to determine the effect of pumpage on the nearby monitoring wells (TW-115S and TW-115D).

2.2.1 Installation of Monitoring Wells

An all-terrain drill rig equipped with 4 ¼-inch hollow-stem augers was used to perform all monitoring well installations during the 2004 supplemental investigation. Geologic materials at all well locations were logged continuously to the extent practicable using a 2-inch diameter by 2-foot long split-barrel sampler. Rock cores were collected from borings TW-115D, TW-116, and TW-119 utilizing a diamond-tipped rock core barrel. Each of the wells was constructed with 2-inch inner diameter (I.D.), schedule 40

PVC pipe, flush-threaded to a 5-foot long section of 0.010-inch, factory slotted PVC well screen (Tables 2-2 and 2-3). From bottom to top the monitoring wells were completed with: 1) filter pack consisting of uniform silica (#40) sand to at least 1 foot above the well screen; 2) 1 foot of fine (#7) sand; and 3) a minimum of 2 feet of hydrated bentonite chips to near ground surface (Appendix A-2). All of the monitoring wells were finished with stick-up style, locking steel protective casings.

TW-115S and TW115D were drilled directly north of EW2, as close to the river as possible (Figure 2-1), to be used in conjunction with existing well MW-7D and pumpage records from EW1 and EW2 to determine the effects of plant pumpage on groundwater flow within the deep alluvial aquifer. TW-115D was drilled to bedrock and cored 15 feet into the shale, to a total depth of 105 feet below ground surface (bgs). The borehole was then backfilled with bentonite to approximately 88 feet bgs and the well was screened near the base of the deep alluvial aquifer to characterize the vertical flow within the aquifer. TW-115S was blind drilled to 36 feet and screened near the top of the aquifer.

TW-116 and TW-117 were drilled approximately one-half mile south/southeast of the impoundment, on the west side of the river. TW-116, farther from the river, was drilled to a depth of 79.2 feet bgs (cored 19 feet into shale), backfilled with bentonite to 55 feet bgs (approximately five feet above the bedrock), and then the augers were rotated backwards out of the hole to allow the sand and gravel to collapse. The well screen was set at 30 feet bgs in clayey sand to gravel, at what was assumed to be the top of the deep alluvial aquifer. Subsequent review of the lithology determined that TW-116 is actually screened in the fine-grained alluvium above the deep alluvial aquifer. TW-117, closer to the river, was drilled to a total depth of 90.5 feet bgs (six inches into shale); the augers were then rotated backwards out of the borehole and the borehole was allowed to collapse to a depth of 21 feet bgs. The well screen was set at 20 feet at the same approximate elevation as TW-116 to allow the two wells to serve as downgradient groundwater elevation calibration points and as lithologic controls on the configuration of the bedrock valley.

TW-118, TW-119, and TW-120 were drilled east of the river. Only TW-119 was drilled to bedrock, as bedrock depth at TW-118 was assumed to be similar to TW-115D and TW-120 was assumed to be similar to TW-119. TW-119 was cored 20 feet into shale, to a total depth of 100 feet bgs. The borehole was sealed with bentonite to 75 feet bgs, approximately five feet above bedrock. The hole was then allowed to collapse as the augers were rotated out to a depth of 21 feet bgs. All three wells were screened near the top of the aquifer.

2.2.2 Hydraulic Testing

Single well recovery tests were performed on newly installed wells. Well TW-120 could not be tested because the depth to groundwater was greater than the length of the pressure transducer cord. Data were collected using a laptop and MiniTroll™ pressure transducers. Pressure transducers were placed in the wells and the tests started. A 0.061 ft^3 steel slug was inserted, and time was allowed for groundwater to reach equilibrium (slug-in test). After groundwater had returned to static water level, the slug was removed and the water column left to equilibrate again (slug-out test). Test duration was 1 to 10 minutes. Upon test completion, the data were downloaded and interpreted using the Bower-Rice (1976) method as coded in the Aqtesolv software, with the exception of TW-115S and TW-118, which were interpreted using the Butler (1998) analysis method (Table 2-4, Appendix A-3).[1]

The MiniTroll™ dataloggers were then deployed in wells TW-115S, TW-115D, and TW-118 for continuous groundwater elevation observations. The dataloggers were set to take pressure head readings of the height of the water column above the transducers every hour for six months.

2.3 Groundwater Sampling and Analysis

Groundwater sampling was performed by AEG according to their standard operating procedure (Appendix A-4). Analysis was performed by PDC laboratories. Analytical methods are listed below:

Analyte	Method
Alkalinity, Tot	SM (18) 2320B
Boron, Tot	SW-846 6020B R0.0
Calcium, Tot	EPA 7140 (prior to 2002) SW-846 6020B R0.0 (since 2002)
Hardness, total	SM (18) 2340C
Manganese, Tot	243.1 (prior to 2002) SW-846 6020B R0.0 (since 2002)
Sulfate, Tot	375.4 (prior to 2002) EPA 300.0 R2.1 (since 2002)
TDS	160.1 (prior to 2002) SM (18) 2540C (since 2002)

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[1] Only one of the two (in or out) tests is reported if the other test yielded a non-linear recovery curve.

2.4 Summary of Hydrogeology and Groundwater Quality

2.4.1 Distribution of Coal Ash Fill

Ash at the Hutsonville Power Station has been managed in Ponds A and D. In addition, ash was placed in a laydown area between the southern portions of Ponds A and D. The ash laydown area was roughly triangular in shape and covered an area of about 6 acres. In 2000, all ash in the laydown area was excavated, and the interim pond (Pond B) and drainage collection pond (Pond C) were constructed in that general location.

Four direct-push probe holes (GP-20 through GP-23) advanced through Pond D during the 1999 Hydrogeologic Assessment indicated ash thickness ranging from about 12 feet at the north end of the impoundment to 31 feet in the central portion of the impoundment (Section C-C'; Figure 3 in the Hydrogeologic Assessment report). Ash in the central and southern portions of Pond D extended as much as 16 feet below the normal water table elevation.

2.4.2 Hydrogeology

The upland portion of the site is underlain by a thin (less than 20 feet thick) layer of sand-rich soil, which is underlain by Pennsylvanian-age sandstone. The lowland portion of the site is in the Wabash River valley, and is underlain by 90 feet of alluvium that coarsens downward. The upper alluvium consists of silt and clay, with a thickness of 5 to 30 feet (Figure 2-1). The lower alluvium is sand and gravel, which extends to Pennsylvanian-age shale at 60 to 90 feet bgs.

The water table throughout most of the upland area occurs within the surficial sand unit. Groundwater flow in this unit is east, toward the Wabash River (see Figures 5 and 6 in the 1999 Hydrogeologic Assessment report). Flow velocity in the upper sand varies with hydraulic gradient and hydraulic conductivity, and was previously reported at 150 to 240 feet per year.

The water table within the Wabash River valley occurs in the surficial silt and clay deposits; therefore, the deep alluvial aquifer is confined. Groundwater flow in the deep alluvial aquifer on the Illinois side of the river is east to northeast, toward the Wabash River (Figures 2-2, 2-3, and 2-4). A typical horizontal gradient in the deep alluvial aquifer south of the site was 0.002 ft/ft (Appendix F). Horizontal groundwater flow velocity was estimated to be approximately 66 ft/yr in the deep alluvial aquifer (Appendix F). The relatively low velocity is a function of the flat gradients in this formation. The high hydraulic conductivity of this formation (2.2 x 10^{-3} to 1.6 x 10^{-1} cm/s) combined with its thickness indicates a highly transmissive formation.

2.4.3 Evaluation of Daily Groundwater and River Elevation Data

Groundwater elevation in TW-115D, TW-115S, and TW-118 were continuously measured[2] and the results compared to determine whether or not power plant pumpage has noticeable effects on groundwater elevation in the deep alluvial aquifer.

There was no apparent relationship between plant pumpage and groundwater elevation (Figure 2-6). This indicates that the cone of depression associated with the plant wells is small, as might be expected given the high transmissivity of the deep alluvial aquifer.

2.4.4 Groundwater Quality and Parameters of Concern

The 1999 Hydrogeologic Assessment identified boron, sulfate, manganese, and TDS as parameters of concern (POCs) because their concentrations in groundwater near Pond D exceeded Illinois Class I groundwater quality standards, which were the applicable standards for this site at the time. Boron and sulfate are indicator parameters of coal ash leachate, and are the primary POCs. Manganese is ubiquitous in soils, may have higher concentrations in soil than in coal ash, and is highly sensitive to redox conditions; therefore, it is not a reliable indicator of coal ash leachate. High TDS may be observed at sites where coal ash leachate migration occurs, because high TDS concentrations reflect elevated concentrations of soluble ash constituents such as calcium, potassium, sodium, and sulfate; however, other natural and anthropogenic sources can cause high TDS concentrations.

2.4.5 Background Concentrations

Background groundwater quality values were calculated in anticipation of site closure under Section 811. These calculations were performed using data from background wells MW-1 and MW-10.[3] Data at these wells were collected beginning in 1984. However, review of these data found anomalously high results for Boron in MW-1, which appear to decrease over time (Figure 2-7). Sulfate concentrations show no

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[2] Due to an equipment malfunction, continuous data were only available for TW-115S after September 2004.

[3] MW-10D was not used because it is finished in sandstone.

such anomaly and have no trend (Figure 2-8). As noted previously, sulfate is also an indicator parameter for coal ash leachate, and the absence of sulfate suggests that the elevated boron concentrations in MW-1 were not due to migration from the ash ponds. Rather, these results may reflect changes in agricultural activity in the area.[4]

Trend analysis was repeatedly performed using the Shapiro-Wilk test, retroactively from 2005 (i.e., based on 2000 to 2005 data, then based on data from 1999 to 2005, then based on 1998 to 2005, etc). This analysis indicated that there is no statistical trend in boron concentrations in either background well since 1998 (Appendix E). Therefore, all background statistics for the upper aquifer are calculated using data collected after January 1, 1998.

All statistical calculations were performed using the MANAGES software (EPRI, 2002). Analyses were performed for the parameters currently monitored at Ponds A and D. The data were first tested for normality and detection frequency. There were few non-detects in the database, and normality varied by parameter. Based on the normality results, the following background tests were performed:

- Tolerance interval at 99 percent confidence and 95 percent coverage for data with a normal distribution (TDS);
- Tolerance interval at 99 percent confidence and 95 percent coverage for data with a log-normal distribution (boron and manganese);
- Non-parametric tolerance interval (maximum concentration) for data that had neither a normal or log-normal distribution.

Background statistical analysis results are summarized in Table 2-5, and the adjusted 811.320 background standards are compared to analytical results in Table 2-6a. Background data and statistical print-outs are included in Appendix E.

There are no locations on the power plant property where an upgradient monitoring well could be screened in the deep alluvial aquifer. The river abuts the west side of the valley north of Pond D, the aquifer does not extend west of Pond D, and Pond D extends to the southern property boundary. As discussed in Section 2.4, groundwater flow in this formation is primarily eastward toward the Wabash River.

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[4] Boron is a common constituent in agricultural fertilizers and pesticides, which account for 3 percent of the boron consumed in the United States (Source: USGS, 2003; http://minerals.usgs.gov/minerals/pubs/commodity/boron/boronmyb03.pdf)

Nine monitoring wells were installed in the deep alluvial aquifer, five on the plant property near Pond D (MW-7D, MW-14, TW, TW-115S, and TW-115D), one[5] south of the plant property (TW-117) and three east of the Wabash River (TW-118, TW-119 and TW-120). Six of these wells have been in place since 2004 (TW-100 series) and do not have sufficient data for statistical analysis, and one (MW-14) shows elevated boron and sulfate concentrations, indicative of ash pond impacts. As a result, background concentrations were calculated using two of the older wells, MW-7D and TW, which are hydraulically downgradient of the impoundment, but are not impacted by power plant activities. The background calculations were performed using the same approach as for the shallow sand:

- Tolerance interval at 99 percent confidence and 95 percent coverage for data with a normal distribution (alkalinity, calcium, sulfate, TDS);
- Tolerance interval at 99 percent confidence and 95 percent coverage for data with a log-normal distribution (boron);
- Non-parametric tolerance interval (maximum concentration) for data that had neither a normal or log-normal distribution.

Deep alluvial aquifer background statistical analysis results are summarized in Table 2-5, and the adjusted 811.320 background standards are compared to analytical results in Table 2-6b. The resulting background concentrations were similar to those calculated for the upper sand, with the exception of sulfate, which was considerably lower (Table 2-5). Background data and statistical print-outs are included in Appendix E.

2.4.6 Groundwater Quality

Boron concentrations exceeded the Section 811.320 applicable background concentrations and Class I groundwater quality standards at monitoring wells MW-6, MW-7, MW-8, and MW-11R, which are downgradient of Pond D (Table 2-6a). The highest boron concentrations were observed along the south perimeter of Pond D (MW-6 and MW-11R), and in the shallow silt unit downgradient of Pond D (MW-8). Sulfate concentrations exceeded the applicable background concentrations and Class I groundwater quality standards at the same four wells.

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[5] TW-116 is screened in fine-grained alluvium just above the deep alluvial aquifer (note the relatively low hydraulic conductivity value listed in Table 2-4). The sand pack for this well extends into the deep alluvial aquifer, and it is a valid point for measuring groundwater elevation in that formation; however, it will not yield samples representative of groundwater in the deep alluvial aquifer.

Since 2002, sulfate and boron were detected at concentrations higher than the 811.320 applicable background concentrations at monitoring well MW-14 (Table 2-6b) that is screened in the deep alluvial aquifer; although these concentrations are lower than Class I groundwater quality standards. Ash impacts were not evident until 2004 when boron concentrations were consistently higher than 1 mg/L. Sulfate and boron concentrations are lower than 811.320 applicable background concentrations at well TW-115S and TW-115D.

Boron was detected at a concentration higher than background in off-site well TW-116, which is screened in clayey sand to gravel near the base of the shallow fine-grained alluvium. However, sulfate concentrations in this well are low. The lack of sulfate, which is more mobile than boron, indicates that the boron is from a different source than the ash pond, possibly due to fertilizer use in nearby agricultural fields, similar to the elevated boron concentrations noted in Background well MW-1 prior to 1998. TW-116 will be replaced with a well nest screened in the deep alluvial aquifer. TW-117 has low boron and sulfate concentrations.

The water quality results at TW-117 indicate that the ash impacts observed at MW-14 have not migrated to the south. The deep alluvial aquifer does not extend west or north of the ash impoundment; therefore, the boron and sulfate observed in MW-14 are migrating east, with the general direction of groundwater flow, and discharging with groundwater to the Wabash river.

2.5 Exposure Pathways (Groundwater, Soil, Surface Water)

There are no groundwater supply wells, other than the plant wells, between Pond D and the Wabash River, which is the ultimate receptor of groundwater impacted by leachate from Pond D. The plant wells and two irrigation wells that are southeast of Pond D are completed in the deep alluvial aquifer in the Wabash River valley, which is overlain by less permeable silt and clay sediments.

As documented previously, groundwater in the shallow upland sand and in the silt unit downgradient of Pond D have elevated boron and sulfate concentrations and therefore represent an exposure pathway; however, these formations are not utilized for water supply.

The deep alluvial aquifer is utilized as a drinking water supply by the city of Hutsonville, approximately 1 mile to the south. However, groundwater flow in this aquifer is east toward the Wabash River (Figures 2-2, 2-3, and 2-4). As a result, there are no potable water supply wells, other than the two plant wells, situated between Pond D and the discharge point for groundwater (the Wabash River). The plant wells have low boron and sulfate concentrations and do not show evidence of impacts from Pond D (Table 2-6b).

The exposed ash in Pond D also represents a direct contact exposure pathway, although access to this area is controlled by a fence around the plant, so the potential risk is low. As stated in Section 1.3, final closure of Pond D will be in accordance with 35 IAC Part 811, and will include a final cover system that meets the requirements of Part 811 or an adjusted standard approved by the Illinois Pollution Control Board (PCB). The cover will eliminate the direct contact pathway.

3 IDENTIFICATION OF LEACHATE MANAGEMENT AND FINAL COVER ALTERNATIVES

3.1 Identification of Alternatives Overview

Consistent with the requirements of 35 IAC Sections 811.324 and 811.325, alternatives designed to achieve closure for Pond D were identified to: 1) be protective of human health and the environment; 2) address identified parameters of concern and exposure pathways (Section 2.5); and 3) achieve the Closure Objectives stated in Section 1.3 of this report as summarized below:

- Manage groundwater quality to meet the requirements of Section 811.320; and
- Construct a final cover system that meets the requirements of Part 811 or an adjusted standard approved by the Illinois Pollution Control Board (PCB).

The Closure Objectives were selected to facilitate an alternatives analysis that meets regulatory requirements and adequately protects human health and the environment.

Alternatives that potentially meet the Closure Objectives are divided into two distinct categories and presented in Table 3-1:

- Leachate Management and Deep Alluvial Aquifer Source Control Alternatives; and
- Final Cover Alternatives.

Additionally, Surface Water Management Alternatives have been incorporated with the alternatives evaluation as they will be a critical component of any final cover alternative selected for the site. General surface water management approaches consist of:

- Routing surface water to the existing catch basin for collection in the drainage collection pond (Pond C) and eventual discharge to the Wabash River;
- Routing surface water via overland flow to the Wabash River; or
- A combination of these two approaches.

3.2 Leachate Management and Deep Alluvial Aquifer Source Control Alternatives

3.2.1 Selection of Alternatives for Initial Screening

Nine leachate management and deep alluvial aquifer source control alternatives were selected for initial evaluation consisting of the following:

- Site monitoring with no leachate collection (Leachate Management Alternative);
- Three variations of groundwater extraction - leachate collection alternatives (Leachate Management Alternative);
- Source control for the deep alluvial aquifer via groundwater extraction (Source Control of Deep Alluvial Aquifer);
- Ash stabilization (Leachate Management Alternative);
- Ash removal and disposal, recycling at an off-site facility, or beneficial reuse (Leachate Management Alternative);
- Ash impoundment reconstruction (Leachate Management Alternative); and
- Containment using a low-permeability barrier wall (Leachate Management Alternative and Source Control of Deep Alluvial Aquifer).

These leachate management alternatives were initially selected from a broad range of available technologies based on their use at similar sites and their potential to meet the Closure Objectives.

3.2.2 Site Monitoring with No Leachate Collection

This alternative consists of a groundwater monitoring program consistent with the requirements of 35 IAC 811.319. No active leachate collection would be performed as a part of this Leachate Management Alternative. Establishing a groundwater monitoring program will be required as a component of each Leachate Management Alternative discussed below; therefore, costs for site monitoring have not been separately evaluated and will be included as part of the detailed analysis of leachate management and final cover alternatives (Section 5).

3.2.3 Groundwater Extraction - Leachate Collection Alternatives

Groundwater extraction alternatives include wells or drains, downgradient of Pond D, to capture groundwater impacted by ash leachate:

- Shallow Groundwater Extraction Wells Combined with an Interceptor Drain/Trench: This Leachate Management Alternative would consist of a network of vertical groundwater extraction wells designed to collect impacted groundwater from the shallow silt and clay unit east of Pond D, and a drain/trench south of Pond D. However, this alternative would be difficult to effectively and efficiently implement because the impacted silt unit east of Pond D has low hydraulic conductivity and the shallow sand south of Pond D is thin, and therefore has low transmissivity.

- Interceptor Drain/Trench: This Leachate Management Alternative would consist of a groundwater interceptor drain/trench along the entire east and south perimeters of Pond D. In the lowland along the east and south perimeter, the interceptor drain/trench would extract groundwater within the silt and clay unit. In the upland area along the south perimeter, the interceptor drain/trench would capture impacted groundwater above the bedrock surface.

- Horizontal Groundwater Extraction Wells Combined with Interceptor Drain/Trench: This Leachate Management Alternative would consist of a network of horizontal groundwater extraction wells designed to capture impacted groundwater along the east perimeter of Pond D. The horizontal wells could be designed to target groundwater impacted by leachate in the shallow silt and clay. Along the south perimeter, an interceptor drain/trench would be designed to capture impacted groundwater in the lowland silt/clay and upland above the bedrock surface.

For each of these Leachate Management Alternatives, collected groundwater would be directly discharged to the drainage collection pond (Pond C) and/or the interim pond (Pond B) for management through the plant's sluice water system and eventual discharge to the Wabash River via the existing NPDES permit.

3.2.4 Source Control of the Deep Alluvial Aquifer

Containment of impacts to the deep alluvial aquifer would be achieved by groundwater extraction through vertical wells located downgradient of Pond D along the southeast corner. As with the Leachate Management Alternatives presented above, groundwater collected as part of this alternative would be directly discharged to the drainage collection pond (Pond C) and/or the interim pond (Pond B) for management through the plant's sluice water system and eventual discharge to the Wabash River via the existing NPDES permit.

Other in-situ alternatives were not considered for source control of the deep alluvial aquifer because in-situ technologies have not been identified for the primary parameters of concern (boron and sulfate). Containment utilizing a low-permeability barrier wall is presented below in Section 3.2.8.

3.2.5 Ash Stabilization

Ash stabilization is a technology designed to micro-encapsulate the ash in a cement-like matrix (monolith) to minimize the rate of groundwater infiltration and leaching of ash constituents to groundwater. Ash fill is stabilized and solidified using one of several reagents delivered either via soil mixing or jet grouting technology. Once the ash is stabilized, leachate volume is greatly reduced, potentially eliminating the need for active leachate collection.

Soil mixing utilizes large diameter augers (5 to 12 feet in diameter) that mechanically mix soils with a stabilizing reagent carried by drilling fluid. Jet grouting utilizes a small drill rig to advance a drill bit into the ash, through which grout is pumped under high pressure. As the drill steel is rotated and slowly raised, a cylindrical grout column is created. The grout injection produces grout columns ranging from approximately 2 to 5 feet in diameter. A key disadvantage of this technology is maintaining the continuity and integrity of the grout column. Discontinuities or irregularities in subsurface conditions can lead to irregularity in grout column diameter. Typically, conservative overlapping is performed to achieve uniform coverage.

3.2.6 Ash Removal and Disposal, Recycling at an Off-Site Facility, or Beneficial Reuse

Removal of ash from Pond D eliminates the source of ash leachate impacting groundwater at the site. Removal of ash requires excavation of a considerable thickness (20 to 30 feet) of ash. Extensive site dewatering would be required throughout the course of the project. For purposes of evaluating this alternative, partial removal (i.e. removal of saturated ash only) was compared to removal of all ash from the unlined impoundment. Key design and technical considerations for excavation include:

- Excavated material would be disposed off-site.
- For the partial removal alternative, following removal of saturated ash, a capillary break would be created by placing a relatively free draining material such as a self-compacting gravel at and above the groundwater interface. This material prevents ash saturation due to capillary rise from the underlying water table and also provides a buffer to prevent resaturation of the ash if groundwater elevation increased in the future. Above the capillary break, excavated ash would be placed as backfill to grade. Above the ash

backfill, an engineered cover would be constructed to minimize surface water infiltration through the unsaturated ash.

- Extensive engineering controls that could include water misting would be required for managing fugitive dust emissions.

3.2.7 Ash Impoundment Reconstruction

Reconstruction of Pond D is identified as a Leachate Management Alternative since the source of ash leachate would be removed. Reconstruction of this impoundment would require extensive excavation and relocation or off-site disposal of all ash. The impoundment would then be reconstructed as a new unit designed to:

- Separate ash from the water table through addition of clean fill to raise the base of the impoundment above the water table; and
- Reduce or eliminate ash leachate generation by retrofitting the impoundment with a low permeability liner and prevent downgradient migration of ash constituents to groundwater.

Upon completion of impoundment reconstruction, removed ash could either be replaced or the unit could be operated as a new ash impoundment. Final reconstruction would be completed once the reconstructed impoundment reached capacity and a final cover was installed (as discussed in Section 3.3).

3.2.8 Containment Using a Low-Permeability Barrier Wall

Installation of a low-permeability vertical barrier wall is identified as a Leachate Management and Deep Alluvial Aquifer Source Control Alternative. The Leachate Management Alternative would be designed to prevent lateral migration of ash leachate via groundwater to the Wabash River. The Deep Alluvial Aquifer Source Control Alternative would be designed to contain or impede the horizontal flow of impacted groundwater within the deep alluvial aquifer.

Construction of a vertical barrier would require keying into a low-permeability geologic formation such as shale bedrock or clay. Two basic wall configurations were considered:

- <u>Partially Encapsulating Wall</u>: A typical layout for this type of barrier consists of a wall along the east and south (downgradient) sides of the impoundment. The barrier would be completed with an interior hydraulic gradient control system utilizing interceptor trenches or extraction wells within the impoundment and upgradient of the wall. The hydraulic gradient controls would prevent hydraulic mounding by maintaining an inward gradient.

- Fully Encapsulating Wall: This type of barrier consists of a wall surrounding the entire perimeter of the ash impoundment to fully encapsulate the saturated ash zone and deflect upgradient groundwater flow around the impoundment. Internal hydraulic controls may be required to manage groundwater fluctuations that could potentially compromise containment integrity.

Several vertical barrier wall technologies are available including sealed sheet piling, cement-bentonite slurry or soil-cement slurry, and jet grouting. Each of these technologies has the capability to create a barrier with hydraulic conductivity approaching 1 x 10^{-7} cm/sec with proper design and QA/QC during installation. However, without a competent low permeability formation in which to key the barrier wall, proper containment cannot be achieved.

3.3 Final Cover Alternatives

Four different final cover alternatives were selected for initial evaluation:

- Geosynthetic final cover (30 mil PVC);
- Compacted clay final cover;
- Layered earthen final cover; and
- Pozzolanic fly ash final cover.

The first two alternatives are consistent with the requirements of 35 IAC Section 811.314. These cover systems consist of a low permeability layer, either a geosynthetic membrane (e.g. 30-mil PVC) or 3 feet of compacted clay, followed by a 3-foot thick final protective layer designed to support vegetation and protect the low permeability layer.

The third alternative, a layered earthen final cover, reflects a simplified approach to traditionally accepted landfill cover design practices and would require an adjusted standard from the Illinois PCB to implement, as the cover does not meet the requirements of Section 811.314. Earthen cover designs have been used to achieve closure at similar fly ash management facilities in Illinois. Instead of relying on low permeability clay or geosynthetic covers, such as PVC, the design of a layered earthen cover incorporates the use of high permeability sand and/or gravel layers to create a capillary break that reduces downward infiltration of water. The capillary break causes retention of water in the rooting zone, which increases transpiration to the atmosphere relative to covers without capillary breaks, yet minimizes saturation in the rooting zone. If the rooting zone becomes saturated, the high permeability sand and/or gravel layer(s) promote rapid lateral drainage and continue to limit infiltration. However, migration of water to this drainage layer would only occur after the retention capacity of the rooting zone is reached.

Given the humid climate in this area, the earthen cover will not be as effective as a compacted clay or PVC cover in limiting infiltration into the ash; however, a net reduction in annual infiltration can be achieved. Additionally, the earthen cover may prove an acceptable alternative because it provides a direct contact barrier, meets the requirements of a final protective layer, and because infiltration represents a small fraction of ash constituents that leach to groundwater in Pond D—the majority of ash constituents present in the groundwater leach from ash situated below the water table via groundwater throughflow. Construction of an earthen cover is a lower cost approach since no geosynthetic materials are used, and it relies on locally available materials.

The fourth and final cover alternative reflects an innovative approach to cover design. Fly ash from an on-site source (Pond A), would be collected and blended with a stabilizing reagent (e.g. quick lime, Portland cement, class C fly ash) to create a cement-like monolithic cover to minimize the rate of groundwater infiltration and leaching of ash constituents to groundwater. Consistent with the requirements of Section 811.314, a 3-foot thick low permeability layer would be constructed from the pozzolanic fly ash mixture followed by a 3-foot thick earthen protective layer. With adequate mixture design and quality control, a low-permeability cover with properties approaching those of a geosynthetic or compacted clay cover can be achieved.

Construction of a pozzolanic fly ash cover would require an adjusted standard from the Illinois PCB to implement; however, regulatory precedent exists for a similar cover technology. Part 816 provides alternative standards for final cover systems at coal ash management facilities using a similar process to stabilize flue gas desulfurization (FGD) sludges with fly ash (Poz-O-Tec™ process). It is likely that construction of a pozzolanic fly ash final cover could meet or exceed the alternative standards for strength and approach the alternative standards for permeability outlined in Section 816.530 for testing of the final cover constructed with the Poz-O-Tec process. Construction of a pozzolanic fly ash cover would likely reflect the highest cost final cover approach; however, the high cost may be offset by the creation of additional capacity for fly ash in the lined ash impoundment (Pond A).

3.4 Surface Water Management Alternatives

Three surface water management alternatives were selected for initial evaluation consisting of the following:

- Route surface water east towards the Wabash River;
- Route surface water west towards the drainage collection pond (Pond C); and
- Route surface water east and west, toward the Wabash River and the drainage collection pond (Pond C).

Diverting all surface water to the Wabash River would require the most fill, while combining surface water drainage to either the Wabash River or Pond C would require the least fill. A box culvert has already been constructed to route surface water from Pond D to Pond C. For purposes of estimating fill volumes to construct the surface water management alternatives, a minimum 5% slope has been assumed to provide adequate drainage and prevent standing water from accumulating in depressions on the final impoundment surface.

A fourth surface water management alternative, creation of a detention pond and dewatering sump for diversion to Pond C, was not considered for the following reasons:

- Section 811.322 prohibits standing water anywhere on a solid waste unit–an adjusted standard from the Illinois PCB would be required to construct a detention basin on the unlined ash impoundment; and
- Use of a detention basin would likely negate the opportunity to receive an adjusted standard for use of an earthen or pozzolanic final cover system.

3.5 Initial Screening Criteria and Results

Initial screening criteria for assessing leachate management, final cover, and surface water management alternatives consist of the following:

- Construction / Implementation Feasibility: Construction feasibility refers to the ability to build the system given site-specific conditions. Implementation feasibility refers to the ability of this alternative to meet technical factors such as appropriateness or suitability, and availability of the technology given site specific constraints and geographic location; and administrative factors such as local and state permitting requirements and regulatory reviews for approval.
- Effectiveness: Effectiveness refers to three criteria consisting of: 1) the extent to which the alternative protects human health and the environment; 2) reduction in contaminant levels to meet Section 811.320 groundwater quality standards; and 3) the extent to which the alternative has been demonstrated at other sites.
- Cost: Costs for the purpose of initial screening refer to relative cost ranges for each of the alternatives, and include utilization of available published cost data from similar projects, vendor data, and engineering judgment. As such, costs are for general

comparative purposes, and are not used singly as a screening tool unless substantial cost differentials would immediately preclude the technology from further consideration.

Of the three initial screening criteria identified above, the most crucial is construction / implementation feasibility. If a technology failed this criterion, then it was not considered for further evaluation. Therefore, the criteria of effectiveness and cost are secondary unless substantial concerns in either of the secondary criteria were identified that would clearly eliminate the alternative (i.e. same feasibility and effectiveness with significantly higher costs).

The results and recommendations of the initial screening are listed in the last column of Table 3-1. The rough cost summaries for each of the alternatives are provided in Appendix B. Table 3-2 provides a summary of the areal extent and volumes of ash in Pond D used for quantity estimation in the rough cost summaries. Table 3-3 provides a material balance analysis for each of the final cover alternatives that explains how each source of fill available on site will be utilized within the final cover alternative. The alternatives selected for further evaluation and modeling consist of the following:

Leachate Management Alternatives

- Site monitoring with no leachate collection.
- Groundwater extraction combined with interceptor drain/trench.
- Interceptor drain/trench.

Source Control in the Deep Alluvial Aquifer via Groundwater Extraction

Final Cover Alternatives

- Geosynthetic final cover.
- Earthen final cover.
- Pozzolanic fly ash final cover.

Surface Water Management Alternatives

- Route surface water east and west towards the Wabash River and the drainage collection pond (Pond C).

3.6 Treatability Study for a Pozzolanic Fly Ash Final Cover

The results of the initial screening included the pozzolanic fly ash final cover alternative for further evaluation and modeling. If the pozzolanic cover can provide similar performance to traditional final cover designs (e.g. compacted clay and/or geosynthetic), the Hutsonville Power Station may have the opportunity to beneficially incorporate fly ash from Pond A, with the added benefit of renewing capacity in Pond A. The treatability study was performed to evaluate the technical feasibility of constructing a pozzolanic fly ash cover from Pond A. Specific objectives included:

- The ability to approach or meet the alternative standards for strength and permeability as outlined in Part 816 for a similar regulatory approved final cover technology: the Poz-O-Tec process;
- The range of admixtures that can be successfully mixed with Pond A fly ash to construct a pozzolanic fly ash final cover; and
- The best mix design for a pozzolanic fly ash cover that provides the best balance of constructability and performance with respect to the Part 816 standards and cost.

VFL Technology Corporation (VFL) was selected to perform the treatability study. The results of the treatability study are included as Appendix C-1; Conceptual Development of a Pozzolanic Cap for Closure of Basin D and the Hutsonville Power Station (Treatability Study).

Specific details regarding the study including geotechnical investigation, raw materials characterization, mix design preparation, mix design performance testing, and extrapolation to full-scale operations are included in the Treatability Study. Reagents that were evaluated during the study included Portland Cement, Class C fly ash, fluidized bed residue ash (FBR), quicklime, fluidized gas desulfurization scrubber sludge (FGD or filter cake), and native soils. VFL evaluated 16 mix designs, as listed in the Treatability Study – Table 3.

Specific conclusions provided in the study (Section 2.0, Treatability Study) indicate that construction of a pozzolanic fly ash final cover system using ash from Pond A is feasible from a geotechnical, treatability, and performance based stance. Specifically, VFL recommended five mix designs that provide the best performance and applicability for construction under field conditions that included:

- Mix Designs 1 and 2 (Pond A fly ash and cement);
- Mix Designs 9 and 10 (Pond A fly ash, on-site soil, and cement); and
- Mix Design 14 (Pond A fly ash, FGD filter cake, and cement).

The performance of each of these mix designs with respect to performance goals listed above are provided in Table 3-4. The following pertinent observations were developed from a comparison of each recommended mix design to the performance goals:

- The permeability results for each mix design do not meet or exceed the performance goal of 1 x 10^{-7} cm/sec;
- The unconfined compressive strength (UCS) (at 84 days) for each mix design exceeds the performance goal of 150 psi;
- Each mix design appears to be constructable in the field; although several constructability concerns were noted for Mix Design 14. Specifically, the rapid strength gain and ultimate UCS of Mix Design 14 (Figure 2, Treatability Study) could present construction challenges. In addition, VFL specifically noted (Section 4.4, Treatability Study) that FGD sludge utilized in Mix Design 14 can be difficult to accurately feed into a portable processing system and adequately mix with the fly ash and other reagents as the material has a tendency to adhere to the sides of the feed hoppers; and
- Three of the five recommended mix designs (Mix Designs 1, 9 and 14) were tested for leaching performance (Table 4, Treatability Study). The results of the TCLP testing of RCRA metals for each mix design indicated that leachate concentrations did not exceed the Groundwater Quality Standards for Class I: Potable Resource Groundwater with the exception of cadmium, detected slightly above the Class I standard at 0.01 mg/L for Mix Design 9. This concentration is well below the Groundwater Quality Standards for Class II: General Resource Groundwater for cadmium at 0.05 mg/L.

Furthermore, VFL expressed a concern with the chemical and physical variability of FGD sludge that could significantly alter the performance characteristics of mix designs that utilize this reagent (Mix Design 14). Based on the results of the study and the comparison with the performance goals, the following considerations have been developed for possible full-scale implementation of a pozzolanic fly ash final cover system for Pond D:

- Low permeability conditions can be achieved that will minimize concerns for continuing impacts to groundwater related to infiltration of surface water to the ash in Pond D;
- The range of available compressive strengths will provide suitable conditions for construction of a pozzolanic final cover;
- Leach testing indicates that the processing of ash from Pond A for pozzolanic final cover materials for Pond D will not result in leachate concentrations that exceed Class I Groundwater Quality Standards;
- A range of mix designs will support effective construction of a pozzolanic final cover system relative to site-specific design requirements; and

- Mix Design 14 is not recommended for the pozzolanic final cover system due to field constructability concerns and potential chemical and physical variability concerns noted by VFL.

4 MODELING AND EVALUATION OF SELECTED ALTERNATIVES

4.1 Purpose

The purpose of the modeling was to predict the effect of closure alternatives selected for further evaluation in Section 3. The modeling was performed using the calibrated groundwater flow and transport model developed for this site, which was documented in the NRT report *Groundwater Model Evaluation of Impoundment Closure Options* (January 2000). The calibrated model from the January 2000 report was utilized as the starting point for this modeling[6], which included variation on five final cover options and four groundwater extraction variations as summarized in Table 4-1.

The prediction modeling was performed with the intent to represent implementation of the final cover and leachate management alternative in 2004. Due to subsequent findings of low level ash impacts at monitoring well MW-14 (Section 2.4) and subsequent installation of off-site monitoring wells (Section 2.2), the assumed timeframe for implementation of the closure alternatives has passed. The net effect from the model perspective is that the time between dewatering of the impoundment (2001) and estimated implementation of the final cover and leachate management alternative (2006 to 2007) will increase. This increase will have no effect on the predictive model comparison and results; therefore, for purposes of modeling and evaluation of selected alternatives, the model presented in this report remains valid and has not been redone.

The alternatives were modeled in the following order:

- Final cover alternatives.
- Final cover alternatives combined with leachate management alternatives.

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[6] In other words, the initial heads and concentrations used in this model were the final calibrated heads and concentrations for the steady-state portion of the model calibrated in 2000. That steady state model was calibrated to represent conditions through the end of 2000, and assumed that Pond D was in service until the end of 2000. Therefore, prediction modeling performed here begins with dewatering beginning in 2001, and assumes that the final cover and leachate management alternatives can first be applied in 2004.

4.2 Model Approach

Transport of boron was modeled because it was the parameter calibrated in the 2000 model. Boron was modeled in 2000 because it is an indicator parameter for coal ash leachate and it is mobile in groundwater.

Three model codes were used to simulate groundwater flow and contaminant transport:

- Post-closure leachate percolation was modeled using the Hydrologic Evaluation of Landfill Performance (HELP) model;
- Groundwater flow was modeled in three dimensions using MODFLOW (The HELP model provided leachate percolation rates for input to MODFLOW); and
- Contaminant transport was modeled in three dimensions using MT3DMS (MODFLOW calculated the flow field that MT3DMS used in the contaminant transport calculations).

The general background and use of the HELP, MODFLOW, and MT3DMS codes are described in detail in the 2000 model report. Specific parameter changes from the 2000 modeling are discussed below.

4.2.1 HELP Modeling

HELP (Version 3.07; Schroeder et. al, 1994) was used to estimate percolation from the impoundment for five cover scenarios. The hydrologic data required by and entered into HELP are listed in Appendix D, Table D-1 and described in the following paragraphs. A disk containing model files is attached to the back of the report.

- CO-1: 3-foot Earth;
- CO-2: 3-foot Earth over geosynthetic layer;
- CO-3a: 3-foot Earth layer over 3-foot pozzolanic layer with K= 1x10-7 cm/sec;
- CO-3b: 3-foot Earth layer over 3-foot pozzolanic layer with K= 1x10-6 cm/sec; and
- CO-3c: 3-foot Earth layer over 3-foot pozzolanic layer with K= 1x10-5 cm/sec.

Scenario CO-1 is the native soil cap scenario from the 2000 modeling. The other scenarios used in this modeling were developed by adding layers to represent PVC, compacted clay, or the pozzolanic layer.

Each cover scenario was simulated assuming the ash was uncapped with no runoff for three years (2001-2003), while the impoundment dewatered and the closure alternative was enacted. Scenario-specific changes were simulated beginning the fourth year (2004) and through the end of the simulation (2025). A 25-year simulation (2001 through 2025) was sufficient for the system to reach equilibrium after enactment of the closure scenario.

4.2.2 MODFLOW/MT3DMS

Percolation rates obtained from HELP were utilized as recharge rates for the Pond D ash cells in MODFLOW. Concentration values for the ash cells were the same as in the 2000 model, except for the period after the cap was installed (2004-2025), when concentration for the ponded portion of Pond D was increased from 5 to 20 mg/L. This change is based on NRT's experience at other impoundments, and assumes that leachate concentrations will increase after the pond is removed. The reasons for this expected increase are associated with removal of the pond water, which has typically has lower concentration than the porewater in the ash, and with removal of the hydraulic head imparted on the impoundment by the pond water when slows percolation rates through the coal ash and increases contact time.

The 2000 model included recharge terms to simulate the former ash laydown area. However, this feature was removed when Ponds B and C were constructed in 2001. This model represented removal of the ash laydown area and replacement with Ponds B and C by changing recharge rates and concentrations in this area to the values used for Pond A (the lined ash impoundment).

4.2.3 Criteria for Evaluation of Modeling Results

Two general criteria were identified for evaluation of modeling results as a measure of the scenario's effectiveness:

- Effectiveness Criteria No. 1: Compliance with the health-based Class I Groundwater Quality Standard for boron (2 mg/L) at the monitoring wells surrounding Pond D; and
- Effectiveness Criteria No. 2: The time frame, in years, in which the modeling scenario achieves the Class I Standard for boron at the monitoring wells.

4.2.4 Simulation of Final Cover and Leachate Management Alternatives

The final cover alternatives described in Section 4.2.1 were first modeled individually. Then two representative cover scenarios were modeled with the leachate collection alternatives. The leachate collection alternatives were simulated in combination with final cover alternatives, rather than individually, because the "no cover" alternative is not being considered for this facility.

For purposes of the modeling evaluation, the leachate collection alternatives were assigned the following designations, referred to as leachate extraction options (LEO):

- LEO-1: Shallow groundwater extraction wells (east) combined with an interceptor drain/trench (south);
- LEO-2: Interceptor drain/trench (east and south);
- LEO-3: Interceptor drain/trench (south only); and
- LEO-4: Interceptor drain/trench (east and south), 700 feet shorter than in LEO-2 along the east alignment.

In addition, two drain/trench depths were modeled, as designated by "a" or "b" for shallow and deep, respectively. The difference between the shallow and deep trench designs is an approximate 3 foot increase in trench depth. The trench depth was varied to evaluate the design depth necessary to effectively collect groundwater affected by ash leachate. LEO-4 was simulated because tiebacks associated with a retaining wall on the Wabash River would interfere with trench installation along the northern portion of Pond D.

Groundwater extraction scenarios (drains and extraction wells) are summarized on Table 4-1. Model layout for the drains and extraction wells are shown on Appendix D, Figures D-1 and D-2.

4.2.5 Simulation of Deep Alluvial Aquifer Source Control Alternative

Groundwater extraction from the deep alluvial aquifer was not explicitly modeled because the area of 811.320 exceedances is limited to one monitoring well within the zone of attenuation, and because boron concentrations are below the health-based Class I Groundwater Quality Standard (2 mg/L); therefore, this aquifer already meets the effectiveness criteria.

4.3 Modeling Results and Recommendations for Alternative Assembly

The groundwater transport modeling results are summarized in Table 4-2 based upon the performance of each model scenario with respect to the two effectiveness criteria identified above in Section 4.2.3. In addition, graphical results showing predicted concentration trends over time are included in Appendix D, Figures D-4 and D-5.

4.3.1 Modeling Results: Final Cover Alternatives

The five cap scenarios modeled using HELP fell into two groups. Scenarios CO-2 and CO-3a had predicted leachate percolation rates that averaged approximately 2 inches per year once dewatering was completed. The other scenarios averaged slightly less than 8 inches per year after dewatering (Figure D-3).

MODFLOW simulations of flow and transport for the five cap scenarios did not identify a final cover that significantly reduced the concentration of boron at the east monitoring wells (MW-7 and MW-8) over time (Figure D-4). Furthermore, the cover scenarios yielded similar results at the downgradient monitoring wells. The only discernable difference was observed at MW-8, where the predicted boron concentration increase for scenarios CO-2 and CO-3a was slightly lower than for the other scenarios. Similar to the 2000 model, this modeling suggests that the difference between cover scenarios is insignificant compared to the effect of dewatering Pond D, and to the effect that leaching of ash below the water table has on groundwater quality east of Pond D.

4.3.2 Modeling Results: Final Cover Alternatives Combined with Leachate Management Alternatives

The cover scenarios produced two groups of results; therefore, two representative cover scenarios were modeled in combination with the leachate management alternatives. Cover CO-2, the synthetic cover alternative, was modeled to represent the low percolation cover scenarios, and cover CO-3c, the pozzolanic cover with hydraulic conductivity of 1×10^{-5} cm/s, was modeled to represent the high percolation cover scenarios.

The modeled leachate collection alternatives had varying effects on predicted groundwater quality (Table 4-2; Figure D-5). In general, each of the leachate extraction option (LEO) scenarios met the evaluation criteria at each of the south and east downgradient monitoring wells with the exception of LEO-3 (interceptor drain/trench, south alignment only), where predicted concentrations remained elevated at monitoring wells MW-7 and MW-8. Other observations from the model results:

- Placement of extraction wells within model layer 2 (silty-clay layer) for LEO-1 resulted in dry cells; therefore, the wells were simulated in layer 3 (deep alluvial aquifer), as discussed above in Section 4.2.4, where they had to be modeled at withdrawal rates sufficient to draw flow from layer 2 to layer 3.

- Each LEO scenario met Criteria No. 1 for each monitoring well with the aforementioned exception;
- Monitoring well MW-6 went dry within four years for each LEO scenario evaluated;
- The interceptor drain/trench scenarios (LEO-2 and LEO-4 scenarios) met Criteria No. 2 faster than the groundwater extraction (east) combined with an interceptor drain/trench scenario (LEO-1 scenarios);
- The differences between the "shallow" and "deep" interceptor drain/trench scenarios fall within the realm of model uncertainty–no distinct advantage was observed for one or the other;
- The differences between the LEO-2 and LEO-4 scenarios also fell within the realm of model uncertainty–no distinct advantage was observed for extending the interceptor drain/trench 700 ft. further north (LEO-2 scenarios). This is not unexpected since all of the ash situated below the water table is located in the central and southern portions of Pond D; and
- There were no significant differences associated with the two final cover scenarios (CO-2 and CO-3c).

4.3.3 Recommendations for Alternatives Assembly

A key objective for groundwater transport modeling is to reduce the number of alternatives assembled for final screening and detailed evaluation. A large number of assembled alternatives renders detailed analysis in the final stage of the evaluation cumbersome and less meaningful. Based on the groundwater transport modeling, the following modeling scenarios were eliminated from further evaluation:

- LEO-1, all scenarios: LEO-1 combinations are not as effective as LEO-2 and LEO-4 combinations (Effectiveness Criteria No. 2, time frame);
- LEO-2, all scenarios: LEO-2 combinations (extending the interceptor drain/trench 700 ft. further north) do not provide significantly better effectiveness (Effectiveness Criteria No. 2, time frame) than LEO-4 scenarios at increased capital cost; and
- All "deep" interceptor drain/trench scenarios: the "deep" interceptor drain/trench does not provide significantly better effectiveness (Effectiveness Criteria No. 2, time frame) at increased capital cost versus shallow trench scenarios.

The remaining modeling scenarios were carried through for alternative assembly. Although the LEO-3 scenarios did not meet the effectiveness criteria along the east impoundment boundary between Pond D and the Wabash River, two of the LEO-3 scenarios were carried through for alternative assembly based on their ability to meet the effectiveness criteria along the south impoundment boundary and prevent off-site migration of groundwater affected by ash leachate. None of the final cover alternatives were eliminated at this time since each has equivalent performance and each offers a unique advantage that will be further evaluated in Section 5.

5 ASSEMBLY AND DETAILED ANALYSIS OF CLOSURE ALTERNATIVES

5.1 Assembly and Selection Rationale

Five final cover alternatives and four combinations of final cover and leachate management alternatives, listed in Table 4-2, were carried through the groundwater transport modeling evaluation for consideration as closure alternatives for detailed analysis. In addition, the modeling results discussed in Section 4 indicate that substitution of final cover alternative CO-3a for CO-2 and substitution of CO-1 for CO-3c would be appropriate for the combinations of final cover and leachate management alternatives as CO-3a and CO-1 provide equivalent effectiveness as CO-2 and CO-3c, respectively. Three of the alternatives carried through and one alternative that substitutes CO-1 for CO-3c were selected for detailed analysis as follows:

- Closure Alternative No. 1: Select one alternative that substantially meets the leachate collection and cap design requirements of 35 IAC Parts 811 and 814. Based on this selection criterion, combination *CO-2, LEOa-4: Geosynthetic Final Cover with East and South Interceptor Drain/Trench* was selected (700 feet shorter along east alignment). This closure alternative adheres to the Section 811.314 requirements for a final cover system, and implements leachate collection along the east and south boundaries of Pond D, and groundwater extraction in the deep alluvial aquifer, to meet the requirements for meeting applicable groundwater quality standards at the edge of the "zone of attenuation" as defined in Section 811.320(c).

- Closure Alternative No. 2: Select one alternative that meets the "effectiveness criteria" (Section 4.2.3) with adjusted standards and includes leachate collection. Based on this selection criterion, combination *CO-1, LEOa-3: Earthen Final Cover with South Interceptor Drain/Trench* was selected. Although this closure alternative was not explicitly modeled, the results of the final cover alternatives modeling (as explained above) indicate that this alternative combination will have equivalent effectiveness as CO-3c, LEOa-3 listed in Table 4-2. This closure alternative balances lower cost with leachate collection designed to prevent off-site migration to the south. An earthen final cover would require an adjusted standard to meet the Section 811.314 final cover requirements. Leachate collection along the south impoundment boundary would adhere to the requirements of Section 811.320 at the south property line; however, an adjusted standard would be needed to allow affected groundwater to exceed the Section 811.320 applicable background concentrations and Class I Groundwater Quality Standards beyond the zone of attenuation between the east edge of Pond D and the Wabash River.

- Closure Alternative No. 3: Select one alternative that represents the lowest cost alternative and meets the "effectiveness criteria" (Section 4.2.3) with adjusted standards and no leachate collection. Based on this selection criterion, final cover alternative *CO-1: Earthen Final Cover* was selected. This closure alternative represents the lowest cost alternative for closure of Pond D and would require adjusted standards to seek relief from several sections of Part 811 and Part 814.302(b)(1).

- Closure Alternative No. 4: Select one alternative that meets the "effectiveness criteria" (Section 4.2.3) with adjusted standards and meets the "intent" of 35 IAC Part 811 and 814 through utilization of technology and construction techniques substantially similar to those promulgated in 35 IAC Part 816 (Alternative Standards for Coal Combustion Power Generating Facilities Waste Landfills). Based on this selection criterion, final cover alternative *CO-3c: Pozzolanic Fly Ash Final Cover* ($K \approx 1 \times 10^{-5}$ *cm/sec)* was selected. This closure alternative provides equivalent effectiveness as Closure Alternative No. 3 and has the added benefit of providing renewed capacity for the Pond A fly ash impoundment. This alternative would require adjusted standards to seek relief from several sections of Part 811 and Part 814.302(b)(1).

Each of the mix designs recommended by VFL for a pozzolanic fly ash final cover had lower hydraulic conductivity than the highest value used for HELP and groundwater transport modeling ($K = 1 \times 10^{-5}$ cm/sec). Since each mix design provides essentially equivalent effectiveness within the modeling performed to evaluate the alternatives, feasibility level cost data were provided by VFL to perform a cost sensitivity analysis of the recommended mix designs. The cost sensitivity analysis is provided in Table 3-4 and the feasibility-level cost data used to create the feasibility cost estimates (Appendix B) for each mix design is provided in Appendix C-2. The results of the cost sensitivity analysis indicated that Mix Design 2 for the pozzolanic fly ash final cover would be the most economical mix design to achieve the performance modeled for Closure Alternative No. 4. Therefore, costs associated with Closure Alternative No. 4 are based on Mix Design 2 for the pozzolanic fly ash final cover.

Surface water management considerations have been included for each of the selected alternatives. Since only one surface water management alternative passed the initial screening [Section 3.5, Table 3-1: Route surface water east and west towards the Wabash River and the drainage collection pond (Pond C)], costs for grade adjustment within Pond D to construct this surface water management alternative are incorporated within the final cover cost estimates. Also, proposed grading contours for this surface water management alternative are shown on Figures 5-1 through 5-3.

5.2 Detailed Analysis of Closure Alternatives

Costs for each of the closure alternatives and the alternate final cover are summarized in Table 5-1 and were compiled using the cost estimates provided in Appendix B. Detailed analysis of the three alternatives is summarized in Table 5-2 and was performed in general accordance with the criteria stipulated in Sections 811.324 and 811.325. Conceptual layouts of Closure Alternatives No. 1 through 4 are shown on Figures 5-1 through 5-3, respectively. Key conclusions from the cost comparison and detailed analysis:

- Closure Alternative No. 1 has the highest initial capital cost and overall cost for a 30-year operating and maintenance (O&M) period, based on 2003 dollars. Performance and reliability are not concerns as the remedial components consisting of a geosynthetic cover, leachate collection via an interceptor drain/trench, and groundwater extraction are demonstrated technologies that are widely available. Ease of implementation will present a significant, although manageable, challenge for operation and maintenance of the deep alluvial aquifer groundwater extraction. System reliability and effectiveness would be further enhanced by careful design, operation and maintenance. This alternative reflects the most conventional approach of the three alternatives; and likely would not require adjusted standards for leachate collection and cap design as the alternative is designed to comply with these requirements in Parts 811 and 814.
- Closure Alternative No. 2 reflects an approach that balances mid-range cost with heightened institutional requirements through the pursuit of adjusted standards. This alternative provides significant cost savings versus Alternative No. 1 in up-front capital cost and for a 30 year O&M period. Performance, effectiveness, and reliability along the south impoundment boundary are nearly equivalent to Alternative No. 1. Along the east impoundment boundary, an adjusted standard would be required to meet performance and effectiveness criteria. An adjusted standard would also be required for construction of an earthen final cover.
- Closure Alternative No. 3 does not rely on leachate collection for performance and represents the lowest cost alternative with significant savings in up-front capital and long term O&M costs. Groundwater transport modeling data suggest that an earthen cover may provide similar performance and long term effectiveness along the south property boundary as Alternatives No. 1 and 2. However, this alternative would require significant adjusted standards for construction of an earthen cover, no leachate collection, and adjusted groundwater quality standards.
- Closure Alternative No. 4 provides equivalent performance, reliability, and effectiveness as the final covers proposed for each alternative at a mid-range capital cost for final cover construction. Plant enhancements resulting from the additional capacity created for fly ash in Pond A may offset capital costs. Similar to Closure Alternative No. 3, adjusted standards would be required for no leachate collection and adjusted groundwater quality standards. In addition, an adjusted standard would be required to gain regulatory acceptance of this technology for construction of a pozzolanic fly ash cover; however, regulatory precedent does exist for similar construction of final covers (35 IAC Part 816).

5.3 Recommended Closure Strategy

Each of the four alternatives is potentially appropriate for the site with similar performance and effectiveness, and reflects a range of approaches contingent on capital expenditure and varying approval of adjusted standards with the Illinois PCB. However, Closure Alternative No. 4, Pozzolanic Fly Ash

Cover, provides the optimal balance of capital expenditure and pursuit of adjusted standards for the following reasons:

- Groundwater transport modeling indicates that a pozzolanic fly ash final cover system will have substantially similar performance and effectiveness as a cover system that meets the requirements of Section 811.314 (e.g. geosynthetic final cover).
- Groundwater transport modeling indicates that the pozzolanic fly ash final cover will achieve the health-based Class I Groundwater Quality Standards along the south property boundary (MW-11R) within approximately 16 years. This alternative should satisfy long-term regulatory concerns with off-site migration.
- No leachate management is proposed along the east impoundment boundary because groundwater impacted by ash leachate discharges to the Wabash River and does not threaten any downgradient groundwater receptors. Based on this discussion, pursuit of an adjusted standard for the applicable groundwater quality standards along the east edge of the "zone of attenuation" is warranted.
- No groundwater extraction is proposed for the deep alluvial aquifer. The concentration of boron detected in MW-14 remains below Class I groundwater quality standards, there is no evidence of migration toward the south, and the only exposure pathway to potable groundwater supply wells is via the plant supply wells. These wells show no evidence of impacts.
- Regulatory precedent exists (35 IAC 816) for construction of a pozzolanic fly ash final cover system using substantially similar technology and construction techniques.
- Significant cost savings may be realized through construction of a pozzolanic fly ash final cover by enhancing plant operations and providing additional capacity for fly ash in Pond A. Based on this discussion, pursuit of an adjusted standard for construction of a pozzolanic fly ash final cover is warranted.

5.4 Recommended Pre-Design Evaluation and Field Testing

NRT recommends additional pre-design evaluation and field testing prior to design and full-scale construction of a pozzolanic fly ash final cover. Additional pre-design evaluation would include additional geotechnical evaluation of Pond D to determine if a stable subgrade for support of a pozzolanic fly ash cover can be constructed, and creation and sampling of a test pad constructed of the pozzolanic materials at the site in substantial conformance with Section 816.530. No additional bench-scale testing is recommended at this time.

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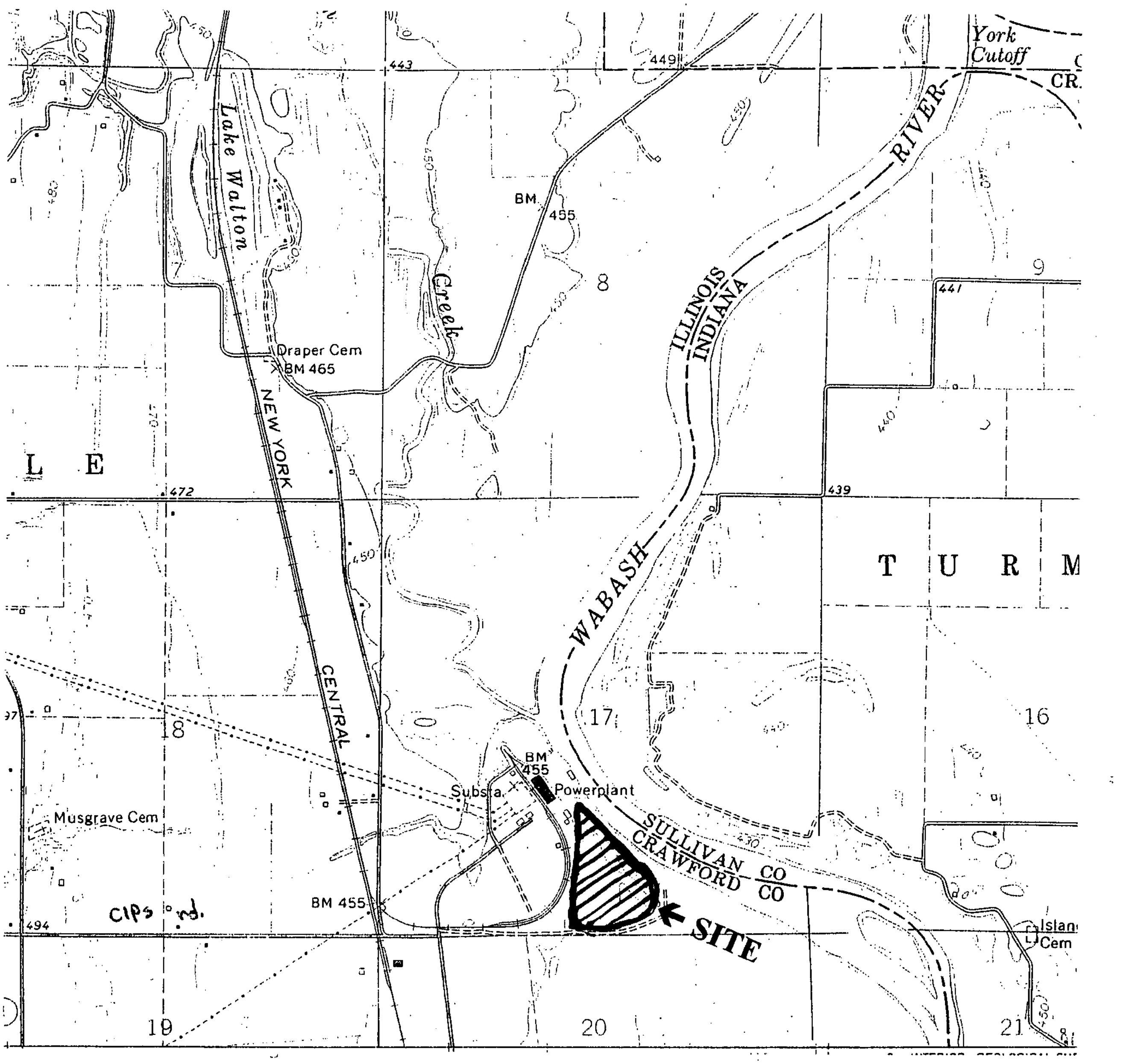
FIGURES



SOURCE: USGS 15 MINUTE QUADRANGLE, WEST UNION. DATED 1966.

QUADRANGLE LOCATION

N

0 2000 4000

SCALE IN FEET

CONTOUR INTERVAL 10 FEET

NATURAL
RESOURCE
TECHNOLOGY

SITE LOCATION MAP

HUTSONVILLE POWER STATION
AMEREN ENERGY GENERATING
HUTSONVILLE, ILLINOIS

DRAWN BY: RLH 07/18/05 APP'D BY: BRH DATE: 07/18/05

PROJECT NO.
1375

DRAWING NO.
1375–A04

FIGURE NO.
1–1

SOURCE NOTES:
THIS MAP WAS OBTAINED FROM A DRAWING BY HANSON ENGINEERS, INC. (HEI), GENERAL PLAN, HEI SHEET NO S02, P.C.M.S. PROJECT, DATED 4/05/00, AND FROM AN AERIAL SURVEY PERFORMED BY SURDEX CORPORATION, HUTSONVILLE ASH POND SURVEY, SURDEX JOB NO. 1100434/190, DATED 4/24/01.

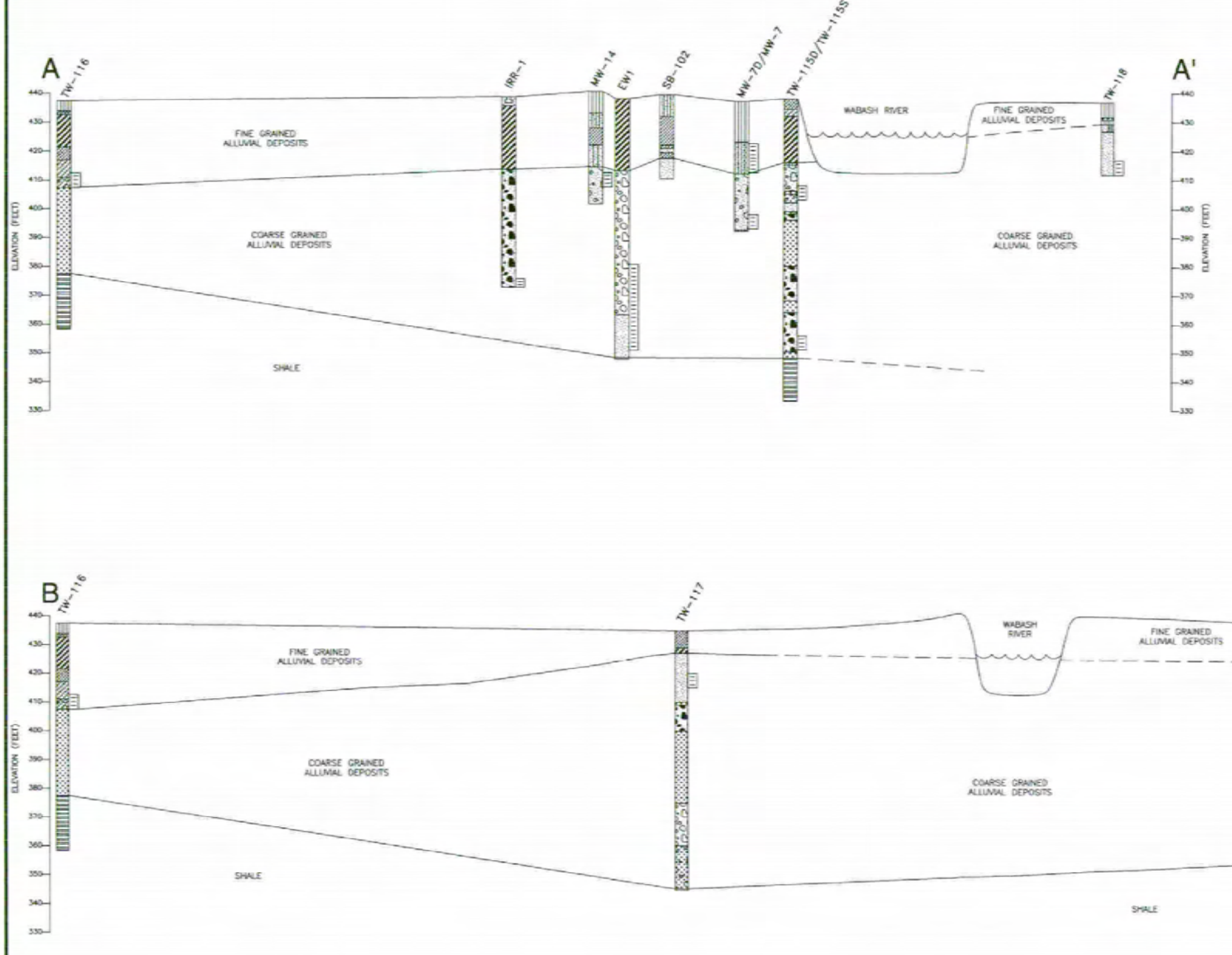
MONITORING WELLS MW-1 THROUGH MW-12, MW-14 AND TW; SOIL BORINGS SB-101 THROUGH SB-103; AND EXTRACTION WELLS EW-1 AND EW-2 WERE SURVEYED BY AMEREN PERSONNEL ON 10/15/01 AND 10/16/01. ALL OTHER MONITORING WELL, SOIL BORING, LEACHATE SAMPLE AND SURFACE WATER SAMPLE LOCATIONS WERE OBTAINED FROM NRT DRAWING 1375-801, PROJECT NO. 1375/1, DATED 8/18/99.

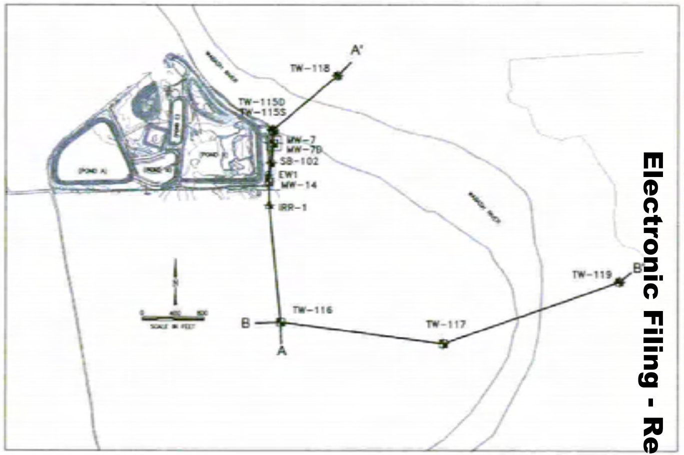
TW-115D AND TW-115S WERE SURVEYED BY CONNOR & CONNOR, INC. ROBINSON, ILLINOIS, JULY 2004.

NOTES:
1. DISCONTINUITIES BETWEEN SURVEYS ARE INDICATED BY BREAKS IN CONTOUR LINES.
2. SOIL BORINGS GP-1 THROUGH GP-4, GP-9 AND SURFACE WATER SAMPLE P2P ARE SCREENED SINCE THEY ARE ASSOCIATED WITH FORMER ASH LAYDOWN AREA NOW REPLACED WITH THE INTERIM POND AND THE DRAINAGE COLLECTION POND. SEE NRT REPORT "HYDROGEOLOGIC ASSESSMENT" FOR FURTHER INFORMATION.

NATURAL RESOURCE TECHNOLOGY

PROJECT NO. 1375/6.1	SITE PLAN
DRAWN BY: TAS RLH 05/17/05	LEACHATE MANAGEMENT AND FINAL COVER ALTERNATIVES REPORT HUTSONVILLE POWER STATION-POND D CLOSURE AMEREN ENERGY GENERATING, HUTSONVILLE, ILLINOIS
CHECKED BY: CAR 05/17/05	
APPROVED BY: BRH 06/07/05	DRAWING NO: 1375-61-B30 REFERENCE:
	FIGURE NO. 1-2



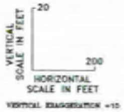


LEGEND

▨	TOPSOIL	▨	WELL GRADED SAND
▥	SILT	▨	WELL GRADED GRAVEL WITH SAND
▨	SILTY LEAN CLAY	▨	WELL GRADED SAND WITH GRAVEL
▨	SANDY SILT	▨	POORLY GRADED SAND
▨	SILTY SAND	▨	POORLY GRADED SAND WITH GRAVEL
▨	LEAN CLAY	▨	SANDY LEAN CLAY
▨	FAT CLAY	▨	CLAYEY SAND
▨	POORLY GRADED GRAVEL	▨	WELL GRADED GRAVEL
▨	CLAYEY GRAVEL	▯	SCREENED INTERVAL
▤	SHALE		

NOTES:

1. IRR-1 IS THE WAMPLER IRRIGATION WELL (ISGS WELL #12-033-36667-00).
2. EW1 IS BASED ON ISGS WELL, PERMIT #47367.
3. DEPTH OF WABASH RIVER IS ASSUMED.



B-B'	TAS	04/28/05	PAR
A-A'	TAS	04/28/05	PAR
ID	CHK'D BY:	DATE:	APP'D BY:

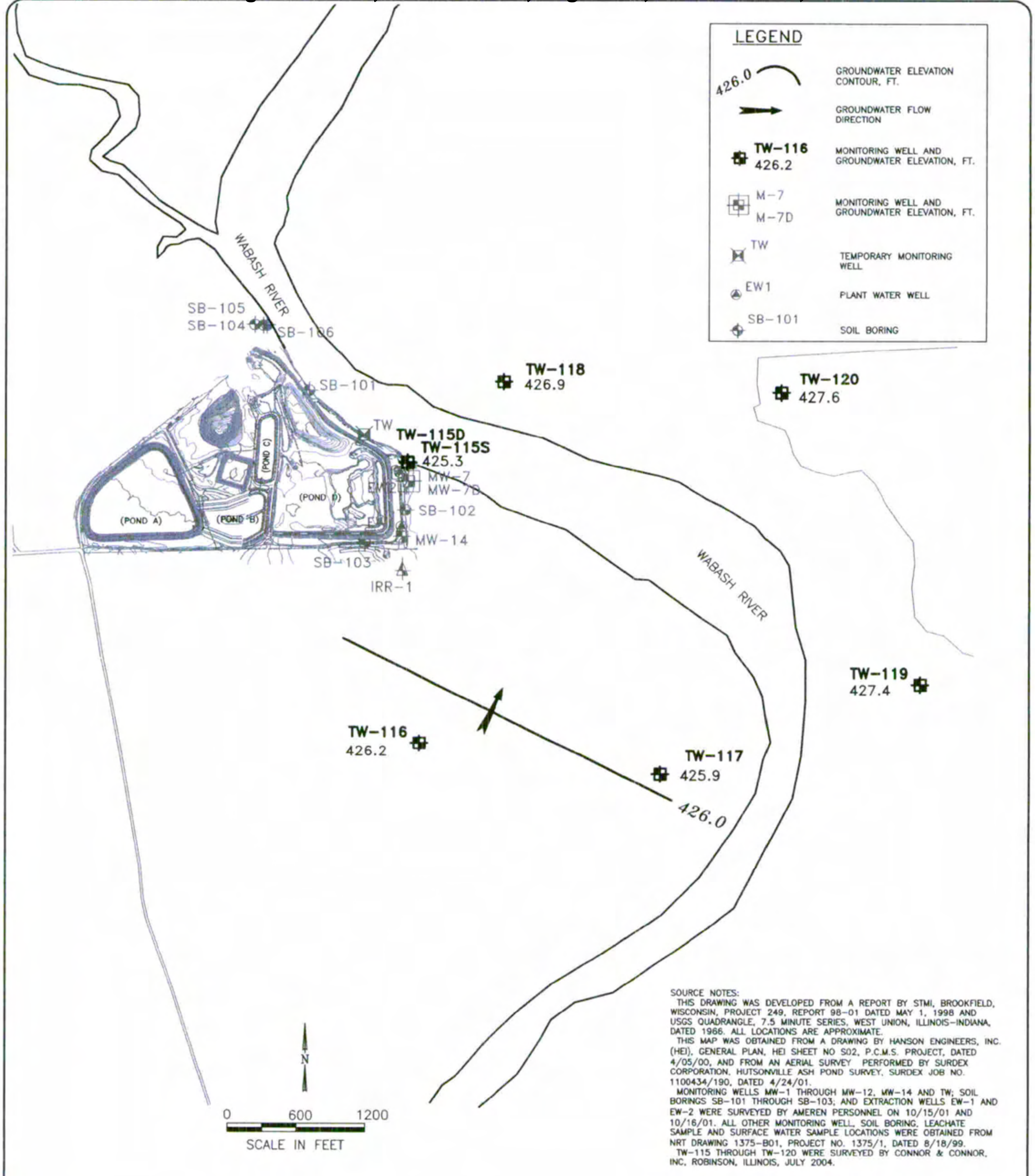
NATURAL
RESOURCE
TECHNOLOGY

PROJECT NO. 1375/6.1
DRAWN BY: RLH/TAS 05/03/05
CHECKED BY: PAR 05/16/05
APPROVED BY: BRH 05/17/05

GEOLOGIC CROSS SECTIONS

LEACHATE MANAGEMENT AND FINAL COVER ALTERNATIVES REPORT
HUTSONVILLE POWER STATION-POND D CLOSURE
AMEREN ENERGY GENERATING
HUTSONVILLE, ILLINOIS

DRAWING NO: 1375-61-B01
REFERENCE:
FIGURE NO. 2



SOURCE NOTES:
THIS DRAWING WAS DEVELOPED FROM A REPORT BY STMI, BROOKFIELD, WISCONSIN, PROJECT 249, REPORT 98-01 DATED MAY 1, 1998 AND USGS QUADRANGLE, 7.5 MINUTE SERIES, WEST UNION, ILLINOIS-INDIANA, DATED 1966. ALL LOCATIONS ARE APPROXIMATE.
THIS MAP WAS OBTAINED FROM A DRAWING BY HANSON ENGINEERS, INC. (HEI), GENERAL PLAN, HEI SHEET NO S02, P.C.M.S. PROJECT, DATED 4/05/00, AND FROM AN AERIAL SURVEY PERFORMED BY SURDEX CORPORATION, HUTSONVILLE ASH POND SURVEY, SURDEX JOB NO. 1100434/190, DATED 4/24/01.
MONITORING WELLS MW-1 THROUGH MW-12, MW-14 AND TW; SOIL BORINGS SB-101 THROUGH SB-103; AND EXTRACTION WELLS EW-1 AND EW-2 WERE SURVEYED BY AMEREN PERSONNEL ON 10/15/01 AND 10/16/01. ALL OTHER MONITORING WELL, SOIL BORING, LEACHATE SAMPLE AND SURFACE WATER SAMPLE LOCATIONS WERE OBTAINED FROM NRT DRAWING 1375-B01, PROJECT NO. 1375/1, DATED 8/18/99.
TW-115 THROUGH TW-120 WERE SURVEYED BY CONNOR & CONNOR, INC, ROBINSON, ILLINOIS, JULY 2004.

NATURAL
RESOURCE
TECHNOLOGY

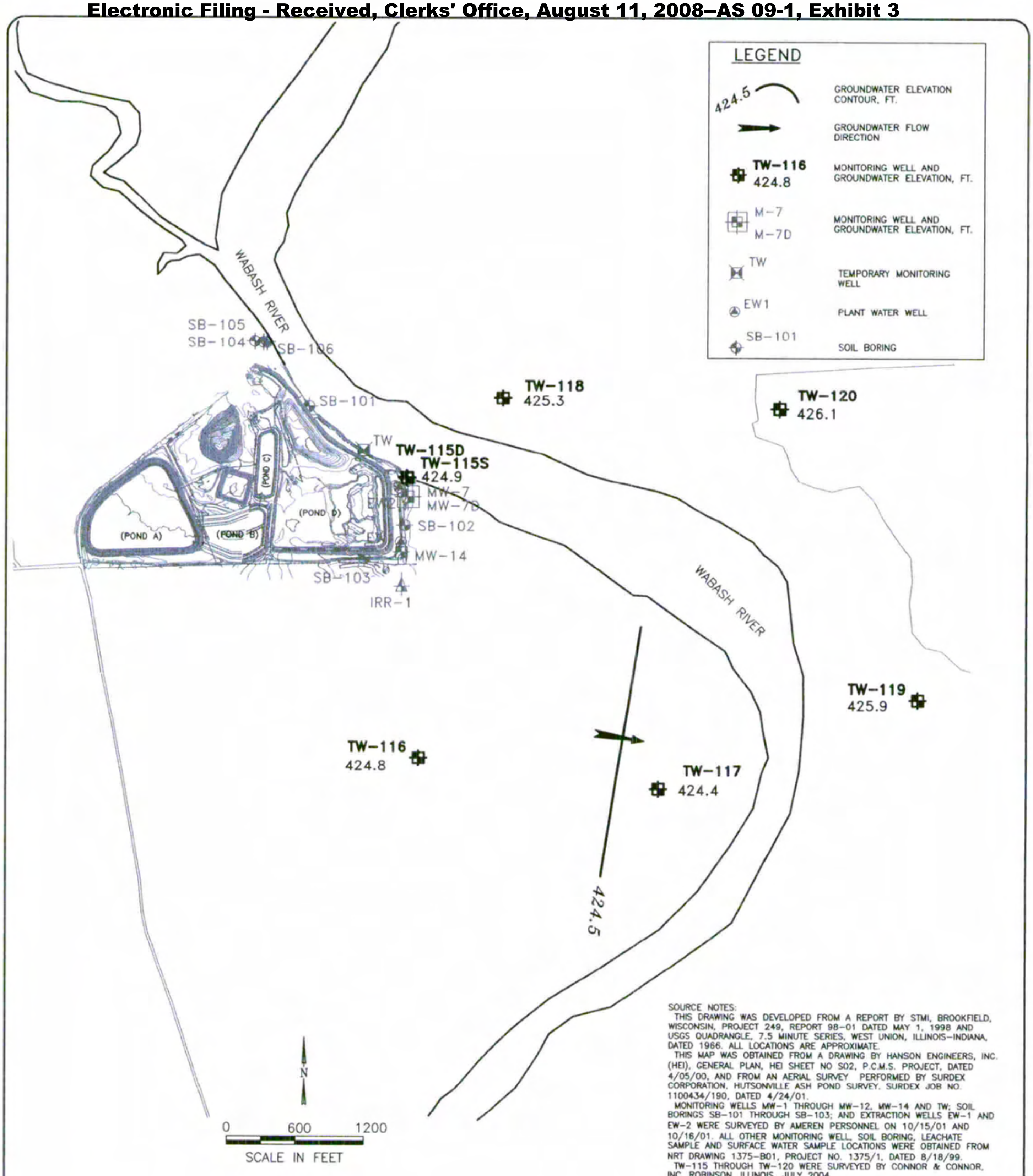
GROUNDWATER ELEVATION CONTOUR
SEPTEMBER 14, 2004
LEACHATE MANAGEMENT AND FINAL COVER ALTERNATIVES REPORT
HUTSONVILLE POWER STATION–POND D CLOSURE
AMEREN ENERGY GENERATING
HUTSONVILLE, ILLINOIS

DRAWN BY: TAS 06/07/05 APP'D BY: BRH DATE: 06/07/05

PROJECT NO.
1375/6.1

DRAWING NO.
1375-61-A04

FIGURE NO.
2-2



SOURCE NOTES:
THIS DRAWING WAS DEVELOPED FROM A REPORT BY STMI, BROOKFIELD, WISCONSIN, PROJECT 249, REPORT 98-01 DATED MAY 1, 1998 AND USGS QUADRANGLE, 7.5 MINUTE SERIES, WEST UNION, ILLINOIS-INDIANA, DATED 1966. ALL LOCATIONS ARE APPROXIMATE.
THIS MAP WAS OBTAINED FROM A DRAWING BY HANSON ENGINEERS, INC. (HEI), GENERAL PLAN, HEI SHEET NO S02, P.C.M.S. PROJECT, DATED 4/05/00, AND FROM AN AERIAL SURVEY PERFORMED BY SURDEX CORPORATION, HUTSONVILLE ASH POND SURVEY, SURDEX JOB NO. 1100434/190, DATED 4/24/01.
MONITORING WELLS MW-1 THROUGH MW-12, MW-14 AND TW; SOIL BORINGS SB-101 THROUGH SB-103; AND EXTRACTION WELLS EW-1 AND EW-2 WERE SURVEYED BY AMEREN PERSONNEL ON 10/15/01 AND 10/16/01. ALL OTHER MONITORING WELL, SOIL BORING, LEACHATE SAMPLE AND SURFACE WATER SAMPLE LOCATIONS WERE OBTAINED FROM NRT DRAWING 1375-B01, PROJECT NO. 1375/1, DATED 8/18/99.
TW-115 THROUGH TW-120 WERE SURVEYED BY CONNOR & CONNOR, INC, ROBINSON, ILLINOIS, JULY 2004.

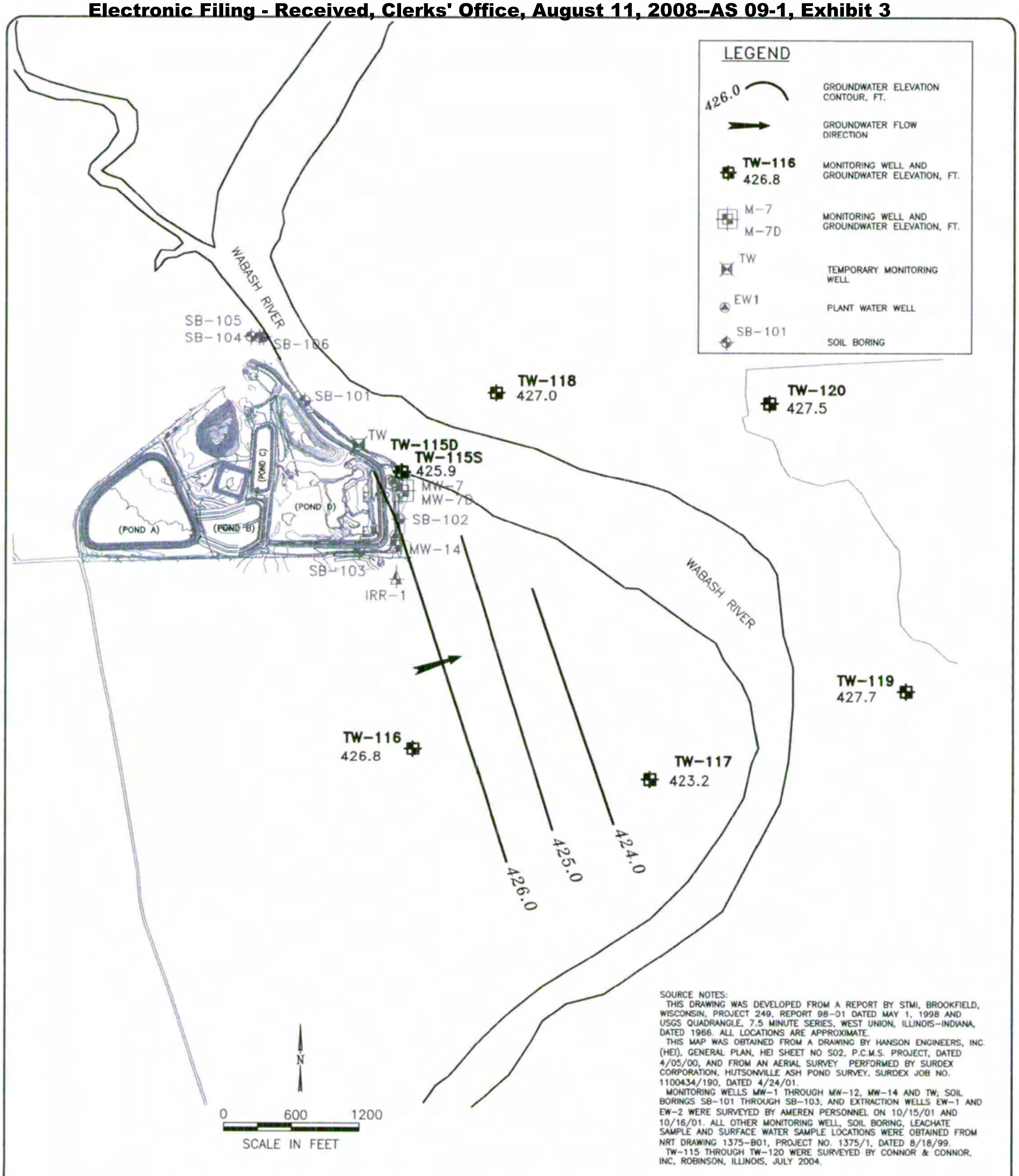
NATURAL
RESOURCE
TECHNOLOGY

GROUNDWATER ELEVATION CONTOUR
OCTOBER 26, 2004
LEACHATE MANAGEMENT AND FINAL COVER ALTERNATIVES REPORT
HUTSONVILLE POWER STATION-POND D CLOSURE
AMEREN ENERGY GENERATING
HUTSONVILLE, ILLINOIS
DRAWN BY: TAS 06/07/05 APP'D BY: BRH DATE: 06/07/05

PROJECT NO.
1375/6.1

DRAWING NO.
1375-61-A03

FIGURE NO.
2-3



SOURCE NOTES:
THIS DRAWING WAS DEVELOPED FROM A REPORT BY STMI, BROOKFIELD, WISCONSIN, PROJECT 249, REPORT 98-01 DATED MAY 1, 1998 AND USGS QUADRANGLE, 7.5 MINUTE SERIES, WEST UNION, ILLINOIS-INDIANA, DATED 1966. ALL LOCATIONS ARE APPROXIMATE.
THIS MAP WAS OBTAINED FROM A DRAWING BY HANSON ENGINEERS, INC. (HEI), GENERAL PLAN, HEI SHEET NO S02, P.C.M.S. PROJECT, DATED 4/05/00, AND FROM AN AERIAL SURVEY PERFORMED BY SURDEX CORPORATION, HUTSONVILLE ASH POND SURVEY, SURDEX JOB NO. 1100434/190, DATED 4/24/01.
MONITORING WELLS MW-1 THROUGH MW-12, MW-14 AND TW; SOIL BORINGS SB-101 THROUGH SB-103; AND EXTRACTION WELLS EW-1 AND EW-2 WERE SURVEYED BY AMEREN PERSONNEL ON 10/15/01 AND 10/16/01. ALL OTHER MONITORING WELL, SOIL BORING, LEACHATE SAMPLE AND SURFACE WATER SAMPLE LOCATIONS WERE OBTAINED FROM NRT DRAWING 1375-B01, PROJECT NO. 1375/1, DATED 8/18/99.
TW-115 THROUGH TW-120 WERE SURVEYED BY CONNOR & CONNOR, INC, ROBINSON, ILLINOIS, JULY 2004.

NATURAL
RESOURCE
TECHNOLOGY

GROUNDWATER ELEVATION CONTOUR
NOVEMBER 16, 2004

LEACHATE MANAGEMENT AND FINAL COVER ALTERNATIVES REPORT
HUTSONVILLE POWER STATION-POND D CLOSURE
AMEREN ENERGY GENERATING
HUTSONVILLE, ILLINOIS

DRAWN BY: TAS 06/07/05 APP'D BY: BRH DATE: 06/07/05

PROJECT NO.
1375/6.1

DRAWING NO.
1375-61-A02

FIGURE NO.
2-4

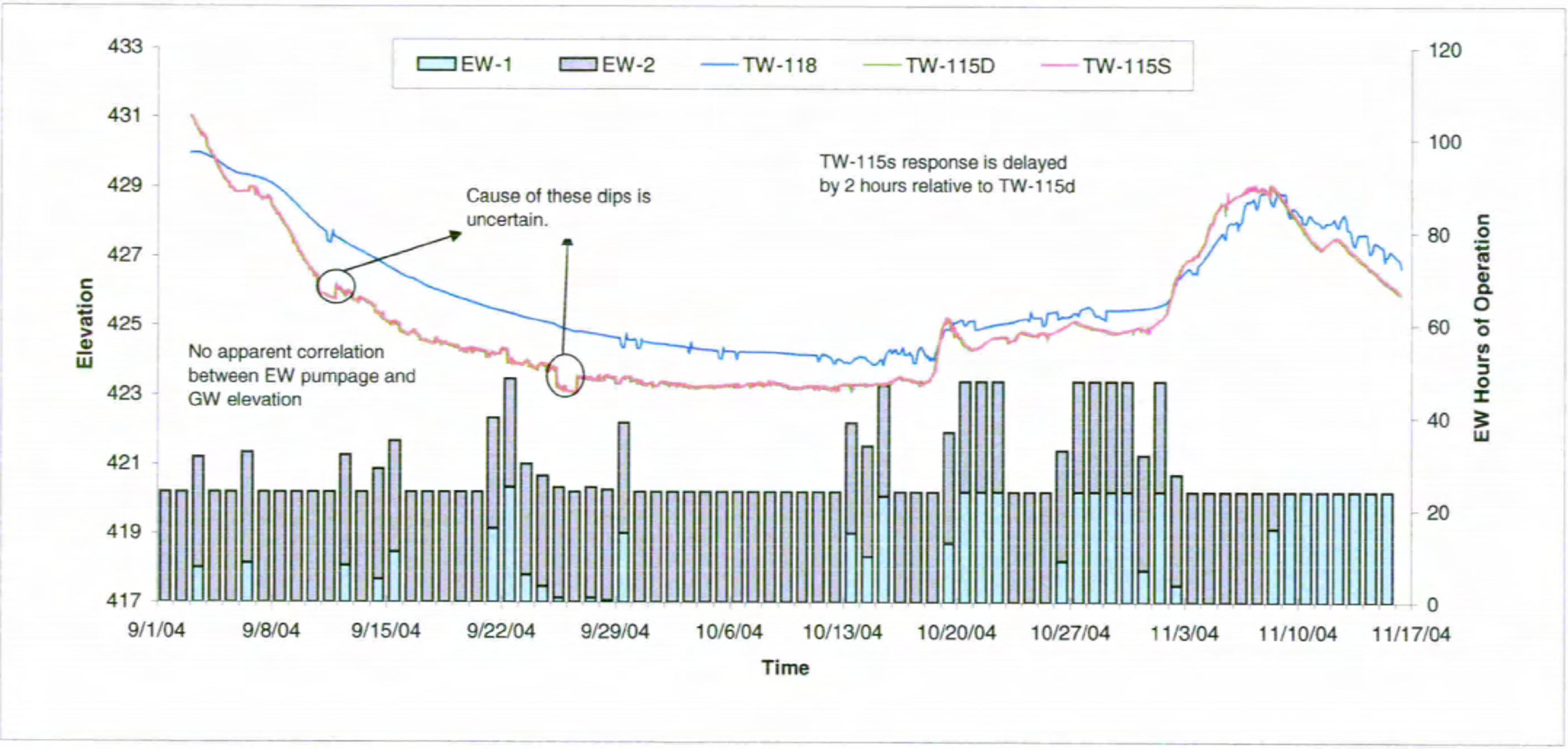


Figure 2-5 Comparison of Groundwater Elevation Data to Well Pumpage – September-November 2004

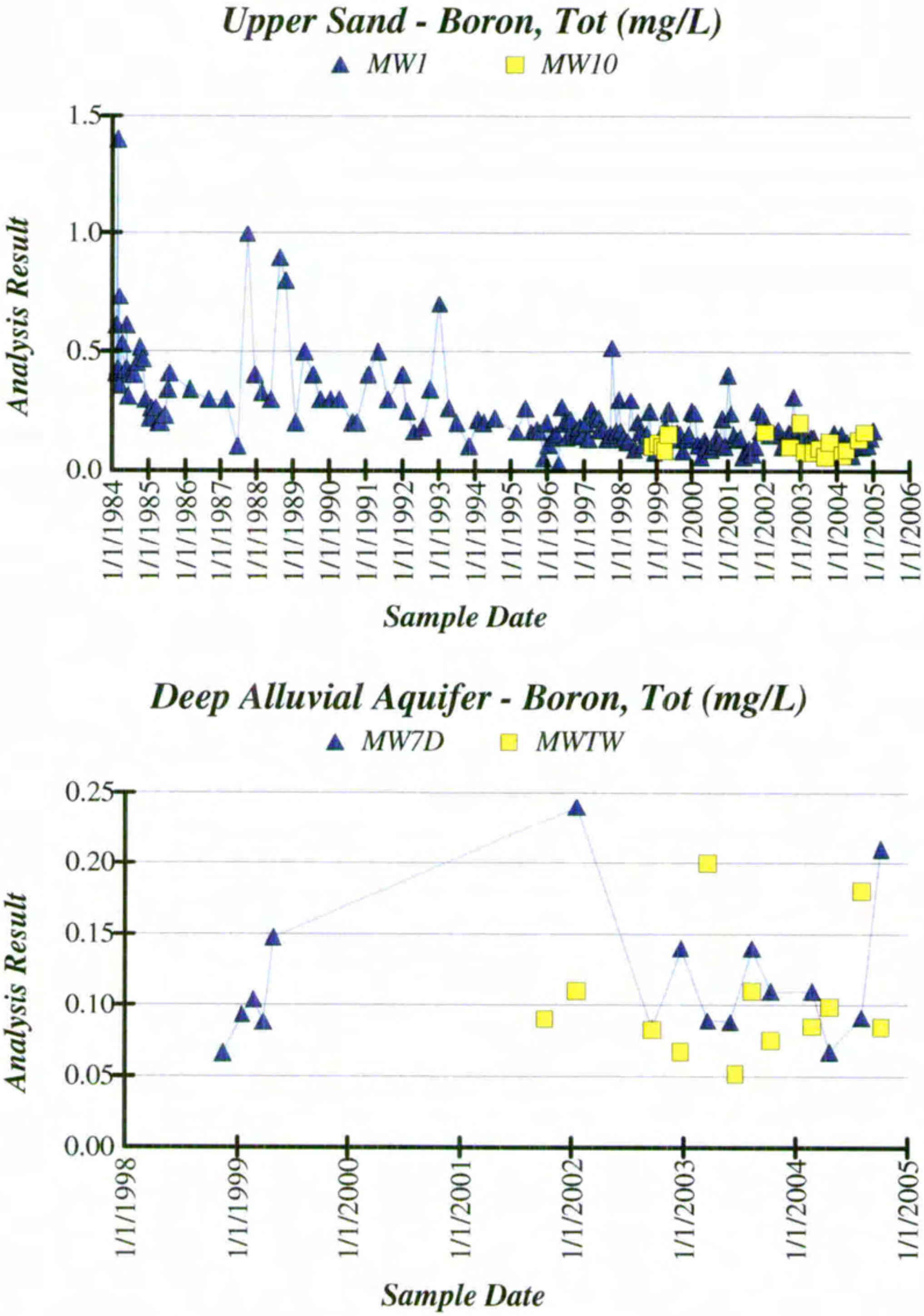


Figure 2-6. Boron Concentration in Background Wells

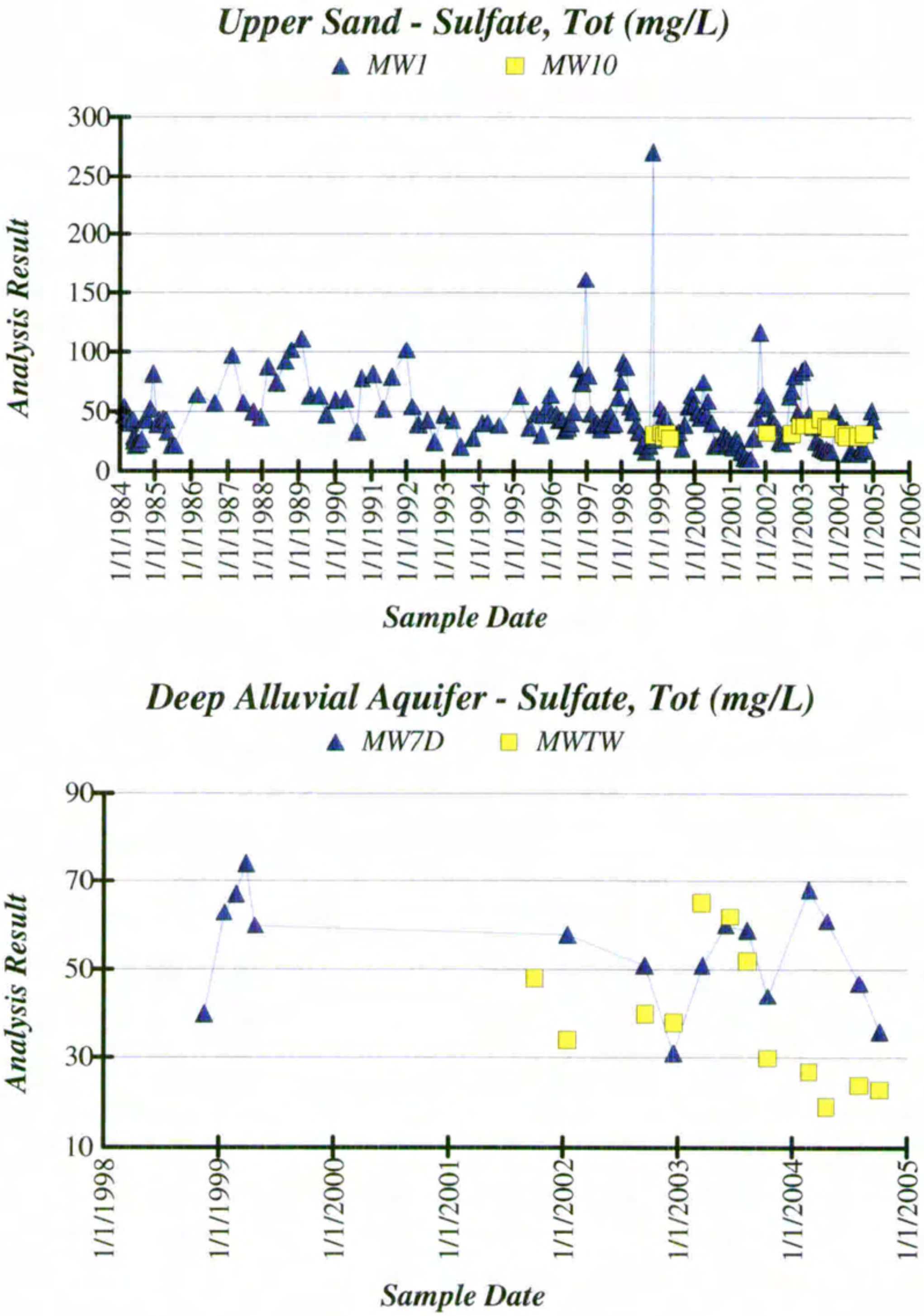
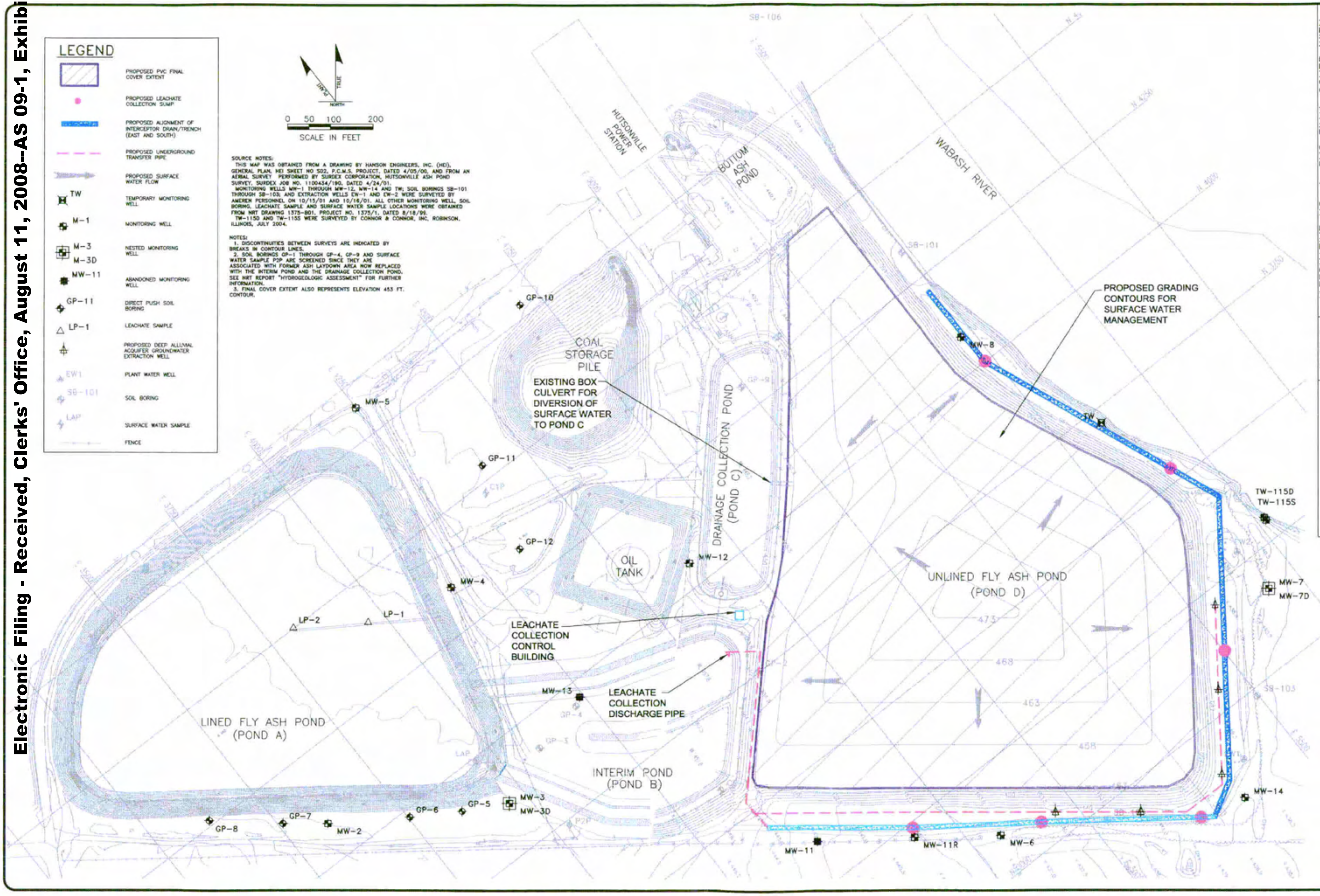


Figure 2-7. Sulfate Concentration in Background Wells



SOURCE NOTES:
THIS MAP WAS OBTAINED FROM A DRAWING BY HANSON ENGINEERS, INC. (HEI), GENERAL PLAN, HEI SHEET NO S02, P.C.M.S. PROJECT, DATED 4/05/00, AND FROM AN AERIAL SURVEY PERFORMED BY SURDEX CORPORATION, HUTSONVILLE ASH POND SURVEY, SURDEX JOB NO. 1100434/190, DATED 4/24/01.
MONITORING WELLS MW-1 THROUGH MW-12, MW-14 AND TW; SOIL BORINGS SB-101 THROUGH SB-103; AND EXTRACTION WELLS EW-1 AND EW-2 WERE SURVEYED BY AMEREN PERSONNEL ON 10/15/01 AND 10/16/01. ALL OTHER MONITORING WELL, SOIL BORING, LEACHATE SAMPLE AND SURFACE WATER SAMPLE LOCATIONS WERE OBTAINED FROM NRT DRAWING 1375-B01, PROJECT NO. 1375/1, DATED 8/18/99.
TW-115D AND TW-115S WERE SURVEYED BY CONNOR & CONNOR, INC. ROBINSON, ILLINOIS, JULY 2004.

NOTES:
1. DISCONTINUITIES BETWEEN SURVEYS ARE INDICATED BY BREAKS IN CONTOUR LINES.
2. SOIL BORINGS GP-1 THROUGH GP-4, GP-9 AND SURFACE WATER SAMPLE P2P ARE SCREENED SINCE THEY ARE ASSOCIATED WITH FORMER ASH LAYDOWN AREA NOW REPLACED WITH THE INTERIM POND AND THE DRAINAGE COLLECTION POND. SEE NRT REPORT "HYDROGEOLOGIC ASSESSMENT" FOR FURTHER INFORMATION.
3. FINAL COVER EXTENT ALSO REPRESENTS ELEVATION 453 FT. CONTOUR.

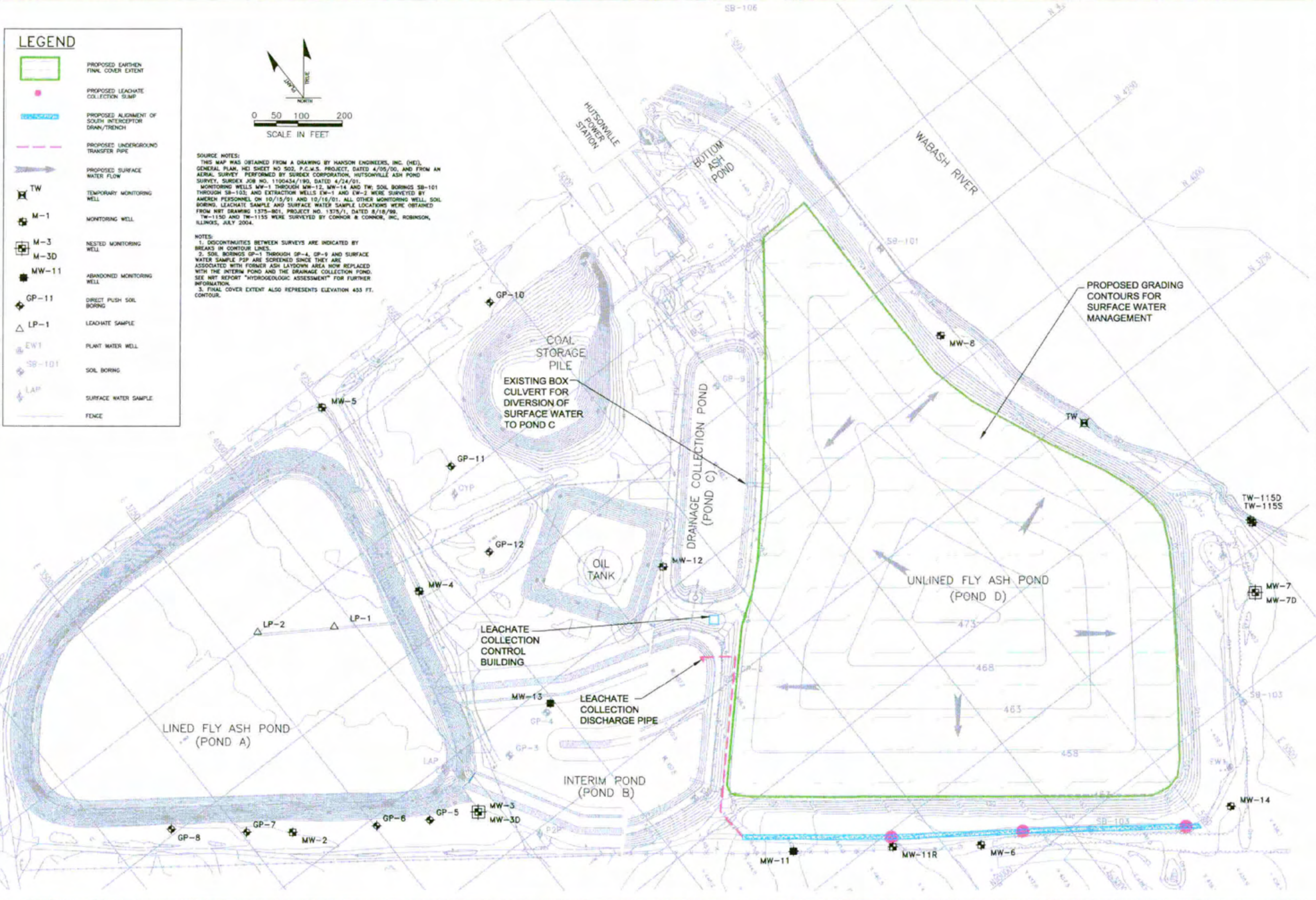
NATURAL RESOURCE TECHNOLOGY

PROJECT NO: 1375/6.1
DRAWN BY: TAS RLH 05/02/05
CHECKED BY: CAR 05/16/05
APPROVED BY: BRH 06/07/05

ALTERNATIVE NO. 1: PVC FINAL COVER WITH EAST AND SOUTH INTERCEPTOR DRAIN/TRENCH AND DEEP GROUNDWATER EXTRACTION SYSTEM
LEACHATE MANAGEMENT AND FINAL COVER ALTERNATIVES REPORT
HUTSONVILLE POWER STATION–POND D CLOSURE
AMEREN ENERGY GENERATING, HUTSONVILLE, ILLINOIS

DRAWING NO: 1375-61-B03C
REFERENCE:

FIGURE NO.
5-1



SOURCE NOTES:

THIS MAP WAS OBTAINED FROM A DRAWING BY HANSON ENGINEERS, INC. (HEI), GENERAL PLAN, HEI SHEET NO 502, P.C.M.S. PROJECT, DATED 4/05/00, AND FROM AN AERIAL SURVEY PERFORMED BY SURDEX CORPORATION, HUTSONVILLE ASH POND SURVEY, SURDEX JOB NO. 1100434/190, DATED 4/24/01.

MONITORING WELLS MW-1 THROUGH MW-12, MW-14 AND TW; SOIL BORINGS SB-101 THROUGH SB-103; AND EXTRACTION WELLS EW-1 AND EW-2 WERE SURVEYED BY AMEREN PERSONNEL ON 10/15/01 AND 10/16/01. ALL OTHER MONITORING WELL, SOIL BORING, LEACHATE SAMPLE AND SURFACE WATER SAMPLE LOCATIONS WERE OBTAINED FROM NRT DRAWING 1375-B01, PROJECT NO. 1375/1, DATED 8/18/99.

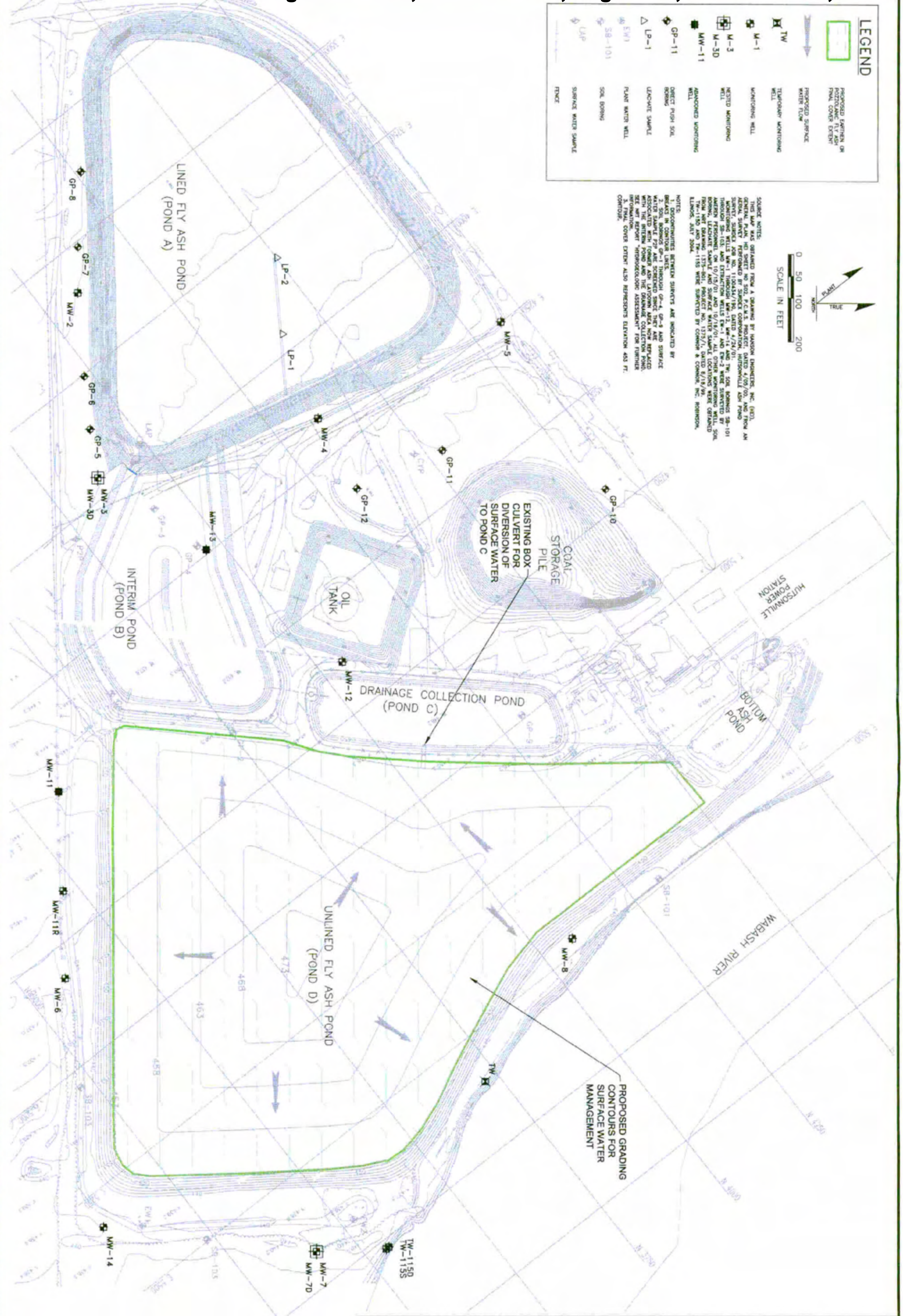
TW-115D AND TW-115S WERE SURVEYED BY CONNOR & CONNOR, INC, ROBINSON, ILLINOIS, JULY 2004.

NOTES:

1. DISCONTINUITIES BETWEEN SURVEYS ARE INDICATED BY BREAKS IN CONTOUR LINES.
2. SOIL BORINGS GP-1 THROUGH GP-4, GP-9 AND SURFACE WATER SAMPLE P2P ARE SCREENED SINCE THEY ARE ASSOCIATED WITH FORMER ASH LAYDOWN AREA NOW REPLACED WITH THE INTERIM POND AND THE DRAINAGE COLLECTION POND. SEE NRT REPORT "HYDROGEOLOGIC ASSESSMENT" FOR FURTHER INFORMATION.
3. FINAL COVER EXTENT ALSO REPRESENTS ELEVATION 453 FT. CONTOUR.

NATURAL
RESOURCE
TECHNOLOGY

PROJECT NO. 1375/6.1	ALTERNATIVE NO. 2: EARTHEN FINAL COVER WITH SOUTH INTERCEPTOR DRAIN/TRENCH
DRAWN BY: TAS RLH 05/03/05	LEACHATE MANAGEMENT AND FINAL COVER ALTERNATIVES REPORT HUTSONVILLE POWER STATION-POND D CLOSURE AMEREN ENERGY GENERATING, HUTSONVILLE, ILLINOIS
CHECKED BY: CAR 05/16/05	
APPROVED BY: BRH 06/07/05	DRAWING NO: 1375-61-B04C REFERENCE:
	FIGURE NO. 5-2



SOURCE NOTES:

THIS MAP WAS OBTAINED FROM A DRAWING BY HANSON ENGINEERS, INC. (HEI), GENERAL PLAN, HEI SHEET NO 502, P.C.N.S. PROJECT, DATED 4/05/00, AND FROM AN AERIAL SURVEY PERFORMED BY SURDEX CORPORATION, HUTSONVILLE ASH POND SURVEY, SURDEX JOB NO. 11004334/190, DATED 4/24/01.

MONITORING WELLS MW-1 THROUGH MW-12, MW-14 AND TW; SOIL BORINGS SB-101 THROUGH SB-103; AND EXTRACTION WELLS EW-1 AND EW-2 WERE SURVEYED BY AMEREN PERSONNEL ON 10/15/01 AND 10/18/01. ALL OTHER MONITORING WELL, SOIL BORING, LEACHATE SAMPLE AND SURFACE WATER SAMPLE LOCATIONS WERE OBTAINED FROM NRT DRAWING 1375-B01, PROJECT NO. 1375/1, DATED 8/18/99.

TW-115D AND TW-115S WERE SURVEYED BY CONNOR & CONNOR, INC. ROBINSON, ILLINOIS, JULY 2004.

NOTES:

1. DISCONTINUITIES BETWEEN SURVEYS ARE INDICATED BY BREAKS IN CONTOUR LINES.
2. SOIL BORINGS GP-1 THROUGH GP-4, GP-9 AND SURFACE WATER SAMPLE P3P ARE SCREENED SINCE THEY ARE ASSOCIATED WITH FORMER ASH LAYDOWN AREA NOW REPLACED WITH THE INTERIM POND AND THE DRAINAGE COLLECTION POND. SEE NRT REPORT "HYDROGEOLOGIC ASSESSMENT" FOR FURTHER INFORMATION.
3. FINAL COVER EXTENT ALSO REPRESENTS ELEVATION 453 FT. CONTOUR.

NATURAL RESOURCE TECHNOLOGY

PROJECT NO. 1375/6.1	ALTERNATIVE NO. 3: EARTHEN FINAL COVER OR ALTERNATIVE NO. 4: POZZOLANIC FLY ASH FINAL COVER	
DRAWN BY: TAS RLH 05/03/05		
CHECKED BY: CAR 05/16/05	LEACHATE MANAGEMENT AND FINAL COVER ALTERNATIVES REPORT HUTSONVILLE POWER STATION–POND D CLOSURE AMEREN ENERGY GENERATING, HUTSONVILLE, ILLINOIS	
APPROVED BY: BRH 06/07/05	DRAWING NO: 1375-61-B05C REFERENCE:	FIGURE NO. 5-3

TABLES

Table 2-1 - Soil Boring and Discrete Groundwater Sampling Data

Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

NRT PROJECT NO.: 1375/3.1
BY: AAS CHKD BY: RJC/CAR
DATE: 11/13/01

Location	Northing	Easting	Ground Elevation	Target Sample Depth	Depth to Water	Bedrock Surface Depth & Elevation	
	(ft)	(ft)	(ft, MSL^2)	(ft, BGS^2)	(ft, BGS)	(ft, BGS)	(ft, MSL)
SB-101	4325	5483	440	no water sample	unknown	>34.5	<405.5
SB-102	2982	5497	440	(17.5-19.5)(26-29)	unknown	>29.0	<410.8
SB-103	2969	5038	442	no water sample	unknown	29.0	412.6
SB-104	--^{9}	--^{9}	--^{9}	no water sample	unknown	11.0	--^{9}
SB-105	--^{9}	--^{9}	--^{9}	no water sample	unknown	9.0	--^{9}
SB-106	--^{9}	--^{9}	--^{9}	no water sample	unknown	>24.5	--^{9}
GP-1	3586	4366	460	17 ^{3}	14	17.3	442.5
GP-2	3753	4610	457	19	9	20.0	437.3
GP-3	3924	4093	459	16	11	16.0	443.3
GP-4	3951	4221	459	16	10	17.0	442.4
GP-5	3918	3859	453	11	6	11.3	441.9
GP-6	3981	3754	453	10	6	10.5	442.5
GP-7	4151	3512	452	10	4	18.0	434.0
GP-8	4263	3380	451	no water sample	4	16.0	435.3
GP-9	4307	4990	453	12	7	21.0	432.4
GP-10	4779	4701	454	12	6	14.3	439.5
GP-11	4534	4399	453	10	5	13.0	439.5
GP-12	4325	4346	451	9	4	9.5	441.3
GP-13	2693	3354	447	9	4	10.0	437.0
GP-14	1105	5752	440	32	10	>40	<400
GP-15	2790	3213	450	12	4	18.0	431.8
GP-16	2887	3065	454	12	4	28.0	425.7
GP-17	2583	3541	446	8	4	12.0	433.6
GP-18	2488	3677	446	12	4	23.8	422.2
GP-19	(6)	(6)	~440	no water sample	10	>32	<410
GP-20	3805	5099	451	21	3	21.0	429.7
GP-21	3594	5239	451	22	3	36.5	414.2
GP-22	4373	5285	459	11 ^{3}	>11.5	11.5	447.2
GP-23	4203	5273	461	22	7	34.0	426.7
LP-1 ^{4}	4405	3961	466	7.3	1	--	--
LP-2 ^{4}	4502	3815	466	8	1	--	--
MW-11R	3217	4655	441	5.5-15.5	14	16.0	424.9
MW-14	2812	5326	441	(22-24)(36-39) 28-33	19	>39	<401.93
TW	3717	5605	438	(25-27)(34-39)	16	>39.5	<398.314

Notes:

1. Four-foot stainless steel screen (for GPs) or polyvinyl chloride (PVC) screen (for LPs).
2. MSL = mean sea level; BGS = below ground surface.
3. Insufficient water sample recovery for laboratory analysis.
4. Temporary 1-inch outside diameter, PVC well point installed in lined ash impoundment.
5. Chips at 3 feet in GP-8 and at 0.5 feet in GP-9.
6. Surveyors could not locate GP-19. It was about 700 feet south of GP-14.
7. Depth to water in wells MW-11R, MW-14 and TW were taken from top of casing.
8. Target sample depths in parentheses for B-103, MW-14 and TW were taken using a hydropunch for deep depths and bailers inside of augers for shallower depths.
9. Location and elevation data not available; these soil boring locations were flooded during the most recent survey on October 15 and 16, 2001.

Table 2-2 - Monitoring Well Locations, Elevations, Depth to Bedrock, and Screened Formation

Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

NRT PROJECT NO.: 1375/3.1
BY: AAS/ PAR CHKD BY: RJC/CAR
DATE: O-11/01, U-5/05

Well	Date Drilled	Northing (ft)[4]	Easting (ft)[4]	Surface Elevation (ft, MSL[2])	TOC[1] Elevation (ft, MSL)	Total Well Depth (ft, BGS)	Depth to Bedrock (ft, BGS)	Bedrock Elevation (ft, MSL)	Bedrock Penetration (ft)	Screened Formation[3]
MW-1	2/14/1984	5606	2964	455.8	459.22	8.9	6.3	449.5	2.7	sand, ss
MW-2	2/10/1984	4087	3594	452.9	455.85	18.1	>21	--	0	s&g
MW-3	2/9/1984	3865	3957	453.6	455.15	10.8	10.3	443.3	0.5	s&g
MW-3D	10/6/1998	3860	3952	453.6	455.28	25.1	10.5	443.1	15.0	ss
MW-4	2/13/1984	4351	4164	453.9	457.02	12.3	10.7	443.2	2.5	s&g, ss
MW-5	2/13/1984	4822	4249	452.2	455.02	17.9	17.7	434.5	1.4	s&g, ss
MW-6	2/9/1984	3095	4818	438.9	443.70	11.5	8.5	430.4	3.0	s&g, ss
MW-7	2/8/1984	3166	5675	438.1	442.78	25.1	>25	--	0	si s&g
MW-7D	10/5/1998	3176	5676	437.5	438.68	44.3	>44	--	0	si s&g
MW-8	2/7/1984	4081	5469	440.0	443.97	22.5	>21.5	--	0	si sand
MW-9	2/14/1984	5408	5205	451.8	454.78	18.4	16.3	435.5	2.4	si s&g, ss
MW-10	10/7/1998	4730	2560	452.8	454.40	10.7	7.5	445.3	3.5	si s&g, ss
MW-10D	10/7/1998	4729	2565	452.7	454.66	21.3	7.5	445.2	14.0	ss
MW-11R	10/3/2001	3217	4655	440.9	443.55	15.5	16.0	424.9	0	s&g
MW-12	10/8/1998	4054	4638	455.3	456.70	16.9	17.0	438.3	0	si s&g
MW-14	10/3/2001	2812	5326	440.9	443.35	33.0	>39	--	0	s&g
TW	10/2/2001	3717	5605	437.8	440.59	39.0	>39.5	--	0	s&g
TW-115D	5/1/2004	898053	1176882	438.4	440.80	87.0	90	348.4	15	gravel
TW-115S	5/1/2004	898047	1176886	438.4	440.89	35.0	90	348.4	0	s&g
TW-116	4/28/2004	895574	1176953	437.5	439.77	32.2	60	377.5	19	cl s&g
TW-117	4/29/2004	895268	1179053	435.0	438.09	21.0	90	345.0	0.5	sand
TW-118	5/4/2004	898745	1177733	437.0	439.21	27.4	>26	--	0	sand
TW-119	5/3/2004	896031	1181339	435.4	438.12	23.3	80	355.4	20	sand
TW-120	5/4/2004	898615	1180157	446.8	449.00	37.6	>36	--	0	s&g

Notes:

1. TOC = top of casing
2. BGS = below ground surface; MSL = mean sea level
3. s&g = sand and gravel, si = silty, ss = sandstone, cl=clayey.
4. Location coordinates for wells installed through 2001 based on plant coordinate system. Coordinates for wells installed in 2004 are state plane.

--: not determined

Table 2-3 - Monitoring Well Completion Details

Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

NRT PROJECT NO.: 1375/3.1
BY: AAS/ PAR CHKD BY: RJC/CAR
DATE: O-11/01, U-5/05

Well	Screen Top Depth (ft, BGS[1])	Screen Top Elevation (ft[1])	Screen Bottom Elevation (ft)	Screen Length (ft)	Casing/ Screen Type	Filter Pack Elevation[2] (ft)	Fine Sand Thickness[3] (ft)	Bentonite Chip Thickness[3] (ft)	Annular Seal Thickness[4] (ft)	Concrete Collar Thickness[5] (ft)	PVC Casing Stickup (ft, AGS[1])	Gallons Water Purged[3,6]	Depth to Water[7] (ft, TOC[1])	Water Level Elevation[7] (ft)
MW-1	4.0	455.3	450.32	5.0	2" I.D. PVC	447.4-453.5			1.5	1.5	3.4		7.43	451.79
MW-2	5.0	450.8	437.75	13.0	2" I.D. PVC	431.8-449.3	--	--	2	2	3.0	--	8.67	447.18
MW-3	4.4	449.4	444.35	5.0	2" I.D. PVC	442.7-448.1	--	--	2	2	1.5	--	7.64	447.51
MW-3D	18.4	435.2	430.18	5.0	2" I.D. PVC	428.2-436.7	1	1	14	3	1.7	20	7.91	447.37
MW-4	5.0	452.2	444.72	7.5	2" I.D. PVC	441.0-450.4	--	--	2	2	3.1	--	9.72	447.30
MW-5	5.0	450.1	437.12	13.0	2" I.D. PVC	433.1-448.3	--	--	2	2	2.8	--	8.46	446.56
MW-6	5.0	438.6	432.20	6.4	2" I.D. PVC	427.5-434.9	--	--	2	2	4.8	--	10.83	432.87
MW-7	15.0	427.7	417.68	10.0	2" I.D. PVC	412.9-423.9	--	--	2	2	4.7	--	10.71	432.07
MW-7D	38.2	399.4	394.38	5.0	2" I.D. PVC	392.5-402.5	3	--	32	3	1.1	27	10.81	427.87
MW-8	16.5	426.5	421.47	5.0	2" I.D. PVC	417.9-423.9	--	--	2	2	4.0	--	16.05	427.92
MW-9	8.5	446.4	436.38	10.0	2" I.D. PVC	433.2-444.0	--	--	2	2	3.0	--	7.59	447.19
MW-10	4.1	448.7	443.70	5.0	2" I.D. PVC	441.9-448.9	--	1	4	--	1.6	20	3.10	451.30
MW-10D	14.3	438.4	433.36	5.0	2" I.D. PVC	431.4-438.9	1	1	14	--	2.0	12	3.68	450.98
MW-11R	2.8	438.1	428.05	10.0	2" I.D. PVC	424.9-436.4	1	--	4	--	2.7	120	13.55	430.00
MW-12	5.5	449.8	439.80	10.0	2" I.D. PVC	438.5-450.5	1	1.5	5	--	1.4	23	9.63	447.07
MW-14	25.5	415.4	410.35	5.0	2" I.D. PVC	401.9-414.9	2	--	24	--	2.4	150	18.23	425.12
TW	31.2	406.6	401.59	5.0	2" I.D. PVC	397.8-405.8	2	--	30	--	2.8	120	16.30	424.29
TW-115D	82	356.4	351.40	5.0	2" I.D. PVC	350.4-357.4	1	3.0	28	--	2.4	135	15.48	425.32
TW-115S	30	408.4	403.40	5.0	2" I.D. PVC	402.4-409.4	1	--	80	--	2.5	40	15.55	425.34
TW-116	25	412.5	407.50	5.0	2" I.D. PVC	406.5-413.5	1	--	23	--	2.3	40	13.55	426.22
TW-117	15	420.0	415.00	5.0	2" I.D. PVC	414.0-421.0	1	--	13	--	3.1	40	12.15	425.94
TW-118	20	417.0	412.00	5.0	2" I.D. PVC	411.0-418.0	1	--	18	--	2.2	30	12.33	426.88
TW-119	15	419.8	414.82	5.0	2" I.D. PVC	414.4-421.4	1	--	13	--	2.7	30	10.77	427.35
TW-120	30	416.4	411.40	5.0	2" I.D. PVC	410.8-417.8	1	--	28	--	2.2	50	21.44	427.56

Notes:

1. TOC = top of well casing; BGS = below ground surface; AGS = above ground surface.
2. All elevations have been adjusted to match information collected during October 2001 survey of the monitoring wells.
3. Data on fine sand thickness, bentonite chip thickness, and gallons of water purged were only available for wells installed since 1998.
4. Annular seal thickness includes bentonite-cement grout and bentonite pellets/chips.
5. Concrete collar was not installed at shallow 1998 wells and all wells installed in 2001 in order to maximize annular seal. Concrete collars were also not installed around 2004 wells due to their anticipated abandonment within approximately 18 months.
6. Volume removed during well development.
7. Depth to groundwater measured on 11/12/98 except as follows: 10/3/01 for wells MW-11R, MW-14 and TW; 9/14/04 for the TW-100 series wells.

--: Not present or unknown.

Table 2-4 - Monitoring Well Slug Test Results

Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

NRT PROJECT NO.: 1375/3.1
BY: AAS/ PAR CHKD BY: RJC/CAR
DATE: O-11/01, U-5/05

Well	Hydraulic Conductivity (ft/min)	Hydraulic Conductivity (cm/s)	Geologic Unit
MW-1[1]	8.0E-05	4.1E-05	Sand & Sandstone
MW-3[1]	5.2E-02	2.7E-02	Silty Sand & Gravel
MW-3D[1]	1.1E-03	5.4E-04	Sandstone
MW-5[1]	1.6E-02	8.0E-03	Silty Sand & Gravel
MW-6[1]	6.3E-02	3.2E-02	Clayey Gravel, Silty Sand, Sandstone
MW-7[1]	5.1E-04	2.6E-04	Sandy Silt, Sand & Gravel
MW-7D[1]	9.5E-02	4.8E-02	Silty Sand & Gravel
MW-9[1]	1.6E-03	8.3E-04	Silt, Silty Sand, Sandstone
MW-10[1]	1.2E-03	6.2E-04	Silty Sand, Sandstone
MW-10D[1]	7.9E-04	4.0E-04	Sandstone
MW-12[1]	1.2E-01	6.2E-02	Sand
MW-13[1,2]	3.5E-02	1.8E-02	Clayey Sand & Gravel
TW[1]	4.7E-02	2.4E-02	Sand
TW-115D[1]	2.3E-02	1.2E-02	Gravel with Sand
TW-115S[3]	1.8E-01	9.3E-02	Gravel to Sand
TW-116[1]	9.0E-04	4.6E-04	Clayey Sand & Gravel
TW-117[1]	1.3E-02	6.7E-03	Sand
TW-118[3]	3.2E-01	1.6E-01	Sand
TW-119[1]	4.4E-03	2.2E-03	Sand

Notes:

1. Bouwer and Rice (1976) analysis method.
2. Slug test data for monitoring well MW-13 provided for reference. MW-13 has been abandoned.
3. Butler (1998) analysis method.

Table 2-5 - Background Statistical Summary

Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

NRT PROJECT NO.: 1375/6.1
BY: BRH CHKD BY: PAR
DATE: 5/6/05

a. Shallow Sand and Gravel

Parameter	units	No. Results[1]	% BDL	Normal/ Lognormal	Minimum	Maximum	TI Upper Limit	811.320 Background	Class I Standard
Alkalinity, total (lab), (mg/L as CACO3)	mg/L	101	0	No / No	98	332	NC	332	NS
Boron, total	mg/L	101	0	No / Yes	0.059	0.4	0.27	0.27	2.0
Calcium, total	mg/L	101	0	No / No	33	160	NC	160	NS
Manganese, total	mg/L	101	4.76	No / Yes	0.001	3.67	2.29	2.3	0.15
pH (field)	std	83	0	No / No	7.03	7.96	NC	7.0 - 8.0	6.5-9.0
Sulfate, total	mg/L	101	0	No / No	10	270	NC	270	400
Total Filterable Residue (TDS)	mg/L	102	0	Yes / No	180	470	456	456	500

b. Deep Alluvial Aquifer

Parameter	units	No. Results[1]	% BDL	Normal/ Lognormal	Minimum	Maximum	TI Upper Limit	811.320 Background	Class I Standard
Alkalinity, total (lab), (mg/L as CACO3)	mg/L	26	0	Yes / Yes	170	300	315	315	NS
Boron, total	mg/L	28	0	No / Yes	0.052	0.24	0.26	0.26	2.0
Calcium, total	mg/L	27	0	Yes / Yes	56	96	102	102	NS
Manganese, total	mg/L	28	0	No / No	0.57	2.977	NC	3.0	0.15
pH (field)	std	18	0	No / No	7.3	8.44	NC	7.3-8.4	6.5-9.0
Sulfate, total	mg/L	28	0	Yes / Yes	19	74	85	85	400
Total Filterable Residue (TDS)	mg/L	29	0	Yes / Yes	280	470	511	511	500

Notes:

1. Based on data from 1/1/1998 through 4/30/2005

Table 2-6a - Groundwater Concentration Results from Monitoring Wells-Shallow Sand and Gravel and Sandstone Wells

Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

Well	Formation	Sample Date	pH s.u.	Alkalinity mg/L	Hardness mg/L	Sulfate mg/L	TDS mg/L	Boron µg/L	Calcium mg/L	Manganese µg/L
			Groundwater Quality Standards for Shallow Sand and Gravel and Sandstone							
Illinois Class I GW Standard			*6.5-9.0*	ns	ns	*400*	*500*	*2,000*	ns	*150*
811.320 Background (From Table 2-5)			**7.0-8.0**	**332**	ns	**270**	**456**	**270**	**160**	**2,300**
MW-1	shallow sand and gravel	9/17/2002	7.53	290	360	68	440	150	99	42
		10/17/2002	--	290	370	80	450	**310**	**160**	19
		11/21/2002	7.12	--	380	--	--	140	90	*150*
		11/25/2002	7.2	290	--	49	360	--	--	--
		12/11/2002	7.09	300	370	39	370	180	96	*270*
		1/8/2003	--	180	274	84	300	140	67	3
		2/5/2003	--	200	300	87	340	140	76	53
		3/17/2003	--	110	180	48	180	120	41	3
		4/7/2003	--	110	160	38	210	140	37	1
		5/5/2003	--	140	170	37	200	140	40	14
		6/2/2003	--	190	220	25	270	110	56	72
		7/7/2003	--	320	310	20	330	92	85	*240*
		8/4/2003	--	280	290	19	320	110	85	47
		9/8/2003	--	240	270	18	300	65	87	22
		10/6/2003	--	270	290	17	320	93	80	70
		11/3/2003	--	290	290	16	340	93	78	120
		12/1/2003	--	240	330	50	370	160	75	13
		1/5/2004	--	230	260	40	260	100	60	41
		2/9/2004	--	140	150	40	190	150	42	25
		3/2/2004	--	160	190	32	240	110	46	32
		4/4/2004	--	140	190	35	210	120	40	44
		5/4/2004	--	210	240	15	260	100	55	*280*
		6/1/2004	--	290	300	15	290	67	77	*220*
		7/12/2004	--	300	380	18	350	82	85	*210*
		8/2/2004	--	290	300	15	330	99	86	*170*
		9/13/2004	--	280	310	20	370	98	80	100
		10/4/2004	--	300	310	18	340	140	85	47
		11/8/2004	--	280	360	35	360	110	85	130
		12/6/2004	--	240	320	51	300	140	84	*260*
		1/3/2005	--	160	260	42	260	170	48	*180*
		2/23/2005	--	140	140	34	200	200	38	*180*
		3/14/2005	--	140	150	26	180	130	40	*300*
		4/19/2005	--	160	170	32	230	140	54	*200*
MW-6	shallow sand and gravel	9/19/2002	7	240	460	200	**690**	**15,000**	130	**3,600**
		12/13/2002	**6.91**	250	490	240	**640**	**16,000**	130	*1,300*
		3/18/2003	--	160	590	**450**	**880**	**11,000**	**170**	7
		5/12/2003	--	230	540	**360**	**880**	**8,200**	150	4
		8/4/2003	--	190	500	**330**	**780**	**13,000**	150	80
		10/13/2003	--	240	550	**300**	**770**	**15,000**	140	*290*
		2/23/2004	--	240	700	**310**	**790**	**14,000**	150	*880*
		4/4/2004	--	280	590	**310**	**810**	**11,000**	140	*890*
		7/12/2004	--	270	700	**360**	**900**	**12,000**	**160**	*1,700*
		11/8/2004	--	180	610	**380**	**900**	**14,000**	140	*590*
		1/4/2005	--	240	700	**380**	**890**	**15,000**	140	*970*
MW-7	shallow sandy silt	9/18/2002	**6.89**	**370**	650	240	**760**	**2,200**	**180**	52
		12/19/2002	**6.91**	**420**	700	250	**790**	**2,500**	**180**	*220*
		3/19/2003	--	280	450	160	**570**	**500**	130	20
		6/2/2003	--	**380**	650	220	**790**	**1,800**	150	24
		8/11/2003	--	**490**	540	220	**790**	**2,100**	**170**	18
		10/13/2003	--	**440**	710	240	**820**	**2,200**	**180**	120
		2/23/2004	--	**430**	760	**280**	**880**	**2,100**	**190**	22
		4/19/2004	--	**420**	840	**310**	**970**	**2,000**	**180**	51
		8/2/2004	--	**460**	780	**310**	**950**	**2,000**	**200**	*160*
		10/4/2004	--	**490**	720	**300**	**1,000**	**2,600**	**210**	120
		3/15/2005	--	**430**	580	220	**730**	**1,400**	150	12

Table 2-6a - Groundwater Concentration Results from Monitoring Wells-Shallow Sand and Gravel and Sandstone Wells
Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

Well	Formation	Sample Date	pH s.u.	Alkalinity mg/L	Hardness mg/L	Sulfate mg/L	TDS mg/L	Boron µg/L	Calcium mg/L	Manganese µg/L
Groundwater Quality Standards for Shallow Sand and Gravel and Sandstone										
Illinois Class I GW Standard			*6.5-9.0*	ns	ns	*400*	*500*	*2,000*	ns	*150*
811.320 Background (From Table 2-5)			**7.0-8.0**	**332**	ns	**270**	**456**	**270**	**160**	**2,300**
MW-8	shallow silt to gravel	9/19/2002	**6.92**	330	1,100	**790**	**1,300**	**10,000**	**320**	**3,800**
		12/19/2002	**6.97**	220	1,100	**740**	**1,600**	**11,000**	**320**	**3,600**
		3/17/2003	--	300	1,300	**960**	**1,700**	**12,000**	**390**	**2,900**
		6/18/2003	--	**360**	1,179	**940**	**1,800**	**12,000**	**360**	**2,500**
		8/11/2003	--	**420**	1,200	**960**	**1,800**	**14,000**	**360**	**2,500**
		10/13/2003	--	**350**	1,300	**930**	**1,800**	**13,000**	**370**	*2,200*
		2/23/2004	--	**360**	1,500	**820**	**1,800**	**13,000**	**340**	**4,700**
		4/19/2004	--	**340**	1,200	**870**	**1,800**	**12,000**	**310**	**2,300**
		8/2/2004	--	280	1,200	**800**	**1,500**	**11,000**	**300**	*2,100*
		10/4/2004	--	220	760	**620**	**1,200**	**11,000**	**200**	*1,300*
		3/16/2005	--	**400**	1,100	**940**	**1,600**	**13,000**	**310**	*2,200*
MW-10	shallow sand and gravel	9/17/2002	7.11	270	320	31	380	98	90	100
		12/19/2002	7.06	260	320	38	330	200	86	4
		2/5/2003	--	230	290	38	310	79	76	1
		5/5/2003	--	300	250	38	270	76	80	2
		7/7/2003	--	240	310	44	340	92	89	22
		9/8/2003	--	260	320	38	380	59	96	13
		10/13/2003	--	220	370	36	450	120	100	19
		3/2/2004	--	220	380	31	410	64	100	8
		4/4/2004	--	230	420	29	390	86	100	29
		8/3/2004	--	270	440	29	450	130	120	45
		10/4/2004	--	330	380	31	**470**	160	110	40
		3/14/2005	--	300	310	33	400	150	93	8
		4/19/2005	--	270	350	32	430	68	130	24
MW-10D	sandstone *background*	9/17/2002	7.29	200	230	30	290	84	65	89
		12/19/2002	7.33	200	250	31	270	96	65	71
		2/5/2003	--	210	230	30	220	240	130	*270*
		5/5/2003	--	250	230	28	240	77	63	74
		7/7/2003	--	210	230	35	270	88	66	82
		9/8/2003	--	210	230	32	270	59	67	82
		10/6/2003	--	230	230	30	280	96	66	82
		3/2/2004	--	210	260	30	270	95	64	65
		4/4/2004	--	210	240	28	260	74	61	88
		8/3/2004	--	220	230	29	280	100	66	81
		10/4/2004	--	220	280	27	280	140	67	93
		3/14/2005	--	240	230	32	260	130	61	55
		4/19/2005	--	200	290	31	270	160	77	180
MW-11R	shallow sand and gravel	9/19/2002	7.15	200	480	**390**	**850**	**6,600**	150	**3,400**
		12/13/2002	7.09	260	950	**690**	**1,300**	**7,000**	**250**	*880*
		3/18/2003	--	210	740	**590**	**1,100**	**5,600**	**220**	*380*
		5/12/2003	--	280	480	**590**	**1,100**	**5,800**	**220**	*590*
		8/4/2003	--	120	620	**650**	**1,200**	**2,600**	**220**	*520*
		10/13/2003	--	120	780	**650**	**1,200**	**2,800**	**220**	*700*
		2/23/2004	--	61	890	**720**	**1,200**	**2,800**	**240**	*1,200*
		4/4/2004	--	260	970	**650**	**1,300**	**4,900**	**240**	*270*
		7/12/2004	--	230	940	**670**	**1,300**	**5,800**	**260**	*320*
		11/8/2004	--	220	810	**650**	**1,300**	**8,000**	**230**	*240*
		1/4/2005	--	140	880	**680**	**1,300**	**4,300**	**290**	*850*
TW-116	shallow clay to gravel	3/28/2005	--	260	300	80	410	**600**	75	*1,000*
		4/11/2005	7.56	250	380	**85**	410	**440**	78	*780*

Notes:

1. Concentrations equaling/ exceeding an Illinois Class I GW Standard are *underlined/ italicized.*
2. Concentrations equaling/ exceeding a 811.320 Background level are **bold/ underlined.**

Table 2-6b - Groundwater Concentration Results from Monitoring Wells-Deep Alluvium Wells

Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

Well	Formation	Sample Date	pH s.u.	Alkalinity mg/L	Hardness mg/L	Sulfate mg/L	TDS mg/L	Boron µg/L	Calcium mg/L	Manganese µg/L
			Groundwater Quality Standards for Deep Alluvium							
Illinois Class I GW Standard			*6.5-9*	ns	ns	*400*	*500*	*2,000*	ns	*150*
811.320 Background (From Table 2-5)			**7.3-8.4**	**315**	ns	**85**	**511**	**260**	**102**	**3,000**
MW-7D	deep alluvium	9/18/2002	7.41	200	270	51	370	83	71	*750*
	background	12/19/2002	7.38	210	320	31	320	140	67	*750*
		3/19/2003	--	170	310	51	350	89	66	*760*
		6/2/2003	--	200	410	60	390	88	68	*680*
		8/11/2003	--	240	270	59	370	140	69	*660*
		10/13/2003	--	220	320	44	320	110	66	*640*
		2/23/2004	--	260	510	68	430	110	89	*770*
		4/19/2004	--	260	420	61	440	67	85	*830*
		8/2/2004	--	260	330	47	360	91	81	*570*
		10/4/2004	--	300	330	36	420	210	85	*660*
		3/15/2005	--	220	240	42	280	62	61	*450*
MW-14	deep alluvium	9/18/2002	**7**	**430**	640	**230**	**790**	190	**180**	*530*
		12/13/2002	**6.92**	**400**	700	**210**	**740**	**570**	**180**	*500*
		3/18/2003	--	**390**	630	**120**	**570**	**730**	**160**	*510*
		5/12/2003	--	**480**	700	**230**	**830**	**1,000**	**180**	*480*
		8/11/2003	--	**430**	640	**180**	**740**	**400**	**160**	*410*
		10/13/2003	--	**430**	680	**200**	**810**	**630**	**170**	*510*
		2/23/2004	--	**460**	690	**190**	**810**	**1,400**	**180**	*430*
		4/4/2004	--	**450**	740	**190**	**780**	**1,500**	**170**	*400*
		8/3/2004	--	**500**	660	**200**	**810**	**1,000**	**180**	*450*
		11/8/2004	--	**440**	700	**180**	**760**	**1,100**	**170**	*510*
		3/15/2005	--	450	620	**220**	**780**	**880**	**160**	*350*
TW	deep alluvium	9/19/2002	7.43	200	270	40	340	82	77	*1,400*
	background	12/19/2002	7.31	230	360	38	340	67	78	*1,200*
		3/17/2003	--	200	300	65	340	200	83	*930*
		6/17/2003	--	210	290	62	370	52	74	*820*
		8/11/2003	--	220	300	52	310	110	71	*1,100*
		10/13/2003	--	200	230	30	280	75	56	*760*
		2/23/2004	--	290	410	27	470	85	86	*2,100*
		4/19/2004	--	260	420	19	340	99	72	*1,200*
		8/2/2004	--	260	420	24	350	180	72	*1,400*
		10/4/2004	--	280	350	23	350	84	77	*1,400*
		3/16/2005	--	187.5	250	34	250	60	57	*640*
TW-115D	deep alluvium	4/11/2005	--	220	300	55	320	22	59	*730*
		4/27/2005	7.41	--	--	--	--	36	--	--
TW-115S	deep alluvium	4/11/2005	--	260	340	46	340	20	75	*200*
		4/27/2005	7.5	--	--	--	--	32	--	--
EW-1	deep alluvium	8/1/2001	--	289	380	60	472	80	**108**	*445*
EW-2	deep alluvium	7/31/2001	--	250	340	60	434	130	92	*590*
		3/23/2005	8.2	260	300	50	--	100	82	*420*
TW-117	deep alluvium	3/28/2005	--	**500**	540	51	**590**	61	**160**	*1,300*
		4/11/2005	--	**460**	550	49	**580**	65	**120**	*840*
		4/27/2005	**6.88**	--	--	--	--	86	--	--
TW-119	deep alluvium	4/27/2005	--	270	320	39	370	40	97	*730*

Notes:

1. Concentrations equaling/ exceeding an Illinois Class I GW Standard are *underlined/ italicized.*
2. Concentrations equaling/ exceeding a 811.320 Background level are **bold/ underlined.**
3. Sample taken from combined header, EW-2 pumped for 24 hours and EW-1 pumped for 1 hour on 3/23/05.

Table 3-1 - Initial Screening of Leachate Management and Final Cover Alternatives

Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

NRT PROJECT NO.: 1375/6.1
BY: CAR / EJT CHKD BY: CAR/BRH (EJT 5/19/05)
DATE: 7/18/05

Closure Alternatives	*Option*	*Description*	*Construction / Implementation Feasibility*	*Effectiveness*	*Relative Cost*		*Carry Forward to Modeling and Further Evaluation (Yes/No)*
					Capital	*Annual O &M*	
Leachate Management Alternatives	**Site Monitoring w/ No Leachate Collection**	Establish groundwater monitoring program for Pond D to evaluate trends in groundwater quality.	The groundwater monitoring network is already in place - additional wells can be added as necessary to enhance the monitoring network. Implementation of this option may require establishment of background concentrations and possibly a petition for adjusted groundwater quality standards.	Site monitoring will have no effect on downgradient groundwater quality or leachate loading rates to the Wabash River.	**QUARTERLY MONITORING CURRENTLY PERFORMED, NO ADDITIONAL COST** Quarterly site monitoring continues at the site and site monitoring would be required for any leachate management or final cover alternative for an indefinite period of time.		**YES** At a minimum, site monitoring will be performed at the site. Additional leachate management alternatives may be incorporated with site monitoring.
	Shallow Groundwater Extraction Combined with Interceptor Drain/Trench	A network of 10-12 groundwater extraction wells along the east boundary of Pond D and an interceptor drain/trench along the south boundary of Pond D to capture leachate mixed with groundwater from the shallow silt/clay unit. Extracted leachate would be conveyed to the Drainage Collection Pond (Pond C) and/or the Interim Pond (Pond B).	Installation of groundwater extraction wells between Pond D and the Wabash River could prove difficult due to spatial constraints, buried utilities, and sheet pile wall tiebacks, which could effect access for conventional drilling equipment and limit conventional well size. The area downgradient of Pond D is below the 100-year flood elevation and prone to flooding. A hydraulic analysis needs to be performed to model additional loading to the sluice water system and to evaluate compliance with the NPDES permit for outfall #002.	Effectiveness is questionable because impacted silty clay unit has low hydraulic conductivity and would be difficult to pump efficiently. System would have to be designed to withstand seasonal flooding of the Wabash River. Collection of leachate and management through Pond B and/or Pond C for eventual discharge to the Wabash River via outfall #002 would reduce concentrations in downgradient groundwater, but would not result in a net reduction of leachate loading to the river. May prevent migration of ash constituents off site, and meet Part 811.320 zone of attenuation requirements, if properly designed.	**$930,000** Questionable effectiveness for capital cost. Cost could increase substantially (2 to 5 times) if treatment of extracted leachate is required.	**$56,000** O & M would continue for an indefinite period (>100 years).	**YES** Groundwater extraction and an interceptor drain/trench could effectively contain downgradient migration of ash constituents. Capital costs are similar to those for installation of an interceptor drain/trench along the entire east and south boundary of Pond D.
	Interceptor Drain/Trench	An interceptor trench and drain would be installed downgradient (east and south) of Pond D to capture leachate mixed with groundwater. The drain would flow to collection sumps designed to convey leachate to the Drainage Collection Pond (Pond C) and/or the Interim Pond (Pond B).	Spatial constraints, buried utilities and sheet pile wall tiebacks, between the river and Pond D could affect constructability of an interceptor trench. A hydraulic analysis would need to be performed to model additional loading to the sluice water system and evaluate compliance with the NPDES permit for outfall #002.	Depending on site access, system could be designed to collect leachate downgradient of Pond D, and will be less susceptible to horizontal variations in hydrogeology than groundwater extraction. An interceptor trench would likely better target the geologic strata (sandy silt) impacted by ash leachate than groundwater extraction wells. Collection of leachate and management through Pond B and/or Pond C for eventual discharge to the Wabash River via outfall #002 may reduce concentrations in downgradient groundwater, but would not result in a net reduction of leachate loading to the river. May prevent migration of ash constituents off site, and meet Part 811.320 zone of attenuation requirements, if properly designed.	**$950,000** Questionable effectiveness for capital cost. Cost could increase substantially (2 to 5 times) if treatment of extracted leachate is required. **$460,000** If an interceptor drain/trench is installed only along the south boundary of Pond D.	**$47,000** O & M would continue for an indefinite period (>100 years). **$30,000** Annual O & M costs for south interceptor drain/trench only.	**YES** Installation of groundwater extraction wells and an interceptor drain/trench could effectively contain downgradient migration of ash constituents. Capital costs are similar to those for installation of groundwater extraction wells along the east boundary and an interceptor drain/trench along the south boundary of Pond D.
	Horizontal Wells Combined with Interceptor Drain/Trench	A system of horizontal extraction wells to intercept the groundwater plume and leachate from Pond D. Extracted leachate would be conveyed to Drainage Collection Pond (Pond C) and/or the Interim Pond (Pond B).	Horizontal wells may be easier to construct than a conventional groundwater extraction or an interceptor drain/trench system. A hydraulic analysis would be needed to model additional loading to the sluice water system and evaluate compliance with the NPDES permit for outfall #002.	It could be difficult to demonstrate the effectiveness of a horizontal well system, especially if preferential flow pathways exist in the sandy silt unit. A horizontal well system may have a more difficult time targeting the geologic strata impacted by ash leachate. Collection of leachate and management through Pond B and/or Pond C for eventual discharge to the Wabash River via outfall #002 would reduce concentrations in downgradient groundwater, but would not result in a net reduction of leachate loading to the river. Installation of the interceptor drain/trench along the south boundary of Pond D may prevent migration of ash constituents off site, and meet Part 811.320 zone of attenuation requirements, if properly designed.	**$1,040,000** High cost leachate management alternative compared to an interceptor trench. Questionable effectiveness for capital cost; further hydrogeologic evaluation may reveal the system is not effective. Cost could increase substantially (2 to 5 times) if treatment of extracted leachate is required.	**$56,000** O & M would continue for an indefinite period (>100 years).	**NO** Highest cost leachate management alternative for direct leachate collection compared to groundwater extraction and interceptor drain/trench. Effectiveness is more questionable than other direct leachate collection technologies.
	Ash Stabilization	Ash fill is stabilized and solidified using one of several reagents to form a cement-like matrix (monolith) that immobilizes ash constituents, increases strength, and decreases permeability.	Stabilization process would result in a substantial increase in volume on site (typically 20 - 40 %). Bench scale test would be needed to determine specific applicability and performance for minimal leaching of contaminants and may demonstrate that stabilization is not a feasible technology.	Stabilized/solidified ash monolith would minimize production of existing ash contaminants such as boron and sulfate, but concentrations of certain trace constituents, such as selenium, may increase with pH. Would reduce mass loading rate to Wabash River; however amount of reduction and effect on downgradient groundwater concentration would be difficult to predict. Long term monitoring would be required to evaluate effectiveness.	**$20,000,000** Very high cost leachate management alternative. Capital cost too high to be seriously considered.	**$5,000** O & M costs would be similar to those associated with a final cover.	**NO** Capital cost is much too high compared to other leachate management alternatives.

Table 3-1 - Initial Screening of Leachate Management and Final Cover Alternatives

Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

NRT PROJECT NO.: 1375/6.1
BY: CAR / EJT CHKD BY: CAR/BRH (EJT 5/19/05)
DATE: 7/18/05

Closure Alternatives	*Option*	*Description*	*Construction / Implementation Feasibility*	*Effectiveness*	*Relative Cost*		*Carry Forward to Modeling and Further Evaluation (Yes/No)*
					Capital	*Annual O &M*	
Leachate Management Alternatives (continued)	**Ash Removal and Disposal, Recycling at an Off-Site Facility, or Beneficial Re-Use**	Ash is excavated and transported to an appropriate landfill; moved to appropriate sites for recycling; or, excavated and re-used on-site. Recycling may include incorporation into cement, for use in agricultural setting as a source of minerals, or as flowable fill in slurry form.	Excavation involves standard construction equipment. Excavation of saturated ash may require shoring, dewatering and use of dragline bucket or mudcat. Saturated ash removal is likely not technically or economically feasible. This alternative would likely require profiling of the ash waste for disposal in an appropriate landfill or identification of large volume users of mixed ash. Recycling may require grading or sorting of ash. Based on prior testing, excavated ash from Pond D may not meet criteria for beneficial re-use.	Removal of ash is an effective means of source control provided that saturated ash is removed, and removal of saturated ash may be very difficult due to its depth below the water table. Removal of ash would result in groundwater quality improvement and reduction of loading rate to the Wabash River.	**$23,000,000 to $34,000,000** Very high capital cost for managing ash leachate. Range of costs represents partial removal (saturated ash only and overburden replacement) to total removal of ash. If general fill or ash disposal/recycling costs increase, capital costs for this alternative could double. Limited ash disposal or recycling may be considered for other closure alternatives.	**None to $5,000** O & M costs would be associated with those for a final cover if partial excavation was performed.	NO Capital cost is much too high compared to other leachate management alternatives.
	Landfill Reconstruction (Ash Excavation; Install Liner and Leachate Collection System; Ash Replacement)	Ash is excavated and moved to facilitate reconstruction as a new unit to limit infiltration, leachate generation, and offsite migration; separate ash from water table; and control erosion.	Landfill reconstruction would require excavation and off-site disposal or relocation of all ash in Pond D. As discussed above, excavation of saturated ash is likely not technically or economically feasible. Clean fill would have to be replaced to create a base for the landfill at least 5 feet above the historical high water table. This option is not implementable simply based on very high estimated capital costs. Potential for significant regulatory issues for permitting a new landfill in an area with impacted groundwater.	Landfill reconstruction could be an effective solution; however a viable method for removing ash up to 15 feet below the water table would be needed for this option to be seriously considered - effectiveness would be greatly reduced, particularly in terms of downgradient groundwater concentrations, if saturated ash could not be removed. Capital risk is too high versus potential gain in effective leachate management.	**NOT EVALUATED** Due to construction feasibility and very high estimated capital costs. Capital risk is too high versus potential gain in effective leachate management. Potential for significant regulatory issues.		NOT EVALUATED
Leachate Management and Source Control of the Deep Alluvial Aquifer	**Containment Using an Impermeable Barrier Wall**	An impermeable vertical barrier wall, constructed of materials to minimize groundwater flow through the barrier, would be installed downgradient or surrounding Pond D.	A slurry wall may not be constructable between Pond D and the Wabash River due to spatial constraints and buried utilities. Installation of a sheet pile wall may be constructable depending on depth. An impermeable barrier wall requires an impermeable key-in formation for effective barrier. Based on the *Slurry Wall Study*, prepared by Hanson Engineers, Inc. and slug tests performed at the site, the sandstone bedrock present at the upland portion of the site would not provide a good key-in layer for an impermeable barrier wall.	An impermeable barrier wall would not be effective at the site since an impermeable key-in layer is not present in all areas.	**NOT EVALUATED** Due to ineffective application at the site. A vertical barrier wall is not implementable or effective for leachate management without a competent key-in layer.		NOT EVALUATED
Source Control of the Deep Alluvial Aquifer	**Groundwater Extraction from the Deep Alluvium**	Vertical groundwater extraction wells along the southeast corner of the impoundment to capture groundwater impacted by ash leachate from the deep alluvial aquifer. Extracted leachate would be conveyed to the Drainage Collection Pond (Pond C) and/or the Interim Pond (Pond B).	The area downgradient of Pond D is below the 100-year flood elevation and prone to flooding. A hydraulic analysis needs to be performed to model additional loading to the sluice water system and to evaluate compliance with the NPDES permit for outfall #002. Extraction of large volumes of groundwater would likely be necessary to affect groundwater flow in the deep alluvium.	System would have to be designed to withstand seasonal flooding of the Wabash River. Collection of leachate and management through Pond B and/or Pond C for eventual discharge to the Wabash River via outfall #002 would reduce concentrations in downgradient groundwater, but would not result in a net reduction of leachate loading to the river. May prevent migration of ash constituents off site, and meet Part 811.320 zone of attenuation requirements, if properly designed.	**$690,000** Questionable effectiveness for capital cost. Cost could increase substantially (2 to 5 times) if treatment of extracted groundwater is required.	**$52,000** O & M would continue for an indefinite period (>100 years).	YES Groundwater extraction from the deep alluvial aquifer could effectively contain downgradient migration of ash constituents in the deep alluvial aquifer.
Final Cover Alternatives	**Geosynthetic Final Cover**	Pond D is covered with a geosynthetic final cover to prevent direct contact, control infiltration of surface water, reduce leachate generation, and provide erosion control.	Geosynthetic final covers are readily constructable and have been installed at other fly ash management facilities to reduce surface water infiltration and leachate generation. A geosynthetic final cover would be constructed in accordance with 35 IAC Part 811.314 (geomembrane followed by 3 feet of final protective cover). Geosynthetic materials are readily available throughout the U.S. Limitations to overcome include raising the final grade to prevent surface water from ponding on the completed fill surface and to promote runoff to the Wabash River or the Drainage Collection Pond (Pond C).	A geosynthetic final cover would effectively reduce surface water infiltration resulting in reduced leachate generation from Pond D. Additionally, the cover would provide protection from erosion and prevent direct contact with ash. This option does not address leaching from saturated ash, which hydrogeologic investigations have identified as a significant component of leachate generation from Pond D, and if used alone would not result in reduction of downgradient groundwater concentrations; however, the cover would result in a net reduction in leachate loading to the Wabash River.	**$5,200,000** Lowest cost final cover option for a 35 IAC 811.314 cover system. Capital costs may decrease as surface water management options are more thoroughly explored and fill estimates are revised. If a local source for fill cannot be located, capital costs may increase.	**$5,000** O & M costs associated with maintaining a 3 foot protective layer, maintaining vegetation and repairing erosion damage.	YES The geosynthetic final cover will be evaluated as the base case for a Part 811.314 cover system. Capital costs are lower than either a clay or pozzolanic final cover that may meet the 811.314 requirements.
	Compacted Clay Final Cover	Pond D is covered with a compacted clay final cover to prevent direct contact, control infiltration of surface water, reduce leachate generation, and provide erosion control.	Compacted clay final covers are readily constructable and have been installed at other fly ash management facilities to reduce surface water infiltration and leachate generation. A compacted clay final cover would be constructed in accordance with 35 IAC Part 811.314 (3 feet of compacted clay followed by 3 feet of final protective cover). A local source for cover grade clay would have to be identified and may not be available. Similar limitations to overcome as a geosynthetic final cover.	A compacted clay final cover would effectively reduce surface water infiltration resulting in reduced leachate generation from Pond D. Additionally, similar to a geosynthetic cover, the clay cover would provide protection from erosion and prevent direct contact with ash. This option does not address leaching from saturated ash, which hydrogeologic investigations have identified as a significant component of leachate generation from Pond D, and if used alone would not result in reduction of groundwater concentrations; however, the cover would result in a net reduction in leachate loading to the Wabash River.	**$5,500,000** Highest cost final cover option for a 35 IAC 811.314 cover system. When compared to a geosynthetic cover, compacted clay is not a cost competitive cover option.	**$5,000** O & M costs associated with maintaining a 3 foot protective layer, maintaining vegetation and repairing erosion damage.	NO Highest cost final cover alternative for a Part 811.314 cover system. Additional capital not warranted versus a geosynthetic final cover system.

Table 3-1 - Initial Screening of Leachate Management and Final Cover Alternatives

Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

NRT PROJECT NO.: 1375/6.1
BY: CAR / EJT CHKD BY: CAR/BRH (EJT 5/19/05)
DATE: 7/18/05

Closure Alternatives	*Option*	*Description*	*Construction / Implementation Feasibility*	*Effectiveness*	*Relative Cost*		*Carry Forward to Modeling and Further Evaluation (Yes/No)*
					Capital	*Annual O &M*	
Final Cover Alternatives (continued)	**Earthen Final Cover**	Pond D is covered with final cover constructed from on-site earthen materials to prevent direct contact, reduce infiltration of surface water, reduce leachate generation, and provide erosion control.	An earthen final cover could be readily constructed from on-site materials and earthen covers have been installed at other fly ash management facilities in Illinois to achieve site closure. An earthen final cover would be constructed from a minimum of 3 feet of earthen materials (i.e. general fill) and designed to reduce surface water infiltration and leachate generation. Local sources for general fill are available. Implementation of an earthen final cover would require approval of an adjusted standard from the PCB to seek relief from the requirements of 35 IAC 811.314. Similar limitations to overcome as a geosynthetic final cover with respect to surface water.	An earthen final cover will reduce surface water infiltration and leachate generation from Pond D, and modeling studies indicated that overall performance would approach that of compacted clay cover. The earthen cover provides erosion control and prevents direct contact with ash. This option does not address leaching from saturated ash, which hydrogeologic investigations have identified as a significant component of leachate generation from Pond D, and if used alone would not result in reduction of groundwater concentrations; however, the cover would result in a net reduction in leachate loading to the Wabash River.	**$4,200,000** Lowest cost final cover option, if the PCB approves an adjusted standard for relief from 35 IAC 811.314.	**$5,000** O & M costs associated with maintaining the earthen cover, maintaining vegetation and repairing erosion damage.	**YES** This alternative represents the lowest cost alternative for final cover construction.
	Pozzolanic Fly Ash Final Cover	Pond D is covered with a pozzolanic fly ash final cover to prevent direct contact, control infiltration of surface water, reduce leachate generation, and provide erosion control.	Pozzolanic fly ash final covers have been constructed at some fly ash management facilities around the U.S. to reduce surface water infiltration and reduce leachate generation. Fly ash would be mixed with stabilizing reagents (e.g. lime, Portland cement, Class C fly ash) to form a cement-like low permeability cover. A pozzolanic final cover would be constructed with 3 feet of pozzolanic fly ash mixture (Low Permeability Layer) followed by 3 feet of final protective cover (Final Protective Layer), similar to a 35 IAC Part 811.314. Implementation of a pozzolanic final cover would require approval of an adjusted standard from the PCB to seek relief from the requirements of 35 IAC 811.314. Construction of a pozzolanic final cover could potentially use fly ash already on-site in the lined ash pond (Pond A) and result in a significant cost savings for materials.	A pozzolanic fly ash final cover would effectively reduce surface water infiltration and leachate generation from Pond D, provide erosion control, and prevent direct contact with ash. This option does not address leaching from saturated ash, which hydrogeologic investigations have identified as a significant component of leachate generation from Pond D, and if used alone would not result in reduction of groundwater concentrations; however, the cover would result in a net reduction in leachate loading to the Wabash River.	**$4,700,000** Mid-range cost final cover option for a 35 IAC 811.314 final cover. However, capital cost for the cover should be evaluated versus the benefit of creating an additional 110,000 yd^3 capacity in the lined ash impoundment.	**$5,000** O & M costs associated with maintaining a two foot protective layer above the pozzolanic cover, maintaining vegetation and repairing erosion damage.	**YES** While this alternative represents the highest cost alternative for a final cover system, it provides the benefit of creating additional capacity in the lined ash impoundment.
Surface Water Management Alternatives	**Route Surface Water East Toward Wabash River**	The grade of Pond D would be adjusted to promote gravity drainage of surface water toward the Wabash River.	Technically and administratively feasible - the grade of Pond D could be readily adjusted to route surface water toward the Wabash River. Can be constructed if adequate source(s) of general fill are identified in close proximity to the site.	This would be an effective surface water management option that could be readily integrated with a final cover.	**SEE FINAL COVER OPTIONS** Fill required for grade adjustment to route surface water drainage is already included as part of the final cover estimates.		**NO** Routing all surface water to the Wabash River would require excess fill.
	Route Surface Water West Toward Drainage Collection Pond (Pond C)	The grade of Pond D would be adjusted to promote gravity drainage of surface water toward Pond C.	Technically and administratively feasible - the grade of Pond D could be readily adjusted to route surface water towards the Drainage Collection Pond (Pond C) similar to layout as shown on Hanson Engineers, Inc. *Interim Ash and Drainage Collection Ponds*, Drawing No. S371. Can be constructed if adequate source(s) of general fill are identified in close proximity to the site. This surface water management option would require less fill than routing surface water towards the Wabash River. A box culvert has already been constructed to allow surface water drainage from Pond D to Pond C.	This would be an effective surface water management option that could be readily integrated with a final cover. If combined with an earthen cover, swales designed to route surface water may have to be lined with a geomembrane.	**SEE FINAL COVER OPTIONS** Fill required for grade adjustment to route surface water drainage is already included as part of the final cover estimates.		**NO** Routing all surface water to the Drainage Collection Pond would require excess fill.
	Route Surface Water East and West, Towards the Wabash River and the Drainage Collection Pond (Pond C)	The grade of Pond D would be adjusted to promote gravity drainage of surface water toward Pond C and to the Wabash River to eliminate the need for excess fill.	Technically and administratively feasible - the grade of Pond D could be readily adjusted to route surface water towards the Drainage Collection Pond (Pond C) and the Wabash River. Can be constructed if adequate source(s) of general fill are identified in close proximity to the site. This surface water management option would require the least amount of fill to construct. A box culvert has already been constructed to allow surface water drainage from Pond D to Pond C.	This would be an effective surface water management option that could be readily integrated with a final cover. If combined with an earthen cover, swales designed to route surface water may have to be lined with a geomembrane.	**SEE FINAL COVER OPTIONS** Fill required for grade adjustment to route surface water drainage towards the Drainage Collection Pond and/or the Wabash River is already included as part of the final cover estimates. Actual costs would likely be less than routing surface water exclusively towards the Wabash River or the Drainage Collection Pond.		**YES** As this surface water management alternative represents the least amount of fill needed to route surface water off of Pond D, it has been incorporated within the final cover alternative estimates.

Table 3-2 - Areal Extent and Volumes of Unsaturated and Saturated Ash In Pond D

Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility
Ameren Energy Generating - Hutsonville, Illinois

NRT PROJECT NO.: 1375/6.1
BY: GRL/EJT CHKD BY: CAR (EJT 5/19/05)
DATE: 7/18/05

Site Specific Parameters	Unit	Unlined Ash Impoundment (Pond D)
Total Volume of Ash	CY	830,000
Volume of Unsaturated Ash	CY	550,000
Volume of Saturated Ash	CY	280,000
Areal Extent of Ash	SF	966,000
	ACRES	22
Areal Extent of Saturated Ash	SF	790,000
	ACRES	18
Thickness of Unsaturated Ash	FT	11-31
Thickness of Saturated Ash	FT	5-14
Depth to Bottom of Saturated Ash	FT	11-31

Source Notes:

1. Total estimated area for saturated ash: areal extent ~ 790,000 ft^2, average thickness ~ 9.5 ft, average depth to bottom of saturated ash ~ 25 ft.
2. Based on above estimates: 280,000 yd^3 saturated ash (790,000 ft^2 x 9.5 ft).
3. Total estimated area for ash: areal extent ~ (22 acres) 966,000 ft^2, average thickness estimated from Geoprobe boring logs (20.9 feet).
4. Based on above estimates: 750,000 yd^3 ash (966,000 ft^2 x average thickness) + 80,000 yd^3 transferred in 2004 = 830,000 yd^3.
5. Total ash volume includes unsaturated ash (550,000 yd^3) and saturated ash (280,000 yd^3).

CY = Cubic yards
SF = Square Feet

Table 3-3 - Final Cover Alternatives Material Balance Analysis

Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

NRT PROJECT NO.: 1375/6.1
BY: CAR CHKD BY: EJT 5/19/05
DATE: 7/18/05

				Final Cover Alternative			
Fill Utilization	**Fill Origin**	**Calculation**	**Unit**	**Clay**	**Pozzolanic**	**Geosynthetic**	**Earthen**
Establish Grade	Fly Ash Stockpile[3] (V_{as})	[A] - Assumption 8	CY	50,500	50,500	50,500	50,500
	Additional Imported Fill[4]	[B = L - (A + C + D + E + F + G + H + I)]	CY	120,700	120,700	206,100	206,100
	Beneficial Reuse Ash	[C] - Assumption 9	CY	--	--	20,000	20,000
Low Permeability Layer[5] (V_{fc})	Clay	[D] - Assumption 5	CY	105,400	--	--	--
	Cement	[E] - 5% of Pozzolanic Cover (dry weight basis)	CY	--	2,500	--	--
	Fly Ash-Pozzolanic Mix	[F = D - E]	CY	--	102,900	--	--
Final Protective Layer[6] (V_{pl})	Beneficial Reuse Ash	[G] - Assumption 9	CY	20,000	20,000	--	--
	Imported Rooting Zone Soil	[H = Assumption 6 - G - I]	CY	85,400	85,400	105,400	87,800
	Sand Drainage Layer[7]	[I] - Assumption 7	CY	--	--	--	17,600
Total Imported Rooting Zone		[J = H + I]	CY	85,400	85,400	105,400	105,400
Total Fill Volume for Pond D[1]		[K] - Assumption 1	CY	382,000	382,000	382,000	382,000

Assumptions and References:

1. The *Total Fill Volume for Pond D* was calculated from design grades with minimum 5% final cover slope for drainage and the existing grades established by aerial survey performed by Connor & Connor on April 14, 2005, and included an estimate of capacity below standing water of 5,000 yd^3; the calculated *Total Fill Volume for Pond D* was approximately 382,000 yd^3. All volume calculations were performed using AutoCad LandDesk Development software.
2. Final cover material estimates are included as part of estimated volume of fill to make Pond D grades.
3. All material balance estimates assume the ash stockpile will be used as fill beneath the final cover.
4. Additional imported fill is required if $V_{as} + V_{fc} + V_{pl} < 357,000\ yd^3$.
5. Low permeability layer volume (105,400 CY) estimated assuming an approximate 22 acre cover area with 3' thick cover: clay and pozzolanic final covers only.
6. Final protective layer volume (105,400 CY) estimated using an approximate 22 acre cover area with 3' thick cover; required for ALL final cover alternatives.
7. For the earthen cover, the final protective layer consists of: 1) a 6" sand drainage layer, and 2) a 2.5' rooting zone layer.
8. Fly ash stockpile volume (50,500 CY) estimate calculated from elevation 453 feet and above.
9. Beneficial ash volume estimated by Hutsonville Power Station personnel at approximately 20,000 yd^3.

CY = Cubic yards

Table 3-4 - Comparison of Recommended Mix Designs to Performance Goals and Cost Sensitivity Analysis

Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

NRT PROJECT NO.: 1375/3.1
BY: CAR CHKD BY: BRH (EJT 5/19/05)
DATE: 7/18/05

		Performance Goals (Substantially consistent with the Part 816 standards)				Cost Sensitivity Analysis
Recommended Pozzolanic Final Cover Mix Design	**Net Capacity Created in Pond A**	**Average Final Cover Permeability**^{3} **Goal: 1 x 10^{-7} cm/sec**	**Unconfined Compressive Strength UCS (psi)** **Goal: 150 psi @ 84 days**	**Field Constructability** **Goal: YES**	**Leaching Performance** **Goal: Leachate Concentrations < Class I Groundwater Quality Standards**	Capital Costs
Pozzolanic Final Cover - Mix Design 1 (Pond A fly ash and cement)	100,480 CY	6.5 x 10^{-7} cm/sec	305	YES	All Parameters < Class I Groundwater Quality Standards	$5,333,000
Pozzolanic Final Cover - Mix Design 2 (Pond A fly ash and cement)	100,480 CY	4.9 x 10^{-6} cm/sec	165	YES	NA	$4,533,000
Pozzolanic Final Cover - Mix Design 9 (Pond A fly ash, on site native soil, and cement)	85,408 CY	1.6 x 10^{-6} cm/sec	191	YES	All Parameters < Class I Groundwater Quality Standards with the exception of cadmium detected slightly above the Class I standard at 0.01 mg/L	$4,864,000
Pozzolanic Final Cover - Mix Design 10 (Pond A fly ash, on site native soil, and cement)	85,408 CY	NA	380	YES	NA	$5,914,000
Pozzolanic Final Cover - Mix Design 14 (Pond A fly ash, FGD filter cake, and cement)	70,336 CY	1.3 x 10^{-7} cm/sec	1,110	High initial strength and tendency to adhere to the sides of the feed hoppers present field construction challenges.	All Parameters < Class I Groundwater Quality Standards	$5,316,000

General Notes:

1. See Section 3.6 for a description of the pozzolanic final cover mix designs.
2. NA: Not Analyzed
3. See VFL Technology Corporation Table 3 for Mix Designs, Strength and Permeability Data (Appendix C-1).
4. FGD: Fluidized gas desulfurization scrubber sludge

Table 4-1 - Selected Alternatives for Groundwater Flow and Transport Modeling

Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

NRT PROJECT NO.: 1375/6.1
BY: CAR CHKD BY: BRH
DATE: 7/18/05

	Model Scenario	Final Cover Alternative (CO)		Leachate Extraction Option (LEO)
		Layering Bottom to Top, Thickness (ft)	Permeability, K (cm/sec)	LEO Description
Final Cover Alternative Scenarios	CO-1	3 ft earth	NA	NONE
	CO-2	Geosynthetic Layer, 3 ft earth	2.00E-11	NONE
	CO-3a	3 ft Pozzolanic Layer, 3 ft earth Layer	1.00E-07	NONE
	CO-3b	3 ft Pozzolanic Layer, 3 ft earth Layer	1.00E-06	NONE
	CO-3c	3 ft Pozzolanic Layer, 3 ft earth Layer	1.00E-05	NONE
Final Cover Combined With Leachate Management Alternatives Scenarios	CO-2, LEOa-1	Geosynthetic Layer, 3 ft earth	2.00E-11	11 Extraction Wells (EAST); 1000 ft TRENCH (SOUTH)
	CO-3c, LEOa-1	3 ft Pozzolanic Layer, 3 ft earth Layer	1.00E-05	11 Extraction Wells (EAST); 1000 ft TRENCH (SOUTH)
	CO-2, LEOb-1	Geosynthetic Layer, 3 ft earth	2.00E-11	11 Extraction Wells (EAST); 1000 ft TRENCH (SOUTH)
	CO-3c, LEOb-1	3 ft Pozzolanic Layer, 3 ft earth Layer	1.00E-05	11 Extraction Wells (EAST); 1000 ft TRENCH (SOUTH)
	CO-2, LEOa-2	Geosynthetic Layer, 3 ft earth	2.00E-11	3200 ft TRENCH (EAST and SOUTH)
	CO-3c, LEOa-2	3 ft Pozzolanic Layer, 3 ft earth Layer	1.00E-05	3200 ft TRENCH (EAST and SOUTH)
	CO-2, LEOb-2	Geosynthetic Layer, 3 ft earth	2.00E-11	3200 ft TRENCH (EAST and SOUTH)
	CO-3c, LEOb-2	3 ft Pozzolanic Layer, 3 ft earth Layer	1.00E-05	3200 ft TRENCH (EAST and SOUTH)
	CO-2, LEOa-3	Geosynthetic Layer, 3 ft earth	2.00E-11	1000 ft TRENCH (SOUTH)
	CO-3c, LEOa-3	3 ft Pozzolanic Layer, 3 ft earth Layer	1.00E-05	1000 ft TRENCH (SOUTH)
	CO-2, LEOb-3	Geosynthetic Layer, 3 ft earth	2.00E-11	1000 ft TRENCH (SOUTH)
	CO-3c, LEOb-3	3 ft Pozzolanic Layer, 3 ft earth Layer	1.00E-05	1000 ft TRENCH (SOUTH)
	CO-2, LEOa-4	Geosynthetic Layer, 3 ft earth	2.00E-11	2500 ft TRENCH (EAST and SOUTH)
	CO-3c, LEOa-4	3 ft Pozzolanic Layer, 3 ft earth Layer	1.00E-05	2500 ft TRENCH (EAST and SOUTH)
	CO-2, LEOb-4	Geosynthetic Layer, 3 ft earth	2.00E-11	2500 ft TRENCH (EAST and SOUTH)
	CO-3c, LEOb-4	3 ft Pozzolanic Layer, 3 ft earth Layer	1.00E-05	2500 ft TRENCH (EAST and SOUTH)

Final Cover Alternatives:

CO-1:	Final Cover Alternative 1 - Earthen Final Cover Scenario
CO-2:	Final Cover Alternative 2 - Geosynthetic Final Cover Scenario
CO-3a:	Final Cover Alternative 3a - Pozzolanic Fly Ash Cover Scenario (K ~ 1.0 x10^{-7} cm/sec)
CO-3b:	Final Cover Alternative 3b - Pozzolanic Fly Ash Cover Scenario (K ~ 1.0 x 10^{-6} cm/sec)
CO-3c:	Final Cover Alternative 3b - Pozzolanic Fly Ash Cover Scenario (K ~ 1.0 x 10^{-5} cm/sec)

Leachate Management Alternatives:

LEO-1:	Leachate Extraction Option 1 - Groundwater extraction (east) combined with an interceptor drain/trench (south)
LEO-2:	Leachate Extraction Option 2 - Interceptor drain/trench (east and south)
LEO-3:	Leachate Extraction Option 3 - Interceptor drain/trench (south only)
LEO-4:	Leachate Extraction Option 4 - Interceptor drain/trench (east and south), 700 feet shorter along east alignment
a:	Indicates "shallow" trench design
b:	Indicates "deep" trench design

Table 4-2 - Groundwater Flow and Transport Model Results
Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

NRT PROJECT NO.: 1375/6.1
BY: CAR CHKD BY: BRH
DATE: 7/18/05

	Model Scenario	Evaluation of Modeling Scenarios Versus Effectiveness Criteria Effectiveness Criteria No. 1: Compliance with Class I Groundwater Quality Standard for Boron (2 mg/L) [YES/NO] / Effectiveness Criteria No. 2: Time Frame [yrs.]				Carry Forward to Assembly of Closure Alternatives[2] (YES/NO)
		Downgradient MW-6	Downgradient MW-7	Downgradient MW-8	Downgradient MW-11R	
Final Cover Alternative Modeling Scenarios	CO-1	DRY / 4	NO	NO	YES / 16.0	YES
	CO-2	DRY / 4	NO	NO	YES / 15.3	YES
	CO-3a	DRY / 4	NO	NO	YES / 15.4	YES
	CO-3b	DRY / 4	NO	NO	YES / 16.1	YES
	CO-3c	DRY / 4	NO	NO	YES / 16.1	YES
Final Cover Combined With Leachate Management Alternatives Scenarios	CO-2, LEOa-1	DRY / 3	YES / 11.8	YES / 8.7	YES / 10.3	NO
	CO-3c, LEOa-1	DRY / 3	YES / 12.0	YES /8.7	YES / 10.3	NO
	CO-2, LEOb-1	DRY / 3	YES / 10.2	YES / 8.5	YES / 8.8	NO
	CO-3c, LEOb-1	DRY / 3	YES / 10.3	YES / 8.5	YES / 8.9	NO
	CO-2, LEOa-2	DRY / 3	YES /5.3	YES / 3.7	YES / 9.9	NO
	CO-3c, LEOa-2	DRY / 3	YES /5.3	YES / 3.7	YES / 9.9	NO
	CO-2, LEOb-2	DRY / 3	YES / 6.8	YES / 3.3	YES / 8.6	NO
	CO-3c, LEOb-2	DRY / 3	YES / 6.9	YES / 3.3	YES / 8.6	NO
	CO-2, LEOa-3	DRY / 3	NO	NO	YES / 9.6	YES
	CO-3c, LEOa-3	DRY / 3	NO	NO	YES / 10.2	YES
	CO-2, LEOb-3	DRY / 3	NO	NO	YES / 8.8	NO
	CO-3c, LEOb-3	DRY / 3	NO	NO	YES / 8.9	NO
	CO-2, LEOa-4	DRY / 3	YES / 5.3	YES / 4.0	YES / 9.9	YES
	CO-3c, LEOa-4	DRY / 3	YES / 5.3	YES / 4.0	YES / 10.0	YES
	CO-2, LEOb-4	DRY / 3	YES / 6.9	YES / 3.5	YES / 8.6	NO
	CO-3c, LEOb-4	DRY / 3	YES / 6.9	YES / 3.5	YES / 8.6	NO

Final Cover Alternatives:
CO-1: Final Cover Alternative 1 - Earthen Final Cover Scenario
CO-2: Final Cover Alternative 2 - Geosynthetic Final Cover Scenario
CO-3a: Final Cover Alternative 3a - Pozzolanic Fly Ash Cover Scenario (K ~ 1.0 x 10^{-7} cm/sec)
CO-3b: Final Cover Alternative 3b - Pozzolanic Fly Ash Cover Scenario (K ~ 1.0 x 10^{-6} cm/sec)
CO-3c: Final Cover Alternative 3c - Pozzolanic Fly Ash Cover Scenario (K ~ 1.0 x 10^{-5} cm/sec)

Leachate Management Alternatives:
LEO-1: Leachate Extraction Option 1 - Groundwater extraction (east) combined with an interceptor drain/trench (south)
LEO-2: Leachate Extraction Option 2 - Interceptor drain/trench (east and south)
LEO-3: Leachate Extraction Option 3 - Interceptor drain/trench (south only)
LEO-4: Leachate Extraction Option 4 - Interceptor drain/trench (east and south), 700 feet shorter along east alignment
a: Indicates "shallow" trench design
b: Indicates "deep" trench design

Notes:
1. See Appendix D for groundwater transport modeling results.
2. Section 4.3.3 provides an explanation of which modeling scenarios carried forward to assembly of the closure alternatives.

Table 5-1 - Closure Alternatives Cost Summary

Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

NRT PROJECT NO.: 1375/6.1
BY: CAR CHKD BY: EJT
DATE: 7/18/05

Closure Alternative	Capital Costs	Annual O & M Costs	Cumulative Capital and O & M Costs	
			5 Year Compared to Today's Dollars	30 Year Compared to Today's Dollars
Closure Alternative No. 1: Geosynthetic Final Cover with East and South Interceptor Drain/Trench, and Deep Alluvial Aquifer Groundwater Extraction	$6,840,000	$104,000	$7,360,000	$9,960,000
Closure Alternative No. 2: Earthen Final Cover With South Interceptor Drain/Trench	$4,660,000	$35,000	$4,835,000	$5,710,000
Closure Alternative No. 3: Earthen Final Cover	$4,200,000	$5,000	$4,225,000	$4,350,000
Closure Alternative No. 4: Pozzolanic Fly Ash Final Cover[2]	$4,530,000	$5,000	$4,555,000	$4,680,000

General Notes:

1. See Section 5.0 for a description of the closure alternatives cost summary.
2. Capital costs for Closure Alternative No.4: Pozzolanic Fly Ash Final Cover based on cost data for Mix Design 2 provided by VFL technology Corporation (Appendix C-2).

*Table 5-2 - **Detailed Analysis of Closure Alternatives***
Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

NRT PROJECT NO.: 1375/3.1
BY: CAR CHKD BY: BRH
DATE: 7/18/05

Criteria	Closure Alternative No. 1 Geosynthetic Final Cover with East and South Interceptor Drain/Trench, and Deep Alluvial Aquifer Groundwater Extraction	Closure Alternative No. 2 Earthen Final Cover With South Interceptor Drain/Trench	Closure Alternative No. 3 Earthen Final Cover	Closure Alternative No. 4 Pozzolanic Fly Ash Final Cover	Evaluation Criteria Summary
Overall Protection of Human Health & the Environment	Alternative No. 1 protects Human Health and the Environment by limiting direct contact exposure to ash and reducing leaching of ash constituents to groundwater via infiltration of surface water. The leachate management and groundwater extraction components of this alternative prevent groundwater affected by ash leachate and ash POCs from discharging to the Wabash River or migrating off-site; thus protecting the river and potential downgradient groundwater receptors pursuant to Class I groundwater quality standards.	Alternative No. 2 protects Human Health and the Environment by limiting direct contact exposure to ash and reducing leaching of ash constituents to groundwater via infiltration of surface water. The leachate management component of this alternative prevents groundwater affected by ash leachate from migrating off-site to the south; thus protecting potential downgradient groundwater receptors.	Alternative No. 3 protects Human Health and the Environment by limiting direct contact exposure to ash and reducing leaching of ash constituents to groundwater via infiltration of surface water. The groundwater monitoring program would be utilized to ensure potential downgradient groundwater receptors are not impacted.	A pozzolanic fly ash final cover would provide similar to equivalent protection to human health and the environment as each of the other final covers proposed in Alternatives 1 to 3.	**Each alternative is protective of human health and the environment.** Specifically, each alternative effectively limits direct contact exposure via a final landfill cover and protects potential downgradient groundwater receptors by capturing or monitoring the groundwater contaminant plume. Alternative No. 1 would likely provide the greatest protection for potential downgradient groundwater receptors via combination of a final cover and significant leachate and groundwater extraction.
Short & Long Term Effectiveness (Analysis of Risk After Implementation)	**Short Term** - This alternative would immediately limit direct contact exposure to ash and reduce leaching of ash constituents via surface water infiltration; improvements in downgradient groundwater quality (boron < 2 mg/L) should be observed at eastern downgradient monitoring wells within 4 to 5 years. **Long Term** - Improvement of groundwater quality may be observed at MW-11R within 10 years. Leachate pumping and groundwater extraction could be required indefinitely - until the mass of ash constituents completely leaches from saturated ash to groundwater. Extended groundwater monitoring would be required. Impoundment cover would have to be maintained indefinitely to limit direct contact exposure.	**Short Term** - This alternative would immediately limit direct contact exposure to ash and reduce leaching of ash constituents via surface water infiltration; improvements in downgradient groundwater quality along the south impoundment boundary will not be observed within 5 years. **Long Term** - Improvement of groundwater quality is not expected along the east impoundment boundary (between the impoundment and the Wabash River); however, improvement of groundwater quality may be observed at MW-11R within approximately 10 years (south boundary). Groundwater extraction could be required indefinitely - until the mass of ash constituents completely leaches from saturated ash to groundwater. Extended groundwater monitoring would be required. Impoundment cover would have to be maintained indefinitely to limit direct contact exposure.	**Short Term** - This alternative would immediately limit direct contact exposure to ash and reduce leaching of ash constituents via surface water infiltration. **Long Term** - Improvement of groundwater quality is not expected along the east impoundment boundary (between the impoundment and the Wabash River); however, improvement in groundwater quality may be observed at MW-11R within 16 years (south boundary). Extended groundwater monitoring would be required. Impoundment cover would have to be maintained indefinitely to limit direct contact exposure.	**Short Term** - A pozzolanic fly ash final cover would immediately limit direct contact exposure to ash and reduce leaching of ash constituents via surface water infiltration. **Long Term** - Improvement of groundwater quality is not expected along the east impoundment boundary (between the impoundment and the Wabash River); however, improvement of groundwater quality may be observed at MW-11R within approximately 16 years (south boundary). Extended groundwater monitoring would be required. Impoundment cover would have to be maintained indefinitely to limit direct contact exposure.	Each alternative could provide both short and long term effectiveness. Alternatives Nos. 1 and 2 effectiveness hinges on groundwater and/or leachate collection via downgradient interceptor drain/trenches and/or wells to capture the affected groundwater and bring the site into compliance in a shorter time frame. **Alternative Nos. 3 and 4 may provide similar long-term effectiveness at the south impoundment boundary as Alternatives Nos. 1 and 2, without up-front capital expense and extensive annual operation and maintenance of a leachate collection system. Alternative No. 1 would provide the greatest short-term effectiveness.**
Ease of Implementation	A geosynthetic landfill cover could be readily implemented at the site - contractors and materials are widely available. Contractors and materials for construction of the interceptor drain/trench system are readily available. Implementation of the groundwater extraction system for the deep alluvial aquifer would present a significant challenge; however, groundwater extraction systems of this magnitude have been successfully constructed.	For an earthen final cover, an adjusted standard from the Illinois PCB would be required. However, earthen covers have been used for closure of several fly ash impoundment facilities throughout Illinois. Contractors and materials are locally available for construction of an earthen cover. Similar to Alternative No. 1, contractors and materials for construction of the interceptor drain/trench system are readily available.	Similar to Alternative No. 2, an adjusted standard from the Illinois PCB would be required to construct an earthen cover. However, earthen covers have been used for closure of several fly ash impoundment facilities throughout Illinois. Contractors and materials are locally available for construction of an earthen cover.	Similar to Alternative No. 3, an adjusted standard from the Illinois PCB would be required to construct a pozzolanic fly ash final cover. A level of effectiveness would likely have to be demonstrated to the Illinois PCB before full-scale construction - this could require additional field scale testing. Contractors and materials are available for construction of a pozzolanic fly ash cover.	Each alternative may require additional evaluation prior to implementation. A pozzolanic fly ash final cover (Alternative No. 4) would likely require additional field study prior to full scale construction. Alternative No. 1 would require a pump test prior to final design. **Alternative No. 2 requires the least amount of study prior to implementation.**
Performance / Reliability / Potential Impacts	A geosynthetic final cover would reduce leaching of ash constituents to groundwater via surface water infiltration. The interceptor drain/trench system would rely on careful design, equipment performance, and proper maintenance. Interceptor trench systems have demonstrated reliability in a variety of environmental applications. Groundwater extraction systems have demonstrated reliability with the proper design, operation and maintenance. Alternative No. 1 would bring Pond D into compliance with the Part 811 regulations in the shortest timeframe due to the most significant leachate collection proposed for all of the alternatives. Potential for adverse environmental affects is minimal to non-existent.	Similar to a geosynthetic final cover, an earthen final cover would reduce leaching of ash constituents to groundwater via surface water infiltration. Alternative No. 2 is not expected to meet the Class I Groundwater Quality Standards along the east (MW-7 and MW-8) impoundment boundary along the Wabash River without an adjusted standard. The interceptor drain/trench system would rely on careful design, equipment performance, and proper maintenance. Interceptor trench systems have demonstrated reliability in a variety of environmental applications. Potential for adverse environmental affects is minimal.	Similar to a geosynthetic final cover, an earthen final cover would reduce leaching of ash constituents to groundwater via surface water infiltration. Alternative No. 3 is not expected to meet the Class I Groundwater Quality Standards along the east (MW-7 and MW-8) impoundment boundary without an adjusted standard. However, the Class I Groundwater Quality Standards may be met at the south impoundment boundary (MW-11R) within approximately 16 years without leachate collection. The potential for adverse environmental affects is minimal.	Similar to an earthen final cover, a pozzolanic fly ash final cover would reduce leaching of ash constituents to groundwater via surface water infiltration. This alternative will likely have similar performance as Closure Alternative No. 3 (Class I Groundwater Quality Standards may be met at the south impoundment boundary (MW-11R) within approximately 16 years). Greater O & M and up-front field testing may be required to assure performance and reliability of a pozzolanic fly ash cover. The potential for adverse environmental affects is minimal with proper design of the pozzolanic fly ash mixture.	Performance of Alternatives 1 and 2 would be enhanced by installation of the interceptor drain/trench leachate collection system. Each alternative could be reliable if properly designed, constructed and maintained. **Alternative No. 1 could provide the greatest performance if the groundwater extraction system is properly operated and maintained.** Historically, groundwater extraction systems are difficult to operate and maintain over long periods of time - reliability could be an issue for Alternative No. 1.

Table 5-2 - Detailed Analysis of Closure Alternatives
Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

NRT PROJECT NO.: 1375/3.1
BY: CAR CHKD BY: BRH
DATE: 7/18/05

Criteria	Closure Alternative No. 1 Geosynthetic Final Cover with East and South Interceptor Drain/Trench, and Deep Alluvial Aquifer Groundwater Extraction	Closure Alternative No. 2 Earthen Final Cover With South Interceptor Drain/Trench	Closure Alternative No. 3 Earthen Final Cover	Closure Alternative No. 4 Pozzolanic Fly Ash Final Cover	Evaluation Criteria Summary
Time-frame for Alternative Completion	Construction of Alternative No. 1 could possibly be completed in a single construction season. Startup of the interceptor trench/drain leachate collection system and the deep alluvial groundwater extraction system could begin within one year. Maintenance of the final cover would be performed indefinitely (>100 years). Maintenance of extraction system would be performed until concentrations of ash constituents decrease to Class I groundwater quality standards.	Construction of Alternative No. 2 could be completed in a single construction season. Startup of the interceptor trench/drain leachate collection system could begin within one year. Maintenance of the final cover and extraction of affected groundwater would be performed indefinitely (>100 years).	Construction of Alternative No. 3 could be completed in a single construction season. The earthen final cover would have to be maintained indefinitely.	Construction of a pozzolanic fly ash final cover could be completed in a single construction season. The pozzolanic fly ash final cover would have to be maintained indefinitely.	**Each alternative would have similar time-frames for construction. Alternatives 1 and 2 would require significant long term operation and maintenance indefinitely for leachate and groundwater extraction.** Long term O&M requirements for the final cover would be similar for each of the alternatives.
Cost	Highest cost closure alternative. Low risk for additional cost as the geosynthetic final cover combined with the interceptor drain/trench and groundwater extraction system will effectively prevent downgradient migration of groundwater affected by ash leachate.	Lower cost closure alternative that incorporates an earthen final cover with a south interceptor drain/trench. Low to medium risk for additional cost depending on adjusted standards approved by the Illinois PCB.	Lowest cost closure alternative. Low to medium risk for additional cost depending on adjusted standards approved by the Illinois PCB and behavior of downgradient migration of groundwater affected by ash leachate over time.	Highest capital cost for a final cover alternative. Additional cost for construction of a pozzolanic fly ash cover versus a lower capital - yet equally protective final cover (e.g. earthen final cover), needs to be evaluated with respect to additional capacity that could be created for fly ash in Pond A for enhancement of future plant operations.	Alternative No. 3 is the lowest cost closure alternative and Alternative No. 1 is the highest cost closure alternative. Alternatives 2 and 3 could provide significant cost savings versus Alternative No. 1 if regulatory approval can be obtained. **Although Alternative No. 4 has higher capital costs than Alternatives 2 and 3, enhancement of future plant operations may off-set the increased cost.**
Institutional Requirements	Alternative No. 1 would not require adjusted standards for leachate collection and cap design with the Illinois PCB to implement. Construction of this alternative would be subject to Illinois EPA review and approval. Modifications of the plant's NPDES permit may be required to accommodate discharge of collected groundwater through the existing ash sluice water system and outfall #002. This alternative would likely have relatively low difficulty to gain regulatory acceptance.	Adjusted standards from the Illinois PCB would likely be required for Alternative No. 2 for: 1) alternative cover construction to seek relief from the Section 811.314 requirements, and 2) adjusted groundwater quality standards, pursuant to Section 811.320. Construction of this alternative would be subject to Illinois EPA review and approval. Modifications of the plant's NPDES permit may be required to accommodate discharge of collected groundwater through the existing ash sluice water system and outfall #002.	Adjusted standards from the Illinois PCB would likely be required for Alternative No. 3 for: 1) alternative cover construction to seek relief from the Part 811 requirements; 2) relief from Section 811.309 and 814.302(b)(1) for no leachate collection; and, 3) adjusted groundwater quality standards, pursuant to Section 811.320. Construction of this alternative would be subject to Illinois EPA review and approval.	Similar to Alternative No. 3, adjusted standards from the Illinois PCB would likely be required for the alternate final cover to seek relief from Part 811 and 814 requirements for alternate cover construction, no leachate collection and adjusted groundwater quality standards. Construction of this alternative would be subject to Illinois EPA review and approval. Regulatory precedent does exist for construction of final cover systems using similar technology (35 IAC Part 816).	Each alternative can potentially gain regulatory approval. Alternatives 2, 3 and 4 would require adjusted standards from the Illinois PCB prior to approval. Alternative No. 1 would likely have very low difficulty to gain regulatory acceptance. **Pursuit of adjusted standards for Alternatives 2, 3 and 4 may be warranted based on the significant cost savings or plant enhancements these alternatives may provide.**

General Notes:
1. See Section 5.0 for a description of the detailed analysis of alternatives.

APPENDIX A

SUPPLEMENTAL SITE INVESTIGATION APPENDICES

APPENDIX A-2

MONITORING WELL COMPLETION REPORTS AND ABANDONMENT LOG

HANSON
ENGINEERS
INCORPORATED

MONITORING WELLS

M-1

ELEVATION 456.5

PIPE & SCREEN

7' pipe	459.5 - 452.5
5' screen	452.5 - 447.5

BACKFILL MATERIALS

concrete grout collar	456.5 - 455.0
bentonite seal	455.0 - 453.5
1/8" gravel pack	453.5 - 447.4

M-2

ELEVATION 453.3

PIPE & SCREEN

8' pipe	456.3 - 448.3
13' screen	448.3 - 435.3

BACKFILL MATERIALS

concrete grout collar	453.3 - 451.3
bentonite seal	451.3 - 449.3
1/8" gravel pack	449.3 - 431.8

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SPRINGFIELD, ILLINOIS ■ PEORIA, ILLINOIS ■ ROCKFORD, ILLINOIS

HANSON
ENGINEERS
INCORPORATED

MONITORING WELLS

M-3

ELEVATION 452.1

PIPE & SCREEN

7.9'	pipe	455.6 - 447.7
5'	screen	447.7 - 442.7

BACKFILL MATERIALS

concrete grout collar	452.1 - 450.1
bentonite seal	450.1 - 448.1
1/8" gravel pack	442.7 - 448.1

M-4

ELEVATION 454.4

PIPE & SCREEN

8'	pipe	457.4 - 449.4
7.5'	screen	449.4 - 441.9

BACKFILL MATERIALS

concrete grout collar	454.4 - 452.4
bentonite seal	452.4 - 450.4
1/8" gravel pack	450.4 - 441.0

NOW IN OUR THIRTIETH YEAR OF SERVICE

1525 SOUTH SIXTH STREET ■ SPRINGFIELD, ILLINOIS 62703-2886 ■ 217/788-2450 ■ TWX 910-242-0519

SPRINGFIELD, ILLINOIS ■ PEORIA, ILLINOIS ■ ROCKFORD, ILLINOIS

HANSON
ENGINEERS
INCORPORATED

MONITORING WELLS

M-5

ELEVATION 452.3

PIPE & SCREEN

8' pipe	455.3 - 447.3
13' screen	447.3 - 434.3

BACKFILL MATERIALS

concrete grout collar	452.3 - 450.3
bentonite seal	450.3 - 448.3
1/8" gravel pack	448.3 - 433.1

M-6

ELEVATION 438.9

PIPE & SCREEN

10' pipe	443.9 - 433.9
6.4' screen	433.9 - 427.5

BACKFILL MATERIALS

concrete grout collar	438.9 - 436.9
bentonite seal	436.9 - 434.9
1/8" gravel pack	434.9 - 427.5

NOW IN OUR THIRTIETH YEAR OF SERVICE

1525 SOUTH SIXTH STREET ■ SPRINGFIELD, ILLINOIS 62703-2886 ■ 217/788-2450 ■ TWX 910-242-0519

SPRINGFIELD, ILLINOIS ■ PEORIA, ILLINOIS ■ ROCKFORD, ILLINOIS

HANSON
ENGINEERS
INCORPORATED®

MONITORING WELLS

M-7

ELEVATION 437.9

PIPE & SCREEN

20'	pipe	442.9 - 422.9
10'	screen	422.9 - 412.9

BACKFILL MATERIALS

concrete grout collar	437.9 - 435.9
bentonite & auger cutting	435.9 - 425.9
bentonite seal	425.9 - 423.9
1/8" gravel pack	423.9 - 412.9

M-8

ELEVATION 439.4

PIPE & SCREEN

21.4'	pipe	444.3 - 422.9
5.0'	screen	422.9 - 417.9

BACKFILL MATERIALS

concrete grout collar	439.4 - 437.4
bentonite & auger cutting	437.4 - 425.9
bentonite seal	425.9 - 423.9
1/8" gravel pack	423.9 - 417.9

NOW IN OUR THIRTIETH YEAR OF SERVICE

1525 SOUTH SIXTH STREET ■ SPRINGFIELD, ILLINOIS 62703-2886 ■ 217/788-2450 ■ TWX 910-242-0519

SPRINGFIELD, ILLINOIS ■ PEORIA, ILLINOIS ■ ROCKFORD, ILLINOIS

HANSON
ENGINEERS
INCORPORATED

MONITORING WELLS

M-9

ELEVATION 452.0

PIPE & SCREEN

11.5'	pipe	455.0 - 443.5
10'	screen	443.5 - 433.5

BACKFILL MATERIALS

concrete grout collar	452 - 450
bentonite, cement & sand	450 - 446
bentonite seal	446 - 444
1/8" gravel pack	444 - 433.2

NOW IN OUR THIRTIETH YEAR OF SERVICE
1525 SOUTH SIXTH STREET ■ SPRINGFIELD, ILLINOIS 62703-2886 ■ 217/788-2450 ■ TWX 910-242-0519
SPRINGFIELD, ILLINOIS ■ PEORIA, ILLINOIS ■ ROCKFORD, ILLINOIS

Electronic Filing - Received, Clerks' Office, August 11, 2008--AS 09-1, Exhibit 3

Natural Resource Technology
N R T

MONITORING WELL CONSTRUCTION

Facility/Project Name: Ameren Hutsonville Power Station Drilling

Local Grid Location of Well: 898046.72 ft. ☒ N. ☐ S. 1176886.34 ft. ☒ E. ☐ W.

Well Name: TW-115s

Facility License, Permit or Monitoring No.

Local Grid Origin ☒ (estimated: ☐) or Well Location ☐

Lat. ____ ° ____ ' ____ " Long. ____ ° ____ ' ____ " or

Unique Well No.

Well Number

Facility ID

St. Plane ____ ft. N, ____ ft. E.

Date Well Installed: 05/01/2004

Section Location: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ R. ____

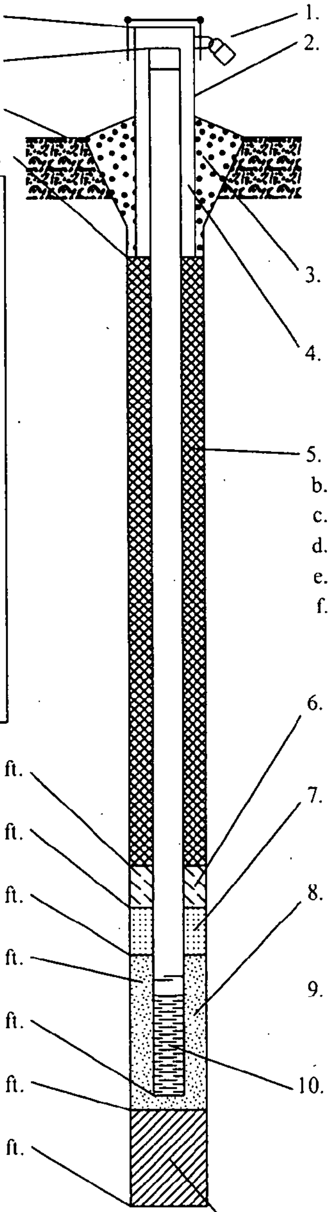
Type of Well: Well Code 12/pz

Well Installed By: (Person's Name and Firm) Steve, Boart Longyear

Distance from Waste/ Source ____ ft.

Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☒ Downgradient n ☐ Not Known

Gov. Lot Number



A. Protective pipe, top elevation ____ ft. MSL

B. Well casing, top elevation 440.89 ft. MSL

C. Land surface elevation 438.4 ft. MSL

D. Surface seal, bottom 437.4 ft. MSL or 1.0 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☒ SP ☒
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis attached? ☐ Yes ☒ No

14. Drilling method used: Rotary ☐ 5 0
Hollow Stem Auger ☒ 4 1
Other ☐

15. Drilling fluid used: Water ☐ 0 2 Air ☐ 0 1
Drilling Mud ☐ 0 3 None ☒ 9 9

16. Drilling additives used? ☐ Yes ☒ No

Describe ____

17. Source of water (attach analysis, if required): ____

E. Bentonite seal, top ____ ft. MSL or ____ ft.

F. Fine sand, top 410.4 ft. MSL or 28.0 ft.

G. Filter pack, top 409.4 ft. MSL or 29.0 ft.

H. Screen joint, top 408.4 ft. MSL or 30.0 ft.

I. Well bottom 403.4 ft. MSL or 35.0 ft.

J. Filter pack, bottom 402.4 ft. MSL or 36.0 ft.

K. Borehole, bottom 402.4 ft. MSL or 36.0 ft.

L. Borehole, diameter 8.3 in.

M. O.D. well casing 2.33 in.

N. I.D. well casing 2.00 in.

1. Cap and lock? ☒ Yes ☐ No

2. Protective cover pipe:
   - a. Inside diameter: 4.0 in.
   - b. Length: 6.0 ft.
   - c. Material: Steel ☒ 0 4
     Other ~~☒~~
   - d. Additional protection? ☐ Yes ☒ No
     If yes, describe: ____

3. Surface seal: Bentonite ☒ 3 0
   Concrete ☐ 0 1
   Other ☐

4. Material between well casing and protective pipe:
   Bentonite ☐ 3 0
   Sand Other ☒

5. Annular space seal: a. Granular/Chipped Bentonite ☒ 3 3
   - b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 3 5
   - c. ____ Lbs/gal mud weight . . . Bentonite slurry ☐ 3 1
   - d. ____ % Bentonite . . . Bentonite-cement grout ☐ 5 0
   - e. ____ Ft^3 volume added for any of the above
   - f. How installed: Tremie ☐ 0 1
     Tremie pumped ☐ 0 2
     Gravity ☒ 0 8

6. Bentonite seal: a. Bentonite granules ☐ 3 3
   - b. ☐ 1/4 in. ☐ 3/8 in. ☐ 1/2 in. Bentonite chips ☐ 3 2
   - c. ____ Other ☐

7. Fine sand material: Manufacturer, product name & mesh size
   - a. #7 Badger
   - b. Volume added ____ ft^3

8. Filter pack material: Manufacturer, product name & mesh size
   - a. #40 Badger
   - b. Volume added ____ ft^3

9. Well casing: Flush threaded PVC schedule 40 ☒ 2 3
   Flush threaded PVC schedule 80 ☐ 2 4
   Other ☐

10. Screen material: PVC
    - a. Screen Type: Factory cut ☒ 1 1
      Continuous slot ☐ 0 1
      Other ☐
    - b. Manufacturer Boart Longyear
    - c. Slot size: 0.010 in.
    - d. Slotted length: 5.0 ft.

11. Backfill material (below filter pack): None ☒ 1 4
    Other ~~☒~~

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: Paula Richardson

Firm: Natural Resource Technology, Inc.
23713 W. Paul Road, Unit D, Pewaukee, WI 53072
Tel: (262) 523-9000
Fax: (262) 523-9001

Template: NRT WELL CONSTRUCTION - Project: 1375 LOGS.GPJ

Natural Resource Technology
N R T

MONITORING WELL CONSTRUCTION

Facility/Project Name: Ameren Hutsonville Power Station Drilling

Local Grid Location of Well: 898052.56 ft. ☒ N. ☐ S. 1176882.3 ft. ☒ E. ☐ W.

Well Name: TW-115d

Facility License, Permit or Monitoring No.

Local Grid Origin ☒ (estimated: ☐) or Well Location ☐

Lat. ___° ___' ___" Long. ___° ___' ___" or

Unique Well No.

Well Number

Facility ID

St. Plane ______ ft. N, ______ ft. E.

Date Well Installed: 05/01/2004

Section Location

Type of Well: Well Code 12/pz

___1/4 of ___ 1/4 of Sec. ___, T. ___ R. ___

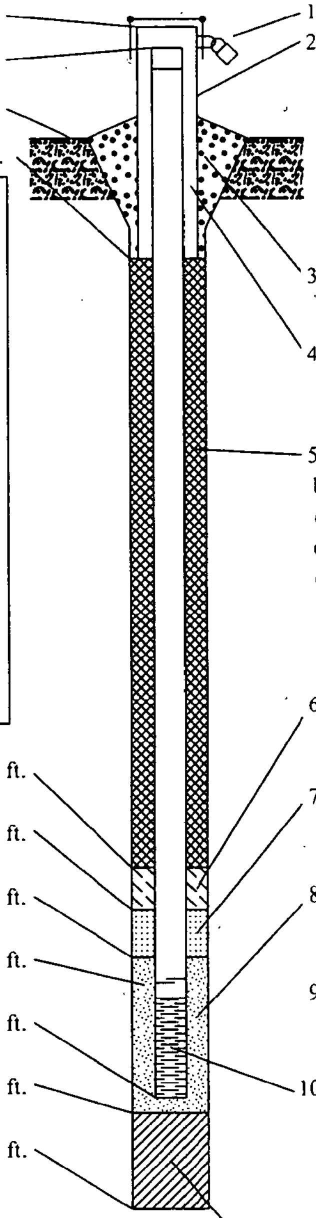
Well Installed By: (Person's Name and Firm): Steve

Boart Longyear

Distance from Waste/ Source ft.

Location of Well Relative to Waste/Source
u ☐ Upgradient s ☐ Sidegradient
d ☒ Downgradient n ☐ Not Known

Gov. Lot Number



A. Protective pipe, top elevation ______ ft. MSL

B. Well casing, top elevation 440.80 ft. MSL

C. Land surface elevation 438.4 ft. MSL

D. Surface seal, bottom 437.4 ft. MSL or 1.0 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☒ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis attached? ☐ Yes ☒ No

14. Drilling method used: Rotary ☐ 5 0
Hollow Stem Auger ☒ 4 1
rock core Other ☒ ▨

15. Drilling fluid used: Water ☒ 0 2 Air ☐ 0 1
Drilling Mud ☐ 0 3 None ☐ 9 9

16. Drilling additives used? ☐ Yes ☒ No

Describe ______

17. Source of water (attach analysis, if required):
Ameren well

E. Bentonite seal, top 361.4 ft. MSL or 77.0 ft.

F. Fine sand, top 358.4 ft. MSL or 80.0 ft.

G. Filter pack, top 357.4 ft. MSL or 81.0 ft.

H. Screen joint, top 356.4 ft. MSL or 82.0 ft.

I. Well bottom 351.4 ft. MSL or 87.0 ft.

J. Filter pack, bottom 350.4 ft. MSL or 88.0 ft.

K. Borehole, bottom 333.4 ft. MSL or 105.0 ft.

L. Borehole, diameter 8.3 in.

M. O.D. well casing 2.33 in.

N. I.D. well casing 2.00 in.

1. Cap and lock? ☒ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 4.0 in.
b. Length: 6.0 ft.
c. Material: Steel ☒ 0 4
______ Other ☒ ▨
d. Additional protection? ☐ Yes ☒ No
If yes, describe: ______

3. Surface seal: Bentonite ☒ 3 0
Concrete ☐ 0 1
______ Other ☐ ▨

4. Material between well casing and protective pipe:
Bentonite ☐ 3 0
Sand Other ☒ ▨

5. Annular space seal: a. Granular/Chipped Bentonite ☒ 3 3
b. ______Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 3 5
c. ______Lbs/gal mud weight . . . Bentonite slurry ☐ 3 1
d. ______% Bentonite . . . Bentonite-cement grout ☐ 5 0
e. ______Ft³ volume added for any of the above
f. How installed: Tremie ☐ 0 1
Tremie pumped ☒ 0 2
Gravity ☐ 0 8

6. Bentonite seal: a. Bentonite granules ☐ 3 3
b. ☐ 1/4 in. ☒ 3/8 in. ☐ 1/2 in. Bentonite chips ☒ 3 2
c. ______ Other ☐ ▨

7. Fine sand material: Manufacturer, product name & mesh size
a. #7 Badger ▨
b. Volume added ______ ft³

8. Filter pack material: Manufacturer, product name & mesh size
a. #40 Badger ▨
b. Volume added ______ ft³

9. Well casing: Flush threaded PVC schedule 40 ☒ 2 3
Flush threaded PVC schedule 80 ☐ 2 4
______ Other ☐ ▨

10. Screen material: PVC ▨
a. Screen Type: Factory cut ☒ 1 1
Continuous slot ☐ 0 1
______ Other ☐ ▨
b. Manufacturer Boart Longyear
c. Slot size: 0.010 in.
d. Slotted length: 5.0 ft.

11. Backfill material (below filter pack): None ☐ 1 4
bentonite Other ☒ ▨

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: Paula Richardson Paula Richardson

Firm: Natural Resource Technology, Inc.
23713 W. Paul Road, Unit D, Pewaukee, WI 53072

Tel: (262) 523-9000
Fax: (262) 523-9001

Natural
Resource
Technology
N R T

MONITORING WELL CONSTRUCTION

Facility/Project Name: Ameren Hutsonville Power Station Drilling

Local Grid Location of Well: 896034.1384 ft. ☒ N. ☐ S. 1175442.33 ft. ☒ E. ☐ W.

Well Name: TW-116

Facility License, Permit or Monitoring No.

Local Grid Origin ☒ (estimated: ☐) or Well Location ☐

Lat. ___ ° ___ ' ___ " Long. ___ ° ___ ' ___ " or

St. Plane ___ ft. N, ___ ft. E.

Unique Well No.

Well Number

Facility ID

Date Well Installed: 04/28/2004

Type of Well: Well Code 12/pz

Section Location: ___ 1/4 of ___ 1/4 of Sec. ___, T. ___ R. ___

Well Installed By: (Person's Name and Firm): Steve, Boart Longyear

Distance from Waste/ Source ___ ft.

Location of Well Relative to Waste/Source: u ☐ Upgradient s ☒ Sidegradient d ☐ Downgradient n ☐ Not Known

Gov. Lot Number

A. Protective pipe, top elevation ___ ft. MSL

B. Well casing, top elevation 439.77 ft. MSL

C. Land surface elevation 437.5 ft. MSL

D. Surface seal, bottom 436.5 ft. MSL or 1.0 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☒ GW ☐ SW ☒ SP ☐
SM ☐ SC ☒ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis attached? ☐ Yes ☒ No

14. Drilling method used: Rotary ☐ 5 0
Hollow Stem Auger ☒ 4 1
rock core Other ☒

15. Drilling fluid used: Water ☒ 0 2 Air ☐ 0 1
Drilling Mud ☐ 0 3 None ☐ 9 9

16. Drilling additives used? ☐ Yes ☒ No

Describe ___

17. Source of water (attach analysis, if required): Ameren well

E. Bentonite seal, top ___ ft. MSL or ___ ft.

F. Fine sand, top 414.5 ft. MSL or 23.0 ft.

G. Filter pack, top 413.5 ft. MSL or 24.0 ft.

H. Screen joint, top 412.5 ft. MSL or 25.0 ft.

I. Well bottom 407.5 ft. MSL or 30.0 ft.

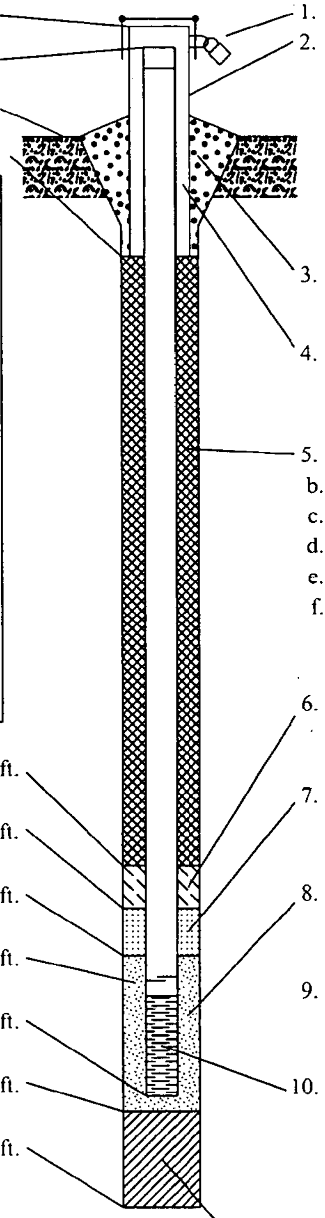
J. Filter pack, bottom 406.5 ft. MSL or 31.0 ft.

K. Borehole, bottom 358.5 ft. MSL or 79.0 ft.

L. Borehole, diameter 8.3 in.

M. O.D. well casing 2.33 in.

N. I.D. well casing 2.00 in.



1. Cap and lock? ☒ Yes ☐ No

2. Protective cover pipe:
   a. Inside diameter: 4.0 in.
   b. Length: 6.0 ft.
   c. Material: Steel ☒ 0 4 Other ☒
   d. Additional protection? ☐ Yes ☒ No
   If yes, describe: ___

3. Surface seal: Bentonite ☒ 3 0 Concrete ☐ 0 1 Other ☐

4. Material between well casing and protective pipe: Bentonite ☐ 3 0 Sand Other ☒

5. Annular space seal: a. Granular/Chipped Bentonite ☒ 3 3
   b. ___ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 3 5
   c. ___ Lbs/gal mud weight . . . Bentonite slurry ☐ 3 1
   d. ___ % Bentonite . . . Bentonite-cement grout ☐ 5 0
   e. ___ Ft^3 volume added for any of the above
   f. How installed: Tremie ☐ 0 1 Tremie pumped ☐ 0 2 Gravity ☒ 0 8

6. Bentonite seal: a. Bentonite granules ☐ 3 3
   b. ☐ 1/4 in. ☐ 3/8 in. ☐ 1/2 in. Bentonite chips ☐ 3 2
   c. ___ Other ☐

7. Fine sand material: Manufacturer, product name & mesh size
   a. #7 Badger
   b. Volume added ___ ft^3

8. Filter pack material: Manufacturer, product name & mesh size
   a. #40 Badger
   b. Volume added ___ ft^3

9. Well casing: Flush threaded PVC schedule 40 ☒ 2 3
   Flush threaded PVC schedule 80 ☐ 2 4
   Other ☐

10. Screen material: PVC
    a. Screen Type: Factory cut ☒ 1 1 Continuous slot ☐ 0 1 Other ☐
    b. Manufacturer Boart Longyear
    c. Slot size: 0.010 in.
    d. Slotted length: 5.0 ft.

11. Backfill material (below filter pack): None ☐ 1 4
    bentonite, Sluff Other ☒

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: Paula Richardson

Firm: Natural Resource Technology, Inc.
23713 W. Paul Road, Unit D, Pewaukee, WI 53072
Tel: (262) 523-9000
Fax: (262) 523-9001

Template: NRT WELL CONSTRUCTION - Project: 1375 LOGS.GPJ

Natural Resource Technology
N R T

Electronic Filing - Received, Clerks' Office, August 11, 2008--AS 09-1, Exhibit 3

MONITORING WELL CONSTRUCTION

Facility/Project Name: Ameren Hutsonville Power Station Drilling

Local Grid Location of Well: 895267.78 ft. ☒ N. ☐ S. 1179053.33 ft. ☒ E. ☐ W.

Well Name: TW-117

Facility License, Permit or Monitoring No.

Local Grid Origin ☒ (estimated: ☐) or Well Location ☐

Lat. ____ ° ____ ' ____ " Long. ____ ° ____ ' ____ " or

Unique Well No.

Well Number

Facility ID

St. Plane ________ ft. N, ________ ft. E.

Date Well Installed: 04/29/2004

Section Location

____ 1/4 of ____ 1/4 of Sec. ____, T. ____ R. ____

Type of Well: Well Code 12/pz

Well Installed By: (Person's Name and Firm) Steve, Boart Longyear

Distance from Waste/ Source ____ ft.

Location of Well Relative to Waste/Source: u ☐ Upgradient s ☒ Sidegradient d ☐ Downgradient n ☐ Not Known

Gov. Lot Number

A. Protective pipe, top elevation ________ ft. MSL

B. Well casing, top elevation 438.09 ft. MSL

C. Land surface elevation 435.0 ft. MSL

D. Surface seal, bottom 434.0 ft. MSL or 1.0 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☒
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis attached? ☐ Yes ☒ No

14. Drilling method used: Rotary ☐ 5 0
Hollow Stem Auger ☒ 4 1
Other ☐ ▨

15. Drilling fluid used: Water ☐ 0 2 Air ☐ 0 1
Drilling Mud ☐ 0 3 None ☒ 9 9

16. Drilling additives used? ☐ Yes ☒ No

Describe ________

17. Source of water (attach analysis, if required):

E. Bentonite seal, top ________ ft. MSL or ________ ft.

F. Fine sand, top 422.0 ft. MSL or 13.0 ft.

G. Filter pack, top 421.0 ft. MSL or 14.0 ft.

H. Screen joint, top 420.0 ft. MSL or 15.0 ft.

I. Well bottom 415.0 ft. MSL or 20.0 ft.

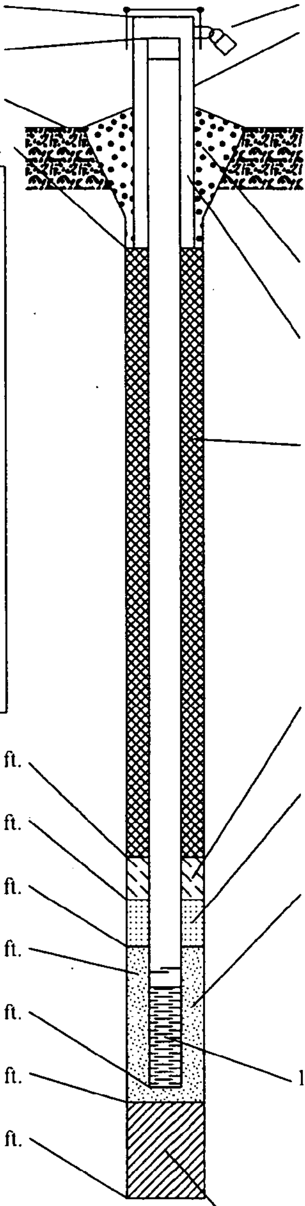
J. Filter pack, bottom 414.0 ft. MSL or 21.0 ft.

K. Borehole, bottom 345.0 ft. MSL or 90.0 ft.

L. Borehole, diameter 8.3 in.

M. O.D. well casing 2.33 in.

N. I.D. well casing 2.00 in.



1. Cap and lock? ☒ Yes ☐ No

2. Protective cover pipe:
   a. Inside diameter: 4.0 in.
   b. Length: 6.0 ft.
   c. Material: Steel ☒ 0 4
      Other ☒ ▨
   d. Additional protection? ☐ Yes ☒ No
      If yes, describe: ________

3. Surface seal: Bentonite ☒ 3 0
   Concrete ☐ 0 1
   Other ☐ ▨

4. Material between well casing and protective pipe:
   Bentonite ☐ 3 0
   Sand Other ☒ ▨

5. Annular space seal: a. Granular/Chipped Bentonite ☒ 3 3
   b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 3 5
   c. ____ Lbs/gal mud weight . . . Bentonite slurry ☐ 3 1
   d. ____ % Bentonite . . . Bentonite-cement grout ☐ 5 0
   e. ____ Ft^3 volume added for any of the above
   f. How installed: Tremie ☐ 0 1
      Tremie pumped ☐ 0 2
      Gravity ☒ 0 8

6. Bentonite seal: a. Bentonite granules ☐ 3 3
   b. ☐ 1/4 in. ☐ 3/8 in. ☐ 1/2 in. Bentonite chips ☐ 3 2
   c. ________ Other ☐ ▨

7. Fine sand material: Manufacturer, product name & mesh size
   a. #7 Badger ▨
   b. Volume added ________ ft^3

8. Filter pack material: Manufacturer, product name & mesh size
   a. #40 Badger ▨
   b. Volume added ________ ft^3

9. Well casing: Flush threaded PVC schedule 40 ☒ 2 3
   Flush threaded PVC schedule 80 ☐ 2 4
   Other ☐ ▨

10. Screen material: PVC ▨
    a. Screen Type: Factory cut ☒ 1 1
       Continuous slot ☐ 0 1
       Other ☐ ▨
    b. Manufacturer Boart Longyear
    c. Slot size: 0.010 in.
    d. Slotted length: 5.0 ft.

11. Backfill material (below filter pack): None ☐ 1 4
    Sluff Other ☒ ▨

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: Paula Richardson Paula Richardson

Firm: Natural Resource Technology, Inc.
23713 W. Paul Road, Unit D, Pewaukee, WI 53072
Tel: (262) 523-9000
Fax: (262) 523-9001

Natural Resource Technology
N R T

MONITORING WELL CONSTRUCTION

Facility/Project Name Ameren Hutsonville Power Station Drilling	Local Grid Location of Well 898090.86 ft. ☒ N. ☐ S. 1177978.73 ft. ☒ E. ☐ W.	Well Name TW-118
Facility License, Permit or Monitoring No.	Local Grid Origin ☒ (estimated: ☐) or Well Location ☐ Lat. __° __' __" Long. __° __' __" or	Unique Well No. / Well Number
Facility ID	St. Plane ___ ft. N, ___ ft. E.	Date Well Installed 05/04/2004
Type of Well Well Code 12/pz	Section Location __1/4 of__ 1/4 of Sec. __, T.__ R.__	Well Installed By: (Person's Name and Firm) Steve Boart Longyear
Distance from Waste/ Source __ ft.	Location of Well Relative to Waste/Source u ☐ Upgradient s ☐ Sidegradient d ☐ Downgradient n ☒ Not Known Gov. Lot Number	

A. Protective pipe, top elevation ____ ft. MSL
B. Well casing, top elevation 439.21 ft. MSL
C. Land surface elevation 437.0 ft. MSL
D. Surface seal, bottom 436.0 ft. MSL or 1.0 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☒
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis attached? ☐ Yes ☒ No

14. Drilling method used: Rotary ☐ 5 0
Hollow Stem Auger ☒ 4 1
____ Other ☐

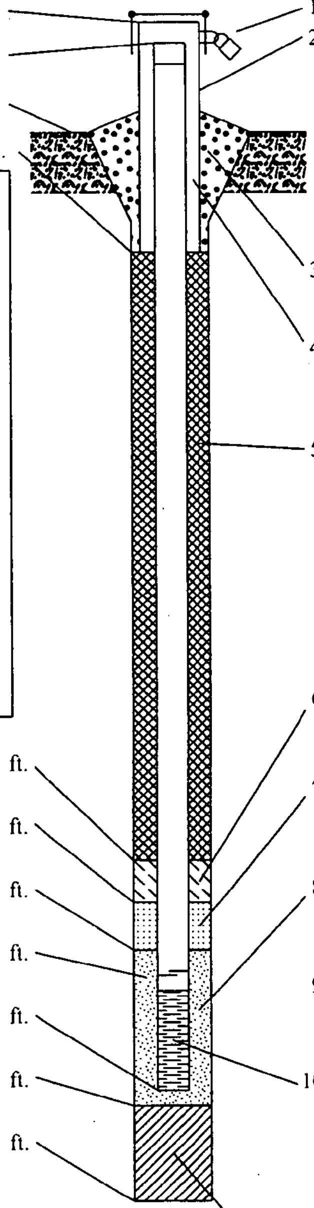
15. Drilling fluid used: Water ☐ 0 2 Air ☐ 0 1
Drilling Mud ☐ 0 3 None ☒ 9 9

16. Drilling additives used? ☐ Yes ☒ No

Describe ____

17. Source of water (attach analysis, if required):
____

E. Bentonite seal, top ____ ft. MSL or ____ ft.
F. Fine sand, top 419.0 ft. MSL or 18.0 ft.
G. Filter pack, top 418.0 ft. MSL or 19.0 ft.
H. Screen joint, top 417.0 ft. MSL or 20.0 ft.
I. Well bottom 412.0 ft. MSL or 25.0 ft.
J. Filter pack, bottom 411.0 ft. MSL or 26.0 ft.
K. Borehole, bottom 411.0 ft. MSL or 26.0 ft.
L. Borehole, diameter 8.3 in.
M. O.D. well casing 2.33 in.
N. I.D. well casing 2.00 in.



1. Cap and lock? ☒ Yes ☐ No
2. Protective cover pipe:
a. Inside diameter: 4.0 in.
b. Length: 6.0 ft.
c. Material: Steel ☒ 0 4
____ Other ☒
d. Additional protection? ☐ Yes ☒ No
If yes, describe: ____
3. Surface seal: Bentonite ☒ 3 0
Concrete ☐ 0 1
____ Other ☐
4. Material between well casing and protective pipe:
Bentonite ☐ 3 0
____ Other ☒
5. Annular space seal: a. Granular/Chipped Bentonite ☒ 3 3
b. ____Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 3 5
c. ____Lbs/gal mud weight . . . Bentonite slurry ☐ 3 1
d. ____% Bentonite . . . Bentonite-cement grout ☐ 5 0
e. ____Ft³ volume added for any of the above
f. How installed: Tremie ☐ 0 1
Tremie pumped ☐ 0 2
Gravity ☒ 0 8
6. Bentonite seal: a. Bentonite granules ☐ 3 3
b. ☐ 1/4 in. ☐ 3/8 in. ☐ 1/2 in. Bentonite chips ☐ 3 2
c. ____ Other ☐
7. Fine sand material: Manufacturer, product name & mesh size
a. #7 Badger
b. Volume added ____ ft³
8. Filter pack material: Manufacturer, product name & mesh size
a. #40 Badger
b. Volume added ____ ft³
9. Well casing: Flush threaded PVC schedule 40 ☒ 2 3
Flush threaded PVC schedule 80 ☐ 2 4
____ Other ☐
10. Screen material: PVC
a. Screen Type: Factory cut ☒ 1 1
Continuous slot ☐ 0 1
____ Other ☐
b. Manufacturer Boart Longyear
c. Slot size: 0.010 in.
d. Slotted length: 5.0 ft.
11. Backfill material (below filter pack): None ☒ 1 4
____ Other ☒

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature Paula Richardson

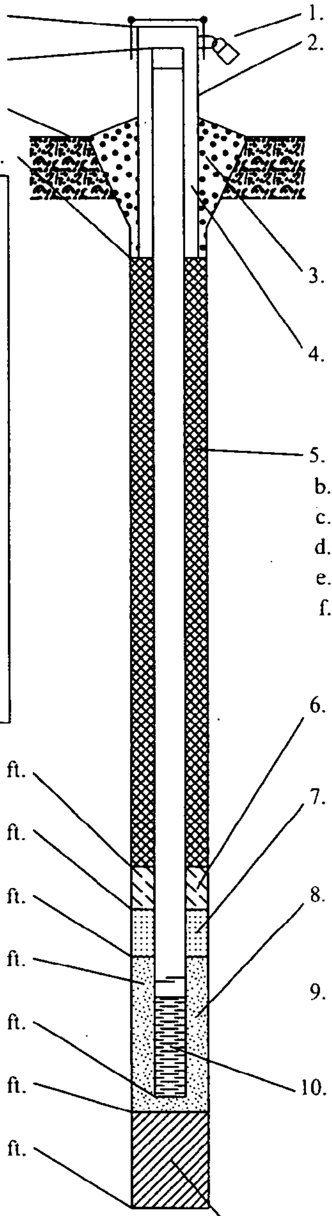
Firm Natural Resource Technology, Inc.
23713 W. Paul Road, Unit D, Pewaukee, WI 53072
Tel: (262) 523-9000
Fax: (262) 523-9001

Template: NRT WELL CONSTRUCTION - Project: 1375 LOGS.GPJ

Natural Resource Technology
N R T

MONITORING WELL CONSTRUCTION

Facility/Project Name: Ameren Hutsonville Power Station Drilling
Local Grid Location of Well: 896030.54 ft. ☒ N. ☐ S. 1181339.05 ft. ☒ E. ☐ W.
Well Name: TW-119
Facility License, Permit or Monitoring No.
Local Grid Origin ☒ (estimated: ☐) or Well Location ☐
Lat. ___ ° ___ ' ___ " Long. ___ ° ___ ' ___ " or
Unique Well No.
Well Number
Facility ID
St. Plane ______ ft. N, ______ ft. E.
Date Well Installed: 05/03/2004
Section Location: ___ 1/4 of ___ 1/4 of Sec. ___, T. ___ R. ___
Type of Well: Well Code 12/pz
Well Installed By: (Person's Name and Firm): Steve, Boart Longyear
Distance from Waste/Source ___ ft.
Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☐ Downgradient n ☒ Not Known
Gov. Lot Number



A. Protective pipe, top elevation ______ ft. MSL
B. Well casing, top elevation 438.12 ft. MSL
C. Land surface elevation 435.4 ft. MSL
D. Surface seal, bottom 434.4 ft. MSL or 1.0 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☒
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐
13. Sieve analysis attached? ☐ Yes ☒ No
14. Drilling method used: Rotary ☐ 5 0
Hollow Stem Auger ☒ 4 1
rock core Other ☒
15. Drilling fluid used: Water ☒ 0 2 Air ☐ 0 1
Drilling Mud ☐ 0 3 None ☐ 9 9
16. Drilling additives used? ☐ Yes ☒ No
Describe ______
17. Source of water (attach analysis, if required):
Town of Hutsonville well

E. Bentonite seal, top ______ ft. MSL or ______ ft.
F. Fine sand, top 422.4 ft. MSL or 13.0 ft.
G. Filter pack, top 421.4 ft. MSL or 14.0 ft.
H. Screen joint, top 420.4 ft. MSL or 15.0 ft.
I. Well bottom 415.4 ft. MSL or 20.0 ft.
J. Filter pack, bottom 414.4 ft. MSL or 21.0 ft.
K. Borehole, bottom 335.4 ft. MSL or 100.0 ft.
L. Borehole, diameter 8.3 in.
M. O.D. well casing 2.33 in.
N. I.D. well casing 2.00 in.

1. Cap and lock? ☒ Yes ☐ No
2. Protective cover pipe:
a. Inside diameter: 4.0 in.
b. Length: 6.0 ft.
c. Material: Steel ☒ 0 4
Other ☒
d. Additional protection? ☐ Yes ☒ No
If yes, describe: ______
3. Surface seal: Bentonite ☒ 3 0
Concrete ☐ 0 1
Other ☐
4. Material between well casing and protective pipe:
Bentonite ☐ 3 0
Sand Other ☒
5. Annular space seal: a. Granular/Chipped Bentonite ☒ 3 3
b. ___ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 3 5
c. ___ Lbs/gal mud weight . . . Bentonite slurry ☐ 3 1
d. ___ % Bentonite . . . Bentonite-cement grout ☐ 5 0
e. ___ Ft^3 volume added for any of the above
f. How installed: Tremie ☐ 0 1
Tremie pumped ☐ 0 2
Gravity ☒ 0 8
6. Bentonite seal: a. Bentonite granules ☐ 3 3
b. ☐ 1/4 in. ☐ 3/8 in. ☐ 1/2 in. Bentonite chips ☐ 3 2
c. ______ Other ☐
7. Fine sand material: Manufacturer, product name & mesh size
a. #7 Badger
b. Volume added ______ ft^3
8. Filter pack material: Manufacturer, product name & mesh size
a. #40 Badger
b. Volume added ______ ft^3
9. Well casing: Flush threaded PVC schedule 40 ☒ 2 3
Flush threaded PVC schedule 80 ☐ 2 4
Other ☐
10. Screen material: PVC
a. Screen Type: Factory cut ☒ 1 1
Continuous slot ☐ 0 1
Other ☐
b. Manufacturer Boart Longyear
c. Slot size: 0.010 in.
d. Slotted length: 5.0 ft.
11. Backfill material (below filter pack): None ☐ 1 4
bentonite, sluff Other ☒

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: Paula Richardson Paula Richardson
Firm: Natural Resource Technology, Inc.
23713 W. Paul Road, Unit D, Pewaukee, WI 53072
Tel: (262) 523-9000
Fax: (262) 523-9001

Natural Resource Technology
N R T

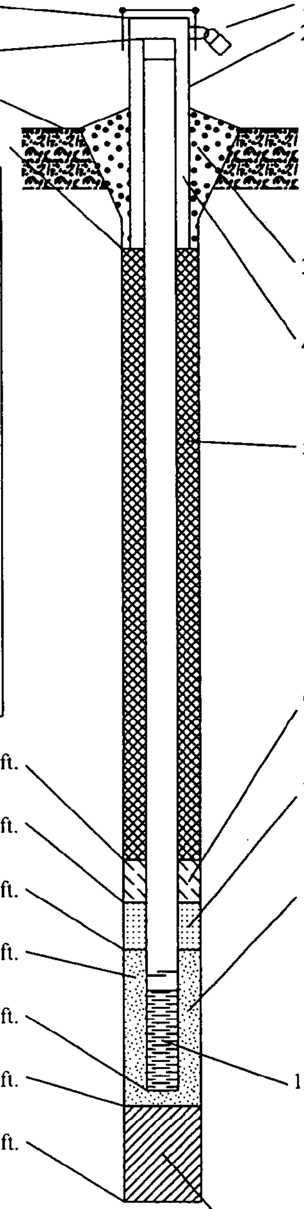
MONITORING WELL CONSTRUCTION

Facility/Project Name: Ameren Hutsonville Power Station Drilling
Local Grid Location of Well: 898614.91 ft. ☒ N. ☐ S. 1180157.14 ft. ☒ E. ☐ W.
Well Name: TW-120
Facility License, Permit or Monitoring No.
Local Grid Origin ☒ (estimated: ☐) or Well Location ☐
Lat. ° ' " Long. ° ' " or
Unique Well No.
Well Number
Facility ID
St. Plane ft. N, ft. E.
Date Well Installed: 05/04/2004
Section Location: 1/4 of 1/4 of Sec. , T. R.
Type of Well: Well Code 12/pz
Well Installed By: (Person's Name and Firm) Steve, Boart Longyear
Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☐ Downgradient n ☒ Not Known
Gov. Lot Number
Distance from Waste/ Source ft.

A. Protective pipe, top elevation ft. MSL
B. Well casing, top elevation 449.00 ft. MSL
C. Land surface elevation 446.8 ft. MSL
D. Surface seal, bottom 445.8 ft. MSL or 1.0 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☒
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐
13. Sieve analysis attached? ☐ Yes ☒ No
14. Drilling method used: Rotary ☐ 5 0
Hollow Stem Auger ☒ 4 1
Other ☐
15. Drilling fluid used: Water ☐ 0 2 Air ☐ 0 1
Drilling Mud ☐ 0 3 None ☒ 9 9
16. Drilling additives used? ☐ Yes ☒ No
Describe
17. Source of water (attach analysis, if required):

E. Bentonite seal, top 421.8 ft. MSL or 25.0 ft.
F. Fine sand, top 418.8 ft. MSL or 28.0 ft.
G. Filter pack, top 417.8 ft. MSL or 29.0 ft.
H. Screen joint, top 416.8 ft. MSL or 30.0 ft.
I. Well bottom 411.8 ft. MSL or 35.0 ft.
J. Filter pack, bottom 410.8 ft. MSL or 36.0 ft.
K. Borehole, bottom 410.8 ft. MSL or 36.0 ft.
L. Borehole, diameter 8.3 in.
M. O.D. well casing 2.33 in.
N. I.D. well casing 2.00 in.



1. Cap and lock? ☒ Yes ☐ No
2. Protective cover pipe:
a. Inside diameter: 4.0 in.
b. Length: 6.0 ft.
c. Material: Steel ☒ 0 4
Other ☒
d. Additional protection? ☐ Yes ☒ No
If yes, describe:
3. Surface seal: Bentonite ☒ 3 0
Concrete ☐ 0 1
Other ☐
4. Material between well casing and protective pipe:
Bentonite ☐ 3 0
Sand Other ☒
5. Annular space seal: a. Granular/Chipped Bentonite ☒ 3 3
b. Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 3 5
c. Lbs/gal mud weight . . . Bentonite slurry ☐ 3 1
d. % Bentonite . . . Bentonite-cement grout ☐ 5 0
e. Ft^3 volume added for any of the above
f. How installed: Tremie ☐ 0 1
Tremie pumped ☐ 0 2
Gravity ☒ 0 8
6. Bentonite seal: a. Bentonite granules ☐ 3 3
b. ☐ 1/4 in. ☐ 3/8 in. ☐ 1/2 in. Bentonite chips ☐ 3 2
c. Other ☐
7. Fine sand material: Manufacturer, product name & mesh size
a. #7 Badger
b. Volume added ft^3
8. Filter pack material: Manufacturer, product name & mesh size
a. #40 Badger
b. Volume added ft^3
9. Well casing: Flush threaded PVC schedule 40 ☒ 2 3
Flush threaded PVC schedule 80 ☐ 2 4
Other ☐
10. Screen material: PVC
a. Screen Type: Factory cut ☒ 1 1
Continuous slot ☐ 0 1
Other ☐
b. Manufacturer Boart Longyear
c. Slot size: 0.010 in.
d. Slotted length: 5.0 ft.
11. Backfill material (below filter pack): None ☒ 1 4
Other ☒

I hereby certify that the information on this form is true and correct to the best of my knowledge.
Signature Paula Richardson Paula Richardson
Firm Natural Resource Technology, Inc.
23713 W. Paul Road, Unit D, Pewaukee, WI 53072
Tel: (262) 523-9000
Fax: (262) 523-9001

Template: NRT WELL CONSTRUCTION - Project: 1375 LOGS.GPJ

MONITORING WELL CONSTRUCTION

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐ ____________

Facility/Project Name: Hutsonville Power STATION

Local Grid Location of Well: ________ ft. ☐ N. ☐ S. ________ ft. ☐ E. ☐ W.

Well Name: MW-11R

Facility License, Permit or Monitoring No.:

Local Grid Origin ☐ (estimated: ☐) or Well Location ☐
Lat. ___° ___' ______" Long. ___° ___' ______" or

Unique Well No.: ______ DNR Well ID No.: ____

Facility ID: [illegible]

St. Plane ________ ft. N, ________ ft. E. S/C/N

Date Well Installed: 10/03/2001 (m m / d d / y y y y)

Type of Well: Well Code 11 / MW

Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec ____, T. ____ N, R. ____ ☐ E ☐ W

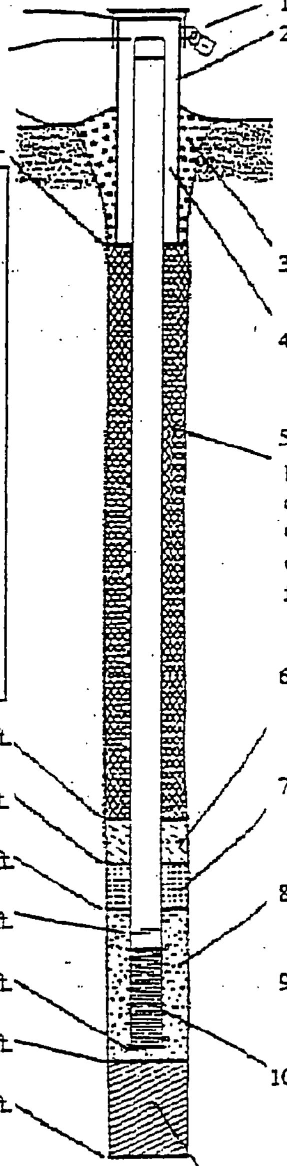
Well Installed By: Name (first, last) and Firm: R. Radke
Boart Longyear

Distance from Waste/Source: 80 ft

Enf. Stds. Apply ☐

Location of Well Relative to Waste/Source: u ☐ Upgradient s ☒ Sidegradient d ☐ Downgradient n ☐ Not Known

Gov. Lot Number: ________



A. Protective pipe, top elevation _ _ _ _ _ _ _ ft. MSL

B. Well casing, top elevation _443.55 ft. MSL

C. Land surface elevation _440.92 ft. MSL

D. Surface seal, bottom _ _ _ _ _ _ ft. MSL or _0.5 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ■
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ■ No

14. Drilling method used: Rotary ☐ 50
Hollow Stem Auger ■ 41
____________ Other ☐ ▨

15. Drilling fluid used: Water ☐ 02 Air ☐ 01
Drilling Mud ☐ 03 None ■ 99

16. Drilling additives used? ☐ Yes ■ No

Describe ____________

17. Source of water (attach analysis, if required):
____

E. Bentonite seal, top _ _ _ _ _ _ ft. MSL or _ _4.0 ft.

F. Fine sand, top _ _ _ _ _ _ ft. MSL or _ _4.0 ft.

G. Filter pack, top _ _ _ _ _ _ ft. MSL or _ _4.5 ft.

H. Screen joint, top _ _ _ _ _ _ ft. MSL or _ _5.5 ft.

I. Well bottom _ _ _ _ _ _ ft. MSL or _15.5 ft.

J. Filter pack, bottom _ _ _ _ _ _ ft. MSL or _16.0 ft.

K. Borehole, bottom _ _ _ _ _ _ ft. MSL or _16.0 ft.

L. Borehole, diameter _8.3 in.

M. O.D. well casing _2.35 in.

N. I.D. well casing _2.10 in.

1. Cap and lock? ☒ Yes ☐ No

2. Protective cover pipe:
   a. Inside diameter: _4.0 in.
   b. Length: _7.0 ft.
   c. Material: Steel ■ 04
   ____________ Other ☐ ▨
   d. Additional protection? ■ Yes ☐ No
   If yes, describe: 3" Bumper Post

3. Surface seal: Bentonite ■ 30
Concrete ☐ 01
____________ Other ☐ ▨

4. Material between well casing and protective pipe:
Bentonite ☐ 30
SAND Other ■ ▨

5. Annular space seal: a. Granular/Chipped Bentonite ■ 33
b. ______ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. ______ Lbs/gal mud weight . . . . . Bentonite slurry ☐ 31
d. ______ % Bentonite . . . . . . Bentonite-cement grout ☐ 50
e. ____________ Ft^3 volume added for any of the above
f. How installed: Tremie ☐ 01
Tremie pumped ☐ 02
Gravity ■ 08

6. Bentonite seal: a. Bentonite granules ■ 33
b. ☐1/4 in. ☐3/8 in. ☐1/2 in. Bentonite chips ☐ 32
c. ____________ Other ☐ ▨

7. Fine sand material: Manufacturer, product name & mesh size
a. #7 BADGER MATERIAL ▨
b. Volume added ____________ ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. #40 AMERICAN MATERIAL ▨
b. Volume added ____________ ft^3

9. Well casing: Flush threaded PVC schedule 40 ■ 23
Flush threaded PVC schedule 80 ☐ 24
____________ Other ☐ ▨

10. Screen material: PVC ▨
   a. Screen type: Factory cut ■ 11
   Continuous slot ☐ 01
   ____________ Other ☐ ▨
   b. Manufacturer Johnson
   c. Slot size: 0.010 in.
   d. Slotted length: 10.0 ft.

11. Backfill material (below filter pack): None ■ 14
____________ Other ☐ ▨

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature

Firm: NATURAL RESOURCE Technology Inc.

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ☐ Other ☐ ____________

MONITORING WELL CONSTRUCTION

Facility/Project Name: Hutsonville Power STATION

Local Grid Location of Well: ________ ft. ☐ N. ☐ S. ________ ft. ☐ E. ☐ W.

Well Name: MW-14

Facility License, Permit or Monitoring No.:

Local Grid Origin ☐ (estimated: ☐) or Well Location ☐

Lat. ___ ° ___ ' ___ " Long. ___ ° ___ ' ___ " or

Unique Well No.: ______

DNR Well ID No.: ______

Facility ID: [illegible]

St. Plane ________ ft. N, ________ ft. E. S/C/N

Date Well Installed: 10/03/2001 (m m / d d / y y y y)

Type of Well: Well Code 12 / P2

Section Location of Waste/Source: ____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E ☐ W

Well Installed By: Name (first, last) and Firm: R. Radke

Boart Longyear

Distance from Waste/Source: 80 ft.

Enf. Stds. Apply ☐

Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☒ Downgradient n ☐ Not Known

Gov. Lot Number: ________

A. Protective pipe, top elevation _ _ _ _ . _ _ ft. MSL

B. Well casing, top elevation _443.35 ft. MSL

C. Land surface elevation _440.93 ft. MSL

D. Surface seal, bottom _ _ _ _ . _ ft. MSL or _0.0 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☒
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☒ No

14. Drilling method used: Rotary ☐ 50
Hollow Stem Auger ☒ 41
________ Other ☐ ▨

15. Drilling fluid used: Water ☐ 02 Air ☐ 01
Drilling Mud ☐ 03 None ☒ 99

16. Drilling additives used? ☐ Yes ☒ No

Describe ________

17. Source of water (attach analysis, if required):
____

E. Bentonite seal, top _ _ _ _ . _ ft. MSL or _24.0 ft.

F. Fine sand, top _ _ _ _ . _ ft. MSL or _24.0 ft.

G. Filter pack, top _ _ _ _ . _ ft. MSL or _26.0 ft.

H. Screen joint, top _ _ _ _ . _ ft. MSL or _28.0 ft.

I. Well bottom _ _ _ _ . _ ft. MSL or _33.0 ft.

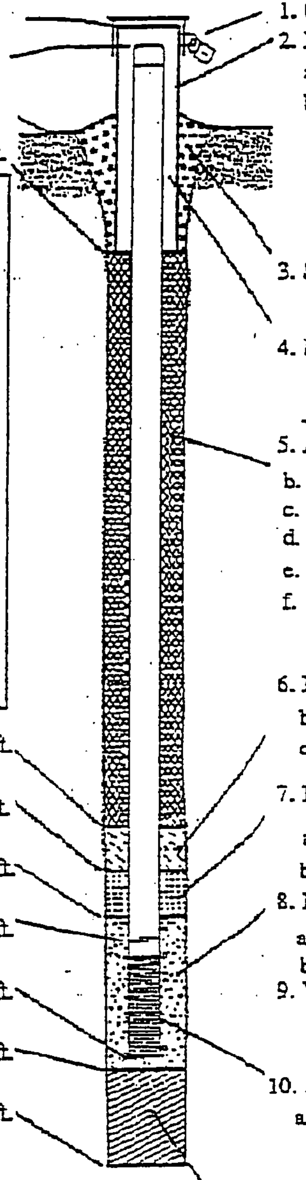
J. Filter pack, bottom _ _ _ _ . _ ft. MSL or _35.0 ft.

K. Borehole, bottom _ _ _ _ . _ ft. MSL or _39.0 ft.

L. Borehole, diameter _8.3 in.

M. O.D. well casing _2.35 in.

N. I.D. well casing _2.10 in.



1. Cap and lock? ☒ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: _4.0 in.
b. Length: _7.0 ft.
c. Material: Steel ☒ 04
________ Other ☐ ▨
d. Additional protection? ☒ Yes ☐ No
If yes, describe: 3" Bumper Post

3. Surface seal: Bentonite ☒ 30
Concrete ☐ 01
________ Other ☐ ▨

4. Material between well casing and protective pipe:
Bentonite ☐ 30
SAND Other ☒ ▨

5. Annular space seal: a. Granular/Chipped Bentonite ☒ 33
b. ____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. ____ Lbs/gal mud weight . . . . . Bentonite slurry ☐ 31
d. ____ % Bentonite . . . . . . Bentonite-cement grout ☐ 50
e. ________ Ft^3 volume added for any of the above
f. How installed: Tremie ☐ 01
Tremie pumped ☐ 02
Gravity ☒ 08

6. Bentonite seal: a. Bentonite granules ☒ 33
b. ☐1/4 in. ☐3/8 in. ☐1/2 in. Bentonite chips ☐ 32
c. ________ Other ☐ ▨

7. Fine sand material: Manufacturer, product name & mesh size
a. #7 BADGER ▨
b. Volume added ________ ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. #40 American Material ▨
b. Volume added ________ ft^3

9. Well casing: Flush threaded PVC schedule 40 ☒ 23
Flush threaded PVC schedule 80 ☐ 24
________ Other ☐ ▨

10. Screen material: PVC ▨
a. Screen type: Factory cut ☒ 11
Continuous slot ☐ 01
________ Other ☐ ▨
b. Manufacturer Johnson
c. Slot size: 0.010 in.
d. Slotted length: _5.0 ft.

11. Backfill material (below filter pack): None ☐ 14
Formation Collapse Other ☒ ▨

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature:

Firm: NATURAl Resource Technology Inc.

MONITORING WELL CONSTRUCTION

Route to: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐ ______

Facility/Project Name: Hutsonville Power STATION

Local Grid Location of Well ______ ft. ☐ N. ☐ S. ______ ft. ☐ E. ☐ W.

Well Name: TW

Facility License, Permit or Monitoring No.

Local Grid Origin ☐ (estimated: ☐) or Well Location ☐
Lat. ___ ° ___ ' ______ " Long. ___ ° ___ ' ______ " or

Unique Well No. ______ DNR Well ID No. ______

Facility ID ______

St. Plane ______ ft. N, ______ ft. E. S/C/N

Date Well Installed: 10/02/2001 (m m d d y y y y)

Type of Well
Well Code 12 / PZ

Section Location of Waste/Source
____ 1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E ☐ W

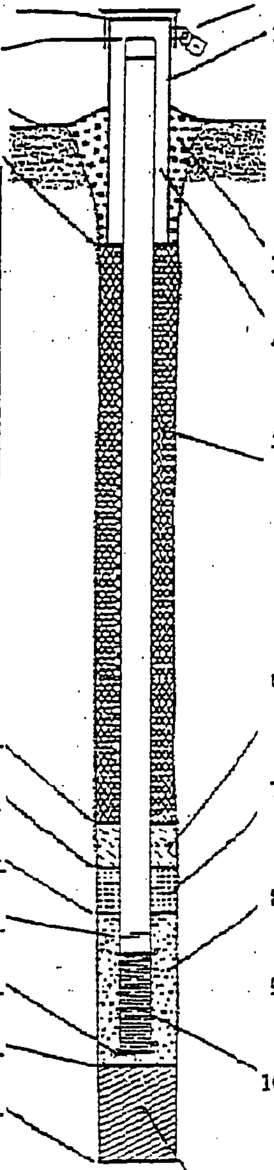
Well Installed By: Name (first, last) and Firm
R. Radke
BOART LONGYEAR

Distance from Waste/Source 80 ft.

Enf. Stds. Apply ☐

Location of Well Relative to Waste/Source
u ☐ Upgradient s ☐ Sidegradient
d ☒ Downgradient n ☐ Not Known

Gov. Lot Number ______



A. Protective pipe, top elevation ________ ft. MSL

B. Well casing, top elevation 440.59 ft. MSL

C. Land surface elevation 437.81 ft. MSL

D. Surface seal, bottom ______ ft. MSL or 0.0 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☒
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☒ No

14. Drilling method used: Rotary ☐ 50
Hollow Stem Auger ☒ 41
Other ☐ ▨ ______

15. Drilling fluid used: Water ☐ 02 Air ☐ 01
Drilling Mud ☐ 03 None ☒ 99

16. Drilling additives used? ☐ Yes ☒ No

Describe ______

17. Source of water (attach analysis, if required):
______

E. Bentonite seal, top ______ ft. MSL or 30.0 ft.

F. Fine sand, top ______ ft. MSL or 30.0 ft.

G. Filter pack, top ______ ft. MSL or 32.0 ft.

H. Screen joint, top ______ ft. MSL or 34.0 ft.

I. Well bottom ______ ft. MSL or 39.0 ft.

J. Filter pack, bottom ______ ft. MSL or 39.5 ft.

K. Borehole, bottom ______ ft. MSL or 39.5 ft.

L. Borehole, diameter 8.3 in.

M. O.D. well casing 2.35 in.

N. I.D. well casing 2.10 in.

1. Cap and lock? ☒ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: 4.0 in.
b. Length: 7.0 ft.
c. Material: Steel ☒ 04
Other ☐ ▨ ______
d. Additional protection? ☒ Yes ☐ No
If yes, describe: 3" Bumper Posts

3. Surface seal: Bentonite ☒ 30
Concrete ☐ 01
Other ☐ ▨ ______

4. Material between well casing and protective pipe:
Bentonite ☐ 30
SAND Other ☒ ▨

5. Annular space seal: a. Granular/Chipped Bentonite ☒ 33
b. ______ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 35
c. ______ Lbs/gal mud weight . . . . . Bentonite slurry ☐ 31
d. ______ % Bentonite . . . . . . Bentonite-cement grout ☐ 50
e. ______ Ft^3 volume added for any of the above
f. How installed: Tremie ☐ 01
Tremie pumped ☐ 02
Gravity ☒ 08

6. Bentonite seal: a. Bentonite granules ☒ 33
b. ☐ 1/4 in. ☐ 3/8 in. ☐ 1/2 in. Bentonite chips ☐ 32
c. ______ Other ☐ ▨

7. Fine sand material: Manufacturer, product name & mesh size
a. #7 BADGER ▨
b. Volume added ______ ft^3

8. Filter pack material: Manufacturer, product name & mesh size
a. #40 AMERICAN MATERIAL ▨
b. Volume added ______ ft^3

9. Well casing: Flush threaded PVC schedule 40 ☒ 23
Flush threaded PVC schedule 80 ☐ 24
Other ☐ ▨ ______

10. Screen material: PVC ▨
a. Screen type: Factory cut ☒ 11
Continuous slot ☐ 01
Other ☐ ▨ ______
b. Manufacturer Johnson
c. Slot size: 0.010 in.
d. Slotted length: 5.0 ft.

11. Backfill material (below filter pack): None ☒ 14
Other ☐ ▨ ______

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature

Firm: NATURAL Resource Technology Inc.

BOART LONGYEAR
Well/Boring Abandonment Form

NOV - 1 2001

Client NRT

Location Hutsonville, IL

Job Name Hutsonville Project

Job Number 3410-1824

Well/Boring Number MW-11

Date of Abandonment 10/03/01

Reason for Abandonment Study Complete

Abandonment Done By R. Radke

Hole Type:	☒ *Monitoring Well*	☐ *Drillhole*	☐ *Pumping Well*
Construction Type:	☒ *Drilled*	☐ *Driven*	☐ *Other* ______
Formation Type:	☒ *Unconsolidated*	☐ *Bedrock*	
Sealing Method:	☒ *Gravity*	☐ *Pumped*	☐ *Other* ______
Sealing Materials:	☒ *Bentonite Chips*	☐ *Cement-Bent Grout*	☐ *Other* ______

Sealing Material	From (ft)	To (ft)	Quantity	Gallon(s) Bag(s)
Topsoil	*Surface*	0.5		Gallon(s)
Bentonite Chips	0.5	16.2	1	Bag(s)

Well Information ONLY

All measurements are from ground surface

Total Well Depth 16.2 *Ft.*

Casing Diameter 2 *In.*

Casing Depth 16.2 *Ft.*

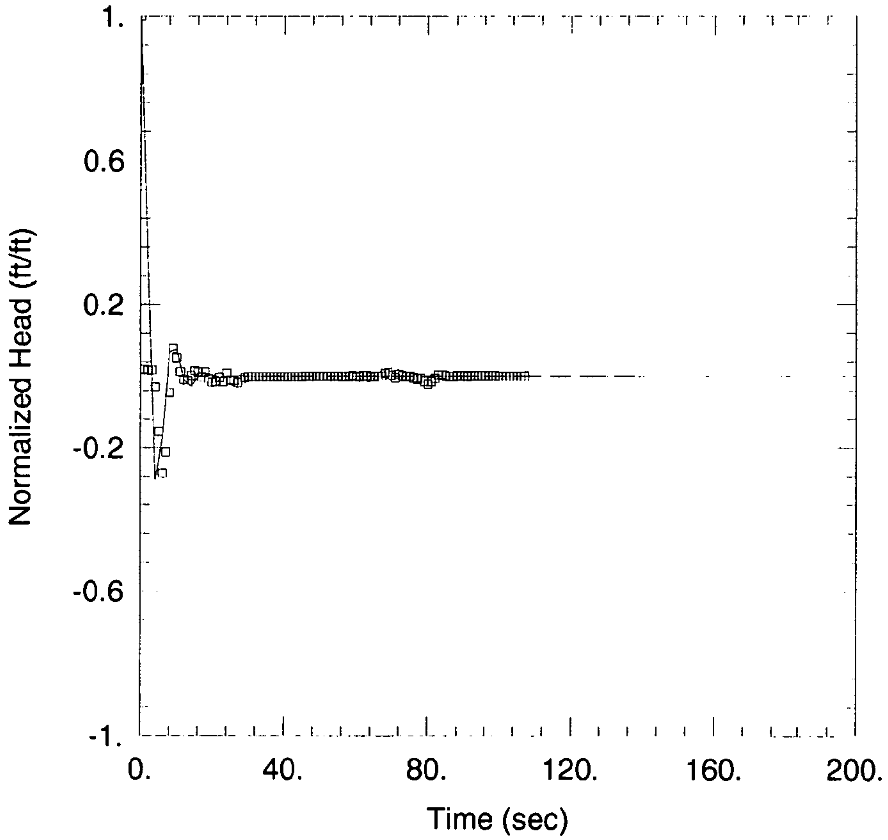
Depth to Water 8.95 *Ft.*

	Yes	*No*
Screen Removed		*x*
Overdrilled		*x*
Casing Left in Place	*x*	
Casing Cut Below Surface	*x*	

Comments:

APPENDIX A-3

SLUG TEST DATA



TW-115S SLUG OUT

Data Set: P:\...\1375 115s slug outA.aqt
Date: 05/11/05 Time: 15:21:28

PROJECT INFORMATION

Company: Natural Resource Technology
Client: Ameren
Project: 1375
Location: Hutsonville, IL
Test Well: TW-115s
Test Date: 5/13/04

SOLUTION

Aquifer Model: Confined
Solution Method: Butler

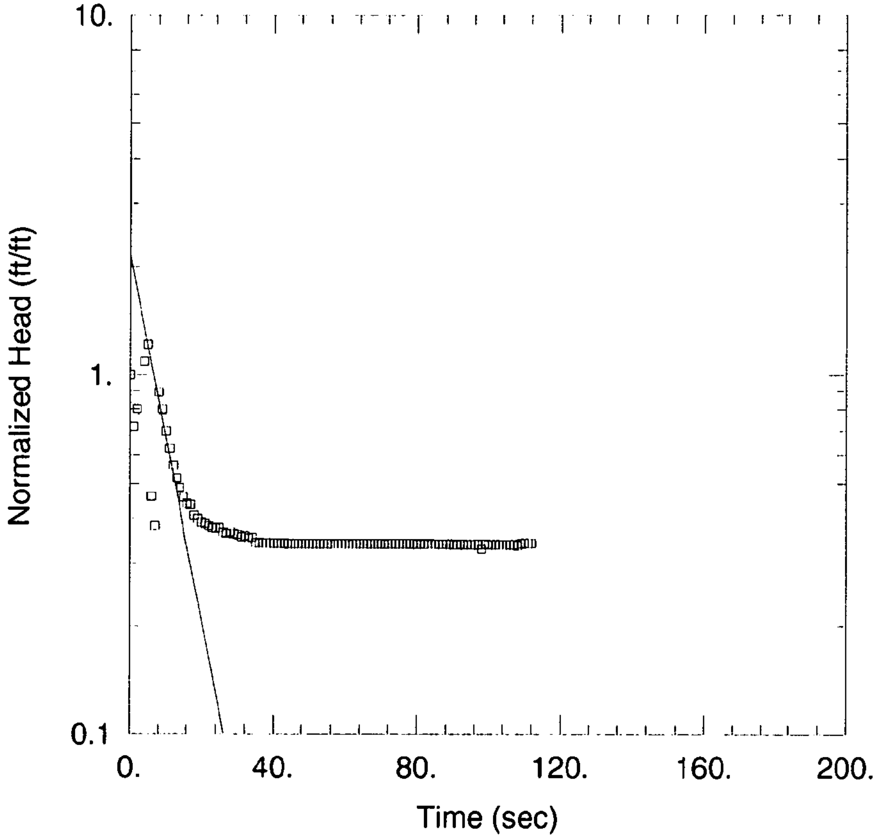
K = 0.09332 cm/sec
C(D) = 0.3464

AQUIFER DATA

Saturated Thickness: 80. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (TW-115s)

Initial Displacement: 2.8 ft
Total Well Penetration Depth: 23.37 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 23.37 ft
Screen Length: 5. ft
Wellbore Radius: 0.0833 ft



TW-115D SLUG OUT

Data Set: P:\...\1375 115d slug outA.aqt
Date: 05/11/05 Time: 15:21:32

PROJECT INFORMATION

Company: Natural Resource Technology
Client: Ameren
Project: 1375
Location: Hutsonville, IL
Test Well: TW-115d
Test Date: 5/13/04

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.0117 cm/sec
y0 = 6.028 ft

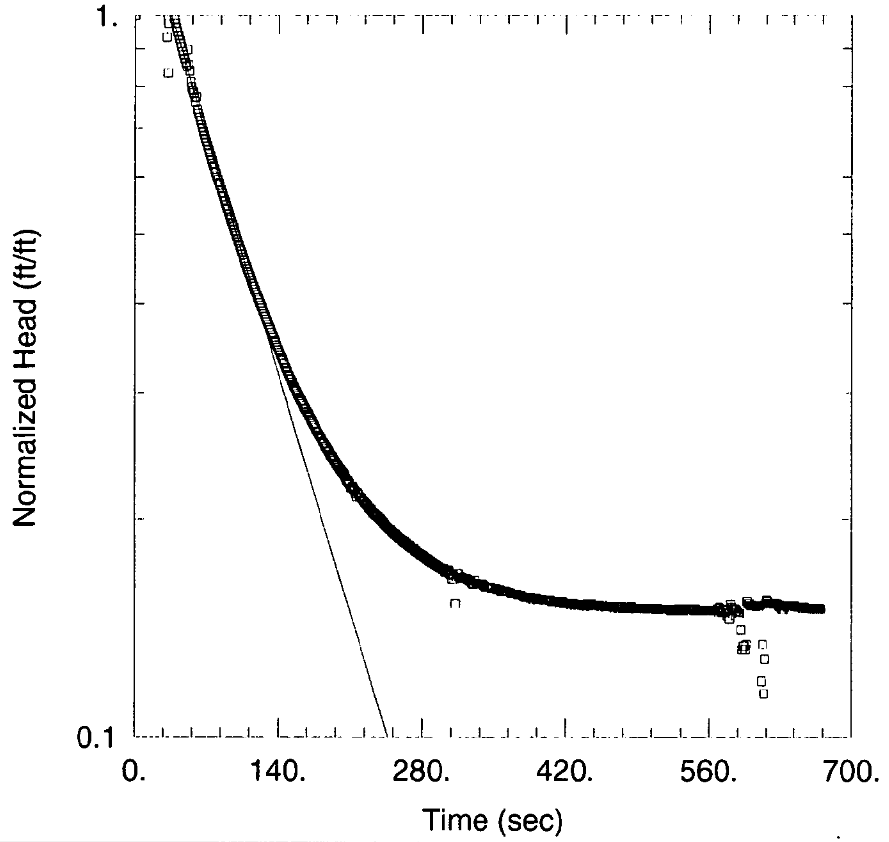
AQUIFER DATA

Saturated Thickness: 77. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (TW-115d)

Initial Displacement: 2.8 ft
Total Well Penetration Depth: 77. ft
Casing Radius: 0.0833 ft

Static Water Column Height: 77. ft
Screen Length: 5. ft
Wellbore Radius: 0.0833 ft



TW-116 SLUG OUT

Data Set: P:\...\1375 116 slug outA.aqt
Date: 05/11/05 Time: 15:21:22

PROJECT INFORMATION

Company: Natural Resource Technology
Client: Ameren
Project: 1375
Location: Hutsonville, IL
Test Well: TW-116
Test Date: 5/13/04

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.0004557 cm/sec
y0 = 4.116 ft

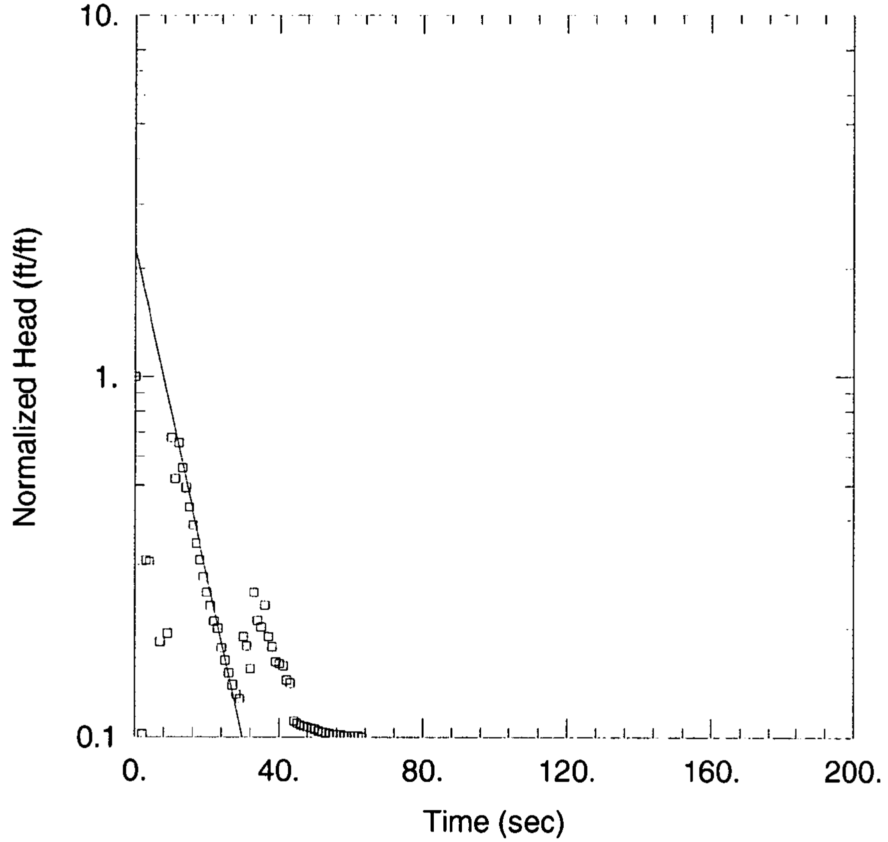
AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (TW-116)

Initial Displacement: 2.8 ft
Total Well Penetration Depth: 20. ft
Casing Radius: 0.0833 ft

Static Water Column Height: 20. ft
Screen Length: 5. ft
Wellbore Radius: 0.354 ft



TW-117 SLUG OUT

Data Set: P:\...\1375 117 slug outA.aqt
Date: 05/11/05 Time: 15:21:18

PROJECT INFORMATION

Company: Natural Resource Technology
Client: Ameren
Project: 1375
Location: Hutsonville, IL
Test Well: TW-117
Test Date: 5/13/04

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

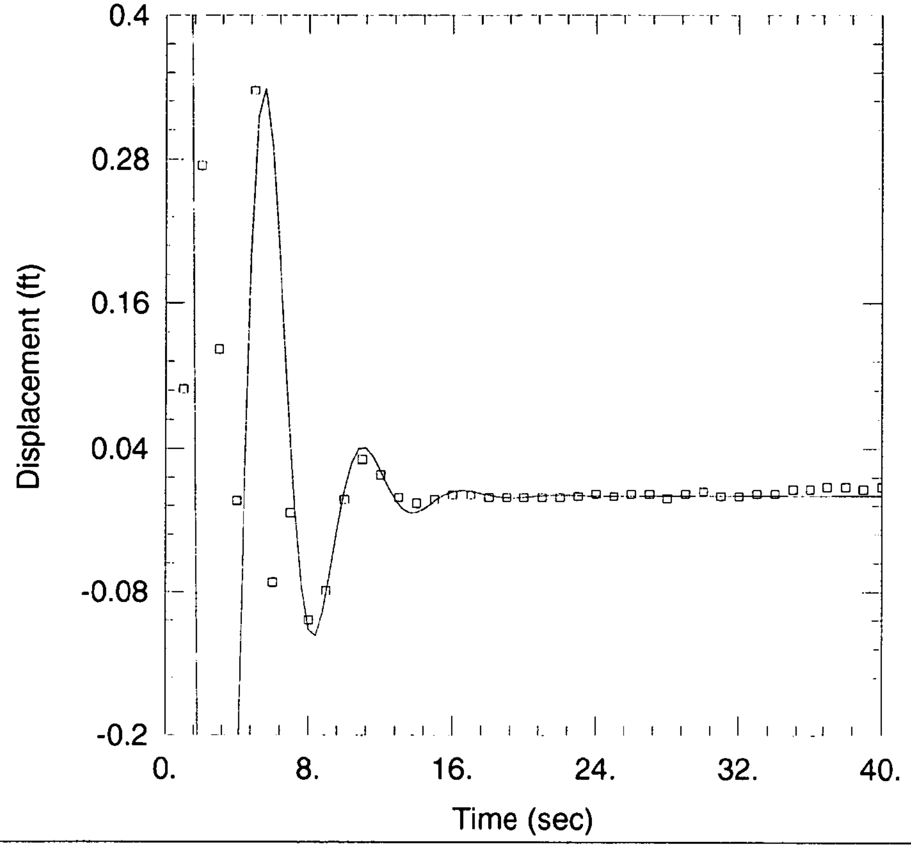
K = 0.006694 cm/sec
y0 = 6.341 ft

AQUIFER DATA

Saturated Thickness: 82. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (TW-117)

Initial Displacement: 2.8 ft
Total Well Penetration Depth: 12. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 12. ft
Screen Length: 5. ft
Wellbore Radius: 0.0833 ft



TW-118 SLUG IN

Data Set: P:\...\1375 118 slug inA.aqt
Date: 05/11/05 Time: 15:21:14

PROJECT INFORMATION

Company: Natural Resource Technology
Client: Ameren
Project: 1375
Location: Hutsonville, IL
Test Well: TW-118
Test Date: 5/13/04

SOLUTION

Aquifer Model: Confined
Solution Method: Butler

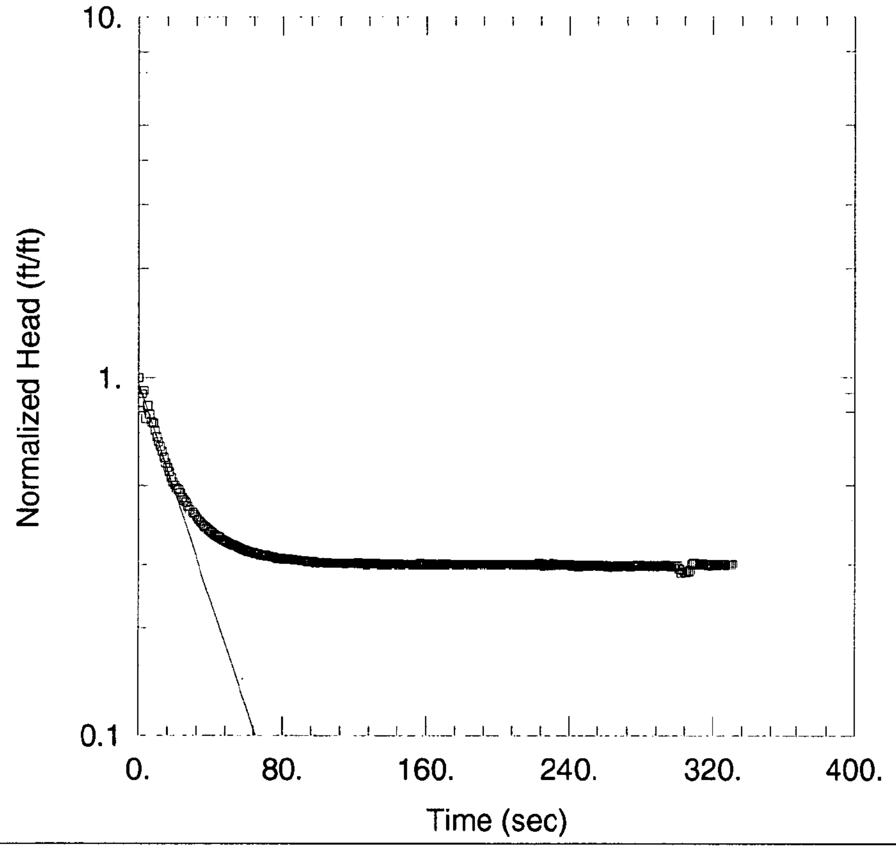
K = 0.1638 cm/sec
C(D) = 0.3179

AQUIFER DATA

Saturated Thickness: 71. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (TW-118)

Initial Displacement: 2.8 ft
Total Well Penetration Depth: 16. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 16. ft
Screen Length: 5. ft
Wellbore Radius: 0.0833 ft



TW-119 SLUG OUT

Data Set: P:\...\1375 119 slug outA.aqt
Date: 05/11/05 Time: 15:21:04

PROJECT INFORMATION

Company: Natural Resource Technology
Client: Ameren
Project: 1375
Location: Hutsonville, IL
Test Well: TW-119
Test Date: 5/13/04

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.002244 cm/sec
y0 = 2.69 ft

AQUIFER DATA

Saturated Thickness: 72. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (TW-119)

Initial Displacement: 2.8 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 13. ft
Screen Length: 5. ft
Wellbore Radius: 0.0833 ft

APPENDIX A-4

GROUNDWATER SAMPLING SOP (AE)

Monitor Well Sampling Procedure

Purpose:

The procedure for Hutsonville Power Station's Monitor Well sampling is based on IEPA Sampling Procedure Instructions. These instructions are prepared to inform owners/operators of treatment, storage and disposal facilities of proper water sampling procedures. It is expected that by complying with these procedures it will help in obtaining analytical results consistent and comparable with those obtained by the Agency. The Monitoring Well sampling is completed on a monthly basis for Monitoring Wells 1 - 5, pH readings and sample filtration is complete at Hutsonville with the samples shipped to the CIPS Central Lab-Springfield (tested for TDS, Boron, Calcium, Hardness, Manganese, Sulfate, and Alkalinity).

Equipment Needed:

Pump and Tubing (Asco portable pump)
Monitor Well Sample Bottles (5 x 1 liter)
Water Level Indicator
Data Entry Sheet
Truck, Car or 12 V Battery
Timer/Stopwatch/Secondhand on watch
Depth = Volume Data Sheet
Adapter/Connector and cord used to hookup the battery to the pump
pH Meter/Probe
Cooler w/ ice (temperature >39*F)

Sampling Procedure:

1) Connect the Adapter to the battery and pump.
2) Use the Water Level Indicator to find the distance to the top of the water in the well.
    a) To do this, slowly lower the Water Level Indicator probe into the well. When the probe reaches the water you will hear the Water Level Indicator buzzer, indicating that water has been reached. When you hear the buzzer, pull back until it stops, and lower slow until the buzzer sounds again.
    b) Read the increments on the wire from the North side of the casing. (Increments in 100th of an inch).
    c) This is the first entry on the Data Entry Sheet. (See below)
3) From this entry, calculate the volume of water in the well, by subtracting it from the well depth + casing height. Use the data sheet when calculating. From this result, use the chart to calculate the volume of water (gals) in the well. Record this value on the data sheet. If the value does not appear on the sheet, the following calculation may be used to estimate the volume of water in the well.

    feet of water x 0.1632 = est. volume of water in the well

4) With the pump on, drop the pump tubing into the well until the pump starts to pump water.
5) Pump at least one well casing volume of water from the monitor well prior to obtaining a water sample. This is to remove stagnant water in the well and obtain water more representative of the monitored aquifer.
    a) To do this, fill the 1L Monitor Well Sample Bottle, and note the time it takes to fill it. Multiply the time by 4. This is the time it takes for the pump, at a designeated setting, to pump 1 gallon of well water.
    b) Multiply the number of gallons of well water by the time it takes to fill one gallon. This is the amount of time it takes to pump the volume of well water out. Pump, at least, this volume of well water out. Record the amount removed on the data sheet.
    c) After removing the required volume of well water, the well should be sampled while it is recharging. The rechargeing of Hutsonville's wells range from instantaneous to approximately 15 min. depending on how dry the season has been.
6) Rinse the sample bottle at least 3 times with well water, fill, measure the pH, record pH, and place in a cooler of ice (only necessary if the temperature outside is more than 39º F).
7) Pull tubing out while pump is running to remove most of the remaining water in the tubing.
8) Repeat steps 1-7 for all remaining Monitor Wells (1-5).

Filtering Procedure:

1) All groundwater samples to be analyzed for <u>inorganic</u> parameters (metals) are to be filtered through a 0.45 micron Cellulose Nitrate filter membrane.
2) Obtain a clean 1 L fliter flask for each sample (5), a clean funnel, and a vacuum pump.

Filtering Procedure: (continued)

3) In order to equilibrate the filter with sample water, allow approximately 100 mls of sample (well mixed) to pass through the filter and into a separate filter flask. Once equilibrated, place the filter in the proper, clean, filter flask.
4) Connected the filter to the flask; connect the pump to the flask, and turn on the pump.
5) Empty each monitor well sample (well mixed) into its respective filter.

Preservation Procedure:

1) Empty the filtrate into its sample bottle using the following preservative techniques (CIPS Chemistry Program Manual).
   a) Metals—10 drops of concentrated HNO_3 in 80-100 mls of sample will drop the pH to less than 2 as required for preservation (use a small, metals bottle).
   b) All other monitor well preservative requirements are time related during storage at 4°C (use 1L bottles). *TDS needs to be analyzed within 7 days.

2) Label all the bottles appropriately, and fill out the PDC Chain of Custody Form.

3) Store the sample in a 4°C refrigerator until shipped to PDC Labs for analyses, which at that time will be trasferred into an ice cooler/chest.

Hutsonville Monitoring Well Samples

Date:

Collected by:

MW #	Depth to top of Water	Calculations	Volume of Water in Well	Quantity Discharged before sampling	pH
1		11.50 -			
2		21.25 -			
3		12.42 -			
4		18.17 -			
5		20.67 -			

Remarks:

APPENDIX A-1

SOIL BORING LOGS

CENTRAL ILLINOIS DRILLING COMPAN
1909 OAKWOOD AVE.
BLOOMINGTON, ILLINOIS 61701
(309) 662-5968

LOG OF BORING

CONTRACTED WITH HANSON ENGINEERS
BORING NO. M-1
PROJECT NAME HUTSONVILLE POWER STATION
CONTRACT NO.
LOCATION PER PLAN
DATUM
HAMMER WT. 140#
HAMMER DROP 30"
HOLE DIA. 8"
SURFACE ELEV.
CORE DIA.
CASING
DATE STARTED 2-14-84
COMPLETED 2-14-84
DRILLING METHOD HSA

ELEV.	DESCRIPTION	STRATA DEPTH	DEPTH SCALE	SAMPLES BLOWS FT.	NO.	TYPE	RECOV.	QP		NOTES
456.5		0.0	30							
455.6	See #A	0.0								
453.4	Lt. brn. sandy silt, wf. clay, occas. f-c sand, occas. f. gravel roots moist-v. moist	3.1		1-2-3	1	ss	18"	1.0 2.4		
450.1	Lt. br. m-c sand, wf. occas. f-m gravel tr. silt wet	6.4	5	6-5-7	2	ss	I7	--		
448.4	Lt. brn. sandstone moist	8.1		6-54-40/2"	3	ss	14	2.2		
447.4	Lt.-gray sandstone	9.1		65-35/1"	4	ss	7	--		WATER 2-14-84
	END OF BORING 9.1'		10 15							DD 6.0 8:30am BAR 7.0 8:55am AAR-- WL 6.5 9:05am F-c gravel 5.0'- Screen 9.0'-4.0' 2" PVC Pipe 4.0' Gravel 9.1'-3.0' Bentonite 3.0'-1 Plug 1.5'-surfac Water level 4.0 ar 2- #A Blk. clayey s wf. tr. f. sand occas. organic fibers topsoil moist

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LOG OF BORING

CONTRACTED WITH HANSON ENGINEERS BORING NO. M-2
PROJECT NAME HUTSONVILLE POWER STATION CONTRACT NO.
LOCATION PER PLAN
DATUM HAMMER WT. 140# HAMMER DROP 30" HOLE DIA. 8"
SURFACE ELEV. CORE DIA. CASING
DATE STARTED 2-10-84 COMPLETED 2-10-84 DRILLING METHOD HSA

ELEV.	DESCRIPTION	STRATA DEPTH	DEPTH SCALE	SAMPLES BLOWS FT.	NO.	TYPE	RECOV.	QP		NOTES
453.3		0.0	30							
452.9	See #A	0.4								
451.2	Brn. silty sand fill v. moist	2.1								
	Brn. m-c sand, wf. m-c gravel tr. silt			8-8-6	1	ss	18"	2.4		
	v. moist		5	7-5-3	2	ss	17	--		
444.9		8.4		3-3-3	3	ss	16	--		WATER 2-10-84
	Brn.-gray m-c sand, wf. m. gravel									DD 8.0 8:00am BAR 11.0 10:30 AAR ---
	wet		10	3-4-7	4	ss	14	--		WI 7.0 2:10pm
				8-7-9	5	ss	17	--		Screen 18.0-5. 2"PVC pipe 5.0' 3.0' surface Gravel 21.5'-1 Bentonite 4.0'- Plug 2.0'-surf.
439.2		14.1								
	Brn.-gray m-c sand, wf. f-m gravel		15	6-8-10	6	ss	17	--		#A Blk. coal refuse 4" wf. occas. silt fil wet
436.0	wet	17.3		10-13-13	7	ss	17	--		
	Gray silty clay, wf. tr. f. sand, occas. f. gravel									
	till moist		20	5-10-13	8	ss	18	4.2		

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LOG OF BORING

CONTRACTED WITH HANSON ENGINEERS
BORING NO. M-2
PROJECT NAME HUTSONVILLE POWER STATION
CONTRACT NO.
LOCATION Per PLan
DATUM
HAMMER WT. 140#
HAMMER DROP 30"
HOLE DIA. 8"
SURFACE ELEV.
CORE DIA.
CASING
DATE STARTED 2-10-84
COMPLETED 2-10-84
DRILLING METHOD HSA

ELEV.	DESCRIPTION	STRATA	DEPTH	SAMPLES						NOTES
		DEPTH	SCALE	BLOWS FT.	NO.	TYPE	RECOV.	QP		
453.3		0.0	30							
431.8		21.5		5-7-11	9	SS	18"	4.0		
	END OF BORING 21.5'									

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LOG OF BORING

CONTRACTED WITH HANSON ENGINEERS
BORING NO. M-2
PROJECT NAME HUTSONVILLE POWER STATION
CONTRACT NO.
LOCATION P-H PLAN
DATUM
HAMMER WT. 140#
HAMMER DROP 30"
HOLE DIA. 8"
SURFACE ELEV.
CORE DIA.
CASING
DATE STARTED 2-0-84
COMPLETED 2-0-84
DRILLING METHOD HSA

ELEV.	DESCRIPTION	STRATA DEPTH	DEPTH SCALE	SAMPLES BLOWS FT.	NO.	TYPE	RECOV.			NOTES
452.1		0.0	30							
451.7	See #A	0.4								
	Rust brn. silty sand,			4-6-8	1	ss	14"	--		
	fill v. moist		5	4-3-4	2	ss	16	--		
445.8	Brn. f-c gravel, wf. m-c sand, occas. sandstone wet	6.3								
444.5		7.6		8-19-11	3	ss	18	--		WATER 1-9-84 DD 5.5' 2:30pm BAR 6.0' 2:45p AAR WL 5.0' 4:45p
443.2	F-m sand v. moist	8.0								
442.7	See #B	9.4	10	15-85/5"	4	ss	17	--		
	END OF BORING 9.4'									#A Blk. coal refuse, 4" cin. wf. silt fill v. moist #B Brn. sandst wf. f-m sand w
			15							Screen 9.4'-4. 2"PVC Pipe 4.4 3.5 Gravel 9.4'-4. Bentonite 4.0' 2.5' Plug 1.5'-surf Grout 2.5'-1.5 4"standpipe 3. 3.9' st

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BLOOMINGTON, ILLINOIS 61701
(309) 662-5968

LOG OF BORING

CONTRACTED WITH HANSON ENGINEERS
BORING NO. M-4
PROJECT NAME HUTSONVILLE POWER STATION
CONTRACT NO.
LOCATION PER PLAN
DATUM
HAMMER WT. 140#
HAMMER DROP 30"
HOLE DIA. 8"
SURFACE ELEV.
CORE DIA.
CASING
DATE STARTED 2-13-84
COMPLETED 2-13-84
DRILLING METHOD HSA

ELEV.	DESCRIPTION	STRATA DEPTH	DEPTH SCALE	SAMPLES BLOWS FT.	NO.	TYPE	RECOV.	QP		NOTES
454.4		0.0	30							
453.1	Blk. asphalt 1.0" F-m gravel 1.0", brn, clayey silt wf. f-m gravel pavement materials moist	1.3								
451.3	Blk. silt, wf. f-c gravel fill moist	3.1		5-5-7	1	ss	16"	--		
448.5	Brn. silty sand, wf. occas. f-m gravel moist	5.9	5	4-3-3	2	ss	18	0.9		
446.2	Br. f-m sand wf. silt v. moist	8.2		3-3-4	3	ss	18	--		WATER 2-13-84
443.5	Br. f-m gravel, wf. c-m sand, silt wet	10.9	10	3-3-3	4	ss	17	0.6		DD 8.0 9:45am BAR 8.0 10:30a AAR --- WL 7.5 11:45a
441.0	Lt.-br. sandstone	13.4		23-77/5" 100/4"	5 6	ss ss	11 4	-- 4.5t		Screen 12.5'-5. 2"PVC Pipe 5.0'-3.0' Gravel 13.4'-4. Bentonite 4.0'-2.0' Plug 2.0'-surf
	END OF BORING 13.4'		15							

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BLOOMINGTON, ILLINOIS 61701
(309) 662-5968

LOG OF BORING

CONTRACTED WITH HANSON ENGINEERS
BORING NO. M-5
PROJECT NAME HUTSONVILLE POWER STATION
CONTRACT NO.
LOCATION PER PLAN
DATUM
HAMMER WT. 140#
HAMMER DROP 30"
HOLE DIA. 8"
SURFACE ELEV.
CORE DIA.
CASING
DATE STARTED 2-13-84
COMPLETED 2-13-84
DRILLING METHOD HSA

ELEV.	DESCRIPTION	STRATA DEPTH	DEPTH SCALE	SAMPLES BLOWS FT.	NO.	TYPE	RECOV.	QP		NOTES
452.3		0.0	30							
451.1	1" coal refuse, brn. clayey silt, wf. f.c gravel	1.2								
	occas. organic fibers fill moist			4-5-5	1	ss	14"	--		
449.2	See #A	3.1								
446.4	Brn. f. sand, wf. occas. c. sand, f. gravel moist v. moist	5.8	5	3-2-4	2	ss	17	0.4		WATER 2-13-84 DD 8.0 2:50pm BAR 11.0 3:50pm AAR ------- WL 6.5' 5:45pm
443.9	Br. f-m sand, wf/ c sand wet	8.4		3-3-4	3	ss	18	0.6		Old metal drain pipe 1.0' west boring running from road to st tion
441.7	Brn. m-c sand, wf. f-c gravel occas. blk. coal refuse mottling	10.6	10	3-4-4	4	ss	18	0.9 1.6		
	Brn.-gray m-c sand, wf. f-m gravel wet			0-3-3	5	ss	16	--		Screen 18.0'-5. 2" PVC pipe 5.0 3.0' stick Gravel 18.0'-4. Bentonite 4.0'- Backfilled 19.2 18.0' wf. grav Plug 2.0'-surf 1-4" standpipe
436.1		16.2	15	5-6-11	6	ss	12	--		
435.4	Brn.-gray sandstone, wf. f-c gravel occas. m-c sand v. moist	16.9		16-15-	7A	ss	12	--		#A Brn. gray si m-c sand, wf. f-c gravel, oc white rock fil wet
				----27	7B	ss	6	--		
433.1	Gray sandstone	19.2		30-70/ 2"	8	ss	8	4.5t		
	END OF BORING 19.2'		20							

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LOG OF BORING

CONTRACTED WITH HANSON ENGINEERS BORING NO. m-6
PROJECT NAME HUTSONVILLE POWER STATION CONTRACT NO.
LOCATION PER PLAN
DATUM HAMMER WT. 140# HAMMER DROP 30" HOLE DIA. 8"
SURFACE ELEV. CORE DIA. CASING
DATE STARTED 2-9-84 COMPLETED 2-9-84 DRILLING METHOD HSA

ELEV.	DESCRIPTION	STRATA DEPTH	DEPTH SCALE	SAMPLES						NOTES
				BLOWS FT.	NO.	TYPE	RECOV.	QP		
438.9		0.0	30							
437.7	Brn. clayey silt wf. tr. f-m sand, occas. organic fibers moist	1.2								
435.5	Brn. clayey silt, wf. f-m sand, occas. f gravel moist	3.4		1-2-4	1	ss	13"	1.2		
433.3	Gray-brn. silty clay, wf. tr. f. sand, occas. f. gravel moist	5.6	5	3-4-5	2	ss	16	--		WATER 2-9-84 DT 8.0 9:20am BAR 9.0 10:30am AAR ---- WL 6.0 1:00pm
431.6	Brn. f-c gravel wf. clay, c. sand moist	7.3		8-8---	3A	ss	12	--		
431.0	Br. sand, tr. sandstone	8.0		----15	3B	ss	6	--		Screen 11.4'-5. 2" PVC pipe 5.0' 5.0' stick
430.5	Br. f-m sand wet	8.4								
	Lt. br. sandstone, wf. f. sand		10	80-20/1"	4	ss	7	--		Gravel 11.4'-4. Bentonite 4.0'- Plug 2.0'-surfac Standpipe 3.0'-
427.5		11.4		100/4.5	5	ss	4.5	--		
	END OF BORING 11.4'									
			15							
			20							

CENTRAL ILLINOIS DRILLING COMPA
1909 OAKWOOD AVE.
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(309) 662-5968

LOG OF BORING

CONTRACTED WITH HANSON ENGINEERS
BORING NO. M-7
PROJECT NAME HUTSONVILLE POWER STATION
CONTRACT NO.
LOCATION PER PLAN
DATUM
HAMMER WT. 140#
HAMMER DROP 30"
HOLE DIA. 8"
SURFACE ELEV.
CORE DIA.
CASING
DATE STARTED 2-8-84
COMPLETED 2-8-84
DRILLING METHOD HSA

ELEV.	DESCRIPTION	STRATA DEPTH	DEPTH SCALE	SAMPLES BLOWS FT.	NO.	TYPE	RECOV.	QP		NOTES
437.9		0.0	30							
436.5	Br. clayey silt, wf. tr. f. sand, occas. organic fibers moist	1.4								
				3-2-7	1	ss	17"	--		
434.0	Br. clayey silt, sand, wf. occas. blk. cinders fill moist	3.9								
			5	2-3-4	2	ss	14	--		
	Lt. brn.-brn. sandy silt, wf. clay									
	moist			3-3-5	3	ss	16	1.7		WATER 2-8-84
429.8		8.1								DD 11.5 11:45a BAR 11.5 3:00p AAR ---- WL 11.5 5:15p
	Brn. sandy silt, wf. tr. clay		10	2-2-3	4	ss	14	1.2		
	very moist			0-0-3	5	ss	15	1.3		Screen 25.0'-1 2" PVC pipe 15. 5.0' stick u
425.0		12.9								Gravel 25.0'-1 Bentonite 14.0 12.0
	Brn. silt, wf. f. sand									Plug 2.0'-surf Bentonite-clay 12.0'-2.0'
	very moist-wet		15	2-2-4	6	ss	16	1.7		Standpipe 3.0' 5.1' stick
420.3		17.6		2-2-3	7	ss	18	1.4		
			20	0-1-3	8	ss	17	1.2		

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LOG OF BORING

CONTRACTED WITH HANSON ENGINEERS
BORING NO. M-7
PROJECT NAME HUTSONVILLE POWER STATION
CONTRACT NO.
LOCATION PER PLAN
DATUM
HAMMER WT. 140#
HAMMER DROP 30"
HOLE DIA. 8"
SURFACE ELEV.
CORE DIA.
CASING
DATE STARTED 2-8-84
COMPLETED 2-8-84
DRILLING METHOD HSA

ELEV.	DESCRIPTION	STRATA DEPTH	DEPTH SCALE	SAMPLES						NOTES
				BLOWS FT.	NO.	TYPE	RECOV.	QP		
437.9		0.0	30							
416.5	Brn. sandy silt wf. lenses, f. sand wet	21.4								
414.5	Brn. f. sand wet	23.4								
412.9	Brn. f-c gravel, wf. m-c sand, tr. silt wet	25.0		7-7-9	9	ss	12"	--		
	END OF BORING 25.0'									

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LOG OF BORING

CONTRACTED WITH HANSON ENGINEERS
BORING NO. M-8
PROJECT NAME HUTSONVILLE POWER PLANT
CONTRACT NO.
LOCATION PER PLAN
DATUM
HAMMER WT. 140#
HAMMER DROP 30"
HOLE DIA. 8"
SURFACE ELEV.
CORE DIA.
CASING
DATE STARTED 2-7-84
COMPLETED 2-7-84
DRILLING METHOD HSA

ELEV.	DESCRIPTION	STRATA	DEPTH	SAMPLES						NOTES
		DEPTH	SCALE	BLOWS FT.	NO.	TYPE	RECOV.	QP		
439.4		0.0	30							
438.1	Brn. clayey silt, wf. tr. f. sand, occas. organic fibers moist	1.3								
	Brn. silty sand			2-5-7	1	ss	18"	1.6		
436.3		3.1								
	Brn. silty sand, wf. tr. f. sand moist		5	2-3-5	2	ss	17	1.4		
				3-5-5	3	ss	18	3.2		WATER 2-7-83
431.0		8.4								
	Brn. clayey silt, wf. tr. f. sand moist		10	2-3-3	4	ss	18	1.8		DD 13.0 11:45a BAR 19.0 3:45p AAR ------ WL 12.0 8:30a 2-8-84
428.5		10.9								
	Brn. gray clayey silt, wf. tr. f. sand, sm. gray silt pockets moist			2-2-2	5	ss	18	1.2		Screen 21.5'-1 Gravel 21.5'-1 Bentonite 15.5 13.5
			15	2-2-3	6	ss	18	1.7		Clay & Bentoni 13.5'-4.0' 2" PVC pipe 16 4.9' stick up Bentonite ceme grout 4.0'-2.0 Plug 2.0'-surf Standpipe 3.0'.
422.0		17.4		1-2-2	7	ss	18	1.2		
	Brn. sandy silt, wf. occas. f. sand lens									Baled well at 5:15pm 2-9-84 11.0' water le
419.6	wet very moist	19.8	20	0-1-2	8	ss	18	1.2		

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LOG OF BORING

CONTRACTED WITH HANSON ENGINEERS
BORING NO. M-8
PROJECT NAME HUTSONVILLE POWER STATION
CONTRACT NO.
LOCATION PER PLAN
DATUM
HAMMER WT. 140#
HAMMER DROP 30"
HOLE DIA. 8"
SURFACE ELEV.
CORE DIA.
CASING
DATE STARTED 2-7-84
COMPLETED 2-8-84
DRILLING METHOD HSA

ELEV.	DESCRIPTION	STRATA DEPTH	DEPTH SCALE	SAMPLES BLOWS FT.	NO.	TYPE	RECOV.	QP		NOTES
439.4		0.0	30							
417.9	Br. silty sand wet	21.5		0-0-0	9	ss	18"	1.1		
	END OF BORING 21.5'									

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LOG OF BORING

CONTRACTED WITH HANSON ENGINEERS
BORING NO. M-9
PROJECT NAME HUTSONVILLE POWER STATION
CONTRACT NO.
LOCATION 33.0' E. OF STAKE
DATUM
HAMMER WT. 140#
HAMMER DROP 30"
HOLE DIA. 8"
SURFACE ELEV.
CORE DIA.
CASING
DATE STARTED 2-14-84
COMPLETED 2-14-84
DRILLING METHOD HSA

ELEV.	DESCRIPTION	STRATA DEPTH	DEPTH SCALE	SAMPLES					
				BLOWS FT.	NO.	TYPE	RECOV.	QP	
452.0		0.0	30						
451.2	See #A	0.8							
450.7	See #B	1.3							
448.6	Brn. silty sand, wf. coal refuse, occas. f. gravel fill moist	3.4		5-10-10	1	ss	18"	2.3	
446.1	Brn. sandy silt, wf. f-m gravel concrete fill moist	5.9	5	4-19-18	2	ss	14	--	
443.9	Brn. sandy silt, wf. ash coal refuse, tr. clay fill moist	8.1		2-1-2	3	ss	16	2.2	
441.4	Gray sandy silt, wf. occas. f. gravel wet	10.6	10	2-2-1	4	ss	10	1.0	
438.6	Brn. f. sand saturated	13.4		0-1-1	5	ss	8	--	
436.5	Gray clayey silt, wf. f. sand, occas. f. gravel	15.5	15	0-3-3	6	ss	14	2.3	
435.6	Br. m-c sand, wf. f-c gravel wet	16.4							
433.2	Brn. sandstone	18.8		18-72-22/1"	7	ss	13	4.5	
				100/3"	8	ss	0	--	
	END OF BORING 18.8'		20						

NOTES

#A Brn.-blk f-
sand, wf. coal
refuse, 5.0" si
wf. f. sand, oc
organic fibers
fill wet

#B Brn. f-m sa
wf. silt fill
moist

Water 2-14-84

DD 8.0 1:15pm
BAR 17.0 2:30pm
AAR ---
WL 9.0 4:15pm

Concrete fragme
3.5'-4.0'

Cobbles, concre
2.6'-3.0

Screen 18.5'-8.
2" PVC pipe 8.5
3.0 stick u
Gravel 18.0'-8.
Bentonite 8.0'-
Cement Grout 6.
4.
Plug 2.0'-surfa
Standpipe

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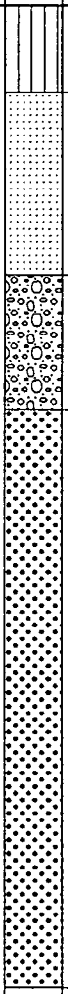
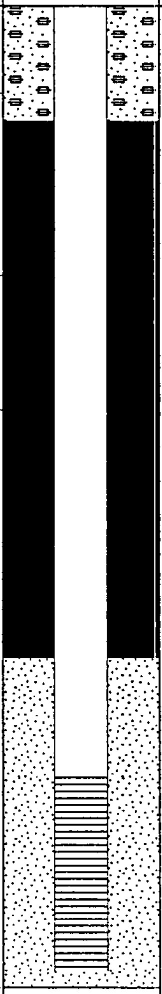
Project Name/No.		Boring No.	Start Date	Page
AmerenCIPS - Hutsonville	249-3	MW-3D	10/6/98	1

Driller	**Logged by:**	**End Date**	**Depth to Water**
AEC, Indianapolis, IN	Steve Mueller/STMI	10/6/98	~6 Feet

Boring Depth	**Boring Diameter**	**Surface Elevation**	**Drill Method**	**Northing**
25.5 Feet	8* Inches	453.7 Feet	HSA/air-rotary	3860.230
Well Depth	**Well Diameter**	**TOC Elev.**	**Sample Method**	**Easting**
25.1 Feet	2-in I.D.	455.28 Feet	2-ft. split-spoon	3952.034

Sample	Blows/6 inches	Sample Depth (ft)	Recovery (%)	Graphic Log	Classification	Description	Well Completion	Comments
☒	1, 2, 3, 6		75		ML	SANDY SILT, little fine-grained gravel, trace coal fragments, medium stiff, dark brown, moist (topsoil)		5-ft by 4-in square steel stick-up casing to ~1.8 ft; concrete seal 0-3 ft.
☒	4, 4, 6, 4		88		SP	SAND, well sorted/rounded, fine-grained, quartz, loose, light brown, to medium brown, saturated below 6 ft		
☒	1, 2, 3, 5	5	75					
☒	2, 2, 2, 10		63			SILTY SAND & GRAVEL, poorly sorted, medium-grained sand, fine-grained subangular to subround gravel, loose, light gray, saturated		
☒	2, 2, 3, 5		50		SW-GW			Bentonite/cement grout 3-16 ft; 1/4-in bentonite chips 16-17 ft.
		10				SANDSTONE, fine-grained, quartz		
		15						Sch. 40 PVC casing flush-threaded to 0.01-in factory-slotted PVC screen 20.1-25.1 ft; #7 fine silica sand 17-18 ft; #5 silica sand pack 18-25.5 ft.
					Ss			
		20						
		25				END OF BORING - 25.5 feet		* 4-in diam. borehole drilled 16-25.5 ft using air-hammer.
		30						





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Project Name/No.		Boring No.	Start Date	Page
AmerenCIPS - Hutsonville	249-3	MW-7D	10/5/98	1

Driller	Logged by:	End Date	Depth to Water
AEC, Indianapolis, IN	Steve Mueller/STMI	10/5/98	~10 Feet

Boring Depth	Boring Diameter	Surface Elevation	Drill Method	Northing
45.0 Feet	8 Inches	437.5 Feet	HSA	3175.915
Well Depth	**Well Diameter**	**TOC Elev.**	**Sample Method**	**Easting**
44.3 Feet	2-in I.D.	438.45 Feet	2-ft. split-spoon	5676.110

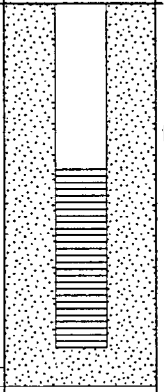
Sample	Blows/6 inches	Sample Depth (ft)	Recovery (%)	Graphic Log	Classification	Description	Well Completion	Comments
						CLAYEY SILT, medium plasticity, trace roots fibers, soft, medium brown, moist, saturated below 10 ft.		
▨	1, 1, 2, 3	5	75					5-ft by 4-in square steel stick-up casing to ~1.3 ft; concrete seal 0-3 ft.
▨	1, 1, 1, 2	10	100		ML			
▨	1, 1, 2, 3	15	100					
▨	0, 0, 1, 2	20	100			SILTY SAND, well sorted/rounded, fine-grained, quartz, grades from clayey silt above, loose, medium brown, saturated		
					SP			
▨	3, 3, 4, 9	25	75			SILTY SAND & GRAVEL, well sorted medium-grained quartz sand, trace coarse sand, fine-grained angular to subangular gravel, medium dense, pale brown, saturated		Bentonite/cement grout 3-35 ft.
▨	5, 8, 6, 8	30	75					
					SP-GP			

Project Name/No.		Boring No.	Start Date	Page
AmerenCIPS - Hutsonville	249-3	MW-7D	10/5/98	2

Driller AEC, Indianapolis, IN	**Logged by:** Steve Mueller/STMI	**End Date** 10/5/98	**Depth to Water** ~10 Feet

Boring Depth 45.0 Feet	**Boring Diameter** 8 Inches	**Surface Elevation** 437.5 Feet	**Drill Method** HSA	**Northing** 3175.915
Well Depth 44.3 Feet	**Well Diameter** 2-in I.D.	**TOC Elev.** 438.45 Feet	**Sample Method** 2-ft. split-spoon	**Easting** 5676.110

Sample	Blows/6 inches	Sample Depth (ft)	Recovery (%)	Graphic Log	Classification	Description	Well Completion	Comments
	sand heave		0					Sch. 40 PVC casing flush-threaded to 0.01-in factory-slotted PVC screen 39.3-44.3 ft; #7 fine silica sand 35-38 ft; #5 silica sand pack 38-45 ft.
	sand heave	40	0					
☒	16, 25, 7, 11	45	75		ML	CLAYEY SILT, medium plasticity, trace sand, stiff, brown, moist END OF BORING - 45 feet		
		50						
		55						
		60						
		65						



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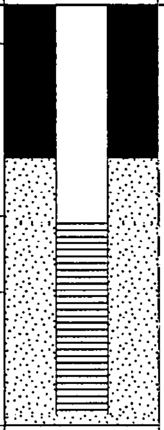
Project Name/No.		Boring No.	Start Date	Page
AmerenCIPS - Hutsonville	249-3	MW-10	10/7/98	1

Driller	Logged by:	End Date	Depth to Water
AEC, Indianapolis, IN	Steve Mueller/STMI	10/7/98	~2.5 Feet

Boring Depth	Boring Diameter	Surface Elevation	Drill Method	Northing
11 Feet	8 Inches	452.9 Feet	HSA	4730.478
Well Depth	**Well Diameter**	**TOC Elev.**	**Sample Method**	**Easting**
10.7 Feet	2-in I.D.	454.23 Feet	2-ft. split-spoon	2559.807

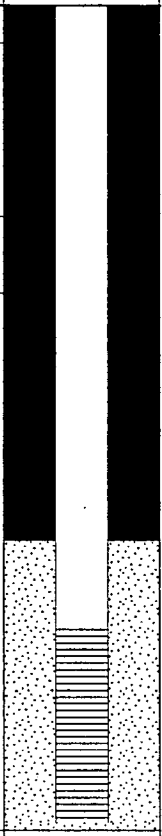
Sample	Blows/6 inches	Sample Depth (ft)	Recovery (%)	Graphic Log	Classification	Description	Well Completion	Comments
☒	1, 2, 2, 2		50		ML	CLAYEY SILT, vegetated with grass, soft, dark brown to black, moist (topsoil)		5-ft by 4-in square steel stick-up casing to ~1.5 ft.
☒	1, 2, 2, 6		50		SP	SILTY SAND, well sorted/rounded, fine-grained, quartz, loose, yellowish orange with dark orange lamina (2-3 mm), saturated below ~2.5 ft		
☒	1, 2, 6, 25	5	100					Bentonite/cement grout 0-3 ft; 1/4-in bentonite chips 3-4 ft.
☒	5, 20, 25, 50		63		SP	SILTY SAND, well sorted/rounded, fine-grained, quartz, laminated, dense, light gray to rust colored, predominantly light gray below 7.5 ft, saturated (weathered bedrock)		
		10			Ss	SANDSTONE, fine-grained, quartz		Sch. 40 PVC casing flush-threaded to 0.01-in factory-slotted PVC screen 5.7-10.7 ft; #5 silica sand pack 4-11 ft.
		15				END OF BORING - 11 feet		
		20						
		25						
		30						

Project Name/No.		Boring No.	Start Date	Page
AmerenCIPS - Hutsonville	249-3	MW-10D	10/7/98	1

Driller	Logged by:	End Date	Depth to Water
AEC, Indianapolis, IN	Steve Mueller/STMI	10/7/98	~2.5 Feet

Boring Depth	Boring Diameter	Surface Elevation	Drill Method	Northing
21.5 Feet	8 Inches	452.9 Feet	HSA	4729.427
Well Depth	**Well Diameter**	**TOC Elev.**	**Sample Method**	**Easting**
21.3 Feet	2-in I.D.	454.65 Feet	see MW-10 log	2564.715

Sample	Blows/6 inches	Sample Depth (ft)	Recovery (%)	Graphic Log	Classification	Description	Well Completion	Comments
					ML	CLAYEY SILT*, vegetated with grass, soft, dark brown to black, moist (topsoil)		5-ft by 4-in square steel stick-up casing to ~2.0 ft.
		5	see MW-10		SP	SILTY SAND*, well sorted/rounded, fine-grained, quartz, loose, yellowish orange with dark orange lamina (2-3 mm), saturated below ~2.5 ft		
					SP	SILTY SAND*, well sorted/rounded, fine-grained, quartz, laminated, dense, light gray to rust colored, predominantly light gray below 7.5 ft, saturated (weathered bedrock)		Bentonite/cement grout 0-13 ft; 1/4-in bentonite chips 13-14 ft.
		10 15 20	drill cuts		Ss	SANDSTONE, fine-grained, quartz, becomes medium-grained, trace gravel clasts, increasingly well cemented/hard (very difficult to auger) below 20 ft.		Sch. 40 PVC casing flush-threaded to 0.01-in factory-slotted PVC screen 16.3-21.3 ft; #7 silica sand 14-15 ft; #5 silica sand pack 15-21.5 ft.
	50 (1")		1"			END OF BORING - 21.5 feet		* based on MW-10 boring log
		25 30						



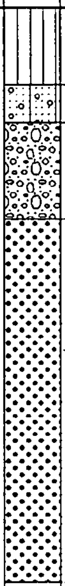
Project Name/No.		Boring No.	Start Date	Page
AmerenCIPS - Hutsonville	249-3	MW-11	10/6/98	1

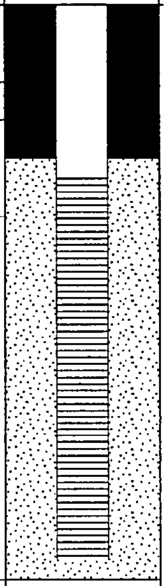
Driller	Logged by:	End Date	Depth to Water
AEC, Indianapolis, IN	Steve Mueller/STMI	10/7/98	~6 Feet

Boring Depth	Boring Diameter	Surface Elevation	Drill Method	Northing
15.0 Feet	8 Inches	443.8 Feet	HSA	3371.329

Well Depth	Well Diameter	TOC Elev.	Sample Method	Easting
14.5 Feet	2-in I.D.	445.45 Feet	2-ft. split-spoon	4451.486

Sample	Blows/6 inches	Sample Depth (ft)	Recovery (%)	Graphic Log	Classification	Description	Well Completion	Comments
☒	1, 2, 3, 4		63		ML	SANDY SILT, little fine-grained gravel, trace coal fragments, medium stiff, medium brown, moist (topsoil)		5-ft by 4-in square steel stick-up casing to ~2.0 ft.
☒	1, 2, 6, 8		63		SM	SILTY SAND, medium- to coarse-grained, quartz, loose, light brown, moist		
☒	3, 5, 25, 50	5	75		SW-GW	SILTY SAND & GRAVEL, poorly sorted, dense, light brown, saturated		Bentonite/cement grout 0-3 ft; 1/4-in bentonite chips 3-4 ft.
					Ss	SANDSTONE		Sch. 40 PVC casing flush-threaded to 0.01-in factory-slotted PVC screen 4.5-14.5 ft; #5 silica sand pack 4-15 ft.
		10						
		15				END OF BORING - 15 feet		
		20						
		25						
		30						





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Project Name/No.		Boring No.	Start Date	Page
AmerenCIPS - Hutsonville	249-3	MW-12	10/8/98	1

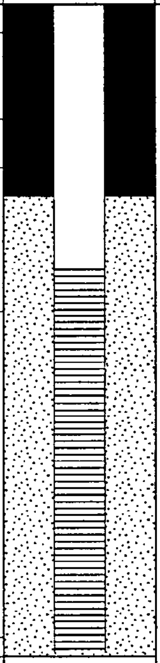
Driller	Logged by:	End Date	Depth to Water
AEC, Indianapolis, IN	Steve Mueller/STMI	10/8/98	~12 Feet

Boring Depth	Boring Diameter	Surface Elevation	Drill Method	Northing
17 Feet	8 Inches	455.5 Feet	HSA	4053.583
Well Depth	**Well Diameter**	**TOC Elev.**	**Sample Method**	**Easting**
16.9 Feet	2-in I.D.	456.74 Feet	2-ft. split-spoon	4637.976

Sample	Blows/6 inches	Sample Depth (ft)	Recovery (%)
☒	1, 1, 1, 1		63
☒	2, 3, 10, 8		100
☒	1, 1, 2, 3	5	63
☒	2, 2, 4, 3		75
☒	1, 2, 3, 2		50
☒	1, 1, 1, 2	10	75
☒	1, 2, 2, 3		75
☒	2, 3, 3, 4	15	100
☒	10, 10, 35, 50		50
		20	
		25	
		30	

Graphic Log	Classification	Description
▥	ML	SANDY SILT, little clay, soft, dark brown, moist (topsoil)
■	Coal Ash	ASH, silty texture, soft, olive gray, moist
●	GM	SILTY SAND & GRAVEL, poorly sorted, medium dense, light brown, moist (fill)
░	SP	SAND, well sorted/rounded, fine-grained, quartz, loose, light brown, moist
░	SW	SAND, poorly sorted, fine- to coarse-grained, subangular to subround, quartz, trace fine gravel, loose, light brown, saturated below ~12 ft
▥	ML	SILT, stiff, light brown, moist
		END OF BORING - 17 feet (bedrock)

Well Completion



Comments

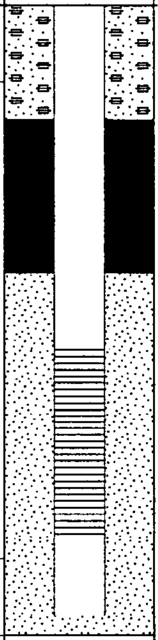
5-ft by 4-in square steel stick-up casing to ~1.5 ft.

Bentonite/cement grout 0-3.5 ft; 1/4-in bentonite chips 3.5-5 ft.

Sch. 40 PVC casing flush-threaded to 0.01-in factory-slotted PVC screen 6.9-16.9 ft; #7 fine silica sand 5-6 ft; #5 silica sand pack 6-17 ft.

Project Name/No.		**Boring No.**	**Start Date**	**Page**
AmerenCIPS - Hutsonville	249-3	MW-13	10/6/98	1
Driller	**Logged by:**		**End Date**	**Depth to Water**
AEC, Indianapolis, IN	Steve Mueller/STMI		10/6/98	~7 Feet
Boring Depth	**Boring Diameter**	**Surface Elevation**	**Drill Method**	**Northing**
16.5 Feet	8 Inches	456.4 Feet	HSA	3961.759
Well Depth	**Well Diameter**	**TOC Elev.**	**Sample Method**	**Easting**
16.0 Feet	2-in I.D.	458.03 Feet	2-ft. split-spoon	4241.200

Sample	**Blows/6 inches**	**Sample Depth (ft)**	**Recovery (%)**	**Graphic Log**	**Classification**	**Description**	**Well Completion**	**Comments**
☒	1, 2, 3, 5		25		SM	SILTY SAND, with gravel, loose, dark brown, moist (topsoil)		5-ft by 4-in square steel stick-up casing to ~2.0 ft; concrete 0-3 ft.
		5			SP	SAND*, well sorted/rounded, fine- to medium-grained, quartz, light brown, saturated below ~9 ft. * based on drill cuttings and geologic log for geoprobe GP-4		Bentonite/cement grout 3-6.3 ft; 1/4-in bentonite chips 6.3-7 ft.
		10						
☒	1, 2, 2, 2		50		SW-GW	CLAYEY SAND & GRAVEL, poorly sorted, fine- to coarse-grained sand, fine-grained subangular gravel, loose, light brown, saturated		Sch. 40 PVC casing flush-threaded to 0.01-in factory-slotted PVC screen 9-14 ft; #7 fine silica sand 7-8 ft; #5 silica sand pack 8-16.5 ft.
		15			Ss	SANDSTONE		
						END OF BORING - 16.5 feet		
		20						
		25						Unslotted casing/sediment sump 14-16 ft.
		30						



Natural Resource Technology, Inc.
Standard Soil Boring Log

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SOIL BORING LOG INFORMATION
Form - General Use Rev. 8-2000

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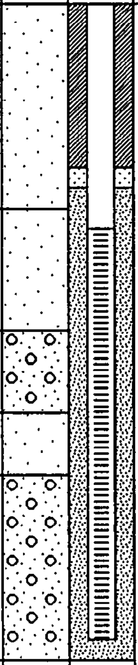
Facility/Project Name *AMEREN Energy Generating - Hutsonville Power Plant*	**License/Permit/Monitoring Number**	**Boring Number** *MW-11R*	
Boring Drilled By (Firm name and name of crew chief) *Boart Longyear* *Randy Radke*	**Date Drilling Started** *10/03/01*	**Date Drilling Completed** *10/03/01*	**Drilling Method** *HSA*
Facility Well No.	**Unique Well No.**	**Common Well Name**	
Final Static Water Level *Feet MSL*	**Surface Elevation** *440.920 Feet MSL*	**Borehole Diameter** *8.25 inches*	
Boring Location **State Plane** *3217.083* Feet N *4654.729* Feet E	**Lat** **Long**	**Local Grid Location (if applicable)** ☐ N ☐ E ☐ S ☐ W	
County *Crawford*		**Civil Town/City/ or Village** *Hutsonville*	



Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth in Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
MW-11R 0-2	18	2 3 4 6	2	0'-5' FILL, gray with orange mottling, coarse sand with clay, dry friable grades to sand with gravel, coarse	FILL									
MW-11R 2.5-4.5	18	3 4 6 6	4											
MW-11R 5-7	20	3 4 4 5	6	5'-8' SAND, orange, poorly graded, coarse	SP									
MW-11R 7.5-9.5	14	2 3 4 3	8	8'-10' SAND with GRAVEL, brown, poorly graded, rounded, fine gravel/coarse sand	SP									
MW-11R 10-12	18	2 2 3 2	10	10'-11'6" SAND, poorly graded, medium to coarse	SP									
			12	11'6"-16' SAND with GRAVEL, brown, poorly graded, rounded, fine gravel/coarse sand	SP									
MW-11R 12.5-14.5	20	2 3 3 3	14											
MW-11R 15-17	3	50/3	16	*EOB @ 16'Auger Refusal*										
			18											
			20											
			22											

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature	Firm **Natural Resource Technology, Inc.**

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Natural Resource Technology
Standard Soil Boring Log

SOIL BORING LOG INFORMATION
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Facility/Project Name *AMEREN Energy Generating - Hutsonville Power Plant*	**License/Permit/Monitoring Number**	**Boring Number** *MW-14*

Boring Drilled By (Firm name and name of crew chief) *Boart Longyear* *Randy Radke*	**Date Drilling Started** *10/03/01*	**Date Drilling Completed** *10/03/01*	**Drilling Method** *HSA*

Facility Well No.	**Unique Well No.**	**Common Well Name**	**Final Static Water Level** *Feet MSL*	**Surface Elevation** *440.930 Feet MSL*	**Borehole Diameter** *8.25 inches*

Boring Location **State Plane**	*2811.508* **Feet N** *5325.781* **Feet E**	**Lat** **Long**	**Local Grid Location (If applicable)** ☐ *N* ☐ *E* ☐ *S* ☐ *W*

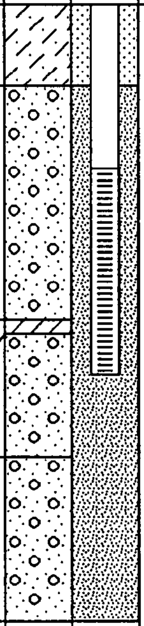
County *Crawford*		**Civil Town/City/ or Village** *Hutsonville*

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth in Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			2	0'-7'6" SILT, brown (10YR 4/3), moist, non-plastic										
MW-14 2.5-4.5	18	2 3 2 3	4		ML									
MW-14 5-7	18	1 1 2 2	6											
MW-14 7.5-9.5	18	1 2 1 2	8	7'6"-12'6" SILT with SAND, brown (10YR 4/3), low plasticity, moist										
MW-14 10-12	24	1 1 1 1	10 12	yellowish brown (10YR 5/4), increase plasticity to medium	ML									
MW-14 12.5-14.5	18	1 1 1 2	14	12'6"-18'6" LEAN CLAY, brown (7.5YR 4/2), 10-15% grey/orange mottling, medium plasicity										
MW-14 15-17	22	1 1 1 1	16		CL									
MW-14 17.5-19.5	18	1 1 1 1	18	18'6"-26' SAND with SILT, wet, non-plastic										
MW-14 20-22	18	1 1 1 1	20 22		SM									
MW-14 22.5-24.5	20	2 2 3 3		23'6"-24' SAND seam, medium	SP SM									

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature	Firm **Natural Resource Technology, Inc.**

Sample		Blow Counts	Depth in Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties					RQD/ Comments
Number and Type	Length Att. & Recovered (in)								Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	
	20			24'-26' SAND with SILT, as above	SM									
MW-14 25-27	18	1 2 2 3	26	26'-39' SAND with GRAVEL, coarse sand, platy fine gravel, poorly graded										
MW-14 27.5-29.5	18	2 3 3 4	28	gravel becomes rounded	SP									
MW-14 30-32	20	3 3 4 5	30											
MW-14 32.5-34.5	18	3 3 5 5	32	4" LEAN CLAY with Gravel seam, gray (5Y 5/1), rounded, fine, 2-7% shell fragments	CL SP									
			34											
			36		SP									Advance Hydropunc discrete water sampler
			38											
			40	*EOB @ 39'*										Drillers note: sand and gravel as above
			42											
			44											
			46											
			48											
			50											
			52											
			54											
			56											
			58											
			60											
			62											



Natural Resource Technology, Inc. SOIL BORING LOG INFORMATION
Standard Soil Boring Log
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Facility/Project Name *AMEREN Energy Generating - Hutsonville Power Plant*	**License/Permit/Monitoring Number**	**Boring Number** *TW*

Boring Drilled By (Firm name and name of crew chief) *Boart Longyear* *Randy Radke*	**Date Drilling Started** *10/02/01*	**Date Drilling Completed** *10/02/01*	**Drilling Method** *HSA*

Facility Well No.	**Unique Well No.**	**Common Well Name**	**Final Static Water Level** *Feet MSL*	**Surface Elevation** *437.814 Feet MSL*	**Borehole Diameter** *8.25 inches*

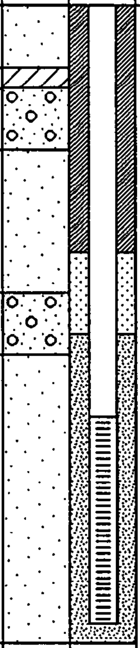
Boring Location **State Plane** *3717.203* **Feet N** *5605.471* **Feet E**	**Lat** **Long**	**Local Grid Location (if applicable)** ☐ *N* ☐ *E* ☐ *S* ☐ *W*

County *Crawford*		**Civil Town/City/ or Village** *Hutsonville*

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth in Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			2	0'-5'8" SILT with SAND, very dark brown (10YR 2/2), grades from topsoil, trace organics throughout	ML	▨	▨							
TW 2.5-4.5	20	2 2 3 3	4											
TW 5-7	18	2 1 2 4	6	5'8"-23' LEAN CLAY, brown (10YR 4/3), medium plasticity, moist		▨								
TW 7.5-9.5	16	1 1 1 2	8	weak red (2.5Y 5/3), trace orange mottling										
TW 10-12	20	1 1 1 1	10											
TW 12.5-14.5	18	1 1 1 1	12 14	trace horizontal fracture, wet	CL									
TW 15-17	18	1 1 1 1	16	5-10% fine sand										
TW 17.5-19.5	20	1/24	18	very dark gray (2.5Y 3/1), trace wood and white shell fragments										
TW 20-22	24	1/24	20 22											
TW 22.5-24.5	10	1/24		23'-25'6" SAND, very dark gray (2.5Y 3/1),	SP									

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature	Firm **Natural Resource Technology, Inc.**



Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth in Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
	10	1/24		medium, loose, wet	SP									
TW 25-27	18	2 2 2 2	26	25'6"–26' LEAN CLAY, as above	CL									
				26'–27'6" SAND with GRAVEL, poorly graded, coarse sand, fine gravel, rounded	SP									
TW 27.5-29.5	20	3 5 9 10	28	27'6"–31' SAND, gray/black and white, poorly graded, medium to coarse, increased coarsness with depth	SP									
TW 30-32	20	4 6 9 9	30											
			32	31'–32'6" SAND and GRAVEL, coarse sand, poorly graded, fine gravel, rounded	SP									
TW 32.5-34.5	12	1 1 1 1	34	32'6"–39'6" SAND, gray, poorly graded, medium to coarse, 5–15% gravel	SP									
TW 35-37	24	2 2 3 4	36											
TW 37.5-39.5	24	3 6 6 10	38											
			40	*EOB @ 39'6"*										
			42											
			44											
			46											
			48											
			50											
			52											
			54											
			56											
			58											
			60											
			62											

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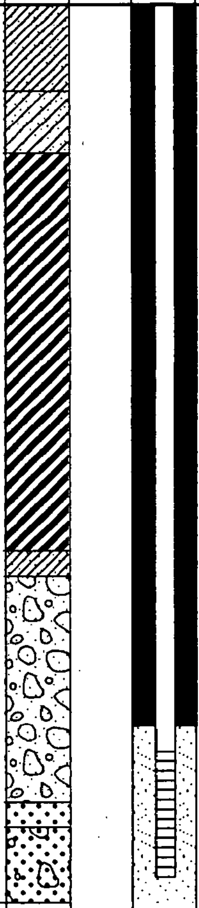
SOIL BORING LOG

Page 1 of 1

Facility/Project Name: Ameren Hutsonville Power Station Drilling
License/Permit/Monitoring Number:
Boring Number: TW-115s
Boring Drilled By: Name of crew chief (first, last) and Firm: Steve, Boart Longyear
Date Drilling Started: 5/1/2004
Date Drilling Completed: 5/1/2004
Drilling Method: hollow stem auger
Unique Well No.:
Well ID No.:
Common Well Name: TW-115s
Final Static Water Level: Feet MSL
Surface Elevation: 438.4 Feet MSL
Borehole Diameter: 8.3 inches
Local Grid Origin ☒ (estimated: ☐) or Boring Location ☐
State Plane N, E S/C/N
1/4 of 1/4 of Section , T R
Lat ° ' "
Long ° ' "
Local Grid Location: 898046.72 Feet ☒ N ☐ S 1176886.34 Feet ☒ E ☐ W
Facility ID:
County:
State:
Civil Town/City/ or Village: Hutsonville

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth From Surface (feet)	Soil/Rock Description And Geologic Origin For Each Major Unit	Hand Pen (tsf)	Field Moisture Condition	U S C S Symbol	Graphic Log	PID/FID (ppm)	Well Diagram	RQD/ Comments/ Lab Test
				0'-36' Drilled without sampling-see log TW-115d for complete description.			CL				
			5				SC				
			10								
			15				CH				
			20								
							CL				
			25								
							GP				
			30								
							SW				
			35				SW				
				END OF BORING AT 36' Well set at 35'							



I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature Paula Richardson
Firm Natural Resource Technology, Inc.
23713 W. Paul Road, Unit D, Pewaukee, WI 53072
Tel: (262) 523-9000
Fax: (262) 523-9001

Template: NRT BORING LOG - Project: 1375 LOGS.GPJ

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SOIL BORING LOG

Page 1 of 5

Facility/Project Name: Ameren Hutsonville Power Station Drilling
License/Permit/Monitoring Number:
Boring Number: TW-115d

Boring Drilled By: Name of crew chief (first, last) and Firm: Steve
Boart Longyear
Date Drilling Started: 4/29/2004
Date Drilling Completed: 5/1/2004
Drilling Method: hsa, core

Unique Well No.:
Well ID No.:
Common Well Name: TW-115d
Final Static Water Level: Feet MSL
Surface Elevation: 438.4 Feet MSL
Borehole Diameter: 8.3 inches

Local Grid Origin ☒ (estimated: ☐) or Boring Location ☐
State Plane N, E S/C/N
1/4 of 1/4 of Section , T R
Lat ° ' "
Long ° ' "
Local Grid Location: 898052.56 Feet ☒ N ☐ S 1176882.3 Feet ☒ E ☐ W

Facility ID:
County:
State:
Civil Town/City/ or Village: Hutsonville

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth From Surface (feet)	Soil/Rock Description And Geologic Origin For Each Major Unit	Hand Pen (tsf)	Field Moisture Condition	U S C S Symbol	Graphic Log	PID/FID (ppm)	Well Diagram	RQD/ Comments/ Lab Test
1 SS	24 12			0'-3.5' SANDY CLAY, very dark greyish brown (10 YR 3/2), very fine sand, moist			CL	▨			
2 SS	24 24							▨			
3 SS	24 24		5	3.5'-6' CLAYEY SAND, mottled grey-brown to tan, very fine sand, moist			SC	▨			
4 SS	24 24			6'-22' FAT CLAY, brown (10 YR 4/3), soft, plastic, moist			CH	▨			
5 SS	24 24							▨			
6 SS	24 4		10					▨			
7 SS	24 24			wet at 13'				▨			
8 SS	24 24		15					▨			

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: Paula Richardson
Paula Richardson
Firm: Natural Resource Technology, Inc.
23713 W. Paul Road, Unit D, Pewaukee, WI 53072
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Boring Number **TW-115d** Page 2 of 5

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth From Surface (feet)	Soil/Rock Description And Geologic Origin For Each Major Unit	Hand Pen (tsf)	Field Moisture Condition	U S C S Symbol	Graphic Log	PID/FID (ppm)	Well Diagram	RQD/ Comments/ Lab Test
9 SS	24 24			6'-22' FAT CLAY, brown (10 YR 4/3), soft, plastic, moist at 16' color change to olive grey (5Y 5/2)							
10 SS	24 24						CH				
11 SS	24 24		20	at 19.8' 2" sand seam, very fine sand 20'-22' trace very fine sand							
12 SS	24 24			22'-22.9' SANDY CLAY 22.9'-32' POORLY GRADED GRAVEL WITH SAND, olive grey (5Y 5/2), rounded, very fine to fine sand			CL				
13 SS	24 0		25								
14 SS	24 8						GP				
15 SS	24 7										
16 SS	24 4		30								
17 SS	24 5			32'-33' WELL GRADED SAND fine to coarse, trace rounded gravel 33'-36' WELL GRADED SAND WITH GRAVEL, very fine to coarse sand, fine to medium gravel, rounded			SW				
18 SS	24 14		35				SW				
19 SS	24 8			36'-39' POORLY GRADED SAND very fine to medium, trace gravel, rounded			SP				
20 SS	24 14			39'-40' WELL GRADED SAND WITH GRAVEL, fine to coarse gravel and sand			SW				
21 SS	24 11		40				GW				

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Boring Number **TW-115d** Page 3 of 5

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth From Surface (feet)	Soil/Rock Description And Geologic Origin For Each Major Unit	Hand Pen (tsf)	Field Moisture Condition	U S C S Symbol	Graphic Log	PID/FID (ppm)	Well Diagram	RQD/ Comments/ Lab Test
22 SS	24 12			40'-42' WELL GRADED GRAVEL WITH SAND, fine to coarse sand, fine to coarse gravel, rounded			GW				
23 SS	24 12		45	42'-58' WELL GRADED SAND fine to coarse sand, trace gravel, rounded 2" gravelly sand seam, fine to coarse gravel at 44'							
24 SS	24 13										
25 SS	24 14										
26 SS	24 13		50				SW				
27 SS	24 16										
28 SS	24 15		55								
29 SS	24 9										
30 SS	24 3			58'-70' WELL GRADED GRAVEL WITH SAND, fine to coarse sand, fine to coarse gravel, rounded							
31 SS	24 7		60								
32 SS	24 24						GW				
33 SS	24 12		65								
34 SS	24 4										

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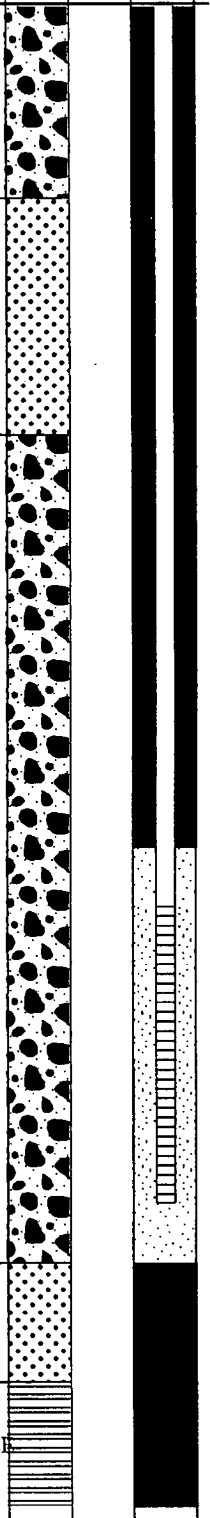
Boring Number **TW-115d** Page 4 of 5

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth From Surface (feet)
35 SS	24 0		
36 SS	24 6		70
37 SS	24 4		
38 SS	24 0		
39 SS	24 0		75
40 SS	24 0		
41 SS	24 0		80
42 SS	24 0		
43 SS	24 0		
44 SS	24 0		85
45 SS	24 12		
46 CORE	180		90

Soil/Rock Description And Geologic Origin For Each Major Unit	Hand Pen (tsf)	Field Moisture Condition	U S C S Symbol	PID/FID (ppm)	RQD/ Comments/ Lab Test
58'-70' <u>WELL GRADED GRAVEL WITH SAND</u>, fine to coarse sand, fine to coarse gravel, rounded			GW		
70'-74' <u>WELL GRADED SAND</u>, fine to coarse			SW		
74'-88' Logged from cuttings, <u>WELL GRADED GRAVEL WITH SAND</u>, fine to coarse sand, fine to coarse gravel			GW		Gravel starts coming up in cuttings.
88'-90' <u>WELL GRADED SAND</u>, very fine to medium			SW		
90'-105' <u>SHALE</u>, grey-blue, friable, moist			SHALE		



Boring Number **TW-115d** Page 5 of 5

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth From Surface (feet)	Soil/Rock Description And Geologic Origin For Each Major Unit	Hand Pen (tsf)	Field Moisture Condition	U S C S Symbol	Graphic Log	PID/FID (ppm)	Well Diagram	RQD/ Comments/ Lab Test
				90'-105' SHALE, grey-blue, friable, moist							
			95								
							SHALE				
			100								
			105	END OF BORING AT 105' Well set at 87'							

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SOIL BORING LOG

Page 1 of 4

Facility/Project Name Ameren Hutsonville Power Station Drilling	License/Permit/Monitoring Number	Boring Number TW-116

Boring Drilled By: Name of crew chief (first, last) and Firm Steve Boart Longyear	Date Drilling Started 4/26/2004	Date Drilling Completed 4/28/2004	Drilling Method hsa, core

Unique Well No.	Well ID No.	Common Well Name TW-116	Final Static Water Level Feet MSL	Surface Elevation 437.5 Feet MSL	Borehole Diameter 8.3 inches

Local Grid Origin ☒ (estimated: ☐) or Boring Location ☐
State Plane N, E S/C/N
1/4 of 1/4 of Section , T____ R____
Lat ____ ° ____ ' ____ "
Long ____ ° ____ ' ____ "
Local Grid Location
896034.1384 Feet ☒ N ☐ S 1175442.33 Feet ☒ E ☐ W

Facility ID	County	State	Civil Town/City/ or Village Hutsonville

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth From Surface (feet)	Soil/Rock Description And Geologic Origin For Each Major Unit	Hand Pen (tsf)	Field Moisture Condition	U S C S Symbol	Graphic Log	PID/FID (ppm)	Well Diagram	RQD/ Comments/ Lab Test
1 SS	24 24			0'-3.5' SILT, very dark greyish brown (10 YR 3/2), rootlets to 6", firm, slightly moist			ML				
2 SS	24 12										
3 SS	24 24			3.5'-4.8' SILTY CLAY, very dark greyish brown, firm, slightly moist			CL/ML				
			5	4.8'-16' FAT CLAY, dark yellowish brown (10YR 4/4), soft, moist			CH				
4 SS	24 24										
5 SS	24 24										
6 SS	24 24		10								
7 SS	24 24										
8 SS	24 24			at 14' very moist							
			15								

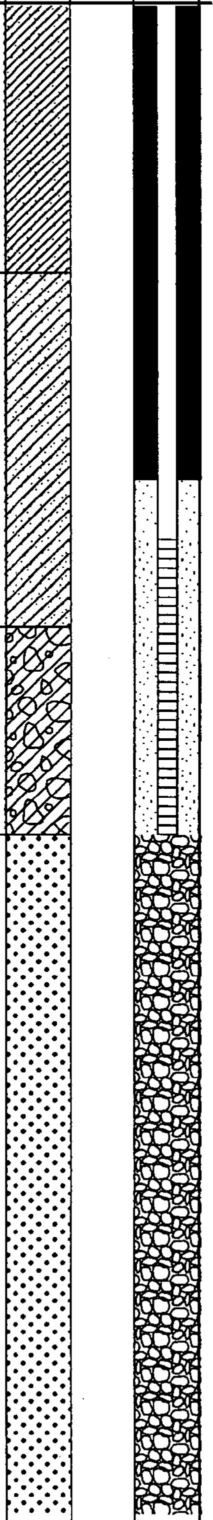
I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature Paula Richardson

Firm Natural Resource Technology, Inc.
23713 W. Paul Road, Unit D, Pewaukee, WI 53072
Tel: (262) 523-9000
Fax: (262) 523-9001

Boring Number **TW-116** Page 2 of 4

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth From Surface (feet)	Soil/Rock Description And Geologic Origin For Each Major Unit	Hand Pen (tsf)	Field Moisture Condition	U S C S Symbol	Graphic Log	PID/FID (ppm)	Well Diagram	RQD/ Comments/ Lab Test
9 SS	24 24			16'-20.5' SANDY LEAN CLAY, olive brown (2.5 Y 4/3), very fine sand, soft, wet			CL				
10 SS	24 24		20	color change to dark grey (2.5 Y 4/1) 20.5'-26.5' CLAYEY SAND, dark grey, very fine sand, wet			SC				
11 SS	24 24		25	26.5'-30' CLAYEY GRAVEL, fine gravel, few shell fragments, wet			GC				
12 SS	24 18		30	30'-60' WELL GRADED SAND, olive brown (2.5 Y 4/4), fine to coarse, subangular to rounded, wet			SW				
13 SS	24 12		35								
14 SS	24 0		40								



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Boring Number **TW-116** Page 3 of 4

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth From Surface (feet)	Soil/Rock Description And Geologic Origin For Each Major Unit	Hand Pen (tsf)	Field Moisture Condition	U S C S Symbol	Graphic Log	PID/FID (ppm)	Well Diagram	RQD/ Comments/ Lab Test
				30'-60' WELL GRADED SAND olive brown (2.5 Y 4/4), fine to coarse, subangular to rounded, wet			SW				
15 SS	24 10		45								
16 SS	24 12		50								
17 SS	24 6		55								
18 SS	24 2		60	60'-79' SHALE, grey-blue, slightly moist, friable			SHALE				
19 CORE	180		65								

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N R T

Boring Number **TW-116** Page 4 of 4

Sample		Blow Counts	Depth From Surface (feet)	Soil/Rock Description And Geologic Origin For Each Major Unit	Hand Pen (tsf)	Field Moisture Condition	U S C S Symbol	Graphic Log	PID/FID (ppm)	Well Diagram	RQD/ Comments/ Lab Test
Number and Type	Length Att. & Recovered (in)										
				60'-79' <u>SHALE</u>, grey-blue, slightly moist, friable							
			70								
							SHALE				
			75								
				coal seam at 79', bit plugged-no water circulation for coring			COAL				
				<u>END OF BORING AT 79.2'</u> Well set at 30'							

Natural
Resource
Technology
N R T

SOIL BORING LOG

Page 1 of 4

Facility/Project Name: Ameren Hutsonville Power Station Drilling
License/Permit/Monitoring Number:
Boring Number: TW-117

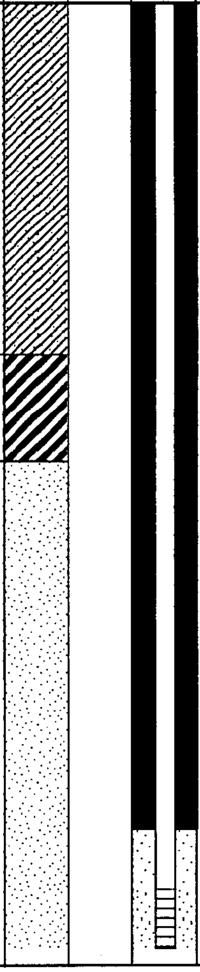
Boring Drilled By: Name of crew chief (first, last) and Firm: Steve, Boart Longyear
Date Drilling Started: 4/28/2004
Date Drilling Completed: 4/29/2004
Drilling Method: hollow stem auger

Unique Well No.:
Well ID No.:
Common Well Name: TW-117
Final Static Water Level: Feet MSL
Surface Elevation: 435.0 Feet MSL
Borehole Diameter: 8.3 inches

Local Grid Origin ☒ (estimated: ☐) or Boring Location ☐
State Plane N, E S/C/N
1/4 of 1/4 of Section , T____ R_____
Lat ____° ____' ______"
Long ____° ____' ______"
Local Grid Location: ☒ N ☒ E
895267.78 Feet ☐ S 1179053.33 Feet ☐ W

Facility ID:
County:
State:
Civil Town/City/ or Village: Hutsonville

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth From Surface (feet)	Soil/Rock Description And Geologic Origin For Each Major Unit	Hand Pen (tsf)	Field Moisture Condition	U S C S Symbol	Graphic Log	PID/FID (ppm)	Well Diagram	RQD/ Comments/ Lab Test
1 SS	24 12			0'-6' SANDY LEAN CLAY, dark olive brown (2.5 Y 3/3), very fine sand, slightly moist							
2 SS	24 24						CL				
3 SS	24 0		5								
4 SS	24 24			6'-7.8' FAT CLAY, dark olive brown, high toughness and plasticity, moist			CH				
5 SS	24 10			7.8'-25' POORLY GRADED SAND, dark yellowish brown (10 YR 4/4), very fine, wet							
6 SS	24 12		10				SP				
7 SS	24 10		15								



I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: Paula Richardson
Paula Richardson

Firm: Natural Resource Technology, Inc.
23713 W. Paul Road, Unit D, Pewaukee, WI 53072
Tel: (262) 523-9000
Fax: (262) 523-9001

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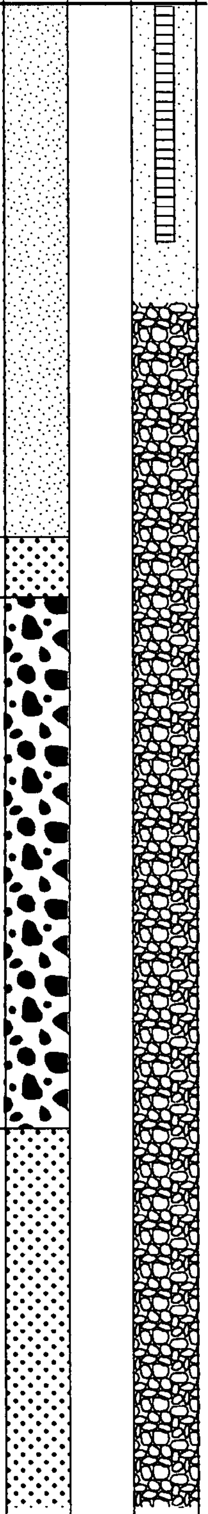
Boring Number **TW-117** Page 2 of 4



Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth From Surface (feet)	Soil/Rock Description And Geologic Origin For Each Major Unit	Hand Pen (tsf)	Field Moisture Condition	U S C S Symbol	Graphic Log	PID/FID (ppm)	Well Diagram	RQD/ Comments/ Lab Test
				7.8'-25' POORLY GRADED SAND dark yellowish brown (10 YR 4/4), very fine, wet trace shell fragments at 16'							
8 SS	24 0		20				SP				
9 SS	24 8		25	25'-26' WELL GRADED SAND fine to medium, coarsens downward			SW				
				26'-35' WELL GRADED GRAVEL, trace sand and shell fragments, rounded							
10 SS	24 4		30				GW				
				grey clay in shoe of split spoon							
11 SS	24 6		35	35'-60' WELL GRADED SAND fine to coarse			SW				
12 SS	24 5		40								

Natural Resource Technology
N R T

Boring Number **TW-117** Page 3 of 4

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth From Surface (feet)	Soil/Rock Description And Geologic Origin For Each Major Unit	Hand Pen (tsf)	Field Moisture Condition	U S C S Symbol	Graphic Log	PID/FID (ppm)	Well Diagram	RQD/ Comments/ Lab Test
☒				35'-60' WELL GRADED SAND, fine to coarse							
13 SS	24 14		45								
14 SS	24 17		50				SW				
15 SS	24 0		55								
16 SS	24 0		60	60'-75' Logged from drill cuttings, POORLY GRADED GRAVEL, coarse, rounded							Went to larger sample interval due to drilling conditions.
							GP				
			65								

Boring Number **TW-117** Page 4 of 4

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth From Surface (feet)	Soil/Rock Description And Geologic Origin For Each Major Unit	Hand Pen (tsf)	Field Moisture Condition	U S C S Symbol	Graphic Log	PID/FID (ppm)	Well Diagram	RQD/ Comments/ Lab Test
				60'-75' Logged from drill cuttings,<u>POORLY GRADED GRAVEL</u>, coarse, rounded							
			70				GP				
17 SS	24 0		75	75'-90' Logged from drill cuttings,<u>WELL GRADED SAND WITH GRAVEL</u>							No samples attempted after 77 feet due to drilling conditions.
			80								
							SW				
			85								
18 SS	6 2		90	90'-90.5' <u>SHALE</u>			SHALE				
				<u>END OF BORING AT 90.5</u>' Well set at 20'							

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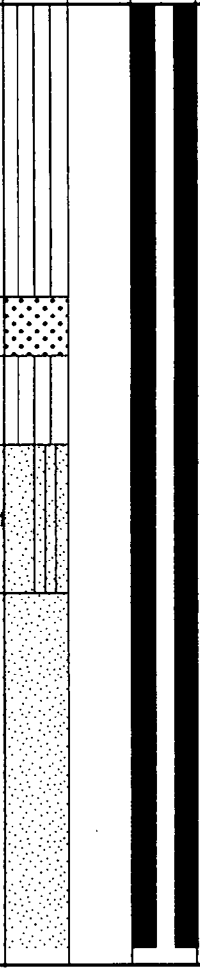
SOIL BORING LOG

Page 1 of 2

Facility/Project Name: Ameren Hutsonville Power Station Drilling
License/Permit/Monitoring Number:
Boring Number: TW-118
Boring Drilled By: Name of crew chief (first, last) and Firm: Steve, Boart Longyear
Date Drilling Started: 5/4/2004
Date Drilling Completed: 5/4/2004
Drilling Method: hollow stem auger
Unique Well No.:
Well ID No.:
Common Well Name: TW-118
Final Static Water Level: Feet MSL
Surface Elevation: 437.0 Feet MSL
Borehole Diameter: 8.3 inches
Local Grid Origin ☒ (estimated: ☐) or Boring Location ☐
State Plane N, E S/C/N
1/4 of 1/4 of Section , T____ R_____
Lat ___° ___' ____"
Long ___° ___' ____"
Local Grid Location: ☒ N 898090.86 Feet ☐ S ☒ E 1177978.73 Feet ☐ W
Facility ID:
County:
State:
Civil Town/City/ or Village: Hutsonville



Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth From Surface (feet)	Soil/Rock Description And Geologic Origin For Each Major Unit	Hand Pen (tsf)	Field Moisture Condition	U S C S Symbol	Graphic Log	PID/FID (ppm)	Well Diagram	RQD/ Comments/ Lab Test
1 SS	24 24			0'-3' SILT, brown (7.5 YR 4/2)			ML				
2 SS	24 24			3'-5' dark reddish grey (5 YR 4/2), trace sand wet at 4'							
3 SS	24 24		5								
4 SS	24 24			5'-6' WELL GRADED SAND, light reddish brown (5 YR 6/3), medium to fine			SW				
				6'-7.5' SILT, brown (7.5 YR 4/2)			ML				
5 SS	24 18			7.5'-10' POORLY GRADED SAND WITH SILT			SP-SM				
6 SS	24 24		10	10'-26' POORLY GRADED SAND, brown (7.5 YR 5/2), medium grained			SP				
7 SS	24 24										
8 SS	24 16		15								

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: Paula Richardson
Firm: Natural Resource Technology, Inc.
23713 W. Paul Road, Unit D, Pewaukee, WI 53072
Tel: (262) 523-9000
Fax: (262) 523-9001

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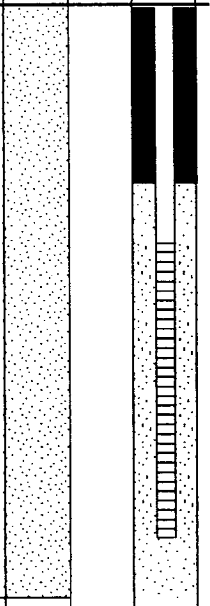
Boring Number **TW-118** Page 2 of 2

Sample											
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth From Surface (feet)	Soil/Rock Description And Geologic Origin For Each Major Unit	Hand Pen (tsf)	Field Moisture Condition	U S C S Symbol	Graphic Log	PID/FID (ppm)	Well Diagram	RQD/ Comments/ Lab Test
				10'-26' POORLY GRADED SAND brown (7.5 YR 5/2), medium grained							
9 SS	24 12										
			20				SP				
10 SS	24 12			@ 22' coarse sand with few gravel							
			25								
				END OF BORING AT 26' Well set at 25'							



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SOIL BORING LOG

Page 1 of 5

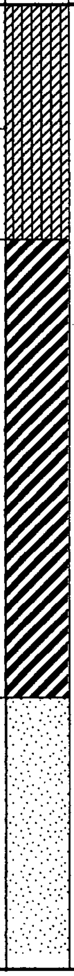
Facility/Project Name Ameren Hutsonville Power Station Drilling	License/Permit/Monitoring Number	Boring Number TW-119	
Boring Drilled By: Name of crew chief (first, last) and Firm Steve Boart Longyear	Date Drilling Started 5/1/2004	Date Drilling Completed 5/3/2004	Drilling Method hsa, core

Unique Well No.	Well ID No.	Common Well Name TW-119	Final Static Water Level Feet MSL	Surface Elevation 435.4 Feet MSL	Borehole Diameter 8.3 inches

Local Grid Origin ☒ (estimated: ☐) or Boring Location ☐
State Plane N, E S/C/N
1/4 of 1/4 of Section , T____R_____
Lat ____° ____' ______"
Long ____° ____' ______"
Local Grid Location
☒ N ☒ E
896030.54 Feet ☐ S 1181339.05 Feet ☐ W

Facility ID	County	State	Civil Town/City/ or Village Hutsonville

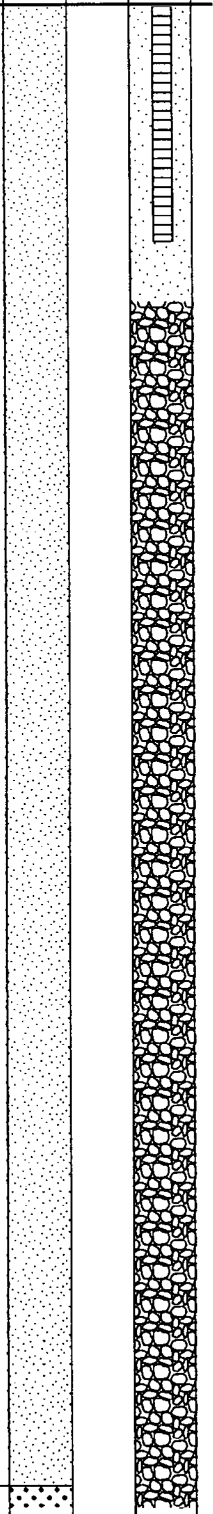
Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth From Surface (feet)	Soil/Rock Description And Geologic Origin For Each Major Unit	Hand Pen (tsf)	Field Moisture Condition	U S C S Symbol	Graphic Log	PID/FID (ppm)	Well Diagram	RQD/ Comments/ Lab Test
1 SS	24 18			0'-4' <u>SILTY CLAY</u>, very dark greyish brown (10 YR 3/2), firm, moist							
2 SS	24 20			color change to dark greyish brown (2.5 Y 4/2)			CL/ML				
3 SS	24 24		5	4'-11.7' <u>FAT CLAY</u>, dark greyish brown, soft, moist							
4 SS	24 21			at 6' very moist							
5 SS	24 24			at 9' wet			CH				
6 SS	24 24		10								
7 SS	24 16			11.7'-41' <u>POORLY GRADED SAND</u> mottled orange brown and grey brown, very fine, wet at 12' color change to dark yellowish brown (10 YR 4/4)			SP				
			15								



I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature Paula Richardson
Paula Richardson

Firm Natural Resource Technology, Inc.
23713 W. Paul Road, Unit D, Pewaukee, WI 53072
Tel: (262) 523-9000
Fax: (262) 523-9001



Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth From Surface (feet)	Soil/Rock Description And Geologic Origin For Each Major Unit	Hand Pen (tsf)	Field Moisture Condition	U S C S Symbol	Graphic Log	PID/FID (ppm)	Well Diagram	RQD/ Comments/ Lab Test
				11.7'-41' <u>POORLY GRADED SAND</u> mottled orange brown and grey brown, very fine, wet							
8 SS	24 6		20								
9 SS	24 0		25								
							SP				
10 SS	24 11		30	very fine to medium sand							
11 SS	24 12		35	very fine to fine sand							
12 SS	24 22		40								

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Boring Number **TW-119** Page 3 of 5

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth From Surface (feet)	Soil/Rock Description And Geologic Origin For Each Major Unit	Hand Pen (tsf)	Field Moisture Condition	U S C S Symbol	Graphic Log	PID/FID (ppm)	Well Diagram	RQD/ Comments/ Lab Test
				41'-45' WELL GRADED SAND, very fine to coarse, trace rounded gravel			SW				
13 SS	24 17		45	45'-60' POORLY GRADED SAND, very fine to medium							
14 SS	24 12		50								
15 SS	24 0		55				SP				
16 SS	24 0		60	60'-80' Logged by drill cuttings, WELL GRADED SAND WITH GRAVEL to WELL GRADED GRAVEL WITH SAND			SW				Gravel starts coming up in cuttings
17 SS	24 0		65								

Natural Resource Technology

N R T

Boring Number **TW-119** Page 4 of 5

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth From Surface (feet)	Soil/Rock Description And Geologic Origin For Each Major Unit	Hand Pen (tsf)	Field Moisture Condition	U S C S Symbol	Graphic Log	PID/FID (ppm)	Well Diagram	RQD/ Comments/ Lab Test
				60'-80' Logged by drill cuttings, WELL GRADED SAND WITH GRAVEL to WELL GRADED GRAVEL WITH SAND							
18 SS	24 0		70								
							SW				
19 SS	24 0		75								
20 CORE	84 24		80	80'-100' SHALE, grey to black, laminated, poorly lithified, no circulation of drilling water							
			85								
21 CORE	72 30										
			90								

Boring Number **TW-119** Page 5 of 5

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth From Surface (feet)	Soil/Rock Description And Geologic Origin For Each Major Unit	Hand Pen (tsf)	Field Moisture Condition	U S C S Symbol	Graphic Log	PID/FID (ppm)	Well Diagram	RQD/ Comments/ Lab Test
22 CORE	84 54		95	80'-100' SHALE, grey to black, laminated, poorly lithified, no circulation of drilling water							
			100	END OF BORING AT 100' Well set at 20'							

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SOIL BORING LOG

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Facility/Project Name Ameren Hutsonville Power Station Drilling	License/Permit/Monitoring Number	Boring Number TW-120

Boring Drilled By: Name of crew chief (first, last) and Firm Steve Boart Longyear	Date Drilling Started 5/3/2004	Date Drilling Completed 5/4/2004	Drilling Method hollow stem auger

Unique Well No.	Well ID No.	Common Well Name TW-120	Final Static Water Level Feet MSL	Surface Elevation 446.8 Feet MSL	Borehole Diameter 8.3 inches

Local Grid Origin ☒ (estimated: ☐) or Boring Location ☐
State Plane N, E S/C/N
1/4 of 1/4 of Section , T____ R_____
Lat ____ ° ____ ' ____ "
Long ____ ° ____ ' ____ "
Local Grid Location
898614.91 Feet ☒ N ☐ S 1180157.14 Feet ☒ E ☐ W

Facility ID	County	State	Civil Town/City/ or Village Hutsonville

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth From Surface (feet)	Soil/Rock Description And Geologic Origin For Each Major Unit	Hand Pen (tsf)	Field Moisture Condition	U S C S Symbol	Graphic Log	PID/FID (ppm)	Well Diagram	RQD/ Comments/ Lab Test
1 SS	24 17			0'-0.5' TOPSOIL							
				0.5'-14' POORLY GRADED SAND brownish yellow (10 YR 6/6), medium							
2 SS	24 15										
3 SS	24 15		5								
							SP				
4 SS	24 12										
			10	color change to reddish yellow (7.5 YR 6/6), moist							
5 SS	24 10		15	14'-36' POORLY GRADED SAND WITH GRAVEL, reddish yellow, medium sand, rounded gravel, moist			SP				

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature Paula Richardson
Firm Natural Resource Technology, Inc.
23713 W. Paul Road, Unit D, Pewaukee, WI 53072
Tel: (262) 523-9000
Fax: (262) 523-9001

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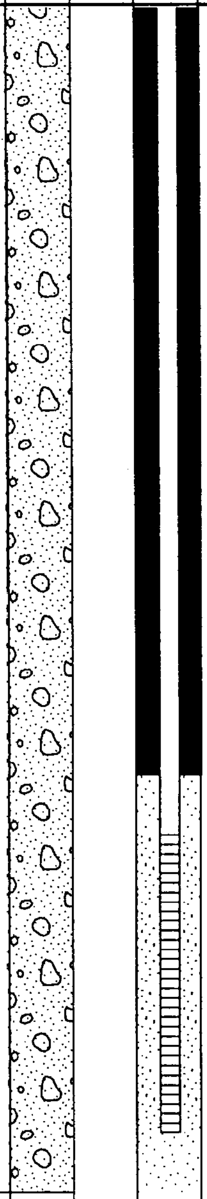
Boring Number **TW-120** Page 2 of 2

Sample		Blow Counts	Depth From Surface (feet)	Soil/Rock Description And Geologic Origin For Each Major Unit	Hand Pen (tsf)	Field Moisture Condition	U S C S Symbol	Graphic Log	PID/FID (ppm)	Well Diagram	RQD/ Comments/ Lab Test
Number and Type	Length Att. & Recovered (in)										
				14'-36' POORLY GRADED SAND WITH GRAVEL, reddish yellow, medium sand, rounded gravel, moist							
6 SS	24 24		20	wet at 19'							
7 SS	24 24		25				SP				
8 SS	24 24		30								
9 SS	24 24		35	34'-36' coarse sand							
				END OF BORING AT 36' Well set at 35'							



APPENDIX B

ALTERNATIVE COST SUMMARY SHEETS

FINAL COVER ALTERNATIVE: Pozzolanic Fly Ash Final Cover - Mix No. 1
Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

NRT PROJECT NO.: 1375/6.1
BY: CAR CHKD BY: BRH
DATE: 6/27/05 EJT (5/19/05)

CONSULTING CAPITAL COSTS	SUB-TOTAL
Consulting	
Hydrogeologic Evaluation, Engineering Design, System Installation Oversight, Final System Documentation Geotechnical Evaluation	$500,000
SUBTOTAL, CONSTRUCTION CAPITAL COSTS	$500,000
30% Estimating Contingency	$150,000
TOTAL, CONSULTING CAPITAL COSTS	**$650,000**

CONSTRUCTION CAPITAL COSTS	QUANTITY	UNIT	UNIT COST	ITEM COST	SUB-TOTAL
Construction					$3,602,622
Mob./Demob.	1	LS	$324,108	$324,108	
Site Facilities & Maintenance (Erosion Controls)	1	LS	$8,000	$8,000	
Regrade Stockpiled Ash to Fill Depressions	50,500	CY	$1.97	$99,485	
Excavate Ash From Pond A for Pozzolanic Mix	100,480	CY	$1.81	$181,869	
Blend Ash w/ Reagents to Form Pozzolanic Mix	100,480	CY	$1.86	$186,893	
Place 3.0' Pozzolanic Ash Final Cover	100,480	CY	$1.61	$161,773	
Place Fly Ash From Pond A to Construct Grade	120,700	CY	$3.42	$412,794	
Place Rooting Zone to Compete Protective Layer	100,480	CY	$9.31	$935,469	
Additional Construction Items Identified by VFL					
Dewatering	1	LS	$23,951	$23,951	
Reagent Cost - Cement[8]	12,824	TON	$95.00	$1,218,280	
Relocate Sluice Pipes and Supports	1	LS	$50,000	$50,000	
SUBTOTAL, CONSTRUCTION CAPITAL COSTS					$3,602,622
30% Estimating Contingency					$1,080,800
TOTAL, CONSTRUCTION CAPITAL COSTS					**$4,683,422**

TOTAL CAPITAL COSTS (Without Additional Excavation in Pond A)	**$5,333,000**

ASSUMPTIONS

1. Total area of Pond D for final cover estimated at 966,000 SF, approximately 22 acres.
2. Pozzolanic fly ash cover consists of: 3 foot Pozzolanic Fly ash Layer - 3 foot Protective Soil Layer.
3. Mix Design No. 1 - 100% Fly Ash w/ 10% cement reagent (dry weight basis). See VFL Technology Corporation Tables.
4. All estimated final cover alternative material quantities are provided in Table 3-3.
5. Earthwork quantities based on VFL Technology Corp. Estimates
   - Earthwork estimates provided by NRT in the original estimate are within 5% of VFL's Earthwork Estimates.
6. Estimate 100,480 yd^3 of ash excavated from Pond A for pozzolanic final cover.
7. Costs for the pozzolanic fly ash cover construction based on estimates provided by VFL Technology Corporation in their letter dated May 9, 2002.

Several line items from *Pozzolanic Fly Ash Final Cover (Initial Estimate)* are incorporated in this estimate as described below:

Line Items: Site Vegetation Clearing (22 acres), Documentation Surveying, and Revegetation (mulch, seed, fertilizer) are included in *Mob./Demob.*

Line Item: Load and Haul to Processing Plant is included in *Excavate Ash From Pond A for Pozzolanic Mix.*

Line Items: Install Beneficial Reuse Ash for Protective Layer, Grain Size Analysis/Geotechnical Testing, and Site Drainage are included in *Install 3.0' Pozzolanic Ash Final Cover* and *Install General Fill to Compete Protective Layer.*

Construction Capital Cost not included in VFL Estimate.

8. Revised reagent cost provided by VFL Technology Corporation in Table #3 dated July 2, 2002 - 3 ft. cover - 12,824 tons of cement (Appendix C-2).
9. Above is a preliminary estimate and may be revised if selected for final design - the consulting costs and estimating contingency provided in this spreadsheet are conservative - actual costs may be lower.
10. For ease of comparison to initial pozzolanic fly ash final cover estimate, the same consulting costs, engineering design costs, and estimating contingency have been used.

FINAL COVER ALTERNATIVE: Pozzolanic Fly Ash Final Cover - Mix No. 2
Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

NRT PROJECT NO.: 1375/6.1
BY: CAR CHKD BY: BRH
DATE: 6/27/05 EJT (5/19/05)

CONSULTING CAPITAL COSTS	SUB-TOTAL
Consulting	
Hydrogeologic Evaluation, Engineering Design, System Installation Oversight, Final System Documentation Geotechnical Evaluation	$500,000
SUBTOTAL, CONSTRUCTION CAPITAL COSTS	$500,000
30% Estimating Contingency	$150,000
TOTAL, CONSULTING CAPITAL COSTS	**$650,000**

CONSTRUCTION CAPITAL COSTS	QUANTITY	UNIT	UNIT COST	ITEM COST	SUB-TOTAL
Construction					$2,987,117
Mob./Demob.	1	LS	$324,108	$324,108	
Site Facilities & Maintenance (Erosion Controls)	1	LS	$8,000	$8,000	
Regrade Stockpiled Ash to Fill Depressions	50,500	CY	$1.97	$99,485	
Excavate Ash From Pond A for Pozzolanic Mix	100,480	CY	$1.81	$181,869	
Blend Ash w/ Reagents to Form Pozzolanic Mix	100,480	CY	$1.86	$186,893	
Place 3.0' Pozzolanic Ash Final Cover	100,480	CY	$1.61	$161,773	
Place Fly Ash From Pond A to Construct Grade	120,700	CY	$3.42	$412,794	
Place Rooting Zone to Compete Protective Layer	100,480	CY	$9.31	$935,469	
Additional Construction Items Identified by VFL					
Dewatering	1	LS	$23,951	$23,951	
Reagent Cost - Cement[8]	6,345	TON	$95.00	$602,775	
Relocate Sluice Pipes and Supports	1	LS	$50,000	$50,000	
SUBTOTAL, CONSTRUCTION CAPITAL COSTS					$2,987,117
30% Estimating Contingency					$896,100
TOTAL, CONSTRUCTION CAPITAL COSTS					**$3,883,217**

TOTAL CAPITAL COSTS (Without Additional Excavation in Pond A)	**$4,533,000**

ASSUMPTIONS

1. Total area of Pond D for final cover estimated at 966,000 SF, approximately 22 acres.
2. Pozzolanic fly ash cover consists of: 3 foot Pozzolanic Fly ash Layer - 3 foot Protective Soil Layer.
3. Mix Design No. 2 - 100% Fly Ash w/ 5% cement reagent (dry weight basis). See VFL Technology Corporation Tables.
4. All estimated final cover alternative material quantities are provided in Table 3-3.
5. Earthwork quantities based on VFL Technology Corp. Estimates
   - Earthwork estimates provided by NRT in the original estimate are within 5% of VFL's Earthwork Estimates.
6. Estimate 100,480 yd^3 of ash excavated from Pond A for pozzolanic final cover.
7. Costs for the pozzolanic fly ash cover construction based on estimates provided by VFL Technology Corporation in their letter dated May 9, 2002.

Several line items from *Pozzolanic Fly Ash Final Cover (Initial Estimate)* are incorporated in this estimate as described below:

Line Items: Site Vegetation Clearing (22 acres), Documentation Surveying, and Revegetation (mulch, seed, fertilizer) are included in *Mob./Demob.*

Line Item: Load and Haul to Processing Plant is included in *Excavate Ash From Pond A for Pozzolanic Mix.*

Line Items: Install Beneficial Reuse Ash for Protective Layer, Grain Size Analysis/Geotechnical Testing, and Site Drainage are included in *Install 3.0' Pozzolanic Ash Final Cover* and *Install General Fill to Compete Protective Layer.*

Construction Capital Cost not included in VFL Estimate.

8. Revised reagent cost provided by VFL Technology Corporation in Table #3 dated July 2, 2002 - 3 ft. cover - 6,345 tons of cement (Appendix C-2).
9. Above is a preliminary estimate and may be revised if selected for final design - the consulting costs and estimating contingency provided in this spreadsheet are conservative - actual costs may be lower.
10. For ease of comparison to initial pozzolanic fly ash final cover estimate, the same consulting costs, engineering design costs, and estimating contingency have been used.

FINAL COVER ALTERNATIVE: Pozzolanic Fly Ash Final Cover - Mix No. 9
Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

NRT PROJECT NO.: 1375/6.1
BY: CAR CHKD BY: BRH
DATE: 6/27/05 EJT (5/19/05)

CONSULTING CAPITAL COSTS	SUB-TOTAL
Consulting	
Hydrogeologic Evaluation, Engineering Design, System Installation Oversight, Final System Documentatio	$500,000
Geotechnical Evaluation	
SUBTOTAL, CONSTRUCTION CAPITAL COSTS	$500,000
30% Estimating Contingency	$150,000
TOTAL, CONSULTING CAPITAL COSTS	**$650,000**

CONSTRUCTION CAPITAL COSTS	QUANTITY	UNIT	UNIT COST	ITEM COST	SUB-TOTAL
Construction					$3,241,575
Mob./Demob.	1	LS	$324,108	$324,108	
Site Facilities & Maintenance (Erosion Controls)	1	LS	$8,000	$8,000	
Regrade Stockpiled Ash to Fill Depressions	50,500	CY	$1.97	$99,485	
Excavate Ash From Pond A for Pozzolanic Mix	85,408	CY	$1.81	$154,588	
Blend Ash w/ Reagents to Form Pozzolanic Mix	85,408	CY	$1.86	$158,859	
Place 3.0' Pozzolanic Ash Final Cover	85,408	CY	$1.61	$137,507	
Place Fly Ash From Pond A to Construct Grade	120,700	CY	$3.42	$412,794	
Place Rooting Zone to Compete Protective Layer	100,480	CY	$9.31	$935,469	
Additional Construction Items Identified by VFL					
Dewatering	1	LS	$23,951	$23,951	
Soil Additive Cost - Black Sand[8]	23,237	TON	$7.00	$162,659	
Reagent Cost - Cement[8]	8,149	TON	$95.00	$774,155	
Relocate Sluice Pipes and Supports	1	LS	$50,000	$50,000	
SUBTOTAL, CONSTRUCTION CAPITAL COSTS					$3,241,575
30% Estimating Contingency					$972,500
TOTAL, CONSTRUCTION CAPITAL COSTS					**$4,214,075**

TOTAL CAPITAL COSTS (Without Additional Excavation in Pond A)	**$4,864,000**

ASSUMPTIONS

1. Total area of Pond D for final cover estimated at 966,000 SF, approximately 22 acres.
2. Pozzolanic fly ash cover consists of: 3 foot Pozzolanic Fly ash Layer - 3 foot Protective Soil Layer.
3. Mix Design No. 9 - 85% Fly Ash w/ 15% black sand (wet weight basis) - 6.3% cement reagent (dry weight basis). See VFL Technology Corp Tables.
4. All estimated final cover alternative material quantities are provided in Table 3-3.
5. Earthwork quantities based on VFL Technology Corp. Estimates
   - Earthwork estimates provided by NRT in the original estimate are within 5% of VFL's Earthwork Estimates.
6. Estimate 85,408 yd^3 of ash excavated from Pond A for pozzolanic final cover.
7. Costs for the pozzolanic fly ash cover construction based on estimates provided by VFL Technology Corporation in their letter dated May 9, 2002. Several line items from *Pozzolanic Fly Ash Final Cover (Initial Estimate)* are incorporated in this estimate as described below:
   Line Items: Site Vegetation Clearing (22 acres), Documentation Surveying, and Revegetation (mulch, seed, fertilizer) are included in *Mob./Demob.*
   Line Item: Load and Haul to Processing Plant is included in *Excavate Ash From Pond A for Pozzolanic Mix.*
   Line Items: Install Beneficial Reuse Ash for Protective Layer, Grain Size Analysis/Geotechnical Testing, and Site Drainage are included in *Install 3.0' Pozzolanic Ash Final Cover* and *Install General Fill to Compete Protective Layer.*
   Construction Capital Cost not included in VFL Estimate.
8. Revised reagent cost provided by VFL Technology Corporation in Table #3 dated July 2, 2002 (Appendix C-2) - 3 ft. cover - 8,149 tons of cement and 23,237 tons of black sand. Addition of black sand will reduce the requirement for fly ash excavation by 15,072 cy (wet weight basis, black sand).
9. Above is a preliminary estimate and may be revised if selected for final design - the consulting costs and estimating contingency provided in this spreadsheet are conservative - actual costs may be lower.
10. For ease of comparison to initial pozzolanic fly ash final cover estimate, the same consulting costs, engineering design costs, and estimating contingency have been used.

FINAL COVER ALTERNATIVE: Pozzolanic Fly Ash Final Cover - Mix No. 10
Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

NRT PROJECT NO.: 1375/6.1
BY: CAR CHKD BY: BRH
DATE: 6/27/05 EJT (5/19/05)

CONSULTING CAPITAL COSTS	SUB-TOTAL
Consulting	
Hydrogeologic Evaluation, Engineering Design, System Installation Oversight, Final System Documentatioı Geotechnical Evaluation	$500,000
SUBTOTAL, CONSTRUCTION CAPITAL COSTS	$500,000
30% Estimating Contingency	$150,000
TOTAL, CONSULTING CAPITAL COSTS	**$650,000**

CONSTRUCTION CAPITAL COSTS	QUANTITY	UNIT	UNIT COST	ITEM COST	SUB-TOTAL
Construction					$4,049,167
Mob./Demob.	1	LS	$324,108	$324,108	
Site Facilities & Maintenance (Erosion Controls)	1	LS	$8,000	$8,000	
Regrade Stockpiled Ash to Fill Depressions	50,500	CY	$1.97	$99,485	
Excavate Ash From Pond A for Pozzolanic Mix	85,408	CY	$1.81	$154,588	
Blend Ash w/ Reagents to Form Pozzolanic Mix	85,408	CY	$1.86	$158,859	
Place 3.0' Pozzolanic Ash Final Cover	85,408	CY	$1.61	$137,507	
Place Fly Ash From Pond A to Construct Grade	120,700	CY	$3.42	$412,794	
Place Rooting Zone to Compete Protective Layer	100,480	CY	$9.31	$935,469	
Additional Construction Items Identified by VFL					
Dewatering	1	LS	$23,951	$23,951	
Soil Additive Cost - Black Sand[8]	23,888	TON	$7.00	$167,216	
Reagent Cost - Cement[8]	16,602	TON	$95.00	$1,577,190	
Relocate Sluice Pipes and Supports	1	LS	$50,000	$50,000	
SUBTOTAL, CONSTRUCTION CAPITAL COSTS					$4,049,167
30% Estimating Contingency					$1,214,800
TOTAL, CONSTRUCTION CAPITAL COSTS					**$5,263,967**

TOTAL CAPITAL COSTS (Without Additional Excavation in Pond A)	**$5,914,000**

ASSUMPTIONS

1. Total area of Pond D for final cover estimated at 966,000 SF, approximately 22 acres.
2. Pozzolanic fly ash cover consists of: 3 foot Pozzolanic Fly ash Layer - 3 foot Protective Soil Layer.
3. Mix Design No. 10 - 85% Fly Ash w/ 15% black sand (wet weight basis) - 12.5% cement reagent (dry weight basis). See VFL Technology Corp Tables
4. All estimated final cover alternative material quantities are provided in Table 3-3.
5. Earthwork quantities based on VFL Technology Corp. Estimates
   - Earthwork estimates provided by NRT in the original estimate are within 5% of VFL's Earthwork Estimates.
6. Estimate 85,408 yd^3 of ash excavated from Pond A for pozzolanic final cover.
7. Costs for the pozzolanic fly ash cover construction based on estimates provided by VFL Technology Corporation in their letter dated May 9, 2002.

Several line items from *Pozzolanic Fly Ash Final Cover (Initial Estimate)* are incorporated in this estimate as described below:

Line Items: Site Vegetation Clearing (22 acres), Documentation Surveying, and Revegetation (mulch, seed, fertilizer) are included in *Mob./Demob.*

Line Item: Load and Haul to Processing Plant is included in *Excavate Ash From Pond A for Pozzolanic Mix.*

Line Items: Install Beneficial Reuse Ash for Protective Layer, Grain Size Analysis/Geotechnical Testing, and Site Drainage are included in *Install 3.0' Pozzolanic Ash Final Cover* and *Install General Fill to Compete Protective Layer.*

Construction Capital Cost not included in VFL Estimate.

8. Revised reagent cost provided by VFL Technology Corporation in Table #3 dated July 2, 2002 (Appendix C-2) - 3 ft. cover - 16,602 tons of cement and 23,888 tons of black sand. Addition of black sand will reduce the requirement for fly ash excavation by 15,072 cy (wet weight basis, black sand).
9. Above is a preliminary estimate and may be revised if selected for final design - the consulting costs and estimating contingency provided in this spreadsheet are conservative - actual costs may be lower.
10. For ease of comparison to initial pozzolanic fly ash final cover estimate, the same consulting costs, engineering design costs, and estimating contingency have been used.

FINAL COVER ALTERNATIVE: Pozzolanic Fly Ash Final Cover - Mix No. 14
Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

NRT PROJECT NO.: 1375/6.1
BY: CAR CHKD BY: BRH
DATE: 6/27/05 EJT (5/19/05)

CONSULTING CAPITAL COSTS	SUB-TOTAL
Consulting	
Hydrogeologic Evaluation, Engineering Design, System Installation Oversight, Final System Documentatio Geotechnical Evaluation	$500,000
SUBTOTAL, CONSTRUCTION CAPITAL COSTS	$500,000
30% Estimating Contingency	$150,000
TOTAL, CONSULTING CAPITAL COSTS	**$650,000**

CONSTRUCTION CAPITAL COSTS	QUANTITY	UNIT	UNIT COST	ITEM COST	SUB-TOTAL
Construction					$3,589,501
Mob./Demob.	1	LS	$324,108	$324,108	
Site Facilities & Maintenance (Erosion Controls)	1	LS	$8,000	$8,000	
Regrade Stockpiled Ash to Fill Depressions	50,500	CY	$1.97	$99,485	
Excavate Ash From Pond A for Pozzolanic Mix	70,336	CY	$1.81	$127,308	
Blend Ash w/ Reagents to Form Pozzolanic Mix	70,336	CY	$1.86	$130,825	
Place 3.0' Pozzolanic Ash Final Cover	70,336	CY	$1.61	$113,241	
Place Fly Ash From Pond A to Make Grade	120,700	CY	$3.42	$412,794	
Place Rooting Zone to Compete Protective Layer	100,480	CY	$9.31	$935,469	
Additional Construction Items Identified by VFL					
Dewatering	1	LS	$23,951	$23,951	
Soil Additive Cost - FGD Sludge[8]	45,985	TON	$5.00	$229,925	
Reagent Cost - Cement[8]	11,941	TON	$95.00	$1,134,395	
Relocate Sluice Pipes and Supports	1	LS	$50,000	$50,000	
SUBTOTAL, CONSTRUCTION CAPITAL COSTS					$3,589,501
30% Estimating Contingency					$1,076,900
TOTAL, CONSTRUCTION CAPITAL COSTS					**$4,666,401**

TOTAL CAPITAL COSTS (Without Additional Excavation in Pond A)	**$5,316,000**

ASSUMPTIONS

1. Total area of Pond D for final cover estimated at 966,000 SF, approximately 22 acres.
2. Pozzolanic fly ash cover consists of: 3 foot Pozzolanic Fly ash Layer - 3 foot Protective Soil Layer.
3. Mix Design No. 14 - 70% Fly Ash w/ 30% FGD Sludge (wet weight basis) - 10% cement reagent (dry weight basis). See VFL Technology Corp Tables.
4. All estimated final cover alternative material quantities are provided in Table 3-3.
5. Earthwork quantities based on VFL Technology Corp. Estimates
   - Earthwork estimates provided by NRT in the original estimate are within 5% of VFL's Earthwork Estimates.
6. Estimate 70,336 yd^3 of ash excavated from Pond A for pozzolanic final cover.
7. Costs for the pozzolanic fly ash cover construction based on estimates provided by VFL Technology Corporation in their letter dated May 9, 2002.

Several line items from *Pozzolanic Fly Ash Final Cover (Initial Estimate)* are incorporated in this estimate as described below:

Line Items: Site Vegetation Clearing (22 acres), Documentation Surveying, and Revegetation (mulch, seed, fertilizer) are included in *Mob./Demob.*

Line Item: Load and Haul to Processing Plant is included in *Excavate Ash From Pond A for Pozzolanic Mix.*

Line Items: Install Beneficial Reuse Ash for Protective Layer, Grain Size Analysis/Geotechnical Testing, and Site Drainage are included in *Install 3.0' Pozzolanic Ash Final Cover* and *Install General Fill to Compete Protective Layer.*

Construction Capital Cost not included in VFL Estimate.

8. Revised reagent cost provided by VFL Technology Corporation in Table #3 dated July 2, 2002 (Appendix C-2) - 3 ft. cover - 11,941 tons of cement and 45,985 tons of FGD Sludge. Addition of FGD sludge will reduce the requirement for fly ash excavation by 30,111.9 cy (wet weight basis, FGD sludge).
9. Above is a preliminary estimate and may be revised if selected for final design - the consulting costs and estimating contingency provided in this spreadsheet are conservative - actual costs may be lower.
10. For ease of comparison to initial pozzolanic fly ash final cover estimate, the same consulting costs, engineering design costs, and estimating contingency have been used.

LEACHATE MANAGEMENT ALTERNATIVE: Groundwater Extraction Combined with Interceptor/Drain Trench
Leachate Management and Final Cover Alternatives Report   NRT PROJECT NO.: 1375/6.1
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure   BY: CAR   CHKD BY: BRH
Ameren Energy Generating - Hutsonville, Illinois   DATE: 6/27/05

CONSULTING CAPITAL COSTS	SUB-TOTAL
Consulting	
Hydrogeologic Evaluation, Engineering Design, System Installation Oversight, Final System Documentatio	$150,000
SUBTOTAL, CONSTRUCTION CAPITAL COSTS	$150,000
30% Estimating Contingency	$45,000
TOTAL, CONSULTING CAPITAL COSTS	**$200,000**

CONSTRUCTION CAPITAL COSTS	QUANTITY	UNIT	UNIT COST	ITEM COST	SUB-TOTAL
General Construction					$108,000
Design Pump Test	1	LS	$50,000	$50,000	
Mob./Demob.	1	LS	$15,000	$15,000	
Erosion Controls	1	LS	$4,000	$4,000	
Site Vegetation Clearing	1	LS	$5,000	$5,000	
Startup/Testing	1	LS	$20,000	$20,000	
Construction and Documentation Surveying	1	LS	$10,000	$10,000	
Restoration of Disturbed Areas	1	LS	$4,000	$4,000	
Extraction Well Construction					$311,700
Extraction Well Installation	11	WELL	$5,000	$55,000	
Trenching	2,600	LF	$4.00	$10,400	
Underground Piping to Drainage Collection Pond C	2,600	LF	$8.00	$20,800	
Electrical and Control Wiring for Each Well	13,050	LF	$5.00	$65,300	
Pre-Engineering System Enclosure and Foundation	1	LS	$40,000	$40,000	
PLC Control System and Electrical	1	LS	$40,000	$40,000	
Groundwater Extraction Pumps	11	EA	$5,000	$55,000	
Additional Trench Backfill	1,300	TONS	$4.00	$5,200	
Stockpile and Replace Trench Material	4,000	CY	$5.00	$20,000	
South Interceptor/Drain Trench Construction					$143,500
Interceptor Trench Excavation	1,800	CY	$6.00	$10,800	
Install 8.5' Avg. (1") Washed River Rock	2,000	TONS	$12.00	$24,000	
Install 6"' Bentonite Seal	90	TONS	$90.00	$8,100	
Install General Fill to Grade (6.5' Avg.)	750	CY	$4.00	$3,000	
Blend Overburden Trench Spoil Into Existing Grade	1,000	CY	$2.00	$2,000	
Install Leachate Collection Sumps	3	EA	$10,000	$30,000	
Pumps for Drainage Collection Sumps (2 Each)	6	EA	$3,000	$18,000	
6" HDPE Drain Tile For Interceptor Trench	1,000	LF	$6.00	$6,000	
Underground Piping to Interim Pond B	1,450	LF	$8.00	$11,600	
Electrical and Control Wiring for Each Well	6,000	LF	$5.00	$30,000	
SUBTOTAL, CONSTRUCTION CAPITAL COSTS					$563,200
30% Estimating Contingency					$169,000
TOTAL, CONSTRUCTION CAPITAL COSTS					**$730,000**

TOTAL CAPITAL COSTS	**$930,000**

LEACHATE MANAGEMENT ALTERNATIVE: Groundwater Extraction Combined with Interceptor/Drain Trench
Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

NRT PROJECT NO.: 1375/6.1
BY: CAR CHKD BY: BRH
DATE: 6/27/05

					SUB-
ANNUAL COSTS					
Annual O & M Costs					$43,000
O & M Sampling Labor & Equipment	1	LS	$5,000	$5,000	
Discharge Sampling Analytical	1	LS	$3,000	$3,000	
Annual Equipment Maintenance	1	LS	$5,000	$5,000	
Electric Costs	1	LS	$30,000	$30,000	
ANNUAL SUBTOTAL					$43,000
30% Estimating Contingency					$12,900
TOTAL ANNUAL COSTS					**$56,000**

ASSUMPTIONS

1. Leachate collection along east via 11 wells for groundwater extraction - 200 ft. spacings - total flow of approximately 10 to 25 gpm.
2. Leachate collection along south via 1,000 foot long interceptor/drain trench - total flow of approximately 10 to 25 gpm.
3. Trench design consists of 6' to11' washed river rock w/ 6" HDPE drain tile, followed by 6" bentonite seal, backfilled to grade with general fill.
4. This options assumes no treatment of extracted leachate and discharge directly to the Interim Pond and/or the Drainage Collection Pond.
5. Results of further hydrogeological assessment and design pump test could impact size and scope of the leachate collection system.
6. Additional sources of estimated costs: RS Means Site Work & Landscape Cost Data.
7. Above is a preliminary estimate and may be revised if selected for final design.

LEACHATE MANAGEMENT ALTERNATIVE: Groundwater Extraction from Deep Alluvial Aquifer
Leachate Management and Final Cover Alternatives Report NRT PROJECT NO.: 1375/6.1
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure BY: EJT CHKD BY: CAR
Ameren Energy Generating - Hutsonville, Illinois DATE: 6/27/05

CONSULTING CAPITAL COSTS	SUB-TOTAL
Consulting	
Hydrogeologic Evaluation, Engineering Design, System Installation Oversight, Final System Documentatio	$150,000
SUBTOTAL, CONSTRUCTION CAPITAL COSTS	$150,000
30% Estimating Contingency	$45,000
TOTAL, CONSULTING CAPITAL COSTS	**$200,000**

CONSTRUCTION CAPITAL COSTS	QUANTITY	UNIT	UNIT COST	ITEM COST	SUB-TOTAL
General Construction					$108,000
Design Pump Test	1	LS	$50,000	$50,000	
Mob./Demob.	1	LS	$15,000	$15,000	
Erosion Controls	1	LS	$4,000	$4,000	
Site Vegetation Clearing	1	LS	$5,000	$5,000	
Startup/Testing	1	LS	$20,000	$20,000	
Construction and Documentation Surveying	1	LS	$10,000	$10,000	
Restoration of Disturbed Areas	1	LS	$4,000	$4,000	
Extraction Well Construction					$271,200
Extraction Well Installation	5	WELL	$15,000	$75,000	
Trenching	1,950	LF	$4.00	$7,800	
Underground Piping to Drainage Collection Pond C	1,950	LF	$8.00	$15,600	
Electrical and Control Wiring for Each Well	9,750	LF	$5.00	$48,800	
Pre-Engineered System Enclosure and Foundation	1	LS	$40,000	$40,000	
PLC Control System and Electrical	1	LS	$40,000	$40,000	
Groundwater Extraction Pumps	5	EA	$5,000	$25,000	
Additional Trench Backfill	1,000	TONS	$4.00	$4,000	
Stockpile and Replace Trench Material	3,000	CY	$5.00	$15,000	
SUBTOTAL, CONSTRUCTION CAPITAL COSTS					$379,200
30% Estimating Contingency					$113,800
TOTAL, CONSTRUCTION CAPITAL COSTS					**$490,000**
TOTAL CAPITAL COSTS					**$690,000**

ANNUAL COSTS					
Annual O & M Costs					$40,000
O & M Sampling Labor & Equipment	1	LS	$20,000	$20,000	
Discharge Sampling Analytical	1	LS	$5,000	$5,000	
Annual Equipment Maintenance	1	LS	$5,000	$5,000	
Electric Costs	1	LS	$10,000	$10,000	
ANNUAL SUBTOTAL					$40,000
30% Estimating Contingency					$12,000
TOTAL ANNUAL COSTS					**$52,000**

ASSUMPTIONS

1. Groundwater extraction at southeast corner of Pond D via 5 wells - 200 ft. spacings - total flow of approximately 250 gpm.
2. Groundwater extraction not necessary east of MW-6 since existing site geology information suggests that aquifer "pinches out" east of this location.
3. Groundwater extraction not necessary north of MW-7 based upon observed extent of impact to deep alluvium.
4. Annual O&M cost represents average lifecycle cost; actual O&M costs will likely be higher than average initially.
4. This options assumes no treatment of extracted leachate and discharge directly to the Interim Pond and/or the Drainage Collection Pond.
5. Results of further hydrogeological assessment and design pump test could impact size and scope of the leachate collection system.
6. Additional sources of estimated costs: RS Means Site Work & Landscape Cost Data.
7. Above is a preliminary estimate and may be revised if selected for final design.

LEACHATE MANAGEMENT ALTERNATIVE: Interceptor Drain/Trench
Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

NRT PROJECT NO.: 1375/6.1
BY: CAR CHKD BY: BRH
DATE: 6/27/05

CONSULTING CAPITAL COSTS	SUB-TOTAL
Consulting	
Hydrogeologic Evaluation, Engineering Design, System Installation Oversight, Final System Documentatioi	$150,000
SUBTOTAL, CONSTRUCTION CAPITAL COSTS	$150,000
30% Estimating Contingency	$45,000
TOTAL, CONSULTING CAPITAL COSTS	**$200,000**

CONSTRUCTION CAPITAL COSTS	QUANTITY	UNIT	UNIT COST	ITEM COST	SUB-TOTAL
General Construction					$184,600
Design Pump Test	1	LS	$25,000	$25,000	
Mob./Demob.	1	LS	$25,000	$25,000	
Erosion Controls	1	LS	$8,000	$8,000	
Site Vegetation Clearing	1	LS	$10,000	$10,000	
Pre-Engineering System Enclosure and Foundation	1	LS	$40,000	$40,000	
PLC Control System and Electrical	1	LS	$30,000	$30,000	
Blend Overburden Trench Spoil Into Existing Grade	3,300	CY	$2.00	$6,600	
Startup/Testing	1	LS	$20,000	$20,000	
Documentation Surveying	1	LS	$10,000	$10,000	
Restoration of Disturbed Areas	1	LS	$10,000	$10,000	
East Interceptor/Drain Trench Construction					$247,500
Interceptor Trench Excavation	4,800	CY	$6.00	$28,800	
Remove and Replace Sheet Pile Tiebacks (34)	34	EA	$1,000	$34,000	
Install 10' (1") Washed River Rock (Drainage Layer)	4,200	TONS	$12.00	$50,400	
Install 6'" Bentonite Seal	210	TONS	$90.00	$18,900	
Install General Fill to Grade (9.5' Avg)	750	CY	$4.00	$3,000	
Install Leachate Collection Sumps	4	EA	$10,000	$40,000	
Pumps for Drainage Collection Sumps (2 Each)	8	EA	$3,000	$24,000	
6" HDPE Drain Tile For Interceptor Trench	2,300	LF	$6.00	$13,800	
Underground piping to Drainage Collection Pond C	2,200	LF	$8.00	$17,600	
Electrical and Control Wiring for Each Well	3,400	LF	$5.00	$17,000	
South Interceptor/Drain Trench Construction					$141,500
Interceptor Trench Excavation	1,800	CY	$6.00	$10,800	
Install 8.5' Avg. (1") Washed River Rock	2,000	TONS	$12.00	$24,000	
Install 6'" Bentonite Seal	90	TONS	$90.00	$8,100	
Install General Fill to Grade (6.5' Avg.)	750	CY	$4.00	$3,000	
Install Leachate Collection Sumps	3	EA	$10,000	$30,000	
Pumps for Drainage Collection Sumps (2 Each)	6	EA	$3,000	$18,000	
6" HDPE Drain Tile For Interceptor Trench	1,000	LF	$6.00	$6,000	
Underground Piping to Interim Pond B	1,450	LF	$8.00	$11,600	
Electrical and Control Wiring for Each Well	6,000	LF	$5.00	$30,000	
SUBTOTAL, CONSTRUCTION CAPITAL COSTS					$573,600
30% Estimating Contingency					$172,100
TOTAL, CONSTRUCTION CAPITAL COSTS					**$750,000**

TOTAL CAPITAL COSTS	**$950,000**

LEACHATE MANAGEMENT ALTERNATIVE: Interceptor Drain/Trench
Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

NRT PROJECT NO.: 1375/6.1
BY: CAR CHKD BY: BRH
DATE: 6/27/05

					SUB-
ANNUAL COSTS					
Annual O & M Costs					$36,000
O & M Sampling Labor & Equipment	1	LS	$5,000	$5,000	
Discharge Sampling Analytical	1	LS	$3,000	$3,000	
Annual Equipment Maintenance	1	LS	$8,000	$8,000	
Electric Costs	1	LS	$20,000	$20,000	
ANNUAL SUBTOTAL					$36,000
30% Estimating Contingency					$10,800
TOTAL ANNUAL COSTS					**$47,000**

ASSUMPTIONS

1. Leachate collection via a 3,300 foot long Interceptor Drain/Trench sloped (1.0%) to seven collection sumps; total groundwater extraction 10-25 GPM.
2. Trench design consists of 6' to 10' washed river rock w/ 6" HDPE drain tile, followed by 6" bentonite seal, backfilled to grade with general fill.
3. The east trench is designed to extract leachate just above the sandy silt and clay / alluvial sand and gravel interface along the Wabash River.
4. This options assumes no treatment of extracted leachate and discharge directly to the Interim Pond and/or the Drainage Collection Pond.
5. Results of further hydrogeological assessment and design pump test could impact size and scope of the leachate collection system.
6. Additional sources of estimated costs: RS Means Site Work & Landscape Cost Data.
7. Above is a preliminary estimate and may be revised if selected for final design.

LEACHATE MANAGEMENT ALTERNATIVE: Horizontal Wells
Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

NRT PROJECT NO.: 1375/6.1
BY: CAR CHKD BY: BRH
DATE: 6/27/05

CONSULTING CAPITAL COSTS	SUB-TOTAL
Consulting	
Hydrogeologic Evaluation, Engineering Design, System Installation Oversight, Final System Documentatio	$150,000
SUBTOTAL, CONSTRUCTION CAPITAL COSTS	$150,000
30% Estimating Contingency	$45,000
TOTAL, CONSULTING CAPITAL COSTS	**$200,000**

CONSTRUCTION CAPITAL COSTS	QUANTITY	UNIT	UNIT COST	ITEM COST	SUB-TOTAL
General Construction					$118,000
Design Pump Test	1	LS	$50,000	$50,000	
Mob./Demob.	1	LS	$25,000	$25,000	
Erosion Controls	1	LS	$4,000	$4,000	
Site Vegetation Clearing	1	LS	$5,000	$5,000	
Startup/Testing	1	LS	$20,000	$20,000	
Documentation Surveying	1	LS	$10,000	$10,000	
Restoration of Disturbed Areas	1	LS	$4,000	$4,000	
Horizontal Well Construction					$382,800
Horizontal Well Drilling and Installation	2,100	LF	$100.00	$210,000	
Horizontal Well Materials	2,100	LF	$15.00	$31,500	
Pumps for Horizontal Well	5	EA	$5,000	$25,000	
Underground piping to Drainage Collection Pond C	600	LF	$8.00	$4,800	
Electrical and Control Wiring for Each Well	6,250	LF	$5.00	$31,300	
Pre-Engineering System Enclosure and Foundation	1	LS	$40,000	$40,000	
PLC Control System and Electrical	1	LS	$40,000	$40,000	
Blend Overburden Trench Spoil Into Existing Grade	100	CY	$2.00	$200	
South Interceptor/Drain Trench Construction					$143,500
Interceptor Trench Excavation	1,800	CY	$6.00	$10,800	
Install 8.5' Avg. (1") Washed River Rock	2,000	TONS	$12.00	$24,000	
Install 6"' Bentonite Seal	90	TONS	$90.00	$8,100	
Install General Fill to Grade (6.5' Avg.)	750	CY	$4.00	$3,000	
Blend Overburden Trench Spoil Into Existing Grade	1,000	CY	$2.00	$2,000	
Install Leachate Collection Sumps	3	EA	$10,000	$30,000	
Pumps for Drainage Collection Sumps (2 Each)	6	EA	$3,000	$18,000	
6" HDPE Drain Tile For Interceptor Trench	1,000	LF	$6.00	$6,000	
Underground Piping to Interim Pond B	1,450	LF	$8.00	$11,600	
Electrical and Control Wiring for Each Well	6,000	LF	$5.00	$30,000	
SUBTOTAL, CONSTRUCTION CAPITAL COSTS					$644,300
30% Estimating Contingency					$193,300
TOTAL, CONSTRUCTION CAPITAL COSTS					**$840,000**

TOTAL CAPITAL COSTS	**$1,040,000**

LEACHATE MANAGEMENT ALTERNATIVE: Horizontal Wells
Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

NRT PROJECT NO.: 1375/6.1
BY: CAR CHKD BY: BRH
DATE: 6/27/05

					SUB-
ANNUAL COSTS					
Annual O & M Costs					$43,000
O & M Sampling Labor & Equipment	1	LS	$5,000	$5,000	
Discharge Sampling Analytical	1	LS	$3,000	$3,000	
Annual Equipment Maintenance	1	LS	$10,000	$10,000	
Electric Costs	1	LS	$25,000	$25,000	
ANNUAL SUBTOTAL					$43,000
30% Estimating Contingency					$12,900
TOTAL ANNUAL COSTS					**$56,000**

ASSUMPTIONS

1. Leachate collection via (4) 400' horizontal wells and (1) 500' horizontal well with submersible pumps; total groundwater extraction 10-25 GPM.
2. Leachate collection along south via 1,000 foot long interceptor/drain trench - total flow of approximately 10 to 25 gpm.
2. Horizontal well design consists of 8" Dia. HDPE Screen.
3. Horizontal well system installed near the sandy silt and clay / alluvial sand and gravel interface.
4. This options assumes no treatment of extracted leachate and discharge directly to the Interim Pond and/or the Drainage Collection Pond.
5. Results of further hydrogeological assessment and design pump test could impact size and scope of the leachate collection system.
6. Additional sources of estimated costs: RS Means Site Work & Landscape Cost Data.
7. Above is a preliminary estimate and may be revised if selected for final design.

LEACHATE MANAGEMENT ALTERNATIVE: Ash Stabilization		
Leachate Management and Final Cover Alternatives Report	NRT PROJECT NO.: 1375/6.1	
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure	BY: CAR	CHKD BY: BRH
Ameren Energy Generating - Hutsonville, Illinois	DATE: 6/27/05	EJT (5/19/05)

CONSULTING CAPITAL COSTS	SUB-TOTAL
Consulting	
Hydrogeologic Evaluation, Engineering Design, System Installation Oversight, Final System Documentatio	$500,000
SUBTOTAL, CONSTRUCTION CAPITAL COSTS	$500,000
30% Estimating Contingency	$150,000
TOTAL, CONSULTING CAPITAL COSTS	**$650,000**

CONSTRUCTION CAPITAL COSTS	QUANTITY	UNIT	UNIT COST	ITEM COST	SUB-TOTAL
Construction					$14,529,000
Bench Scale / Pilot Testing	1	LS	$50,000	$50,000	
Stabilization Drill Rig Mobilization/Demob.	1	LS	$250,000	$250,000	
Fencing and Erosion Control	1	LS	$20,000	$20,000	
Stabilizing Reagent Materials	280,000	CY	$19.00	$5,320,000	
Treatment Via Shallow Soil Mixing Rig (SSM)	280,000	CY	$30.00	$8,400,000	
Additional Testing/Quality Control	1	LS	$250,000	$250,000	
Regrade Overburden From SSM Treatment	112,000	CY	$2.00	$224,000	
Documentation Surveying	1	LS	$15,000	$15,000	
SUBTOTAL, CONSTRUCTION CAPITAL COSTS					$14,529,000
30% Estimating Contingency					$4,358,700
TOTAL, CONSTRUCTION CAPITAL COSTS					**$18,900,000**

TOTAL CAPITAL COSTS	**$20,000,000**

ASSUMPTIONS

1. Total estimated area for saturated ash: areal extent ~ 790,000 ft^2, average thickness ~ 9.5 ft, average depth to bottom of saturated ash ~ 25 ft.
2. Based on above estimates 280,000 yd^3 (790,000 ft^2 x 9.5 ft) targeted for SSM treatment.
3. This estimate is for stabilization of saturated ash only.
4. See final cover estimates for costs associated with final landfill cover construction less backfill costs (overburden from SSM treatment used for fill).
5. Earthwork quantities based on a 1.6 ton : 1 cubic yard (CY) ratio; all earthwork quantities are approximate and need to be field verified during design.
6. Additional sources of estimated costs: previous ash landfill cover construction, RS Means Site Work & Landscape Cost Data.
7. Above is a preliminary estimate and may be revised if selected for final design.

LEACHATE MANAGEMENT ALTERNATIVE: Ash Removal and Disposal, Recycling, or Beneficial Reuse
Leachate Management and Final Cover Alternatives Report — NRT PROJECT NO.: 1375/6.1
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure — BY: CAR — CHKD BY: BRH
Ameren Energy Generating - Hutsonville, Illinois — DATE: 6/27/05 — EJT (5/19/05)

CONSULTING CAPITAL COSTS	SUB-TOTAL
Consulting	
Hydrogeologic Evaluation, Engineering Design, System Installation Oversight, Final System Documentatio	$500,000
SUBTOTAL, CONSTRUCTION CAPITAL COSTS	$500,000
30% Estimating Contingency	$150,000
TOTAL, CONSULTING CAPITAL COSTS	**$650,000**

CONSTRUCTION CAPITAL COSTS	QUANTITY	UNIT	UNIT COST	ITEM COST	SUB-TOTAL
Construction					$17,345,000
Mob./Demob.	1	LS	$50,000.00	$50,000	
Site Facilities & Maintenance	1	LS	$8,000.00	$8,000	
Site Vegetation Clearing (22 acres)	22	ACRES	$1,000.00	$22,000	
Excavate Ash Overburden & Stockpile	550,000	CY	$4.00	$2,200,000	
Excavate Saturated Ash via Mudcat & Stockpile	280,000	CY	$7.00	$1,960,000	
Surface Water / Drainage Control / Erosion Controls	1	LS	$100,000.00	$100,000	
Import General Fill, Place & Compact	430,000	CY	$8.40	$3,612,000	
Off-Site Disposal/Recycling of Saturated Ash	280,000	CY	$25.50	$7,140,000	
Overburden Ash Replacement/Compaction/Regrade	550,000	CY	$4.00	$2,200,000	
Grain Size Analysis/Geotechnical Testing	1	LS	$16,000.00	$16,000	
Documentation Surveying	1	LS	$15,000.00	$15,000	
Revegetation (mulch, seed, fertilizer)	22	ACRES	$1,000.00	$22,000	
SUBTOTAL, CONSTRUCTION CAPITAL COSTS					$17,345,000
30% Estimating Contingency					$5,203,500
TOTAL, CONSTRUCTION CAPITAL COSTS					**$22,500,000**

TOTAL CAPITAL COSTS	**$23,000,000**

ASSUMPTIONS

1. Total estimated area for saturated ash: areal extent ~ 790,000 ft^2, average thickness ~ 9.5 ft, average depth to bottom of saturated ash ~ 25 ft (Table 3-2).
2. Based on above estimates: 280,000 yd^3 saturated ash (790,000 ft^2 x 9.5 ft); 550,000 yd^3 overburden ash (790,000 ft^2 x 15.5 ft+ 80,000 yd^3 - 2004 transfer) targeted for excavation (Table 3-2).
3. Estimate includes removal of saturated ash and replacement with clean fill to approximately 5 feet above the static water table ~ 430,000 yd^3.
4. Excavated saturated ash to be stockpiled, dried and disposed/recycled off-site; overburden ash to be replaced atop clean fill.
5. See landfill cap estimates for costs associated with final landfill cover construction less backfill costs (placement of additional fill will raise grade).
6. Earthwork quantities based on a 1.6 ton : 1 cubic yard (CY) ratio; all earthwork quantities are approximate and need to be field verified during design.
7. Based on numbers discussed during 6-15-01 meeting including: $4.00/ton to haul clean fill on-site.
8. Off-site disposal/recycling of ash cost based on previous cost estimates prepared by Hutsonville Power Station personnel for similar off-site disposal ($7.00/ton transportation, $7.40/ton disposal, $1.50/ton loading @ 1.6 tons/yd^3 ~ $25.50/$yd^3$).
   This cost could significantly increase with variable landfill pricing.
9. Additional sources of estimated costs: previous ash landfill cover construction, RS Means Site Work & Landscape Cost Data.
10. Above is a preliminary estimate and may be revised if selected for final design.

LEACHATE MANAGEMENT ALTERNATIVE: Ash Removal and Off-Site Disposal

Leachate Management and Final Cover Alternatives Report	NRT PROJECT NO.: 1375/6.1
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure	BY: CAR CHKD BY: BRH
Ameren Energy Generating - Hutsonville, Illinois	DATE: 6/27/05 EJT (5/19/05)

CONSULTING CAPITAL COSTS	SUB-TOTAL
Consulting	
Hydrogeologic Evaluation, Engineering Design, System Installation Oversight, Final System Documentatioı	$500,000
SUBTOTAL, CONSTRUCTION CAPITAL COSTS	$500,000
30% Estimating Contingency	$150,000
TOTAL, CONSULTING CAPITAL COSTS	**$650,000**

CONSTRUCTION CAPITAL COSTS	QUANTITY	UNIT	UNIT COST	ITEM COST	SUB-TOTAL
Construction					$25,558,000
Mob./Demob.	1	LS	$50,000.00	$50,000	
Site Facilities & Maintenance	1	LS	$8,000.00	$8,000	
Site Vegetation Clearing (22 acres)	22	ACRES	$1,000.00	$22,000	
Excavate Ash & Stockpile	550,000	CY	$4.00	$2,200,000	
Excavate Saturated Ash via Mudcat & Stockpile	280,000	CY	$7.00	$1,960,000	
Surface Water / Drainage Control / Erosion Controls	1	LS	$100,000.00	$100,000	
Off-Site Disposal/Recycling of Ash	830,000	CY	$25.50	$21,165,000	
Grain Size Analysis/Geotechnical Testing	1	LS	$16,000.00	$16,000	
Documentation Surveying	1	LS	$15,000.00	$15,000	
Revegetation (mulch, seed, fertilizer)	22	ACRES	$1,000.00	$22,000	
SUBTOTAL, CONSTRUCTION CAPITAL COSTS					$25,558,000
30% Estimating Contingency					$7,667,400
TOTAL, CONSTRUCTION CAPITAL COSTS					**$33,200,000**

TOTAL CAPITAL COSTS	**$34,000,000**

ASSUMPTIONS

1. Total estimated area for saturated ash: areal extent ~ 790,000 ft^2, average thickness ~ 9.5 ft, average depth to bottom of saturated ash ~ 25 ft.
2. Based on above estimates: 280,000 yd^3 saturated ash (790,000 ft^2 x 9.5 ft)
3. Total estimated area for ash: areal extent ~ (22 acres) 966,000 ft^2, average thickness estimated from Geoprobe boring logs (20.9 feet).
4. Based on above estimates: 830,000 yd^3 ash (966,000 ft^2 x average thickness [20.9 feet] + 80,000 yd^3 ash transfer in 2004).
5. Estimate includes removal of dry ash (550,000 yd^3) and saturated ash (280,000 yd^3).
6. All estimated areas and volumes are provided in Table 3-2.
7. Excavated ash and saturated ash to be stockpiled, dried and disposed/recycled off-site
8. This estimate does not include replacement of clean fill to an elevation above the static water table.
9. Earthwork quantities based on a 1.6 ton : 1 cubic yard (CY) ratio; all earthwork quantities are approximate and need to be field verified during design.
10. Off-site disposal/recycling of ash cost based on previous cost estimates prepared by Hutsonville Power Station personnel for similar off-site disposal ($7.00/ton transportation, $7.40/ton disposal, $1.50/ton loading @ 1.6 tons/yd^3 ~ $25.50/$yd^3$).
    This cost could significantly increase with variable landfill pricing.
11. Additional sources of estimated costs: previous final cover construction, RS Means Site Work & Landscape Cost Data.
12. Above is a preliminary estimate and may be revised if selected for final design.

LEACHATE MANAGEMENT ALTERNATIVE: Interceptor Drain/Trench (South Alignment Only)

Leachate Management and Final Cover Alternatives Report	NRT PROJECT NO.: 1375/6.1	
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure	BY: CAR	CHKD BY: BRH
Ameren Energy Generating - Hutsonville, Illinois	DATE: 6/27/05	

CONSULTING CAPITAL COSTS	SUB-TOTAL
Consulting	
Hydrogeologic Evaluation, Engineering Design, System Installation Oversight, Final System Documentation	$70,000
SUBTOTAL, CONSTRUCTION CAPITAL COSTS	$70,000
30% Estimating Contingency	$21,000
TOTAL, CONSULTING CAPITAL COSTS	**$90,000**

CONSTRUCTION CAPITAL COSTS	QUANTITY	UNIT	UNIT COST	ITEM COST	SUB-TOTAL
South Interceptor/Drain Trench Construction					$281,500
Design Pump Test	1	LS	$15,000	$15,000	
Mob./Demob.	1	LS	$20,000	$20,000	
Erosion Controls	1	LS	$4,000	$4,000	
Site Vegetation Clearing	1	LS	$5,000	$5,000	
Pre-Engineering System Enclosure and Foundation	1	LS	$40,000	$40,000	
PLC Control System and Electrical	1	LS	$30,000	$30,000	
Blend Overburden Trench Spoil Into Existing Grades	1,000	CY	$2.00	$2,000	
Startup/Testing	1	LS	$15,000	$15,000	
Documentation Surveying	1	LS	$5,000	$5,000	
Restoration of Disturbed Areas	1	LS	$4,000	$4,000	
Interceptor Trench Excavation	1,800	CY	$6.00	$10,800	
Install 8.5' Avg. (1") Washed River Rock	2,000	TONS	$12.00	$24,000	
Install 6"' Bentonite Seal	90	TONS	$90.00	$8,100	
Install General Fill to Grade (6.5' Avg.)	750	CY	$4.00	$3,000	
Install Leachate Collection Sumps	3	EA	$10,000	$30,000	
Pumps for Drainage Collection Sumps (2 Each)	6	EA	$3,000	$18,000	
6" HDPE Drain Tile For Interceptor Trench	1,000	LF	$6.00	$6,000	
Underground Piping to Interim Pond B	1,450	LF	$8.00	$11,600	
Electrical and Control Wiring for Each Well	6,000	LF	$5.00	$30,000	
SUBTOTAL, CONSTRUCTION CAPITAL COSTS					$281,500
30% Estimating Contingency					$84,500
TOTAL, CONSTRUCTION CAPITAL COSTS					**$370,000**

TOTAL CAPITAL COSTS	**$460,000**

ANNUAL COSTS					
Annual O & M Costs					$23,000
O & M Sampling Labor & Equipment	1	LS	$5,000	$5,000	
Discharge Sampling Analytical	1	LS	$3,000	$3,000	
Annual Equipment Maintenance	1	LS	$5,000	$5,000	
Electric Costs	1	LS	$10,000	$10,000	
ANNUAL SUBTOTAL					$23,000
30% Estimating Contingency					$6,900
TOTAL ANNUAL COSTS					**$30,000**

ASSUMPTIONS

1. Leachate collection along south via 1,000 foot long interceptor/drain trench - total flow of approximately 10 to 25 gpm.
2. Trench design consists of 6' to 11' washed river rock w/ 6" HDPE drain tile, followed by 6" bentonite seal, backfilled to grade with general fill.
3. This options assumes no treatment of extracted leachate and discharge directly to the Interim Pond.
4. Results of further hydrogeological assessment and design pump test could impact size and scope of the leachate collection system.
5. Additional sources of estimated costs: RS Means Site Work & Landscape Cost Data.
6. Above is a preliminary estimate and may be revised if selected for final design.

FINAL COVER ALTERNATIVE: Geosynthetic Final Cover

Leachate Management and Final Cover Alternatives Report	NRT PROJECT NO.: 1375/6.1
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure	BY: CAR CHKD BY: BRH
Ameren Energy Generating - Hutsonville, Illinois	DATE: 6/27/05 EJT (5/19/05)

CONSULTING CAPITAL COSTS	SUB-TOTAL
Consulting	
Hydrogeologic Evaluation, Engineering Design, System Installation Oversight, Final System Documentatioi	$400,000
SUBTOTAL, CONSTRUCTION CAPITAL COSTS	$400,000
30% Estimating Contingency	$120,000
TOTAL, CONSULTING CAPITAL COSTS	**$520,000**

CONSTRUCTION CAPITAL COSTS	QUANTITY	UNIT	UNIT COST	ITEM COST	SUB-TOTAL
Construction					$3,602,300
Mob./Demob.	1	LS	$25,000	$25,000	
Site Facilities & Maintenance (Erosion Controls)	1	LS	$8,000	$8,000	
Site Vegetation Clearing (22 acres)	22	ACRES	$1,000	$22,000	
Regrade Stockpiled Ash to Fill Depressions	50,500	CY	$2.00	$101,000	
4" Bedding Layer for PVC (Silty Sand)	12,000	CY	$12.00	$144,000	
Install 30 mil PVC Geomembrane Cover	966,000	SF	$0.23	$222,200	
Install 200 mil Geocomposite Drainage Layer	966,000	SF	$0.28	$270,500	
Place Rooting Zone to Complete Protective Layer	105,400	CY	$8.40	$885,400	
Place Beneficial Reuse Ash to Construct Grade	20,000	CY	$4.00	$80,000	
Place General Fill to Construct Grade	206,100	CY	$8.40	$1,731,200	
Grain Size Analysis/Geotechnical Testing	1	LS	$10,000	$10,000	
Site Drainage/piping	22	ACRES	$3,000	$66,000	
Documentation Surveying	1	LS	$15,000	$15,000	
Revegetation (mulch, seed, fertilizer)	22	ACRES	$1,000	$22,000	
SUBTOTAL, CONSTRUCTION CAPITAL COSTS					$3,602,300
30% Estimating Contingency					$1,080,700
TOTAL, CONSTRUCTION CAPITAL COSTS					**$4,700,000**

TOTAL CAPITAL COSTS	**$5,200,000**

ASSUMPTIONS

1. Total area of Pond D for final cover estimated at 966,000 SF, approximately 22 acres.
2. Geosynthetic Cover consists of: 4" Bedding layer - 30 mil PVC Geomembrane - 200 mil Geocomposite Drainage Layer - 3 foot Protective Soil Layer.
3. All estimated final cover alternative material quantities are provided in Table 3-3.
4. Earthwork quantities based on a 1.6 ton : 1 cubic yard (CY) ratio; all earthwork quantities are approximate and need to be field verified during design.
5. Above costs based on numbers discussed during 6-15-01 meeting including: $4.00/ton to haul clean fill on-site.
6. Additional sources of estimated costs: previous final cover construction, RS Means Site Work & Landscape Cost Data.
7. Above is a preliminary estimate and may be revised if selected for final design.

FINAL COVER ALTERNATIVE: Compacted Clay Final Cover
Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

NRT PROJECT NO.: 1375/6.1
BY: CAR CHKD BY: BRH
DATE: 6/27/05 EJT (5/19/05)

CONSULTING CAPITAL COSTS	SUB-TOTAL
Consulting	
Hydrogeologic Evaluation, Engineering Design, System Installation Oversight, Final System Documentatioı	$450,000
SUBTOTAL, CONSTRUCTION CAPITAL COSTS	$450,000
30% Estimating Contingency	$135,000
TOTAL, CONSULTING CAPITAL COSTS	**$590,000**

CONSTRUCTION CAPITAL COSTS	QUANTITY	UNIT	UNIT COST	ITEM COST	SUB-TOTAL
Construction					$3,802,400
Mob./Demob.	1	LS	$25,000	$25,000	
Site Facilities & Maintenance (Erosion Controls)	1	LS	$8,000	$8,000	
Site Vegetation Clearing (22 acres)	22	ACRES	$1,000	$22,000	
Regrade Stockpiled Ash to Fill Depressions	50,500	CY	$2.00	$101,000	
Place Beneficial Reuse Ash for Protective Layer	20,000	CY	$4.00	$80,000	
Place Rooting Zone to Complete Protective Layer	85,400	CY	$8.40	$717,400	
Clay - Purchased, Delivered and Installed (3.0')	105,400	CY	$16.50	$1,739,100	
Place General Fill to Construct Grade	120,700	CY	$8.40	$1,013,900	
Grain Size Analysis/Geotechnical Testing	1	LS	$15,000	$15,000	
Site Drainage	22	ACRES	$2,000	$44,000	
Documentation Surveying	1	LS	$15,000	$15,000	
Revegetation (mulch, seed, fertilizer)	22	ACRES	$1,000	$22,000	
SUBTOTAL, CONSTRUCTION CAPITAL COSTS					$3,802,400
30% Estimating Contingency					$1,140,700
TOTAL, CONSTRUCTION CAPITAL COSTS					**$4,900,000**

TOTAL CAPITAL COSTS	**$5,500,000**

ASSUMPTIONS
1. Total area of Pond D for final cover estimated at 966,000 SF, approximately 22 acres.
2. Compacted Clay cover consists of: 3 foot Compacted Clay Layer - 3 foot Protective Soil Layer.
3. All estimated final cover alternative material quantities are provided in Table 3-3.
4. Earthwork quantities based on a 1.6 ton : 1 cubic yard (CY) ratio; all earthwork quantities are approximate and need to be field verified during design.
5. Above costs based on numbers discussed during 6-15-01 meeting including: $4.00/ton to haul clean fill on-site.
6. Additional sources of estimated costs: previous final cover construction, RS Means Site Work & Landscape Cost Data.

FINAL COVER ALTERNATIVE: Earthen Final Cover
Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

NRT PROJECT NO.: 1375/6.1
BY: CAR CHKD BY: BRH
DATE: 6/27/05 EJT (5/19/05)

CONSULTING CAPITAL COSTS	SUB-TOTAL
Consulting	
Hydrogeologic Evaluation, Engineering Design, System Installation Oversight, Final System Documentatioı	$250,000
SUBTOTAL, CONSTRUCTION CAPITAL COSTS	$250,000
30% Estimating Contingency	$75,000
TOTAL, CONSULTING CAPITAL COSTS	**$330,000**

CONSTRUCTION CAPITAL COSTS	QUANTITY	UNIT	UNIT COST	ITEM COST	SUB-TOTAL
Construction					$3,001,900
Mob./Demob.	1	LS	$25,000	$25,000	
Site Facilities & Maintenance (Erosion Controls)	1	LS	$8,000	$8,000	
Site Vegetation Clearing (22 acres)	22	ACRES	$1,000	$22,000	
Regrade Stockpiled Ash to Fill Depressions	50,500	CY	$2.00	$101,000	
Place Drainage Layer (6" Clean Sand)	17,600	CY	$12.00	$211,200	
Place Rooting Zone for Protective Layer	87,800	CY	$8.40	$737,500	
Place Beneficial Reuse Ash to Make Grade	20,000	CY	$4.00	$80,000	
Place General Fill to Construct Grade	206,100	CY	$8.40	$1,731,200	
Grain Size Analysis/Geotechnical Testing	1	LS	$5,000	$5,000	
Site Drainage	22	ACRES	$2,000	$44,000	
Documentation Surveying	1	LS	$15,000	$15,000	
Revegetation (mulch, seed, fertilizer)	22	ACRES	$1,000	$22,000	
SUBTOTAL, CONSTRUCTION CAPITAL COSTS					$3,001,900
30% Estimating Contingency					$900,600
TOTAL, CONSTRUCTION CAPITAL COSTS					**$3,900,000**

TOTAL CAPITAL COSTS	**$4,200,000**

ASSUMPTIONS

1. Total area of Pond D for final cover estimated at 966,000 SF, approximately 22 acres.
2. Earthen Cover Consists of: 6" Sand Drainage Layer (Capillary Barrier) - 2.5 foot Protective Soil Layer.
3. All estimated final cover alternative material quantities are provided in Table 3-3.
4. Earthwork quantities based on a 1.6 ton : 1 cubic yard (CY) ratio; all earthwork quantities are approximate and need to be field verified during design.
5. Above costs based on numbers discussed during 6-15-01 meeting including: $4.00/ton to haul clean fill on-site.
6. Additional sources of estimated costs: previous final cover construction, RS Means Site Work & Landscape Cost Data.

FINAL COVER ALTERNATIVE: Pozzolanic Fly Ash Final Cover (Initial Estimate)
Leachate Management and Final Cover Alternatives Report — NRT PROJECT NO.: 1375/6.1
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure — BY: CAR — CHKD BY: BRH
Ameren Energy Generating - Hutsonville, Illinois — DATE: 6/27/05 — EJT (5/19/05)

CONSULTING CAPITAL COSTS	SUB-TOTAL
Consulting	
Hydrogeologic Evaluation, Engineering Design, System Installation Oversight, Final System Documentatioı	$500,000
SUBTOTAL, CONSTRUCTION CAPITAL COSTS	$500,000
30% Estimating Contingency	$150,000
TOTAL, CONSULTING CAPITAL COSTS	**$650,000**

CONSTRUCTION CAPITAL COSTS	QUANTITY	UNIT	UNIT COST	ITEM COST	SUB-TOTAL
Construction					$3,038,800
Mob./Demob.[7]	1	LS	$150,000	$150,000	
Site Facilities & Maintenance (Erosion Controls)	1	LS	$8,000	$8,000	
Site Vegetation Clearing (22 acres)	22	ACRES	$1,000	$22,000	
Regrade Stockpiled Ash to Fill Depressions	50,500	CY	$2.00	$101,000	
Excavate Ash From Pond A for Pozzolanic Mix [7]	102,900	CY	$3.10	$319,000	
Load and Ash Haul to Processing Plant[7]	102,900	CY	$1.85	$190,400	
Blend Ash w/ Reagents to Form Pozzolanic Mix [7]	105,400	CY	$5.50	$579,700	
Place 3.0' Pozzolanic Ash Final Cover [7]	105,400	CY	$2.85	$300,400	
Place Beneficial Reuse Ash for Protective Layer	20,000	CY	$4.00	$80,000	
Place Rooting Zone to Compete Protective Layer	85,400	CY	$8.40	$717,400	
Place Fly Ash From Pond A to Make Grade	120,700	CY	$3.81	$459,900	
Grain Size Analysis/Geotechnical Testing	1	LS	$30,000	$30,000	
Site Drainage	22	ACRES	$2,000	$44,000	
Documentation Surveying	1	LS	$15,000	$15,000	
Revegetation (mulch, seed, fertilizer)	22	ACRES	$1,000	$22,000	
SUBTOTAL, CONSTRUCTION CAPITAL COSTS					$3,038,800
30% Estimating Contingency					$911,600
TOTAL, CONSTRUCTION CAPITAL COSTS					**$4,000,000**

TOTAL CAPITAL COSTS	**$4,700,000**

ASSUMPTIONS

1. Total area of Pond D for final cover estimated at 966,000 SF, approximately 22 acres.
2. Pozzolanic flyash cover consists of: 3 foot Pozzolanic Flyash Layer - 3 foot Protective Soil Layer.
3. All estimated final cover alternative material quantities are provided in Table 3-3.
4. Earthwork quantities based on a 1.6 ton : 1 cubic yard (CY) ratio; all earthwork quantities are approximate and need to be field verified during design.
5. Above costs based on numbers discussed during 6-15-01 meeting including: $4.00/ton to haul clean fill on-site.
6. 102,900 yd^3 of ash excavated from Pond A.
7. Costs for the pozzolanic flyash cover construction partially based on rough estimates provided by VFL Technology Corporation - Pre-Bench Study.
8. Additional sources of estimated costs: previous final cover construction, RS Means Site Work & Landscape Cost Data.
9. Above is a preliminary estimate and may be revised if selected for final design.

APPENDIX C

TREATABILITY STUDY FOR A POZZOLANIC FINAL COVER SYSTEM

APPENDIX C-2

VFL COST DATA

TABLE #3

HUTSONVILLE POWER, AMERNEN ENERGY
CONCEPTUAL REAGENT COST PER YARD OF MIX

Mix	Mix Design %[4]							Solids	Density		Mix	*150720 yards required* *5% Grade* 4.5' Cap					*100480 yards required* *5% Grade* 3' Cap				
Number	Fly Ash (Comp 1-6)	Soil[3] (Black Sand)	FGD Sludge[2] (Hoosier Energy)	Cement (Lafarge)	C Ash (Newton)	FBR (ADM)	Q-lime (Miss.)	Initial (%)	Wet (lbs/ft^3)	Dry (lbs/ft^3)	Density (T/yd3)	Reagent Tons	Soil Tons	Scrubber Tons	Additive Cost per YD3	Total Reagent Cost	Reagent Tons	Soil Tons	Scrubber Tons	Additive Cost per YD3	Total Reagent Cost
1	100	0		10.0				81.5	116.0	94.5	1.57	19236	0	0	$12.12	$1,827,443	12824	0	0	$12.12	$1,218,295
2	100	0		5.0				80.3	116.5	93.5	1.57	9517	0	0	$6.00	$904,148	6345	0	0	$6.00	$602,766
3	100	0			15.0			82.3	113.4	93.3	1.53	28485	0	0	$1.32	$199,392	18990	0	0	$1.32	$132,928
4	100	0			30.0			83.5	107.5	89.8	1.45	54792	0	0	$2.54	$383,547	36528	0	0	$2.54	$255,698
5	100	0				10.0		82.2	106.4	87.5	1.44	17796	0	0	$2.83	$427,100	11864	0	0	$2.83	$284,733
6	100	0				20.0		84.3	97.7	82.4	1.32	33516	0	0	$5.34	$804,393	22344	0	0	$5.34	$536,262
7	100	0					10.0	81.1	107.1	86.9	1.45	17673	0	0	$11.14	$1,678,953	11782	0	0	$11.14	$1,119,302
8	100	0					5.0	80.5	113.4	91.2	1.53	9283	0	0	$5.85	$881,893	6189	0	0	$5.85	$587,929
9	85	15		6.3				83.5	114.2	95.4	1.54	12224	34855	0	$9.31	$1,402,872	8149	23237	0	$9.31	$935,248
10	85	15		12.5				83.4	117.4	97.9	1.58	24903	35831	0	$15.70	$2,365,769	16602	23888	0	$15.70	$1,577,180
11	85	15					6.3	83.5	110.7	92.4	1.49	11849	33787	0	$7.47	$1,125,649	7899	22524	0	$7.47	$750,433
12	85	15					10.0	81.9	113.1	92.6	1.53	18847	34519	0	$11.88	$1,790,502	12565	23013	0	$11.88	$1,193,668
13	70		30	5.0				77.3	112.4	86.9	1.52	8839	0	68605	$7.85	$1,182,687	5892	0	45736	$7.85	$788,458
14	70		30	10.0				77.9	113.0	88.0	1.53	17911	0	68977	$13.58	$2,046,433	11941	0	45985	$13.58	$1,364,289
15	70		30				6.6	79.9	114.2	91.2	1.54	12254	0	69710	$10.04	$1,512,634	8169	0	46473	$10.04	$1,008,422
16	70		30				10.0	81.1	112.4	91.2	1.52	18548	0	68611	$13.97	$2,105,092	12365	0	45741	$13.97	$1,403,395

Note: All mixes performed on composite of decanted ash (No. A1-A6).
Stockpile time for all mixes was 30 minutes.

[1] UCS strength data is average of 2 cylinders.

[2] FGD Sludge added on a wet weight basis to ash.

[3] Soil added on a wet weight basis to ash.

[4] Reagents added on a dry weight basis to soil - fly ash and sludge - fly ash blends.

[5] Reagent costs are estimated

[6] Mixes 1,2,5 and 9 are the best mix possibilities at this point. Two mixes will be selected for 30-day permeability from mixes 11-16.

Reagent	$/ton
Cement	95
Lime	95
Soil	7
Scrubber Sludge -est	5
FBR	24
Class C Ash	7

APPENDIX C-1

CONCEPTUAL DEVEOPMENT OF POZZOLANIC CAP FOR CLOSURE OF BASIN D AT THE HUTSONVILLE POWER STATION

Conceptual Development
Of a Pozzolanic Cap
For the
Closure of
Basin D at the
Hutsonville Power Station

VFL Technology Corp.
16 Hagerty Boulevard
West Chester, Pennsylvania 19382
(610) 918-1100 - PHONE
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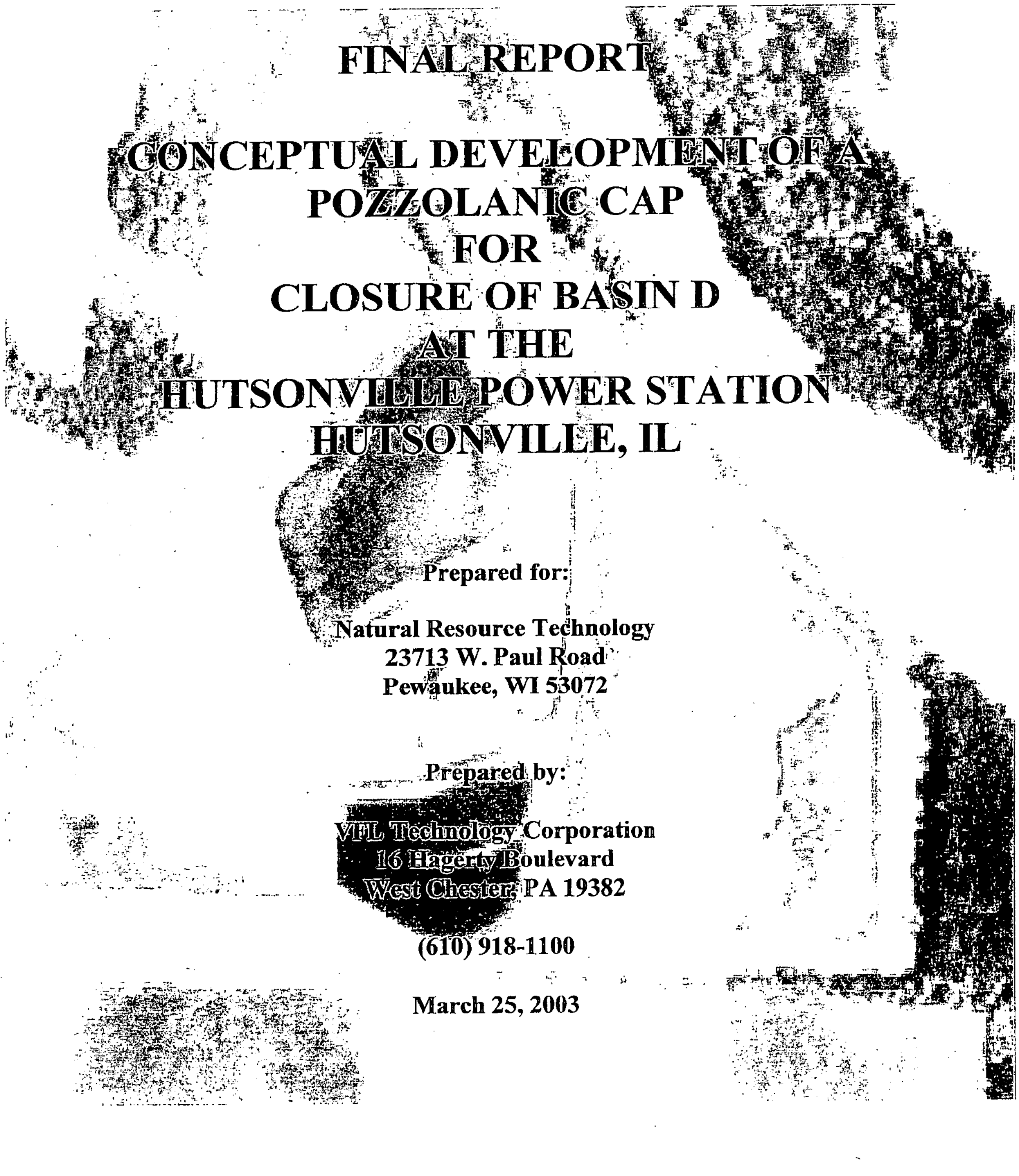

FINAL REPORT

CONCEPTUAL DEVELOPMENT OF A POZZOLANIC CAP FOR CLOSURE OF BASIN D AT THE HUTSONVILLE POWER STATION HUTSONVILLE, IL

Prepared for:

Natural Resource Technology
23713 W. Paul Road
Pewaukee, WI 53072

Prepared by:

VFL Technology Corporation
16 Hagerty Boulevard
West Chester, PA 19382

(610) 918-1100

March 25, 2003

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4.4 MIX DESIGN PERFORMANCE TESTING

5 EXRAPOLATION TO FULL-SCALE OPERATIONS

APPENDIX

Final Report

Conceptual Development of a Pozzolanic Cap for the Closure of Basin D at the Hutsonville Power Station

1.0 Background

Basin D at the Hutsonville Power Station (Photo #1) is an inactive ash disposal area that will be closed under Illinois Title 35 Part 811. Natural Resource Technology (NRT), Pewaukee, Wisconsin, contracted the services of VFL Technology Corp. (VFL) to determine the feasibility of developing a concept for the creation, manufacture, and placement of a pozzolanic cap for Basin D.

The purpose of this report is to present a final summary of the information, findings and test results that have been generated for the conceptual development of the pozzolanic cap for the closure of Basin D at the Hutsonville Power Station in Hutsonville Illinois.

The Program Goals of this study were to:

- Attempt to develop a pozzolanic cap material that would achieve a permeability of 1 x 10^{-7}cm/sec, have an unconfined compressive strength of approximately 150 psi, and have minimal cracking after placement.
- Develop a pozzolanic material that is environmentally acceptable and minimizes leaching.
- If the 1 x 10^{-7}cm/sec permeability goal is unrealistic or unachievable with these materials, estimate the most realistic performance of these materials under field conditions.
- Produce a cost-effective pozzolanic cap material that can be easily handled and placed with common earth moving equipment.

To accomplish these goals, VFL and NRT developed a scope of work for the project. VFL employed the help of GeoSystems Consultants Inc. (GeoSystems) to assist with the geotechnical engineering portion of the program. The scope of work basically included:

- A field assessment of the site (VFL and GeoSystems);
- A review of existing geotechnical data of the site to determine if additional information is needed to finalize the cap design and construction (GeoSystems).

PHOTO 1 Hutsonville Power Station Basins A and D

- Collect samples of the Basin materials (VFL);
- Conduct a treatability study to determine if a pozzolanic cap can be developed to meet the current design guidelines for closure cap construction and develop an operational approach to construct the cap (VFL); and
- Conceptual development of the basic cap design, appearance and estimated volumes of material to be used in the cap construction (GeoSystems).

On March 5 and 6, 2002, representatives of VFL and GeoSystems visited the Hutsonville site. Samples from basins A and D were collected, and existing geotechnical data was reviewed. The Hutsonville ash samples were tested at VFL's Corporate laboratory in West Chester Pa. using a variety of locally available stabilization reagents.

2.0 Overall Program Conclusions

- The preliminary geotechnical evaluation indicates that the construction of a pozzolanic cap is feasible; however, some additional, more refined analyses are needed to finalize the engineering and design of the cap system.

- The results of the Treatability Study program show that it is feasible to construct a structurally stable, environmentally acceptable Pozzolanic Cap and use this cap in the final closure of Basin D at the Huntsville Power Station. Although the permeability results do not meet the original goal of 1×10^{-7}cm/sec, the results of several mixes are in the mid to low 10^{-7}cm/sec range.

- By using Basin A ash as a construction material for the pozzolanic cap, approximately 160,000 yds^3 of ash can be utilized; 100,000yd^3 as a pozzolanic final cover and 60,000yd^3 to adjust the Basin A final slopes.

- All of the mixes that were considered potential candidates for cap construction easily met the unconfined compressive strength goal of 150 psi.

3.0 Geotechnical Investigation

As indicated above, the geotechnical data review, conceptual design, material volume estimates, preliminary settlement and slope stability analyses were conducted by GeoSystems. The report of their findings and analyses has been included in Appendix 1 of this report.

In summary, GeoSystems believes the construction of a pozzolanic cap is feasible and will be an effective system.

An overview of the conclusions of the GeoSystems report indicate:

- .... A parametric analysis varying cap permeability from1 x 10^{-5}cm/sec to 1 x 10^{-7}cm/sec yielded "effectiveness" ranging from 78% to 97%........
- .....As the slope of the final cover increases from 1% to 5%, the volume of regrading reduces from 110,000yds^3 to 75,000 yds^3 ......
- .....With a 5% slope, the volume of ash fill material needed from Basin A is estimated to be 160,000 yds^3 ....
- .....The volume of the pozzolanic cap (3 feet thick) is estimated to be 100,000 yds^3 and varies little as the slope varies from 1% to 5%.........

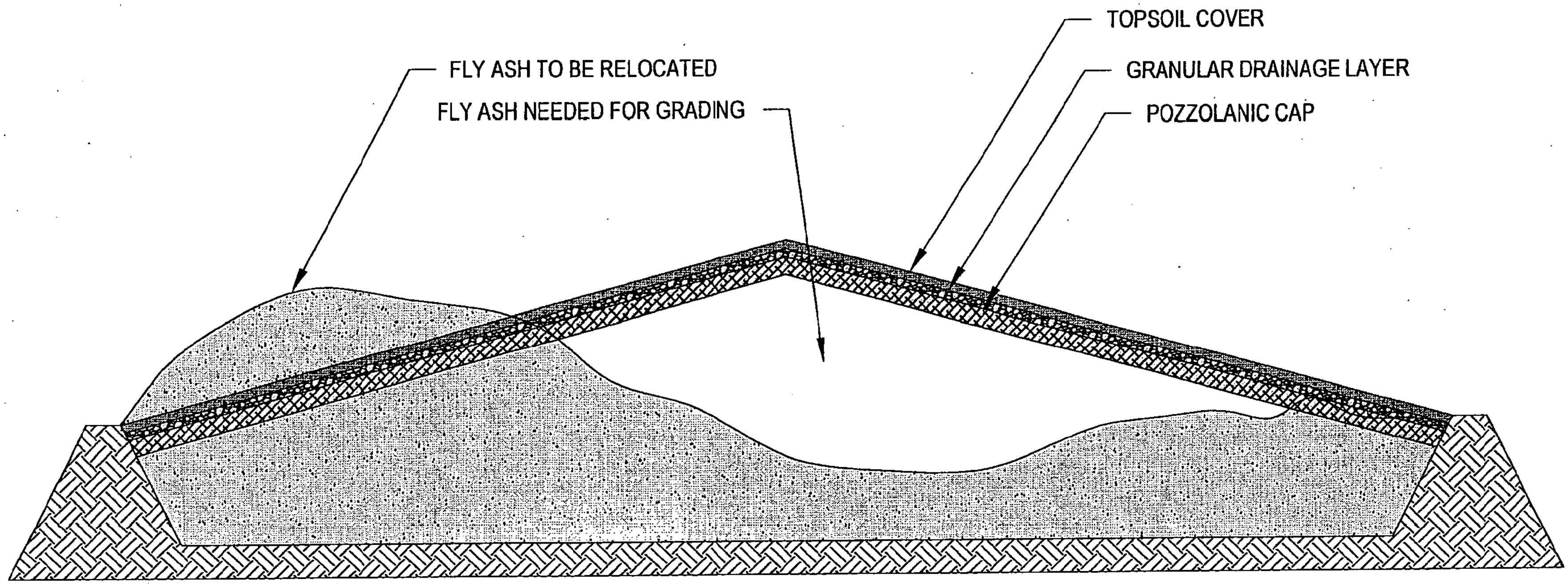
A graphical presentation of a conceptual, representative cross section of Basin D showing the cap design, regrading requirements, needed fly ash fill material from Basin A, etc. was developed by GeoSystems (part of GeoSystems report - see Appendix 1) and has been included here as Figure 1 for reference purposes.

4.0 Treatability Study

A few "Performance Goals" were established for the final pozzolanic cap material. The intent was to see if the stabilized materials could meet the existing cap design specifications, and if not, determine how well they performed against these existing specifications. The "Performance Goals" for this project were to:

- Develop a permeability of 1 x 10^{-7}cm/sec, or determine how close the stabilized materials can realistically come to these specifications.
- Develop approximately 150 psi unconfined compressive strength;
- Attempt to develop a cost-effective mix design that can be easily implemented and constructed in the field;
- Minimize cracking; and
- Develop a cap system that was environmentally acceptable (minimizes leaching).

VFL's treatability study can be broken down into four basic areas: Raw Materials Characterization; Reagents; Mix Design Development and Mix Design Performance Testing. Each of these areas is discussed further in the following sections of this report.



REPRESENTATIVE CROSS SECTION
POND D
HUTSONVILLE POWER STATION
HUTSONVILLE, ILLINOIS

GeoSystems Consultants, Inc.

PROJECT NO.: 02G106
APRIL 2002

FIGURE 1

REVISED 12-26-02

M:\Projects\2002\2002G106\dwg\Schematic-r1.dwg, 12/26/2002 04:03:09 PM.

4.1 Raw Materials Characterization

During the site visit, VFL collected six (6) samples of sluiced ash from different locations in Basin A, and two (2) samples of ash from different locations in Basin D. The six samples from Basin A and two samples from Basin D were individually tested for moisture content, pH, density and Loss on Ignition (LOI).

The solids content of the ash excavated from Basin A ranged from 71.4% to 74.2% solids (40.0% to 34.8% moisture – on a dry weight basis or dwb). The dry weight basis refers to the test that uses the dry weight of the sample in the calculation. Please see the further explanation in this section. The pH values for Basin A ranged from 8.4 to 11.0, while the LOI's for Basin A ranged from 2.1% to 8.9%. All ash samples showed varying degrees of bleeding (draining of free liquids from the material).

As indicated previously, the intent is to use material from Basin A to produce the pozzolanic cap for the closure of Basin D. In order to simulate full-scale operations, the "as received" samples of ash from Basin A were allowed to decant/drain. This was done to estimate the handling and solids content characteristics of the ash that will be used in the full-scale operations. The data showed that some of the ash samples decanted/drained nicely, while others did not decant/drain as well. The decanted/drained solids content of the Basin A materials ranged from 73.9% to 81% solids (35.3% to 23.5% moisture – dwb), or a 11.8% to 32.5% decrease in moisture content.

At this point a more thorough explanation of solids content and moisture content is required. The calculations are:

$$\text{Solids Content \%} = \frac{\text{Dry Weight of Sample}}{\text{Wet Weight of Sample}} \times 100$$

$$\text{Moisture Content \% (dwb)} = \frac{\text{Weight of Water in the Sample}}{\text{Dry Weight of Sample}} \times 100$$

As shown, both calculations are sometimes needed to explain what is happening with certain materials. We have provided both sets of numbers at various points in this text. Generally moisture content is referred to when describing soils. Solids content is required for our purposes when describing mixtures of materials that may not all be soils. The two systems developed independently based on the type of work taking place. In summary, moisture content is generally soil based and solids content is mixed material based.

The two samples of ash collected from Basin D showed a solids content range of 72.9% to 82.6% solids (37.2% to 21.1% moisture – dwb). The sample that showed the high solids content was taken from a stockpile of material that was sitting on the Basin (age unknown). The pH's for the two samples collected from Basin D were 8.8 and 8.2 respectively. The results of the physical analysis of the ash samples can be found on Table 1.

TABLE 1
Physical Characterization of the Hutsonville Ash

Basin #	Sample Number	Sample ID	As Received		Decanted	Loss on	Particle Size			Density (Wet/Dry)	
			pH (SU)	Solids (%)	Solids (%)	Ignition %	#100	#200 % Passing	#325	Rodded lbs/ft^3	Compacted lbs/ft^3
A	A-1	#1, Inflow	10.4	72.7	80.8	3.1	95.9	83.8	64.1		
A	A-2	#2 Inflow +1	9.6	74.2	80.8	2.1					
A	A-3	#3 Inflow +2	11.0	72.2	81.0	4.5	90.4	78.0	63.1		
A	A-4	#4 Inflow +3	11.0	71.4	79.3	2.6					
A	A-5	#5 Inflow +4	8.6	72.3	78.2	2.5					
A	A-6	#6 Outfall	8.4	72.5	73.9	8.9	93.0	79.5	66.0		
A	A-7	Composite A1-A6	10.0	NA	79.6		95.9	85.6	71.4	87.6 / 69.7	115.2 / 91.7
D	D-1	Basin D	8.8	72.9		5.2					
D	D-2	56K Stkpl.	8.2	82.6	NA	4.0					

In addition to the physical characterization of the ash samples listed above, an elemental analysis and TCLP leachate analysis for the 8 RCRA metals was run on a composite sample of the Hutsonville ash. The composite sample was generated by combining equal portions of ash samples A-1 through A-6. The results of the chemical analyses are listed in Table 2. The actual data reports from Dalare Labs in Philadelphia, Pa. have been included in Appendix A-2.

TABLE 2
Elemental and TCLP Analysis of the Hutsonville Ash

PARAMETER	Basin A Fly Ash Composite METALS ANALYSIS	
	TOTAL	LEACHABLE
Arsenic	34.4	0.020
Barium	95.0	0.56
Cadmium	< 1.0	0.01
Chromium	24.3	< 0.01
Lead	55.6	0.12
Mercury	0.076	< 0.001
Selenium	18.3	0.013
Silver	< 1.0	< 0.01

Notes: ***Total = Total Elemental Concentration in mg/kg***
Leachable = TCLP Leachable Metals in mg/L
< = Less than

4.2 Reagents

VFL has used numerous reagents in the development of pozzolanic construction materials. VFL reviewed these various reagents and based on previous full-scale experience with similar projects, selected what it believes to be the best performing, commercially available (in large quantities), and most cost-effective reagents for this project, from sources in the vicinity of the job site. These reagents include:

- Portland Cement;
- Class C Fly Ash (self-setting type);
- Fluidized Bed Residue Ash;
- Quicklime;
- FGD Scrubber Sludge (used to make the particle size of the mix design finer, which improves permeability); and
- Native Soils (used to make the particle size of the mix design finer, which improves permeability).

VFL experienced a few minor delays in the treatability study portion of the project. These delays are directly attributed to the delays in receiving some of the samples of reagents from the various vendors. One of the most problematic was the FGD Scrubber Sludge, which was finally received on date *06/06/02*.

4.3 Mix Design Preparation

In order to simulate full-scale conditions, VFL combined the six (6) decanted/drained samples of ash from Basin A into one (1) composite ash sample that was used to prepare all of the mixes. The solids content of this composite sample was approximately 79% solids (26.6% moisture – dwb).

All mix designs were prepared in a laboratory mixer and mixed to the consistency expected to be achieved using full-scale processing equipment. All mix designs were damp, granular, soil-like materials that could be easily handled and placed with common earth moving equipment. All of the mixes were prepared on the "wet side of optimum moisture" to assure that there was enough moisture in the mix for reagent hydration and proper compaction. This "wet side of optimum moisture" consistency also minimizes the potential for dusting during full-scale operations. After blending, the mixes were allowed to rest and cure for one hour prior to compaction in the test cylinder molds. This was done to simulate the approximate amount of time the mixed material would need to be moved from the mixing plant spread and compacted. See Table 2 for the mix designs developed in this project.

Solids contents, as well as wet and dry compacted densities were recorded for all mixes. These values will be used as operating specifications during full-scale production and placement operations.

All mixes were compacted into standard size compaction molds, labeled, and stored in sealed plastic bags to insure proper curing and prevent moisture loss during their curing cycle.

4.4 Mix Design Performance Testing

Immediately after mix preparation, all of the mixes were evaluated for consistency, handlability, and constructability. As previously mentioned, all of the mixes had a damp, granular, soil-like consistency. All mixes could be easily handled, transported and placed with common earth moving equipment. All of the mixes could support heavy equipment traffic immediately after placement and compaction. This means that multiple lifts of stabilized material could be sequentially placed on top of each other throughout the day during full-scale operations.

As proposed, all of the mixes were tested for unconfined compressive strength (UCS) in accordance with ASTM C - 39. All compressive strength cylinders were tested in duplicate and capped prior to UCS testing. The mix designs and UCS test results can be found in Table 3.

Overall, the mixes generally performed as expected, with the exception of the quicklime mixes. All mixes showed good solids contents as well as wet and dry compacted densities. Based on the mix densities, costs, UCS results, etc, the best performing mixes were selected for the next phase of permeability testing. These mixes were:

Mix 1 – 10% cement
Mix 2 – 5% cement
Mix 5 – 5% fluidized bed residue
Mix 9 – 6.3% cement + 15% native soils
Mix14 – 30% FGD Filtercake + 10% cement
Mix 16 - 30% FGD Filtercake + 10% quicklime

Triaxial permeability tests were run on the above listed mixes after 28 and 84 days of curing. The results of these tests are listed in Table 3. During the 84 day permeability testing, a problem was discovered in the test results. All of the test specimens showed higher (more permeable) values than the 28 day results. In some cases, it was over an order of magnitude. This data trend is extremely unusual for pozzolanic reaction mechanisms, which are known to improve with time. It was concluded that the entire set of cylinders must have been damaged during transport and handling. Companion cylinders were tested again after curing 84 days and these permeability values fell in the expected range.

The only mix that did not show the normal permeability improvement characteristics was Mix #16. All of the indicator parameters for this Mix looked promising (consistency, compaction characteristics, densities, strength development, etc.), yet the permeability data did not follow the usual trends.

At this point, the mixes prepared in this program are considered to be excellent indicator mixes to examine the feasibility of the program and provide data to determine the basis for a final mix design. Further refinement of the mix design can be assessed to improve performance, permeability, and cost-effectiveness of the pozzolanic cap material as necessary.

After reviewing all of the permeability data listed in Table 3, it appears that the realistic performance range for these types of pozzolanic materials is the low 10^{-6}cm/sec to the mid→low 10^{-7}cm/sec range for materials to be produced under full-scale field conditions. The typical 1 x 10^{-7}cm/sec liner spec means that the material must be in the 10^{-8}cm/sec range so as not to exceed the1 x 10^{-7}cm/sec spec under field conditions. These types of values are extremely difficult to meet with most materials under field conditions.

TABLE 3
TREATABILITY STUDY SUMMARY SHEET

Mix	Mix Design %			Reagents[4]				Solids	pH	Density		UCS[1]			Permeability K20 - (cm/sec)	
Number	Fly Ash	Filter Cake[2]	Soil[3]	Cement	C Ash	FBR	Q-lime			Wet	Dry	28 day	56 day	84 day	28 day	84 day
	(Comp 1-6)		(Black Sand)	(Lafarge)	(Newton)	(ADM)	(Miss.)	(%)	(SU)	(lbs/ft^3)	(lbs/ft^3)	(PSI)	(PSI)	(PSI)		
1	100		0	10.0				81.5	11.9	116.0	94.5	184	231	305	5.37E-07	7.64E-07
2	100		0	5.0				80.3	11.7	116.5	93.5	79	125	165	5.03E-06	4.74E-06
3	100		0		15.0			82.3	10.9	113.4	93.3	31	41	37		
4	100		0		30.0			83.5	11.4	107.5	89.8	81	124	114		
5	100		0			10.0		82.2	12.3	106.4	87.5	277	276	372	1.75E-06	5.84E-06
6	100		0			20.0		84.3	12.5	97.7	82.4	291	583	609		
7	100		0				10.0	81.1	12.5	107.1	86.9	38	70	138		
8	100		0				5.0	80.5	12.3	113.4	91.2	22	27	82		
9	85		15	6.3				83.5	11.7	114.2	95.4	110	142	191	1.99E-06	1.30E-06
10	85		15	12.5				83.4	11.9	117.4	97.9	320	416	380		
11	85		15				6.3	83.5	12.4	110.7	92.4	26	42	48		
12	85		15				10.0	81.9	12.6	113.1	92.6	35	84	82		
13	70	30		5.0				77.3	11.6	112.4	86.9	123	168	164		
14[5]	70	30		10.0				77.9	12.0	113.0	88.0	364	856	1110	1.22E-07	1.38E-07
15	70	30					6.6	79.9	12.8	114.2	91.2	130	194	304		
16[5]	70	30					10.0	81.1	12.9	112.4	91.2	157	314	603	4.32E-05	2.91E-05

Note: *Reagent added on a dry weight basis to to soil-fly ash blend.*
Stockpile Time for all mixes was 30 minutes

[1] *UCS strength data is average of 2 cylinders.*

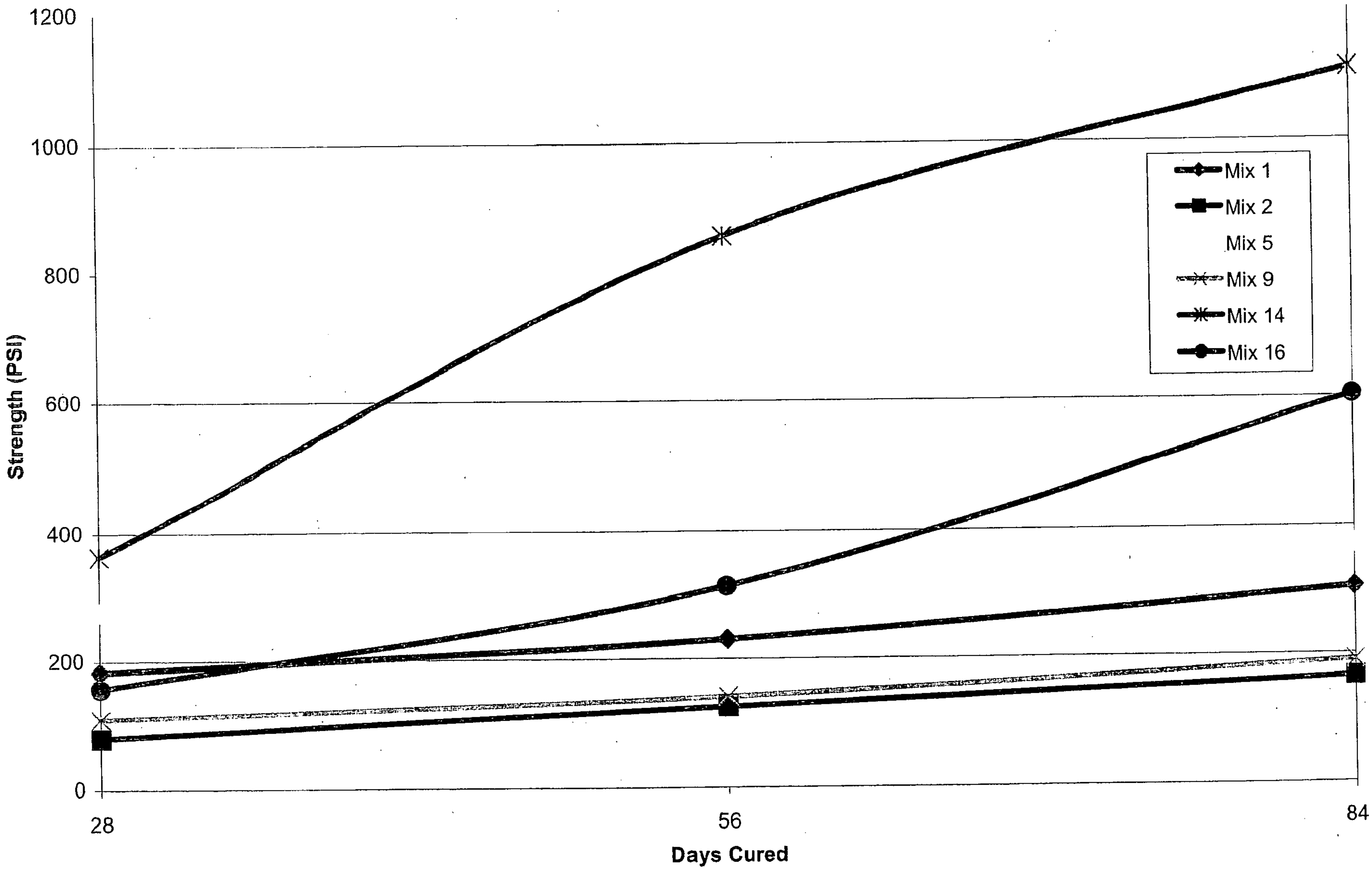
[2] *FGD sludge added on a wet weight basis to ash.*

[3] *Soil added on a wet weight basis.*

[4] *Reagents added on a dry weight basis*

[5] *Second set of permeability results for mixes 14 and 16 are at 56-day cures.*

FIGURE 2
Unconfined Compressive Strength Development for Selected Mixes



Based on all of the above data, the four (4) best performing mixes in the study were then tested for leachate characteristics using the TCLP leaching procedure. The results of the TCLP leaching tests are presented in Table 4.

TABLE 4
TCLP Leachate Analysis of the Treated Ash

PARAMETER	Untreated Fly Ash	TREATED ASH Mix #2	Mix #5	Mix #9	Mix #14
Arsenic	0.020	< 0.010	< 0.010	< 0.010	< 0.010
Barium	0.56	0.28	0.25	0.14	0.11
Cadmium	0.01	< 0.01	< 0.01	0.01	< 0.01
Chromium	< 0.01	0.06	< 0.01	0.05	< 0.01
Lead	0.12	< 0.02	< 0.02	< 0.02	< 0.02
Mercury	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Selenium	0.013	0.019	0.010	< 0.010	< 0.010
Silver	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

Notes: *Treated material cured for 84 days*
All results expressed in ppm.unless otherwise noted.
ppm = Parts per Million
< = Less than

As shown in Table 4, all of the mixes showed very low leaching potential. One interesting trend to observe is the fact that all of the stabilized mixes reduced the leachable level of arsenic, barium and lead when compared to the original, untreated ash. This is a common trend seen in the leachate characteristics of pozzolanic stabilization matrices.

Upon reviewing all of the data generated in the study, the most promising reagents and material blends to produce a pozzolanic cap under field conditions appear to be:

- Basin A fly ash and cement (Mix 1 and 2)
- Basin A fly ash, onsite soil and cement (Mix 9 and 10)
- Basin A fly ash, FGD Filtercake and cement (Mix 14)

FBR was not included in the final selection for several reasons. FBR has been used in the past for various construction needs including permeability which is why we have included it in this treatability study. FBR is quite useful when handled properly and used in the correct application. Recently, there have been reports on several construction projects that some FBR's are susceptible to expansion problems. Situations where it should be avoided are employing it where slight expansion is not acceptable.

FGD sludge is a good additive for most mix applications. However, FGD sludge from each power plant can be very different (chemically and physically) based on the coal source and type of boiler used. Another issue that VFL has with FGD sludge, in this specific application, is making sure that it is mixed thoroughly with the other ingredients. FGD sludge is a very sticky material. It is difficult to accurately feed it into a portable processing system because the FGD sludge has a tendency to adhere to the sides of feed hoppers that are used on portable pugmill plants (known as bridging). In most construction applications, where precise mix designs are not required, this is not a problem.

The mixes containing cement tend to be the easiest to quality control in field construction applications. Cement is a manufactured product and varies very little. Further optimization testing is recommended for the final mix design prior to full-scale operations. VFL would recommend that a test pad be constructed with full-scale equipment and sampled in substantial conformance with 35 Illinois Administrative Code (IAC) Part 816 to evaluate the proposed process equipment train and optimized the final mix design.

5.0 Extrapolation to Full-Scale Operations

The basic full-scale operational approach that VFL would use to construct the pozzolanic cap for Basin D's closure would conform to the following schedule of events:

- Regrade Basin D to the lines and grades specified by the Engineer.
- Excavate the fly ash from Basin A and allow it to drain to the proper moisture content before using it in the mix design. Run On/Run Off to and from the area will be controlled and water drained from the ash will be routed back through the plants pond system.
- Construct a processing area in the vicinity of the two Basins. Erect the processing plant, silos and any other ancillary processing equipment needed. Construct haul roads to and from the placement area.
- Process the designated mix design.
- Place and compact the stabilized cap mix in a reasonable time frame allowing the material a curing period prior to compaction to the lines and grades established by the Engineer for the final cap design.
- Cover the placed material with the cover soils to protect the pozzolanic cap from severe weather events.

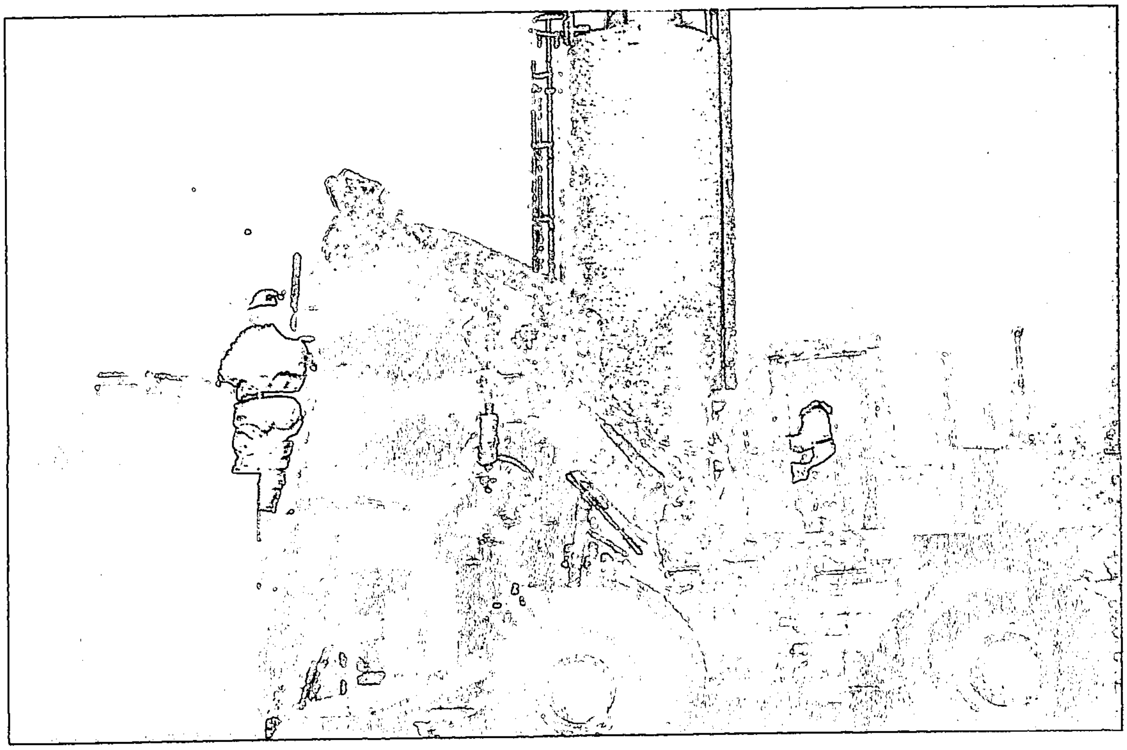
- Place the topsoil and vegetate as soon as possible.

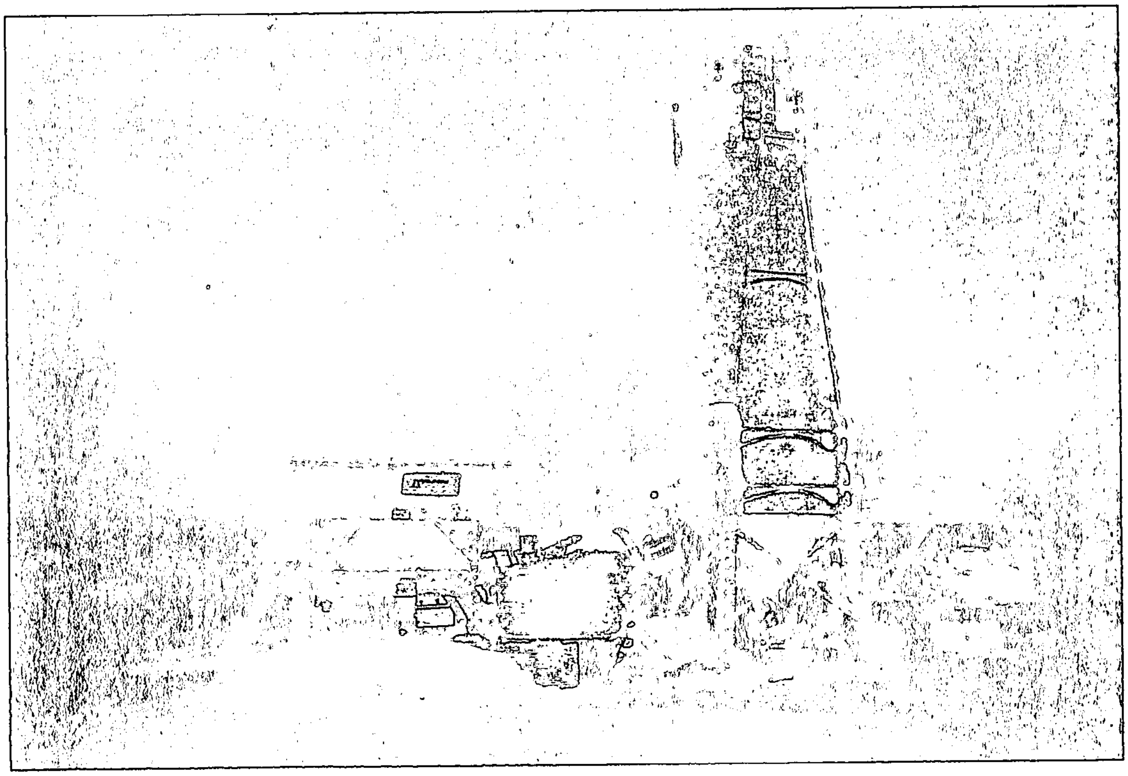
To develop the necessary documentation for submittal to the State Regulatory Agencies, the basic Quality Control program for the pozzolanic cap construction would involve:

- Quality Control conformation testing on the materials to be used in the cover system and their placement.
- Process control testing of the mix design during production in substantial conformance with 35 IAC Part 816.
- Quality Control of the cap mix design during placement and compaction in substantial conformance with QA/QC procedures outlined in 35 IAC Part 816.
- Moisture monitoring on the excavated and drained Basin A fly ash. Control and QC confirmation checks on the reagents and any other materials of construction that will be used in the mix design.
- Plant calibration.
- Insure that Basin D has been regraded to the lines and grades specified.
- Insure that the cover system has been installed to the lines and grades specified.

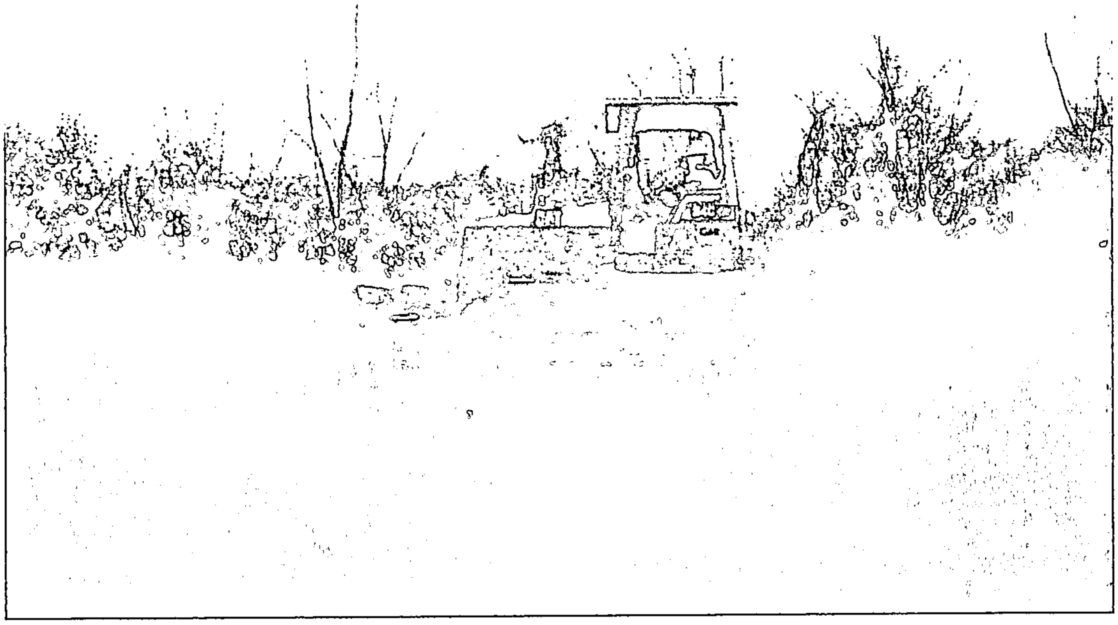
The cap construction activities listed in this section have been used by VFL on several other pozzolanic cap projects. To demonstrate this, the following photos of a pozzolanic cap system that VFL constructed on an industrial landfill in New Jersey have been included for review.

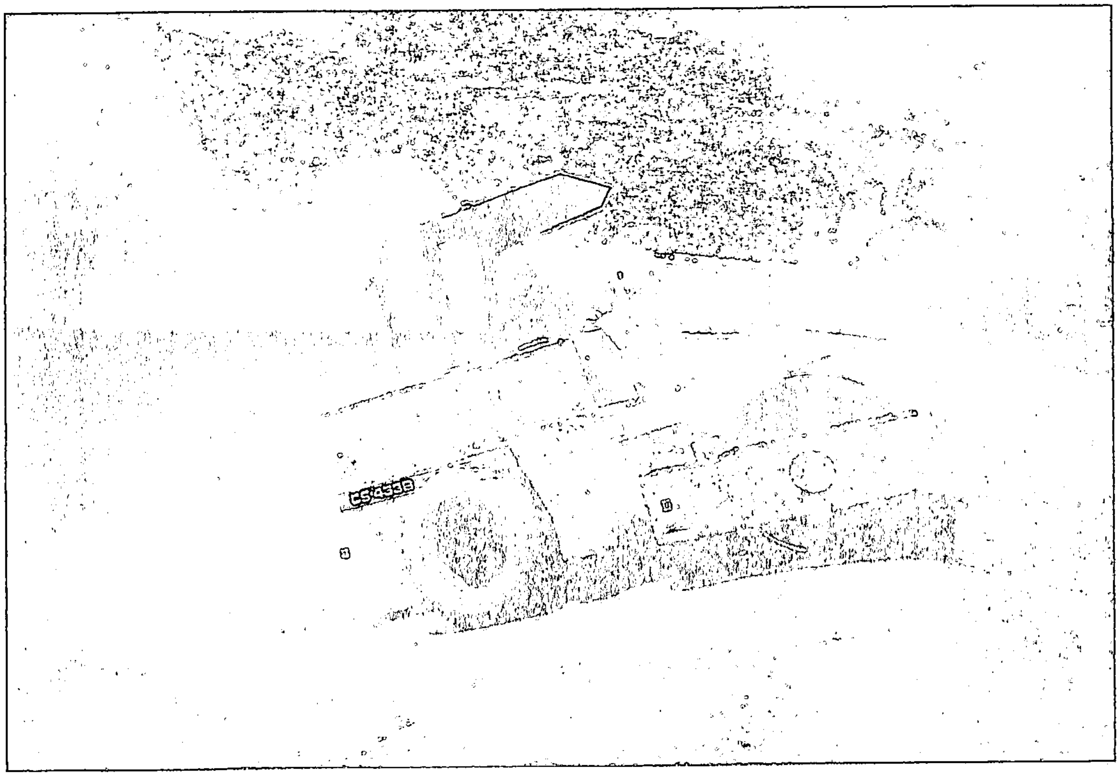
REGRADING LANDFILL



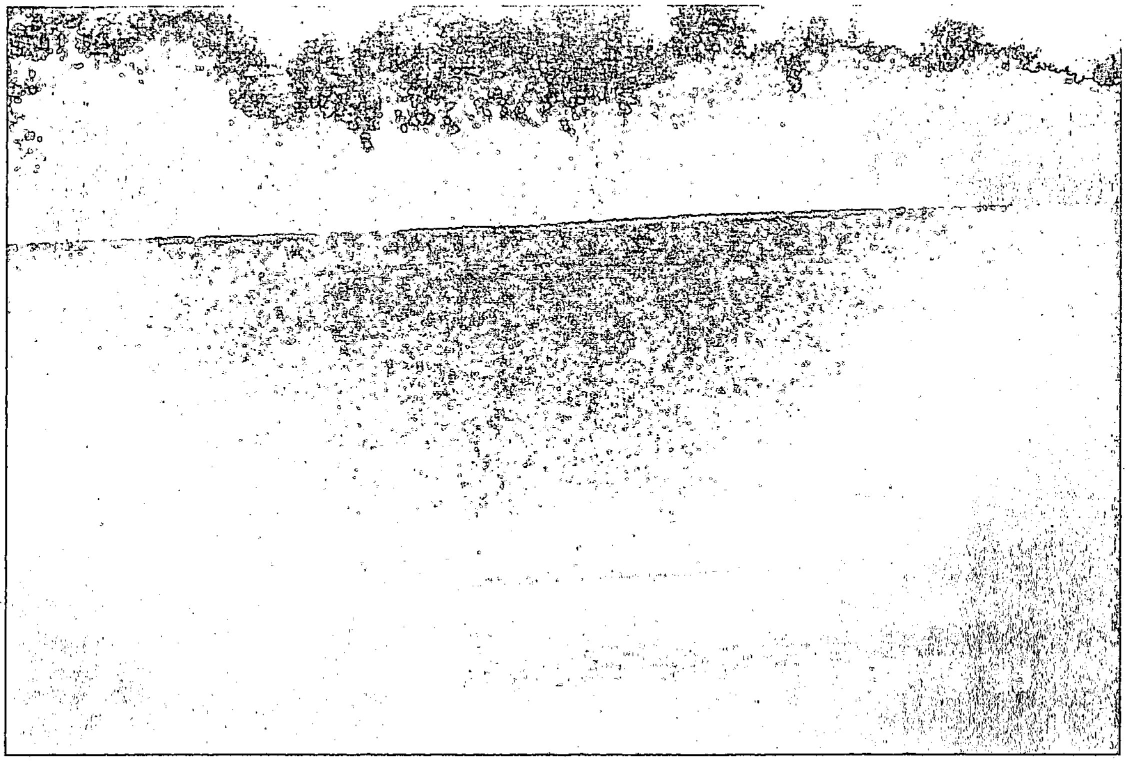


PROCESSING EQUIPMENT

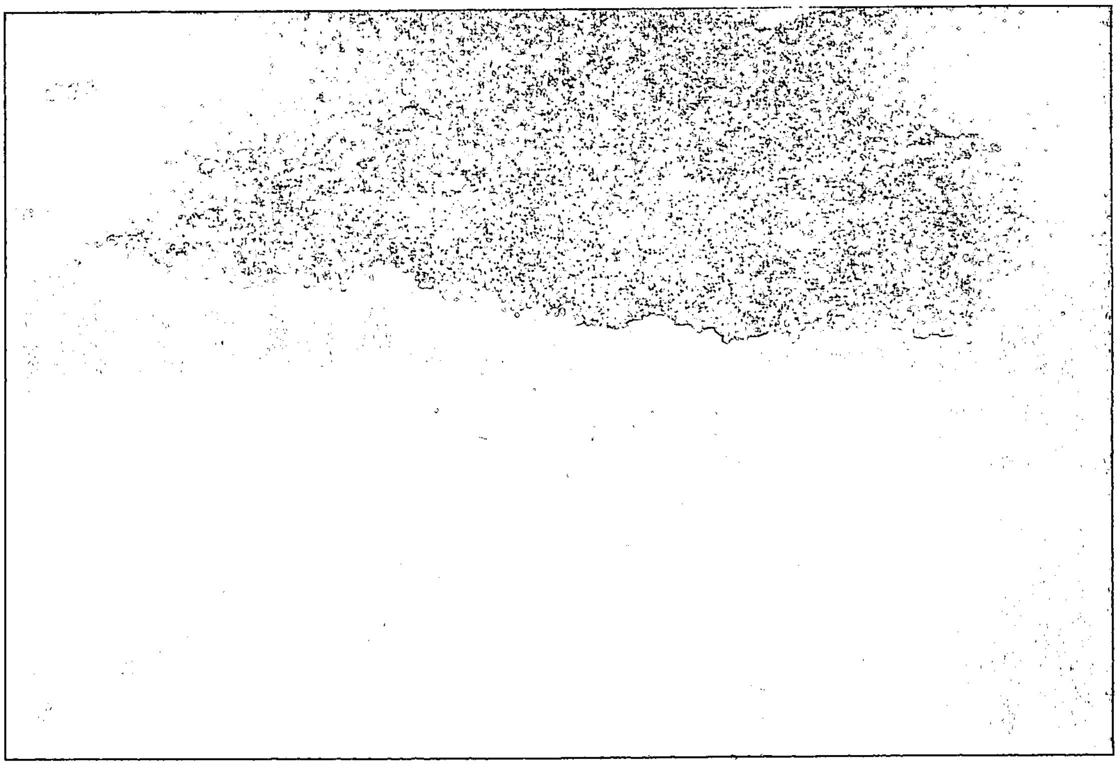


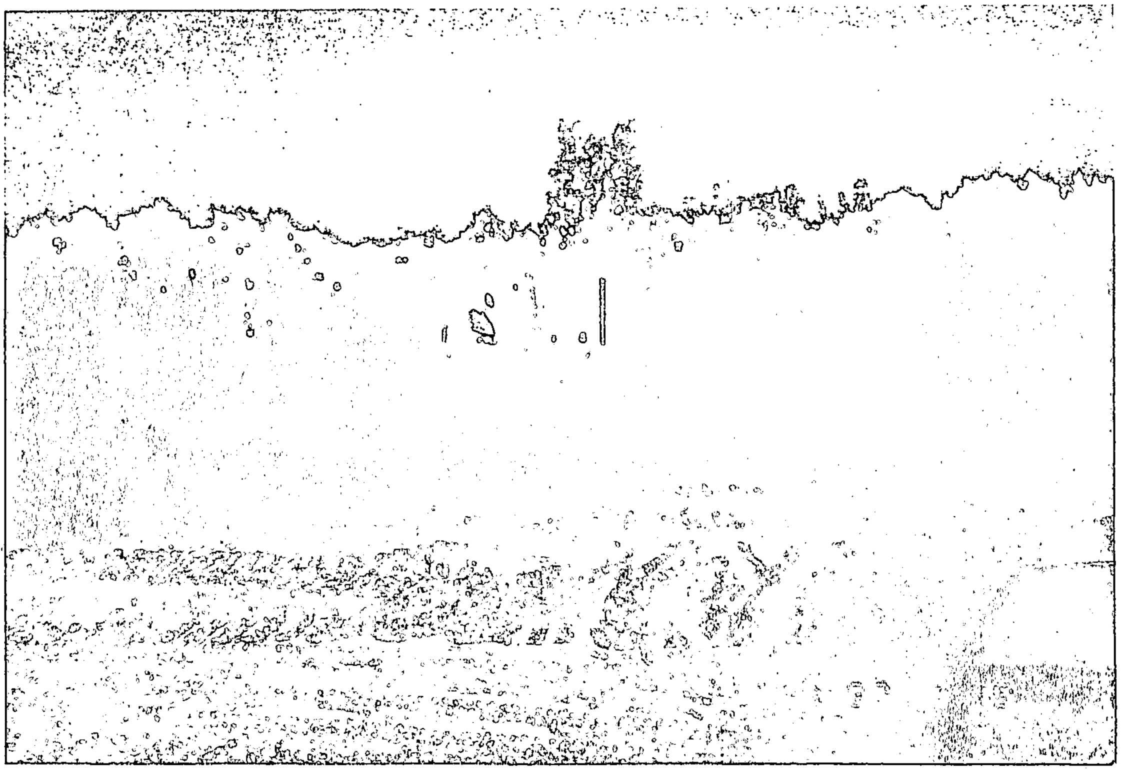


PLACEMENT AND COMPACTION OF THE
POZZOLANIC CAP MATERIAL

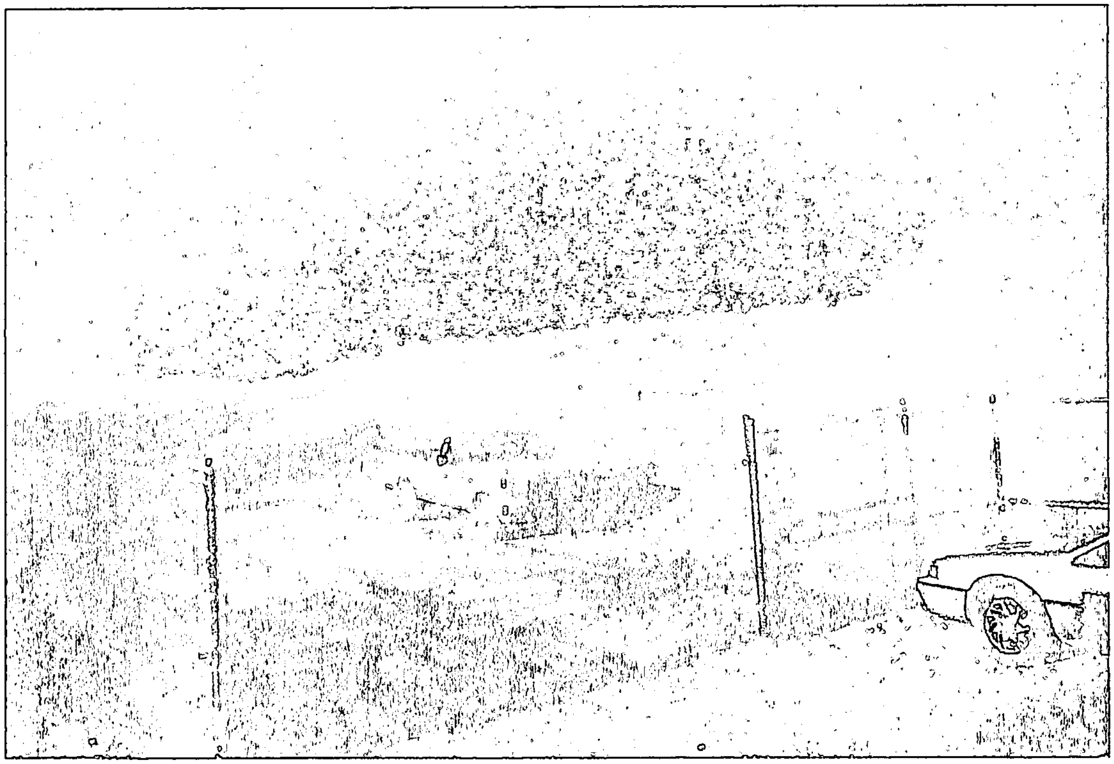


COMPACTED AND GRADED
POZZOLANIC CAP MATERIAL





PLACEMENT OF THE DRAINAGE LAYER
AND TOP SOIL FOR COVER SYSTEM



FINISHED LANDFILL

Appendix A-1

Draft Geotechnical Report
by
GeoSystems Consultants Inc.
Fort Washington, Pa.

GeoSystems Consultants, Inc.
514 Pennsylvania Avenue
Fort Washington, PA 19034
Telephone: (215) 654-9600 Fax: (215) 643-9440

June 7, 2002
2002G106
Revised 24 December 2002

VFL Technology Corporation
16 Hagerty Boulevard
West Chester, PA 19382-7594

Attention: Mr. Douglas Martin

Re: Geotechnical Evaluation
Closure of the Fly ash Basins and Stockpile
Hutsonville Power Station
Hutsonville, IL

Dear Mr. Martin:

In accordance with VFL Technology Corporation's request, GeoSystems Consultants, Inc. is pleased to submit this Final Report regarding the Geotechnical aspects relating to the closure of Flyash Basin "D" (Basin "D") at the subject site. The closure will utilize conditioned and processed coal ash from Flyash Basin "A" (Basin "A") and other Stockpiled materials in Basin "D" at the Hutsonville Power Station in Hutsonville, Illinois. GeoSystems Consultants provided geotechnical engineering consultation services to the VFL team for this project. The professional services provided are presented below.

PROFESSIONAL SERVICES

Professional Services provided for this project consist of the following tasks

Task 1: Site Walk A Site walk was conducted on March 5 and 6, 2002, as was a site meeting with representatives of Natural Resource Technology (NRT), Inc. (Christopher A. Robb), and Steve Miller, James Alberta, & Jaquie Bush of AMEREN SERVICES Hutsonville Power Station. A Field Assessment of geotechnical conditions at Basin "D," and sampling of Basins "A" and "D" were also performed. Samples obtained were shipped to VFL's West Chester Facility. One bucket of flyash from Basin "D" was then transported to GeoSystems' Fort Washington facility.

Task 2: Review Readily Available Geotechnical Data

Mr. C.A. Robb of NRT submitted selected geotechnical data regarding the subsurface conditions, site drawings, and tables containing volumetric data for Basin "D." A list of these documents is included as Attachment 1. These documents were reviewed to ascertain subsurface conditions in the vicinity of Basin "D." Several inferred subsurface cross section and the associated test boring logs were evaluated. These data were then used to develop an "Idealized Cross Section" of the completed Basin closure at the location GeoSystems believes is the critical section with respect to slope stability. Soil strength characteristics were estimated based on information presented in relevant test boring logs. Where soil (strength) data was not available, GeoSystems used engineering judgment to select reasonable strength values for subsurface and embankment soils and impounded flyash.

GeoSystems also obtained and reviewed selected sections of the State of Illinois Title 35: Environmental Protection, Subtitle B (Waste Disposal Part 816, Alternative Standards for Coal Combustion Power Generating Facilities Waste Landfills), and Subtitle G (Waste Disposal Part 811, Standards for New Solid Waste Landfills).

Task 3: Engineering Consultation Services

GeoSystems provided Engineering Consulting Services regarding the geotechnical issues for the project. Specifically the following issues were addressed:

Field Investigation Program

GeoSystems identified data gaps in the geotechnical information provided with respect to performing the design evaluation. These deficiencies include insufficient laboratory data that characterizes physical and engineering properties of the impounded flyash, containment dikes, the various soil strata underlying the site, and the stratigraphy in the areas judged to be critical with respect to slope stability. It is our opinion that at least 6 additional test borings are required to develop adequate cross sections in critical areas and to obtain samples for physical and engineering property laboratory testing. These data would be used to perform analyses regarding slope stability and settlement.

Alternate Cap Effectiveness

Based on a review of the pertinent sections of the State of Illinois Title 35 Code, a pozzolanic barrier layer is an acceptable alternate cover system in lieu of using a goemembrane cover system. To evaluate the effectiveness of the pozzolanic cover system, the HELP computer model was used.

USEPA's computer model HELP (Hydrologic Evaluation of Landfill Performance) has been used to perform a water balance to estimate the quantity of fluid percolating through the final cover system to the basin materials, estimate the amount of runoff, and head on the cover system barrier layer.

HELP uses a water balance method to estimate the quantity of precipitation which will theoretically penetrate the basin final cover system and percolate through the waste. Site-specific climatological and design data can be input into the model in order to assess final cover performance.

To determine the quantity of rainfall penetrating the final cover, the model estimates runoff, cover system drainage, and evapotranspiration. These calculations are generally based on assumptions made regarding the runoff coefficient, root zone depth, quality of plant cover, soil porosity, field capacity, and initial water content. All rainwater remaining after runoff, cover system drainage, and evapotranspiration can either become leachate or can be incorporated into the waste.

The HELP model is generally accepted as a useful tool in the evaluation of cap and liner designs. To simplify the analysis of these designs, it makes several assumptions. These include steady state flow and homogeneous isotropic layers. Steady state flow may be achieved in an unknown number of years after the site has been closed and final cover installed. The non-homogeneous nature of the basin materials could result in rainwater channeling through voids, resulting in non-uniform flow. The effect of rainwater absorption by the waste or trapped rainwater remaining from active operations can be accounted for by setting the initial water content of the waste. These assumptions make the HELP model useful as a tool to compare various design options.

The information needed to run the HELP model includes climatologic, design, soil, and runoff data. To assist the user in operating the HELP model, the program can generate synthetic climatologic data for 20 years using internal databases with weather conditions for 139 cities throughout the United States (Evansville, IN was used for present study, which is about 90 miles from the site), 7 vegetation cover types, and 18 soil types. The user may select default values from these databases that best represent the expected site-specific conditions. Details of data input and modeling results (using the 20-year synthetic weather generator) are presented in Attachment 2.

HELP analyses were performed using a 6-foot thick cap section (3 feet pozzolanic cap, 3 feet cover soil: 0.5 to 1.5 feet drainage, 2.5 to 1.5 feet cover soil). Permeability of the pozzolanic cap was varied from $1x10^{-5}$ to $1x\ 10^{-7}$ cm/sec, and final cover slopes varied from 1% to 5%.

Based on the results of the modeling, the proposed cover design for Hutsonville Flyash Basin "D" for the flat cap area would result in a range of 78 to 97 percent effectiveness in eliminating drainage through the cover system to the basin materials. These percentages are based on the average total precipitation for one year and the "percolation from base of cover" values calculated using the HELP model (see Table 1). The "percolation from base of cover" is assumed to be the amount of leachate, which is a conservative assumption that ignores the potential for storage in the waste material. However, it does not account for fluid generated by the waste materials. The "percolation from base of cover" has been computed on a gallons-per-acre-per-day basis. For the Hutsonville Flyash Basin "D," percolation ranges from 90 gallons-per-acre-per-day (Case 2B) to 680 gallons-per-acre-per-day (Case 1A). The calculated results from HELP model runs indicate that the maximum head associated with the 24-hour, 25-year storm event on the barrier layer within the drainage layer is less than 6 inches. This head can be accommodated in the drainage layer and the overlying granular cover soil.

Potential Post-Closure Settlement

Calculations to estimate differential settlements affecting the performance of the cap elements were made using the GeoSystems Consultants' computer program SETTLE. This program calculates total settlements consisting of the sum of consolidation, elastic compression and/or secondary compression of each layer. The settlement would be mainly due to the consolidation of the flyash layer. This layer is normally consolidated and is soft. No site-specific consolidated characteristics of this layer are available. To compute settlements, data for similar materials from other sites was used. Available correlations for consolidation properties were utilized. The following properties were used in the analysis:

Unit total weight (γ_t) = 90.0 pcf (flyash), 100.0 pcf (silty clay)
Compression Index (C_c') = 0.17 (flyash), 1.25 (silty clay)
Pore Pressure Factor (A) = 1.0
Poisson's Ratio (μ) = 0.35
Coefficient of Secondary Compression (C_α') = 0.005 (flyash), 0.010 (silty clay)

The 5% final cover slope was evaluated for settlement potential. Based on a reasonable expected value for Compression Index, settlement at the center of the closed Basin "D" was calculated to be about 1 foot. This estimate of settlement was based on an assumed value for the flyash Compression Index. Actual Compression Index data from laboratory testing of the Basin "D" flyash together with consolidation characteristics of the various strata underlying Basin "D" are required to perform an analysis for final submission.

Slope Stability Analyses

Preliminary slope Stability Analyses for the closed Hutsonville Flyash Basin "D" were performed using the strength parameters obtained from site data provided, and assumed soil properties where no data was available. Analyses were made using computer program XSTABL Version 4.1. Using this computer program, a search for critical surface having minimum factor of safety was made. Both circular and block modes of failure were investigated.

Based on review of results from the Preliminary Slope Stability Analyses, insufficient data are available to perform a comprehensive evaluation at this time. A supplemental field investigation designed to obtain relevant soil property data is needed to perform the required Slope Stability analyses for submission to the state.

Volume Calculations

Volume calculations for fly ash utilization associated with the various slopes (1% to 5%) for the finale closure configurations were performed. The results are presented in Attachment 3. Based on the analyses performed, the following conclusions have been developed:

- As the slope of the final cover increases from 1% to 5% the volume of soil to be regraded reduces from 110,000 yd^3 for 1% to 75,000 yd^3 for 5%.
- As the slope of the final cover increases from 1% to 5%, the volume of structural fill increases from 0 yd^3 for 1% to 160,000 yd^3 for 5%.
- The volume of protective soil cover (3 feet including vegetative support layer and drainage layer) varies little with the change in final cover grade from 1% to 5% (~100,000 yd^3).
- The volume of pozzolanic cap (3 feet thick) varies little with the change in final cover grade from 1% to 5% (~100,000 yd^3).
- Utilization of flyash from Basin "A" increases with increasing slope from 1% to 5%.

Erosion Potential

Erosion control of the cover system is important, because loss of the soil cover overlying the barrier layer increases the potential for damage by gnawing/burrowing animals, thus decreasing the effectiveness of the barrier. Erosion may be wind- and/or water-induced. The potential for erosion by these two environmental factors should be evaluated using the Universal Soil Loss Equation (USLE) and the Wind Erosion Equation (WEE). Erosion calculations are highly dependent upon the type and condition of vegetation anticipated after closure. Erosion loss due to wind and water can be calculated based on the anticipated short and long term condition of the cover system. No calculations were performed for this phase of the design process.

Freeze-Thaw Effects

The maximum estimated frost penetration depth in Central Illinois is 30 inches and the average depth of frost penetration is about 10 inches. A conceptual cover system design for the flat area could provide for soil depth above the barrier. A final cover will not be sensitive to freeze-thaw effects when properly designed

Air Emission Control

Airborne migration of landfill materials will be predominantly migration of dust particles during closure subgrade preparation and initial placement of the general fill layer. As the general fill layer (variable thickness) installation proceeds, the potential for fugitive dust containing landfilled materials would lessen and then be virtually eliminated once the general fill has been partially completed over the entire site.

CONCLUSIONS

Additional field investigation is necessary to better define the geotechnical properties of the impounded flyash, containment dikes, and various soil strata underlying the site, as well as better defining the stratigraphy for the critical sections identified.

A pozzolanic cap having a minimum thickness of 3 feet (0.91 meters) can be constructed. A parametric analysis varying cap permeability from $1x10^{-5}$ cm/s to $1x10^{-7}$ cm/s yielded "effectiveness": ranging from 78 percent to 97 percent. The permeability of the cap greatly influences its "effectiveness."

Post-closure settlement has been estimated to be about 1 foot for the cases evaluated. This is a rough estimate based on interpretation of engineering properties from soil descriptions presented in the boring logs provided, and assumed properties of the impounded flyash. Laboratory test data were available for use in these evaluations.

Based on review of results from the Preliminary Analyses, insufficient data are available to perform a comprehensive evaluation at this time. A supplemental field investigation designed to obtain relevant soil property data is needed to perform the required Slope Stability analyses for submission to the state.

LIMITATIONS

The conclusions and recommendations presented in this report are based on the assumptions that the subsurface conditions at the site and the assumed soil properties do not deviate appreciably from those disclosed by the test boring data provided and that the proposed design is substantially in conformance with the project description. GeoSystems Consultants should be notified immediately should differing conditions be encountered or if significant changes in design are contemplated, so that appropriate revisions can be made to the recommendations.

We sincerely appreciate the opportunity to submit this Progress Report for this challenging project. If you have any questions, please do not hesitate to contact us.Very truly yours,

GEOSYSTEMS CONSULTANTS, INC.

Craig R Calabria

Craig R. Calabria, Ph.D., P.E.
Principal

Table 1: Pozzolanic Cap Effectiveness

% Effectiveness			
Cases	Pozzolanic Cap Permeability (cm/s)		
	1×10^{-5}	1×10^{-6}	1×10^{-7}
Case 1A	78%	78%	95%
Case 1B	78%	79%	95%
Case 2A	78%	81%	96%
Case 2B	79%	86%	97%

Case 1A:	30" topsoil, 6" sand at 1×10^{-3} cm/s, 36" pozzolanic cap on a 1% slope
Case 1B:	30" topsoil, 6" sand at 1×10^{-3} cm/s, 36" pozzolanic cap on a 5% slope
Case 2A:	18" topsoil, 18" sand at 1×10^{-2} cm/s, 36" pozzolanic cap on a 1% slope
Case 2B:	18" topsoil, 18" sand at 1×10^{-2} cm/s, 36" pozzolanic cap on a 5% slope

Attachment 1

Natural
Resource
Technology, Inc.

TRANSMITTAL

To: VFL Technology Corporation
16 Hagerty Boulevard
West Chester, PA 19382

Attn: Mr. Doug Martin

Date: March 11, 2002
Project No: 1375
From: Christopher A. Robb CAR
Re: Data Transfer –Soil Borings, Topography, etc.
Ameren Services - Hutsonville Power Station

x For Your Files x As Requested x For Review ☐ Approve and Return

---

Copies:	Description
1	Boring Logs – EW-1, MW-6, MW-7, MW-7D, MW-8, GP-20 to GP-23, MW-11, MW-11R, SB-101 to SB-103, MW-14, TW
1	Sheet Pile Wall Site Plan (S-350) and Details (S-351): (PARTIAL COPY)
1	Figure No. 3 - Geologic Cross Sections (1375-B12)
1	Figure No. 4 – Bedrock Elevation Contours (1375-B11)
1	Figure No. 5 – Alternative No. 3: Earthen Final Cover (1375-B33C)
1	Figure No. 2 – Site Plan (1375-B30), **via electronic mail**
1	Table 3-2 – Areal Extent and Volumes of Unsaturated and Saturated Ash In Pond D
1	Table 3-3 – Final Cover Alternatives Material Balance Analysis
1	Title 35 IAC Part 811 and 816, **via electronic mail**

Comments:

Doug,
Please find enclosed copies of the above listed materials. The following is a quick list of some additional potentially useful information:

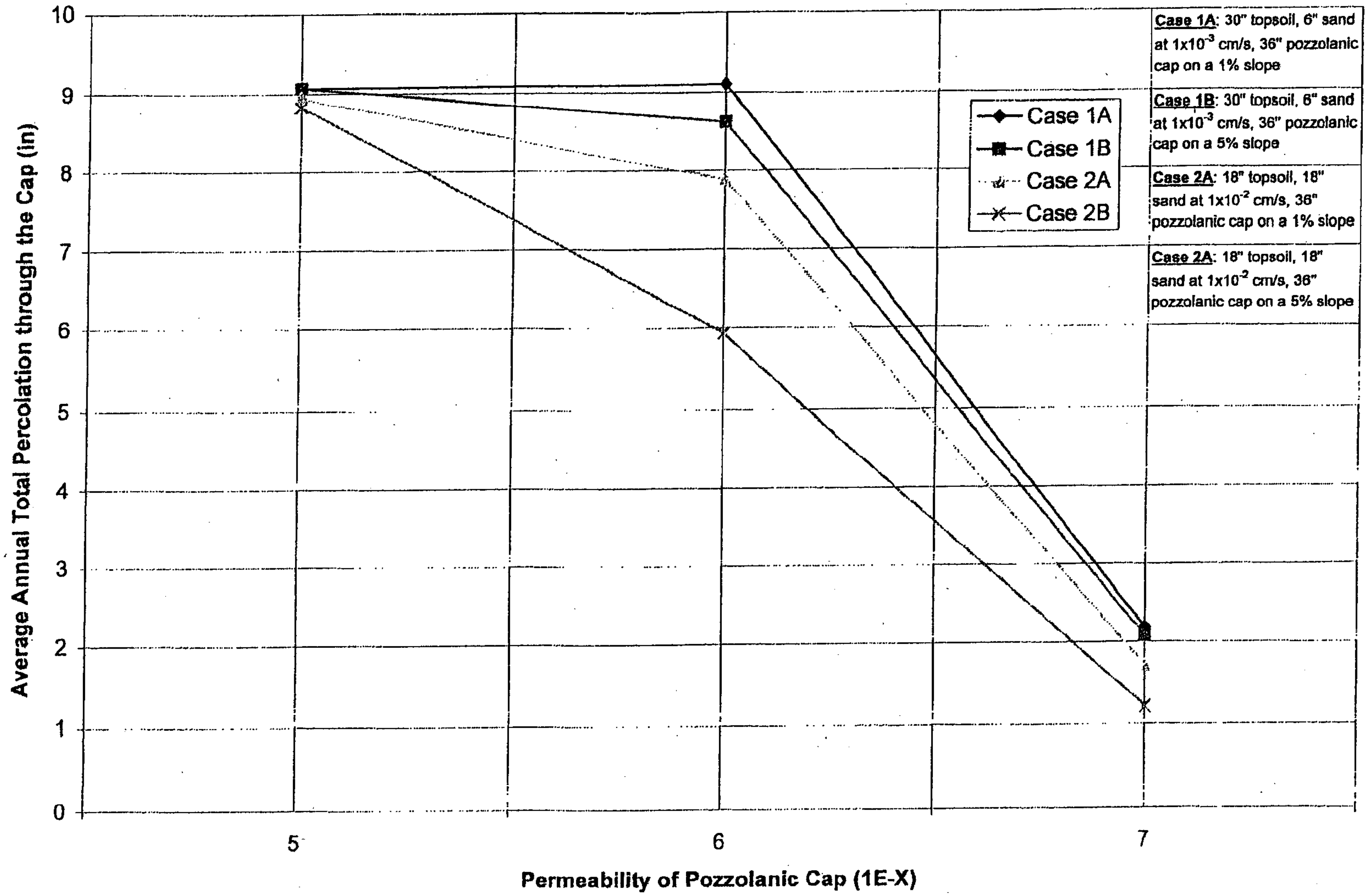
- GP-20, 21, 22 and 23 are inside of the unlined ash impoundment (Pond D).
- No soil borings were performed in Pond D's berm.
- For Pond D fill: estimated approximately 15,500 cy fill below water surface.

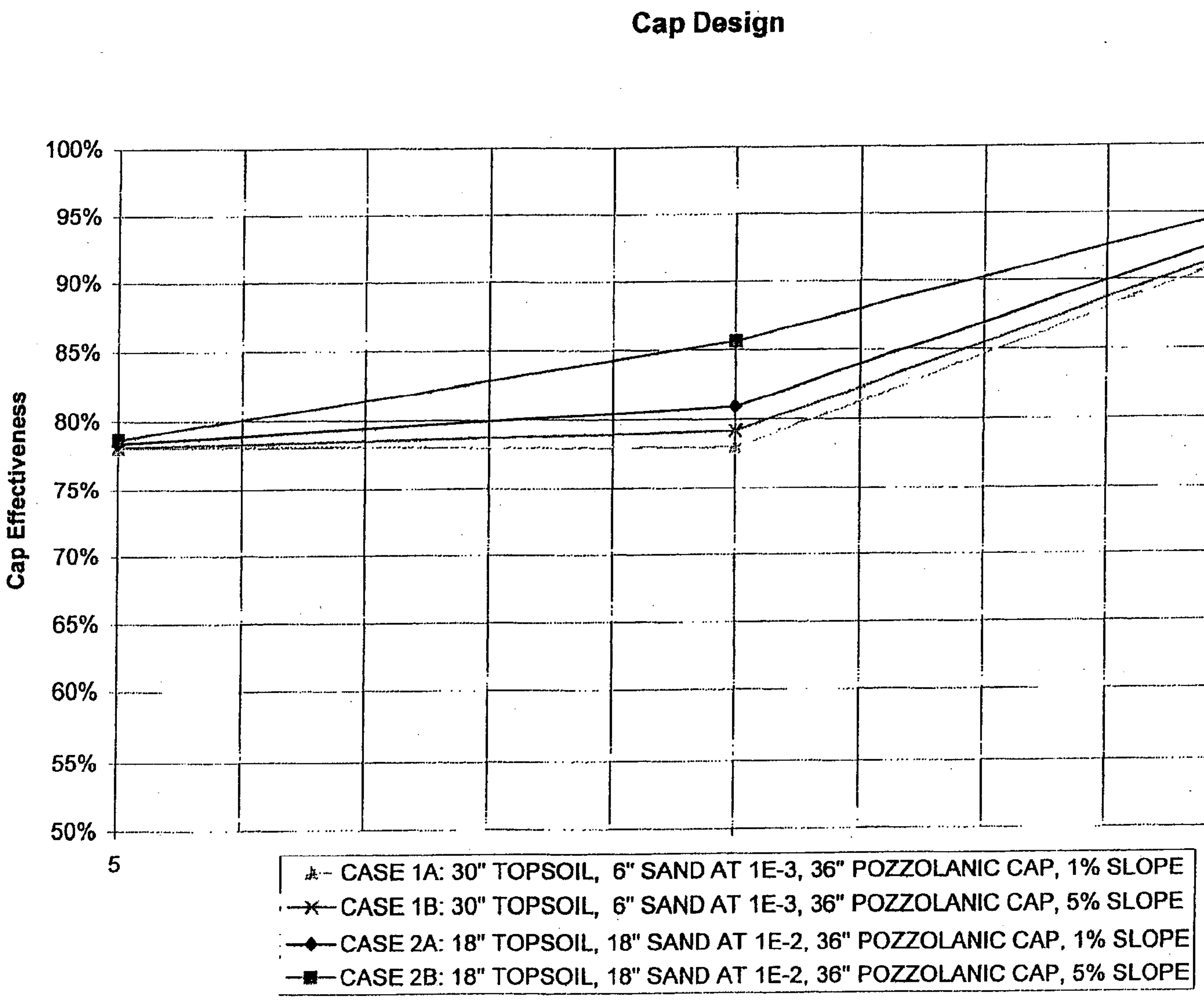
23713 W. Paul Road, Pewaukee, WI 53072 ■ Phone 262/523-9000 ■ Fax 262/523-9001

[1375 VFL Data Request 020311trans.doc]

Attachment 2

POZZOLANIC CAP PERFORMANCE




Cap Design
Cap Effectiveness
100%
95%
90%
85%
80%
75%
70%
65%
60%
55%
50%
5
7
CASE 1A: 30" TOPSOIL, 6" SAND AT 1E-3, 36" POZZOLANIC CAP, 1% SLOPE
CASE 1B: 30" TOPSOIL, 6" SAND AT 1E-3, 36" POZZOLANIC CAP, 5% SLOPE
CASE 2A: 18" TOPSOIL, 18" SAND AT 1E-2, 36" POZZOLANIC CAP, 1% SLOPE
CASE 2B: 18" TOPSOIL, 18" SAND AT 1E-2, 36" POZZOLANIC CAP, 5% SLOPE

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**                                                                           **
**                                                                           **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE                **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                 **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                    **
**                    USAE WATERWAYS EXPERIMENT STATION                      **
**              FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                           **
**                                                                           **
*******************************************************************************
*******************************************************************************


PRECIPITATION DATA FILE:      M:\ENGINE~1\HELP-M~1\DATA4.D4
TEMPERATURE DATA FILE:        M:\ENGINE~1\HELP-M~1\DATA7.D7
SOLAR RADIATION DATA FILE:    M:\ENGINE~1\HELP-M~1\DATA13.D13
EVAPOTRANSPIRATION DATA:      M:\ENGINE~1\HELP-M~1\DATA11.D11
SOIL AND DESIGN DATA FILE:    M:\ENGINE~1\HELP-M~1\DATA10.D10
OUTPUT DATA FILE:             M:\ENGINE~1\HELP-M~1\VFL-15.OUT


TIME:  16:55     DATE:   3/27/2002


*******************************************************************************

     TITLE:  VFL/Ameren Services-Hutsonville Power Station

*******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                         TYPE 1 - VERTICAL PERCOLATION LAYER
                            MATERIAL TEXTURE NUMBER   8
           THICKNESS                  =      18.00   INCHES
           POROSITY                   =       0.4630 VOL/VOL
           FIELD CAPACITY             =       0.2320 VOL/VOL
           WILTING POINT              =       0.1160 VOL/VOL
           INITIAL SOIL WATER CONTENT =       0.2404 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.369999994000E-03 CM/SEC


                                  LAYER  2
                                  --------

                          TYPE 2 - LATERAL DRAINAGE LAYER
```

```
                                VFL-15.OUT
                     MATERIAL TEXTURE NUMBER   5
       THICKNESS                      =     18.00   INCHES
       POROSITY                       =      0.4570 VOL/VOL
       FIELD CAPACITY                 =      0.1310 VOL/VOL
       WILTING POINT                  =      0.0580 VOL/VOL
       INITIAL SOIL WATER CONTENT     =      0.1477 VOL/VOL
       EFFECTIVE SAT. HYD. COND.      =  0.100000005000E-02 CM/SEC
       SLOPE                          =      1.00   PERCENT
       DRAINAGE LENGTH                =    375.0    FEET


                              LAYER  3
                              --------

                     TYPE 3 - BARRIER SOIL LINER
                     MATERIAL TEXTURE NUMBER   0
       THICKNESS                      =     36.00   INCHES
       POROSITY                       =      0.5410 VOL/VOL
       FIELD CAPACITY                 =      0.1870 VOL/VOL
       WILTING POINT                  =      0.0470 VOL/VOL
       INITIAL SOIL WATER CONTENT     =      0.5410 VOL/VOL
       EFFECTIVE SAT. HYD. COND.      =  0.999999975000E-05 CM/SEC


                GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                ----------------------------------------

     NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
              SOIL DATA BASE USING SOIL TEXTURE # 8 WITH A
              FAIR STAND OF GRASS, A SURFACE SLOPE OF  1.%
              AND A SLOPE LENGTH OF  375. FEET.

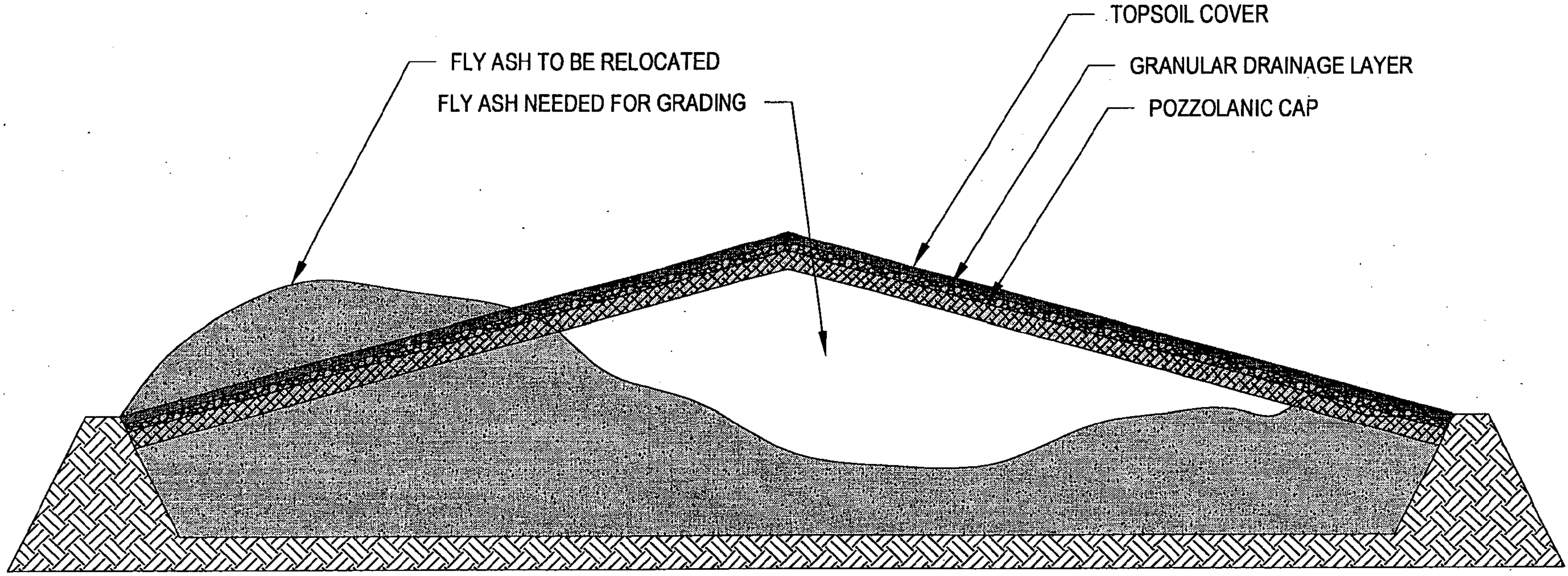
     SCS RUNOFF CURVE NUMBER            =     78.50
     FRACTION OF AREA ALLOWING RUNOFF   =    100.0    PERCENT
     AREA PROJECTED ON HORIZONTAL PLANE =      1.000  ACRES
     EVAPORATIVE ZONE DEPTH             =     21.0    INCHES
     INITIAL WATER IN EVAPORATIVE ZONE  =      5.014  INCHES
     UPPER LIMIT OF EVAPORATIVE STORAGE =      9.705  INCHES
     LOWER LIMIT OF EVAPORATIVE STORAGE =      2.262  INCHES
     INITIAL SNOW WATER                 =      0.000  INCHES
     INITIAL WATER IN LAYER MATERIALS   =     26.462  INCHES
     TOTAL INITIAL WATER                =     26.462  INCHES
     TOTAL SUBSURFACE INFLOW            =      0.00   INCHES/YEAR


                 EVAPOTRANSPIRATION AND WEATHER DATA
                 -----------------------------------

     NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
              EVANSVILLE              INDIANA

         STATION LATITUDE                         =  38.03 DEGREES
         MAXIMUM LEAF AREA INDEX                  =   0.00
         START OF GROWING SEASON (JULIAN DATE)    =     96
         END OF GROWING SEASON (JULIAN DATE)      =    300
         EVAPORATIVE ZONE DEPTH                   =  21.0  INCHES
```

Attachment 3



REVISED 12-26-02

REPRESENTATIVE CROSS SECTION
POND D
HUTSONVILLE POWER STATION
HUTSONVILLE, ILLINOIS

GeoSystems Consultants, Inc.

PROJECT NO.: 02G106

APRIL 2002

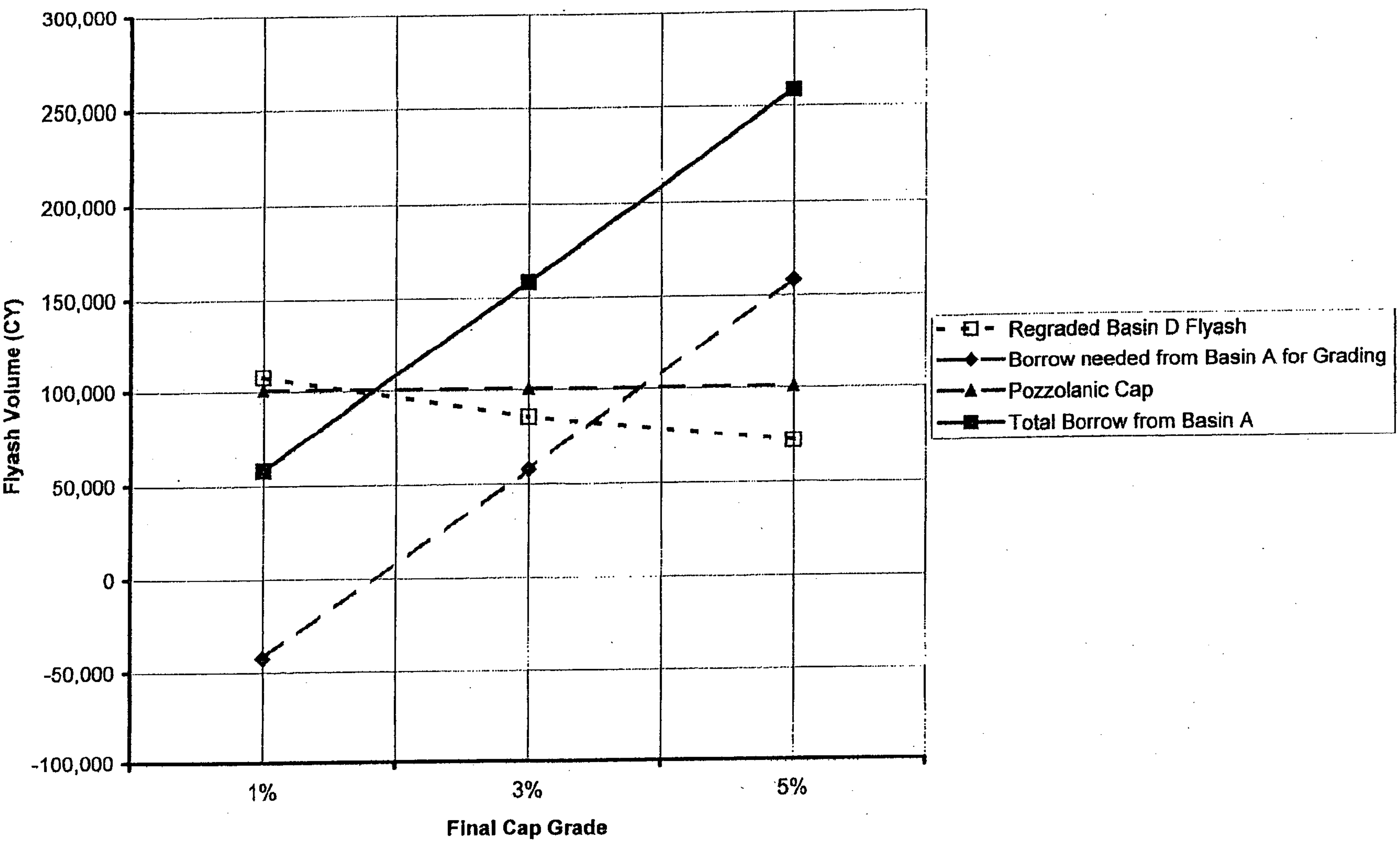
FIGURE 1

M:\Projects\2002\2002G106\dwg\Schematic-r1.dwg, 12/26/2002 04:03:09 PM

Ameren Services - Hutsonville Power Station
Basin "D" Closure
EARTHWORK QUANTITIES

VOLUMES	SLOPE		
	1%	3%	5%
GRADING			
Basin "D" Flyash to be relocated	107,561	85,751	71,811
Calculated fill from Basin "A"	(57,828)	42,338	142,531
Material needed to fill basins	15,500	15,500	15,500
Total borrow material from Basin"A"	(42,328)	57,838	158,031
CAP			
Total Cap	201,047	200,745	200,960
36" Pozzolanic Cap	100,524	100,373	100,480
18" Drainage Layer	50,262	50,186	50,240
18" Topsoil	50,262	50,186	50,240
TOTAL FLYASH BORROW REQUIRED	58,195	158,211	258,511

Earthwork Quantities for Closure



Appendix A –2

Analytical Laboratory Reports
from
Dalare Laboratories
Philadelphia Pa.

DAI
Dalare Associates Inc.
217 S. 24th Street / Philadelphia, PA. 19103
Telephone 215 - 567 - 1953 / Facsimile 215 - 567 - 1168
ANALYTICAL AND ENVIRONMENTAL TESTING

April 25, 2002

VFL Technology
Attn.: Rocus Peters
16 Hagerty Blvd.
West Chester, PA 19382

Dear Mr. Peters:

We have examined the sample submitted and would report our findings as follows:

Date Received: 4/2/02

Analytical Report # 328

	Hutsonville Power Fly Ash (3/28/02)
Total Metals:	
Arsenic	34.4 mg/Kg
Barium	95.0 mg/Kg
Cadmium	< 1.0 mg/Kg
Chromium	24.3 mg/Kg
Lead	55.6 mg/Kg
Mercury	0.076 mg/Kg
Selenium	18.3 mg/Kg
Silver	< 1.0 mg/Kg
TCLP Leachate:	
Arsenic	0.020 mg/L
Barium	0.56 mg/L
Cadmium	0.01 mg/L
Chromium	< 0.01 mg/L
Lead	0.12 mg/L
Mercury	< 0.001 mg/L
Selenium	0.013 mg/L
Silver	< 0.01 mg/L

mg/Kg = milligrams per Kilogram
mg/L = milligrams per Liter
< = Less than

Very truly yours,

DALARE ASSOCIATES, INC.

Paul A. Weber

Paul A. Weber

PAW:jc

DAI
Dalare Associates Inc.
217 S. 24th Street / Philadelphia, PA. 19103
Telephone 215 - 567 - 1953 / Facsimile 215 - 567 - 1168

ANALYTICAL AND ENVIRONMENTAL TESTING

October 2, 2002

VFL Technology
Attn.: Rocus Peters
16 Hagerty Blvd.
West Chester, PA 19382

Dear Mr. Peters:

We have examined the samples submitted and would report our findings as follows:

Date Received: 9/27/02

Analytical Report # 910

Hutsonville

TCLP Leachate:	Mix #2	Mix #5
Arsenic	< 0.010 PPM	< 0.010 PPM
Barium	0.28 PPM	0.25 PPM
Cadmium	< 0.01 PPM	< 0.01 PPM
Chromium	0.06 PPM	< 0.01 PPM
Lead	< 0.02 PPM	< 0.02 PPM
Mercury	< 0.001 PPM	< 0.001 PPM
Selenium	0.019 PPM	0.010 PPM
Silver	< 0.01 PPM	< 0.01 PPM

PPM - Parts per Million
< - Less than

The TCLP Leachate was analyzed in accordance with the method described in the Federal Register, Volume 55, No.61, 3/29/90, pages 11863-75.

Very truly yours,

DALARE ASSOCIATES, INC.

Paul A. Weber

Paul A. Weber

PAW:jc

DAI

Dalare Associates Inc.
217 S. 24th Street / Philadelphia, PA. 19103
Telephone 215 - 567 - 1953 / Facsimile 215 - 567 - 1168

ANALYTICAL AND ENVIRONMENTAL TESTING

October 2, 2002

VFL Technology
Attn.: Rocus Peters
16 Hagerty Blvd.
West Chester, PA 19382

Dear Mr. Peters:

We have examined the samples submitted and would report our findings as follows:

Date Received: 9/18/02

Analytical Report # 908

Hutsonville

	Mix #9		Mix #14	
TCLP Leachate:				
Arsenic	< 0.010	PPM	< 0.010	PPM
Barium	0.14	PPM	0.11	PPM
Cadmium	0.01	PPM	< 0.01	PPM
Chromium	0.05	PPM	< 0.01	PPM
Lead	< 0.02	PPM	< 0.02	PPM
Mercury	< 0.001	PPM	< 0.001	PPM
Selenium	< 0.010	PPM	< 0.010	PPM
Silver	< 0.01	PPM	< 0.01	PPM

PPM - Parts per Million
< - Less than

The TCLP Leachate was analyzed in accordance with the method described in the Federal Register, Volume 55, No.61, 3/29/90, pages 11863-75.

Very truly yours,

DALARE ASSOCIATES, INC.

Paul A. Weber

Paul A. Weber

PAW:jc

APPENDIX D

GROUNDWATER TRANSPORT MODELING RESULTS AND SUPPORTING DOCUMENTATION

Table D-1
HELP Input Parameters

Time Period	2001-2003	2004-2025					Notes
Cap Report Designation	**Dewatering**	**CO-1**	**CO-2**	**CO-3a**	**CO-3b**	**CO-3c**	
Climate-General							
City	Evansville	Evansville	Evansville	Evansville	Evansville	Evansville	
Latitude	39.13	39.13	39.13	39.13	39.13	39.13	Plant
Evap Zone	9	21	21	21	21	21	bare (9), fair (21)
Leaf Index	1	2	2	2	2	2	bare (1), fair (2)
All Others							Defaults for Evansville, IN
Climate-precip/temp/ET							
All	see note	see note	see note	see note	see note	see note	Synthetically generated using Evansville defaults, plant 30 year averages precip, and average temperature in Palestine
Soils-General							
Area	1	1	1	1	1	1	unit area
% where runoff possible	0	100	100	100	100	100	
Specify Initial MC	Y	Y	Y	Y	Y	Y	
Surface Water/Snow	60*	0	0	0	0	0	represents ponded condition
Soils-Layers							
1	ash	native	native	native	native	native	
2	ash	ash	synthetic	pozzolonic	pozzolonic	pozzolonic	
3	ash	ash	ash	ash	ash	ash	
4		ash	ash	ash	ash	ash	
5			ash	ash	ash	ash	
Soil Parameters--native							
Type		1	1	1	1	1	vertical percolation layer
Thickness (in)		36	36	36	36	36	
Texture		8	8	8	8	8	loam, default parameters used
Moisture Content		0.232	0.232	0.232	0.232	0.232	set equal to field capacity
Soil Parameters--synthetic							
Type			4				geomembrane
Thickness (in)			0.03				
Texture			37				default for PVC
K (cm/s)			2.00E-11				
Pinhole density			1				
Installation Defects			4				
Placement Quality			3				good placement quality
Soil Parameters--pozzolanic							
Type				3	3	3	barrier layer (see note below)
Thickness (in)				36	36	36	
Texture				16	16	16	default barrier soil
Moisture Content				0.187	0.187	0.187	set equal to field capacity
K (cm/s)				1.00E-07	1.00E-06	1.00E-05	
Soil Parameters--ash layers							
Type	1	1	1	1	1	1	
Thickness (in)	60	60	60	60	60	60	
Texture	30	30	30	30	30	30	
Porosity	0.541	0.541	0.541	0.541	0.541	0.541	
Field Capacity	0.187	0.187	0.187	0.187	0.187	0.187	
Wilting point	0.047	0.047	0.047	0.047	0.047	0.047	
Moisture Content - L1	0.541	0.2504	0.2504	0.2504	0.2504	0.2504	base case moisture content for saturated (ponded) conditions, CO- case MC values equal to MC at end of base case simulation
Moisture Content - L2	0.541	0.2883	0.2883	0.2883	0.2883	0.2883	
Moisture Content - L3	0.541	0.3212	0.3212	0.3212	0.3212	0.3212	
K (cm/s)	5.00E-05	5.00E-05	5.00E-05	5.00E-05	5.00E-05	5.00E-05	
Soils--Runoff							
Equation	n/a	HELP CN	HELP CN	HELP CN	HELP CN	HELP CN	
Slope	n/a	2%	2%	2%	2%	2%	
Length (ft)	n/a	500	500	500	500	500	
Texture	n/a	8	8	8	8	8	
Vegetation	n/a	fair	fair	fair	fair	fair	
Execution Parameters							
Years	1-3	4-25	4-25	4-25	4-25	4-25	
Report Daily	n	n	n	n	n	n	
Report Monthly	y	y	y	y	y	y	
Report Annual	y	y	y	y	y	y	
Output Filename (*.out)	Base	CO-1	CO-2	CO-3a	CO-3b	CO-3c	
Precip File (*.D4)	hutx	hutx4_23	hutx4_23	hutx4_23	hutx4_23	hutx4_23	
Temp File (*.D7)	hutx	hutx4_23	hutx4_23	hutx4_23	hutx4_23	hutx4_23	
SR (*.D13)	hutbase	hutco	hutco	hutco	hutco	hutco	
ET/general (*.D11)	hutbase	hutco	hutco	hutco	hutco	hutco	
Soil File (*.D10)	Base	CO-1	CO-2	CO-3a	CO-3b	CO-3c	

Note:

Pozzolanic cap scenarios (CO-3a,b,c) were modeled as both vertical percolation layers and barrier layers. Results when modeled as vertical percolation layers were identical to each other, and identical to results for CO-3C when modeled as a vertical percolation layer. Barrier layer results are presented here to show maximum modeled difference between scenarios

Table D-2
Pond D Recharge Rates used in MODFLOW
Based on HELP-Predicted Perrcolation Rates

Model Year	Stress Period	Period Length (days)	Recharge Rates Used in MODFLOW (feet/day)					Notes
			CO-1	CO-2	CO-3a	CO-3b	CO-3c	
2001	1	120	0.0670	0.0670	0.0670	0.0670	0.0670	Dewatering, no cap or leachate collection system modeled
2001	2	123	0.0103	0.0103	0.0103	0.0103	0.0103	
2001	3	122	0.0032	0.0032	0.0032	0.0032	0.0032	
2002	4	120	0.0036	0.0036	0.0036	0.0036	0.0036	
2002	5	123	0.0085	0.0085	0.0085	0.0085	0.0085	
2002	6	122	0.0045	0.0045	0.0045	0.0045	0.0045	
2003	7	365	0.0042	0.0042	0.0042	0.0042	0.0042	
2004	8	365	0.0018	0.0018	0.0018	0.0019	0.0019	Cap (and leachate collection system) modeled during these two stress periods
2005-2025	9	7665	0.0018	0.0004	0.0005	0.0018	0.0018	

Table D-3
MODFLOW Drain Construction for LEO-1, LEO-2, LEO-3, and LEO-4

Drain	Drain Length (feet)	Drain Pipe Diameter (feet)	Drain Bed Thickness (feet)	Drain Bed Hydraulic Conductivity (cm/s)	Drain Bed Hydraulic Conductivity (ft/day)	South/East Drain Base Elevation	North/West Drain Base Elevation	MODFLOW Layer Number	MODFLOW Drain Reach
1a	1000	3	1	0.1	283	440	423	2	1
2a	70	3	1	0.1	283	423	423	2	2
3a	105	3	1	0.1	283	423	422	2	3
4a	615	3	1	0.1	283	422	420	2	4
5a	710	3	1	0.1	283	420	425	2	5
6a	700	3	1	0.1	283	425	425	2	6
1b	1000	3	1	0.1	283	437	420	2	1
2b	70	3	1	0.1	283	420	420	2	2
3b	105	3	1	0.1	283	420	419	2	3
4b	615	3	1	0.1	283	419	417	2	4
5b	710	3	1	0.1	283	417	422	2	5
6b	700	3	1	0.1	283	422	422	2	6

Extraction Type	Leachate Extraction Option							
	LEOa-1	**LEOb-1**	**LEOa-2**	**LEOb-2**	**LEOa-3**	**LEOb-3**	**LEOa-4**	**LEOb-4**
1a	On	-	On	-	On	-	On	-
2a	-	-	On	-	-	-	On	-
3a	-	-	On	-	-	-	On	-
4a	-	-	On	-	-	-	On	-
5a	-	-	On	-	-	-	On	-
6a	-	-	On	-	-	-	-	-
1b	-	On	-	On	-	On	-	On
2b	-	-	-	On	-	-	-	On
3b	-	-	-	On	-	-	-	On
4b	-	-	-	On	-	-	-	On
5b	-	-	-	On	-	-	-	On
6b	-	-	-	On	-	-	-	-
Extraction Wells	On	On	-	-	-	-	-	-

Table D-4
Hutsonville Pond D Leachate Collection Scenarios
Estimated Discharge Volumes (MODFLOW Data)

CO-2 and LEOa-1

Stress		Wells - Volume		Drain	
Period	Step	ft^3/day	gpm	ft^3/day	gpm
8	1	42,350	220	11,890	62
	2	42,350	220	10,265	53
	3	42,350	220	9,929	52
	4	42,350	220	9,752	51
	5	42,350	220	9,615	50
	6	42,350	220	9,530	50
9	1	42,350	220	9,397	49
	2	42,350	220	9,314	48
	3	42,350	220	9,239	48
	4	42,350	220	9,169	48
	5	42,350	220	9,102	47
	6	42,350	220	9,055	47
	7	42,350	220	9,032	47
	8	42,350	220	9,004	47
	9	42,350	220	8,993	47
	10	42,350	220	8,978	47
	11	42,350	220	8,954	47
	12	42,350	220	8,941	46
	13	42,350	220	8,941	46
	14	42,350	220	8,941	46
	15	42,350	220	8,941	46
	16	42,350	220	8,941	46
	17	42,350	220	8,941	46
	18	42,350	220	8,941	46
	Average	42,350	220	9,325	48

CO-2 and LEOb-1

Stress		Wells - Volume		Drain	
Period	Step	ft^3/day	gpm	ft^3/day	gpm
8	1	42,350	220	26,197	136
	2	42,350	220	23,715	123
	3	42,350	220	23,254	121
	4	42,350	220	23,049	120
	5	42,350	220	22,945	119
	6	42,350	220	22,862	119
9	1	42,350	220	22,728	118
	2	42,350	220	22,645	118
	3	42,350	220	22,554	117
	4	42,350	220	22,518	117
	5	42,350	220	22,461	117
	6	42,350	220	22,427	117
	7	42,350	220	22,394	116
	8	42,350	220	22,365	116
	9	42,350	220	22,344	116
	10	42,350	220	22,329	116
	11	42,350	220	22,324	116
	12	42,350	220	22,316	116
	13	42,350	220	22,316	116
	14	42,350	220	22,316	116
	15	42,350	220	22,316	116
	16	42,350	220	22,316	116
	17	42,350	220	22,311	116
	18	42,350	220	22,308	116
	Average	42,350	220	22,721	118

CO-2 and LEOa-2

Stress		Wells - Volume		Drain	
Period	Step	ft^3/day	gpm	ft^3/day	gpm
8	1	0	0	184,200	957
	2	0	0	177,860	924
	3	0	0	176,870	919
	4	0	0	176,460	917
	5	0	0	176,230	915
	6	0	0	176,040	914
9	1	0	0	175,680	913
	2	0	0	175,400	911
	3	0	0	175,240	910
	4	0	0	175,120	910
	5	0	0	174,930	909
	6	0	0	174,870	908
	7	0	0	174,850	908
	8	0	0	174,770	908
	9	0	0	174,720	908
	10	0	0	174,680	907
	11	0	0	174,650	907
	12	0	0	174,650	907
	13	0	0	174,650	907
	14	0	0	174,650	907
	15	0	0	174,650	907
	16	0	0	174,650	907
	17	0	0	174,650	907
	18	0	0	174,650	907
	Average	0	0	175,630	912

CO-2 and LEOb-2

Stress		Wells - Volume		Drain	
Period	Step	ft^3/day	gpm	ft^3/day	gpm
8	1	0	0	265,280	1378
	2	0	0	257,920	1340
	3	0	0	256,850	1334
	4	0	0	256,430	1332
	5	0	0	256,210	1331
	6	0	0	256,030	1330
9	1	0	0	255,620	1328
	2	0	0	255,390	1327
	3	0	0	255,190	1326
	4	0	0	255,130	1325
	5	0	0	255,010	1325
	6	0	0	254,940	1324
	7	0	0	254,890	1324
	8	0	0	254,810	1324
	9	0	0	254,730	1323
	10	0	0	254,680	1323
	11	0	0	254,680	1323
	12	0	0	254,660	1323
	13	0	0	254,660	1323
	14	0	0	254,660	1323
	15	0	0	254,660	1323
	16	0	0	254,660	1323
	17	0	0	254,660	1323
	18	0	0	254,660	1323
	Average	0	0	255,684	1328

Table D-4 (continued)
Hutsonville Pond D Leachate Collection Scenarios
Estimated Discharge Volumes (MODFLOW Data)

CO-2 and LEOa-3					
Stress		Wells - Volume		Drain	
Period	Step	ft^3/day	gpm	ft^3/day	gpm
8	1	0	0	14,191	74
	2	0	0	12,791	66
	3	0	0	12,517	65
	4	0	0	12,361	64
	5	0	0	12,234	64
	6	0	0	12,152	63
9	1	0	0	12,017	62
	2	0	0	11,934	62
	3	0	0	11,859	62
	4	0	0	11,797	61
	5	0	0	11,729	61
	6	0	0	11,685	61
	7	0	0	11,662	61
	8	0	0	11,628	60
	9	0	0	11,605	60
	10	0	0	11,594	60
	11	0	0	11,579	60
	12	0	0	11,576	60
	13	0	0	11,576	60
	14	0	0	11,576	60
	15	0	0	11,574	60
	16	0	0	11,574	60
	17	0	0	11,574	60
	18	0	0	11,574	60
	Average	0	0	11,932	62

CO-2 and LEOb-3					
Stress		Wells - Volume		Drain	
Period	Step	ft^3/day	gpm	ft^3/day	gpm
8	1	0	0	28,412	148
	2	0	0	26,176	136
	3	0	0	25,772	134
	4	0	0	25,573	133
	5	0	0	25,474	132
	6	0	0	25,389	132
9	1	0	0	25,267	131
	2	0	0	25,181	131
	3	0	0	25,096	130
	4	0	0	25,057	130
	5	0	0	25,000	130
	6	0	0	24,966	130
	7	0	0	24,927	129
	8	0	0	24,907	129
	9	0	0	24,891	129
	10	0	0	24,865	129
	11	0	0	24,863	129
	12	0	0	24,850	129
	13	0	0	24,850	129
	14	0	0	24,850	129
	15	0	0	24,850	129
	16	0	0	24,850	129
	17	0	0	24,850	129
	18	0	0	24,850	129
	Average	0	0	25,240	131

CO-2 and LEOa-4					
Stress		Wells - Volume		Drain	
Period	Step	ft^3/day	gpm	ft^3/day	gpm
8	1	0	0	149,490	777
	2	0	0	143,740	747
	3	0	0	142,840	742
	4	0	0	142,470	740
	5	0	0	142,260	739
	6	0	0	142,130	738
9	1	0	0	141,810	737
	2	0	0	141,620	736
	3	0	0	141,510	735
	4	0	0	141,410	735
	5	0	0	141,290	734
	6	0	0	141,250	734
	7	0	0	141,240	734
	8	0	0	141,200	734
	9	0	0	141,130	733
	10	0	0	141,110	733
	11	0	0	141,090	733
	12	0	0	141,090	733
	13	0	0	141,080	733
	14	0	0	141,080	733
	15	0	0	141,080	733
	16	0	0	141,080	733
	17	0	0	141,080	733
	18	0	0	141,080	733
	Average	0	0	141,882	737

CO-2 and LEOb-4					
Stress		Wells - Volume		Drain	
Period	Step	ft^3/day	gpm	ft^3/day	gpm
8	1	0	0	183,420	953
	2	0	0	176,720	918
	3	0	0	175,740	913
	4	0	0	175,380	911
	5	0	0	175,180	910
	6	0	0	175,040	909
9	1	0	0	174,720	908
	2	0	0	174,550	907
	3	0	0	174,420	906
	4	0	0	174,370	906
	5	0	0	174,280	905
	6	0	0	174,230	905
	7	0	0	174,200	905
	8	0	0	174,150	905
	9	0	0	174,080	904
	10	0	0	174,050	904
	11	0	0	174,050	904
	12	0	0	174,040	904
	13	0	0	174,040	904
	14	0	0	174,040	904
	15	0	0	174,030	904
	16	0	0	174,030	904
	17	0	0	174,030	904
	18	0	0	174,030	904
	Average	0	0	174,868	908

Table D-4 (continued)
Hutsonville Pond D Leachate Collection Scenarios
Estimated Discharge Volumes (MODFLOW Data)

CO-3c and LEOa-1

Stress		Wells - Volume		Drain	
Period	Step	ft^3/day	gpm	ft^3/day	gpm
8	1	42,350	220	11,892	62
	2	42,350	220	10,273	53
	3	42,350	220	9,939	52
	4	42,350	220	9,770	51
	5	42,350	220	9,633	50
	6	42,350	220	9,540	50
9	1	42,350	220	9,501	49
	2	42,350	220	9,460	49
	3	42,350	220	9,418	49
	4	42,350	220	9,369	49
	5	42,350	220	9,314	48
	6	42,350	220	9,281	48
	7	42,350	220	9,268	48
	8	42,350	220	9,232	48
	9	42,350	220	9,216	48
	10	42,350	220	9,203	48
	11	42,350	220	9,188	48
	12	42,350	220	9,188	48
	13	42,350	220	9,188	48
	14	42,350	220	9,180	48
	15	42,350	220	9,180	48
	16	42,350	220	9,182	48
	17	42,350	220	9,180	48
	18	42,350	220	9,177	48
Average		42,350	220	9,490	49

CO-3c and LEOb-1

Stress		Wells - Volume		Drain	
Period	Step	ft^3/day	gpm	ft^3/day	gpm
8	1	42,350	220	26,200	136
	2	42,350	220	23,723	123
	3	42,350	220	23,264	121
	4	42,350	220	23,062	120
	5	42,350	220	22,961	119
	6	42,350	220	22,873	119
9	1	42,350	220	22,829	119
	2	42,350	220	22,785	118
	3	42,350	220	22,717	118
	4	42,350	220	22,702	118
	5	42,350	220	22,655	118
	6	42,350	220	22,632	118
	7	42,350	220	22,593	117
	8	42,350	220	22,577	117
	9	42,350	220	22,552	117
	10	42,350	220	22,544	117
	11	42,350	220	22,539	117
	12	42,350	220	22,536	117
	13	42,350	220	22,536	117
	14	42,350	220	22,539	117
	15	42,350	220	22,536	117
	16	42,350	220	22,539	117
	17	42,350	220	22,536	117
	18	42,350	220	22,536	117
Average		42,350	220	22,874	119

CO-3c and LEOa-2

Stress		Wells - Volume		Drain	
Period	Step	ft^3/day	gpm	ft^3/day	gpm
8	1	0	0	184,220	957
	2	0	0	177,890	924
	3	0	0	176,910	919
	4	0	0	176,490	917
	5	0	0	176,250	916
	6	0	0	176,090	915
9	1	0	0	176,010	914
	2	0	0	175,860	914
	3	0	0	175,770	913
	4	0	0	175,690	913
	5	0	0	175,550	912
	6	0	0	175,510	912
	7	0	0	175,510	912
	8	0	0	175,420	911
	9	0	0	175,380	911
	10	0	0	175,340	911
	11	0	0	175,300	911
	12	0	0	175,300	911
	13	0	0	175,300	911
	14	0	0	175,300	911
	15	0	0	175,300	911
	16	0	0	175,300	911
	17	0	0	175,300	911
	18	0	0	175,300	911
Average		0	0	176,095	915

CO-3c and LEOb-2

Stress		Wells - Volume		Drain	
Period	Step	ft^3/day	gpm	ft^3/day	gpm
8	1	0	0	265,290	1378
	2	0	0	257,940	1340
	3	0	0	256,890	1334
	4	0	0	256,470	1332
	5	0	0	256,240	1331
	6	0	0	256,060	1330
9	1	0	0	255,940	1330
	2	0	0	255,800	1329
	3	0	0	255,680	1328
	4	0	0	255,650	1328
	5	0	0	255,530	1327
	6	0	0	255,490	1327
	7	0	0	255,470	1327
	8	0	0	255,380	1327
	9	0	0	255,310	1326
	10	0	0	255,280	1326
	11	0	0	255,280	1326
	12	0	0	255,280	1326
	13	0	0	255,280	1326
	14	0	0	255,280	1326
	15	0	0	255,240	1326
	16	0	0	255,240	1326
	17	0	0	255,240	1326
	18	0	0	255,240	1326
Average		0	0	256,104	1330

Table D-4 (continued)
Hutsonville Pond D Leachate Collection Scenarios
Estimated Discharge Volumes (MODFLOW Data)

CO-3c and LEOa-3

Stress		Wells - Volume		Drain	
Period	Step	ft^3/day	gpm	ft^3/day	gpm
8	1	0	0	14,196	74
	2	0	0	12,799	66
	3	0	0	12,530	65
	4	0	0	12,374	64
	5	0	0	12,250	64
	6	0	0	12,162	63
9	1	0	0	12,115	63
	2	0	0	12,079	63
	3	0	0	12,035	63
	4	0	0	11,999	62
	5	0	0	11,942	62
	6	0	0	11,911	62
	7	0	0	11,895	62
	8	0	0	11,861	62
	9	0	0	11,843	62
	10	0	0	11,835	61
	11	0	0	11,812	61
	12	0	0	11,812	61
	13	0	0	11,812	61
	14	0	0	11,807	61
	15	0	0	11,807	61
	16	0	0	11,807	61
	17	0	0	11,807	61
	18	0	0	11,807	61
	Average	0	0	12,096	63

CO-3c and LEOb-3

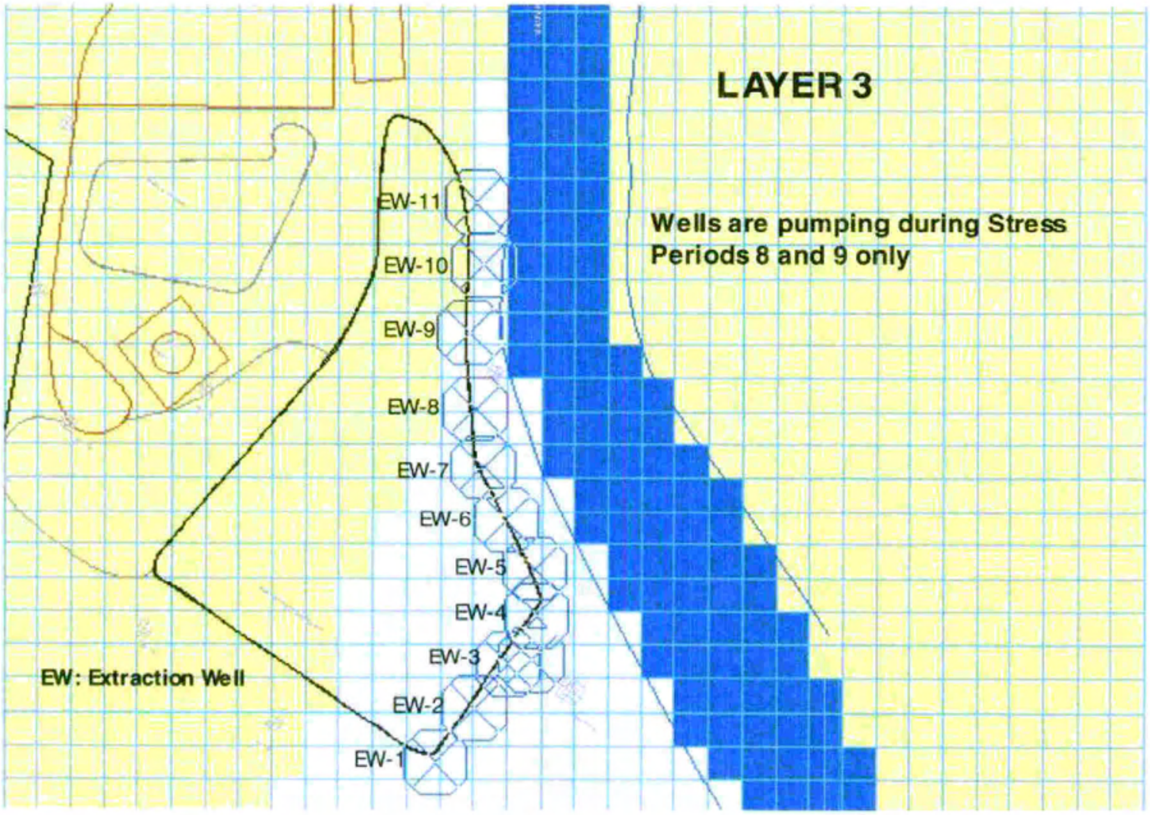
Stress		Wells - Volume		Drain	
Period	Step	ft^3/day	gpm	ft^3/day	gpm
8	1	0	0	28,417	148
	2	0	0	26,187	136
	3	0	0	25,782	134
	4	0	0	25,586	133
	5	0	0	25,487	132
	6	0	0	25,409	132
9	1	0	0	25,365	132
	2	0	0	25,319	132
	3	0	0	25,259	131
	4	0	0	25,241	131
	5	0	0	25,197	131
	6	0	0	25,176	131
	7	0	0	25,137	131
	8	0	0	25,124	131
	9	0	0	25,101	130
	10	0	0	25,078	130
	11	0	0	25,080	130
	12	0	0	25,065	130
	13	0	0	25,067	130
	14	0	0	25,065	130
	15	0	0	25,065	130
	16	0	0	25,067	130
	17	0	0	25,067	130
	18	0	0	25,067	130
	Average	0	0	25,392	132

CO-3c and LEOa-4

Stress		Wells - Volume		Drain	
Period	Step	ft^3/day	gpm	ft^3/day	gpm
8	1	0	0	149,520	777
	2	0	0	143,760	747
	3	0	0	142,870	742
	4	0	0	142,510	740
	5	0	0	142,290	739
	6	0	0	142,150	738
9	1	0	0	142,090	738
	2	0	0	141,980	738
	3	0	0	141,910	737
	4	0	0	141,850	737
	5	0	0	141,750	736
	6	0	0	141,710	736
	7	0	0	141,720	736
	8	0	0	141,660	736
	9	0	0	141,610	736
	10	0	0	141,580	735
	11	0	0	141,560	735
	12	0	0	141,560	735
	13	0	0	141,560	735
	14	0	0	141,560	735
	15	0	0	141,560	735
	16	0	0	141,560	735
	17	0	0	141,560	735
	18	0	0	141,560	735
	Average	0	0	142,227	739

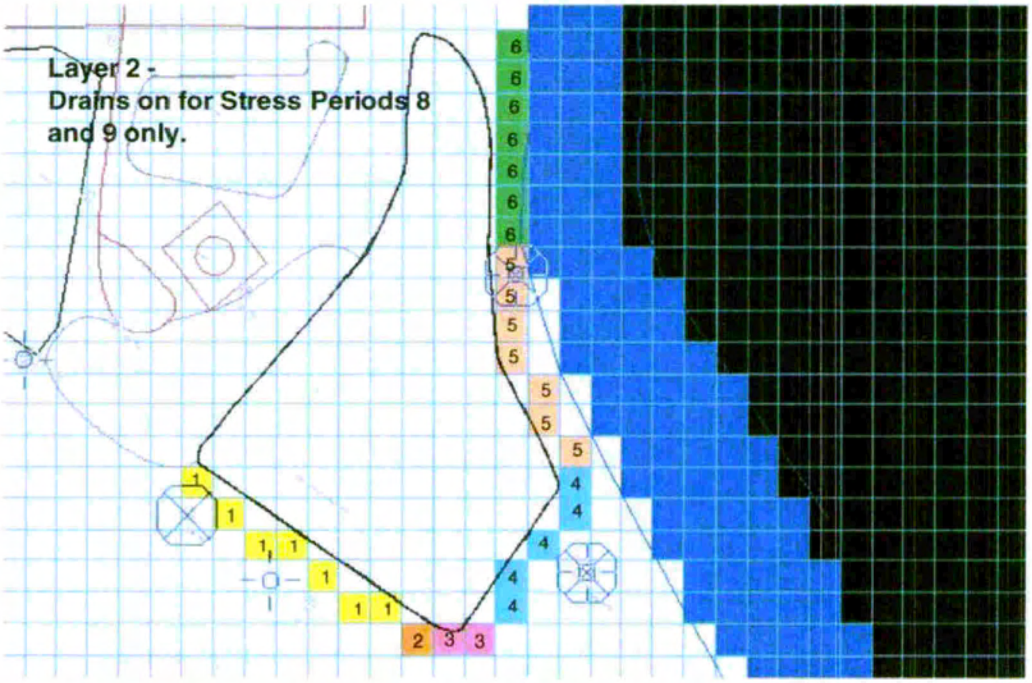
CO-3c and LEOb-4

Stress		Wells - Volume		Drain	
Period	Step	ft^3/day	gpm	ft^3/day	gpm
8	1	0	0	183,440	953
	2	0	0	176,740	918
	3	0	0	175,770	913
	4	0	0	175,390	911
	5	0	0	175,210	910
	6	0	0	175,070	909
9	1	0	0	174,970	909
	2	0	0	174,880	908
	3	0	0	174,790	908
	4	0	0	174,780	908
	5	0	0	174,690	907
	6	0	0	174,660	907
	7	0	0	174,630	907
	8	0	0	174,580	907
	9	0	0	174,520	907
	10	0	0	174,490	906
	11	0	0	174,490	906
	12	0	0	174,480	906
	13	0	0	174,470	906
	14	0	0	174,470	906
	15	0	0	174,470	906
	16	0	0	174,470	906
	17	0	0	174,470	906
	18	0	0	174,470	906
	Average	0	0	175,183	910



Extraction Wells	Top Layer of Screen	Bottom Layer of Screen	Pumping Rate (feet^3/day)	Pumping Rate (gallons/minute)
EW-1 through EW-11	3	3	3850	20

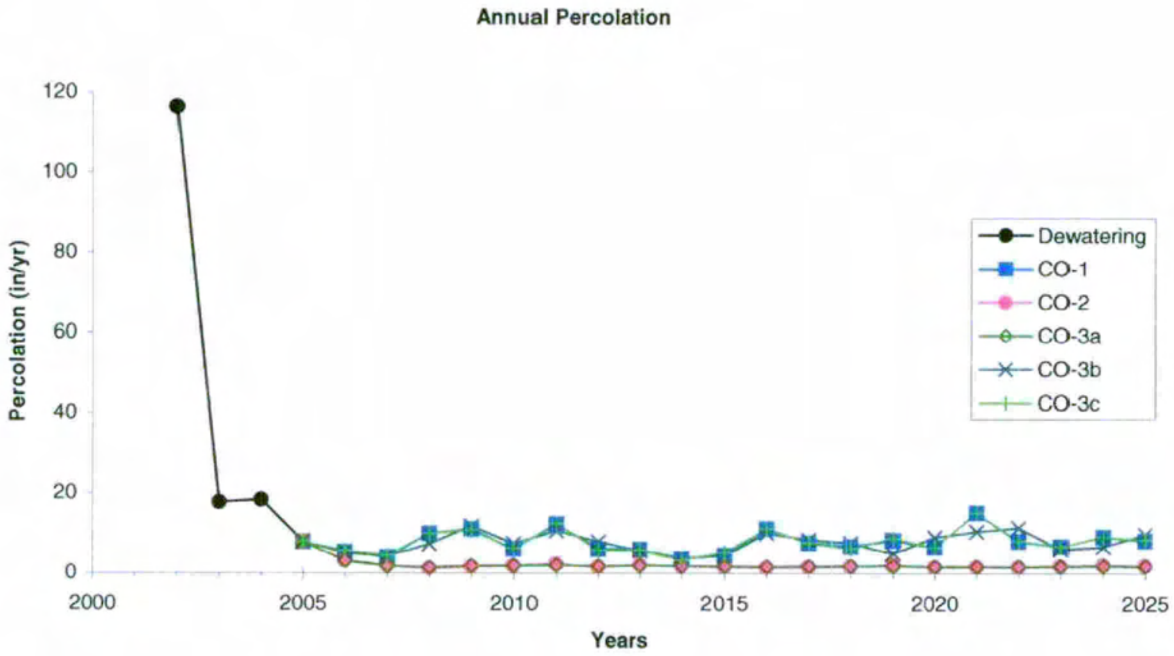
Figure D-1. MODFLOW extraction well layout



Extraction Type	Leachate Extraction Option							
	LEOa-1	LEOb-1	LEOa-2	LEOb-2	LEOa-3	LEOb-3	LEOa-4	LEOb-4
Drain 1a	On	-	On	-	On	-	On	-
Drain 2a	-	-	On	-	-	-	On	-
Drain 3a	-	-	On	-	-	-	On	-
Drain 4a	-	-	On	-	-	-	On	-
Drain 5a	-	-	On	-	-	-	On	-
Drain 6a	-	-	On	-	-	-	-	-
Drain 1b	-	On	-	On	-	On	-	On
Drain 2b	-	-	-	On	-	-	-	On
Drain 3b	-	-	-	On	-	-	-	On
Drain 4b	-	-	-	On	-	-	-	On
Drain 5b	-	-	-	On	-	-	-	On
Drain 6b	-	-	-	On	-	-	-	-
Wells	On	On	-	-	-	-	-	-

Drain	Drain Length (feet)	Drain Pipe Diameter (feet)	Drain Bed Thickness (feet)	Drain Bed K (cm/s)	Drain Bed K (ft/day)	South/East Drain Base Elevation	North/West Drain Base Elevation	Layer	Drain Reach
1a	1000	3	1	0.1	283	440	423	2	1
2a	70	3	1	0.1	283	423	423	2	2
3a	105	3	1	0.1	283	423	422	2	3
4a	615	3	1	0.1	283	422	420	2	4
5a	710	3	1	0.1	283	420	425	2	5
6a	700	3	1	0.1	283	425	425	2	6
1b	1000	3	1	0.1	283	437	420	2	1
2b	70	3	1	0.1	283	420	420	2	2
3b	105	3	1	0.1	283	420	419	2	3
4b	615	3	1	0.1	283	419	417	2	4
5b	710	3	1	0.1	283	417	422	2	5
6b	700	3	1	0.1	283	422	422	2	6

Figure D-2. MODFLOW drain layout.



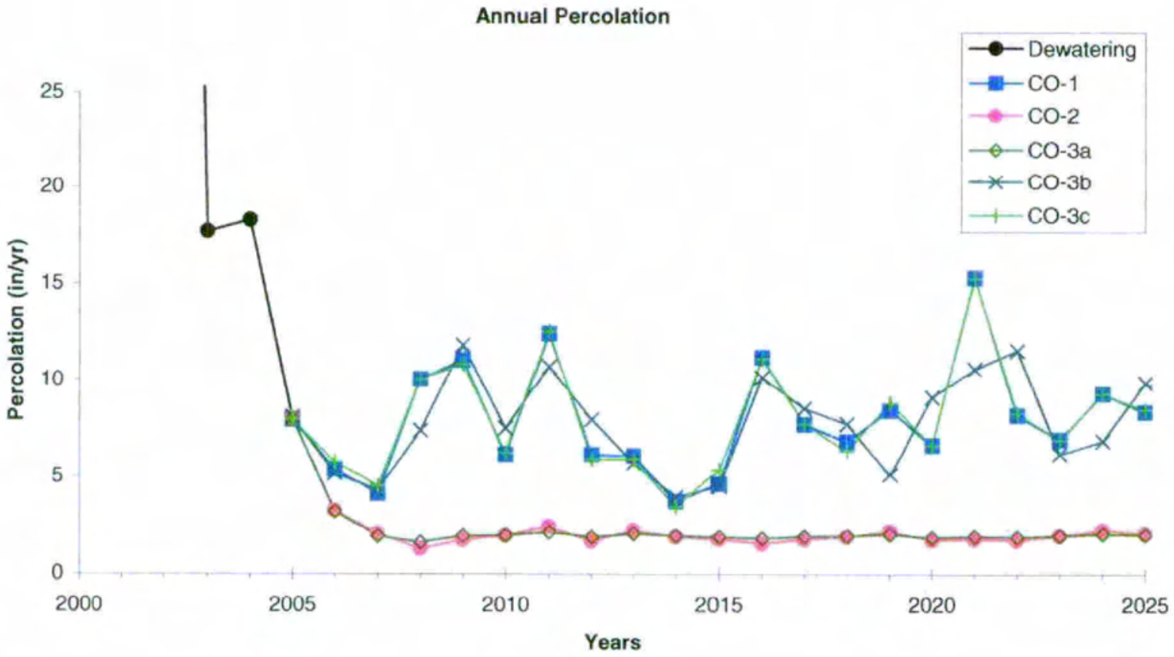


Figure D-3. HELP predicted percolation rates.

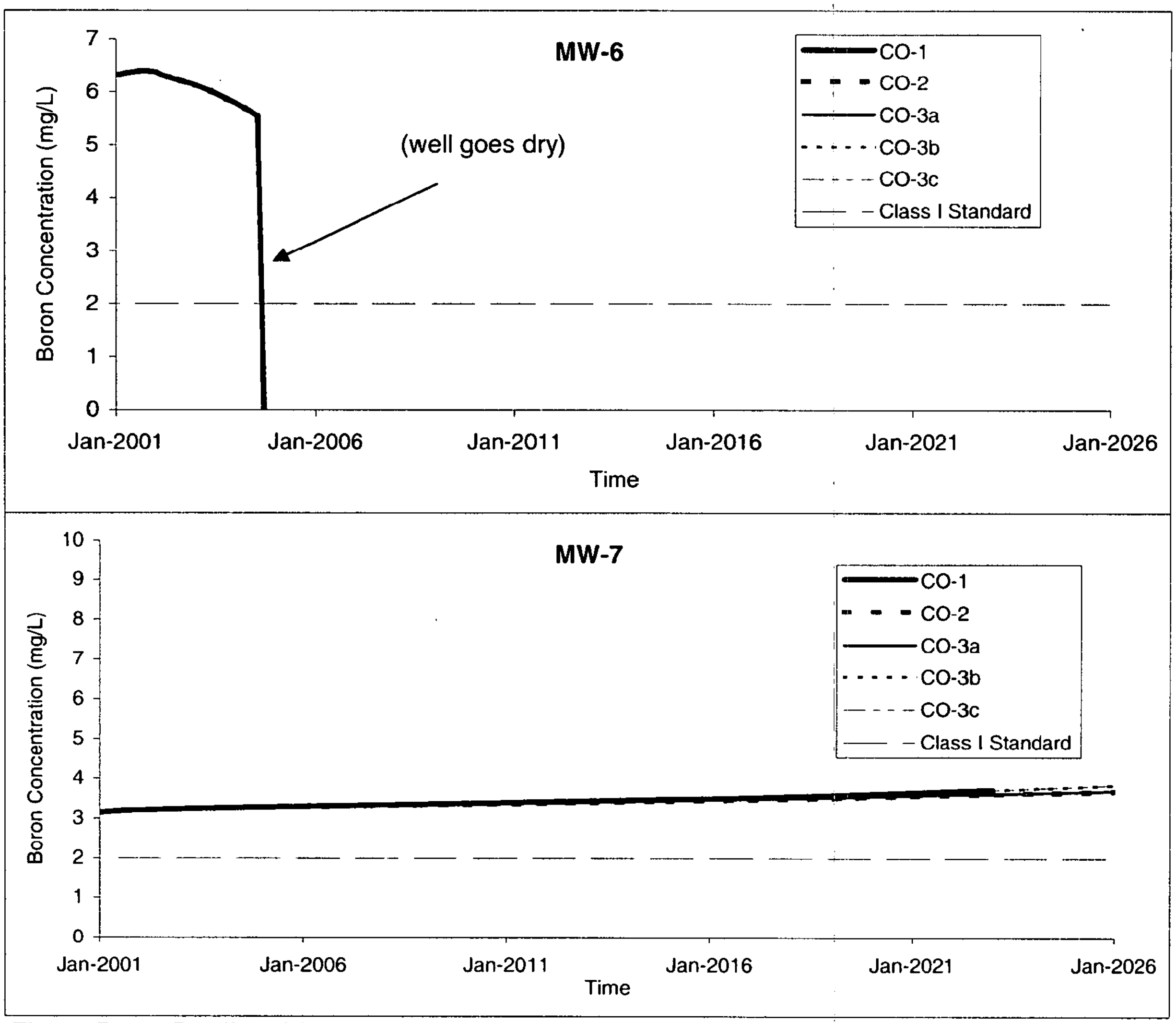


Figure D-4a. Predicted Boron concentrations for cover only scenarios.

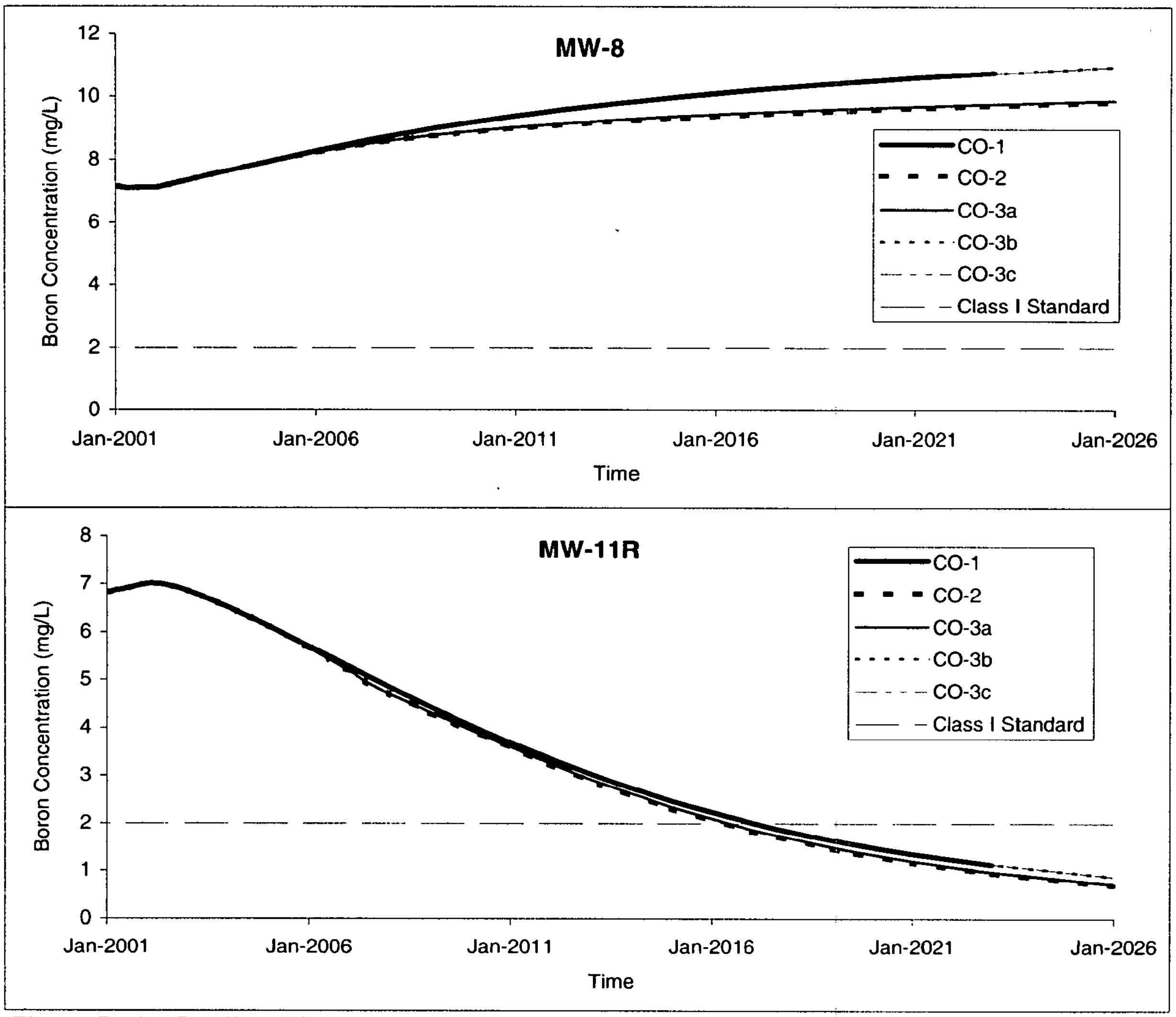


Figure D-4b. Predicted Boron concentrations for cover only scenarios.

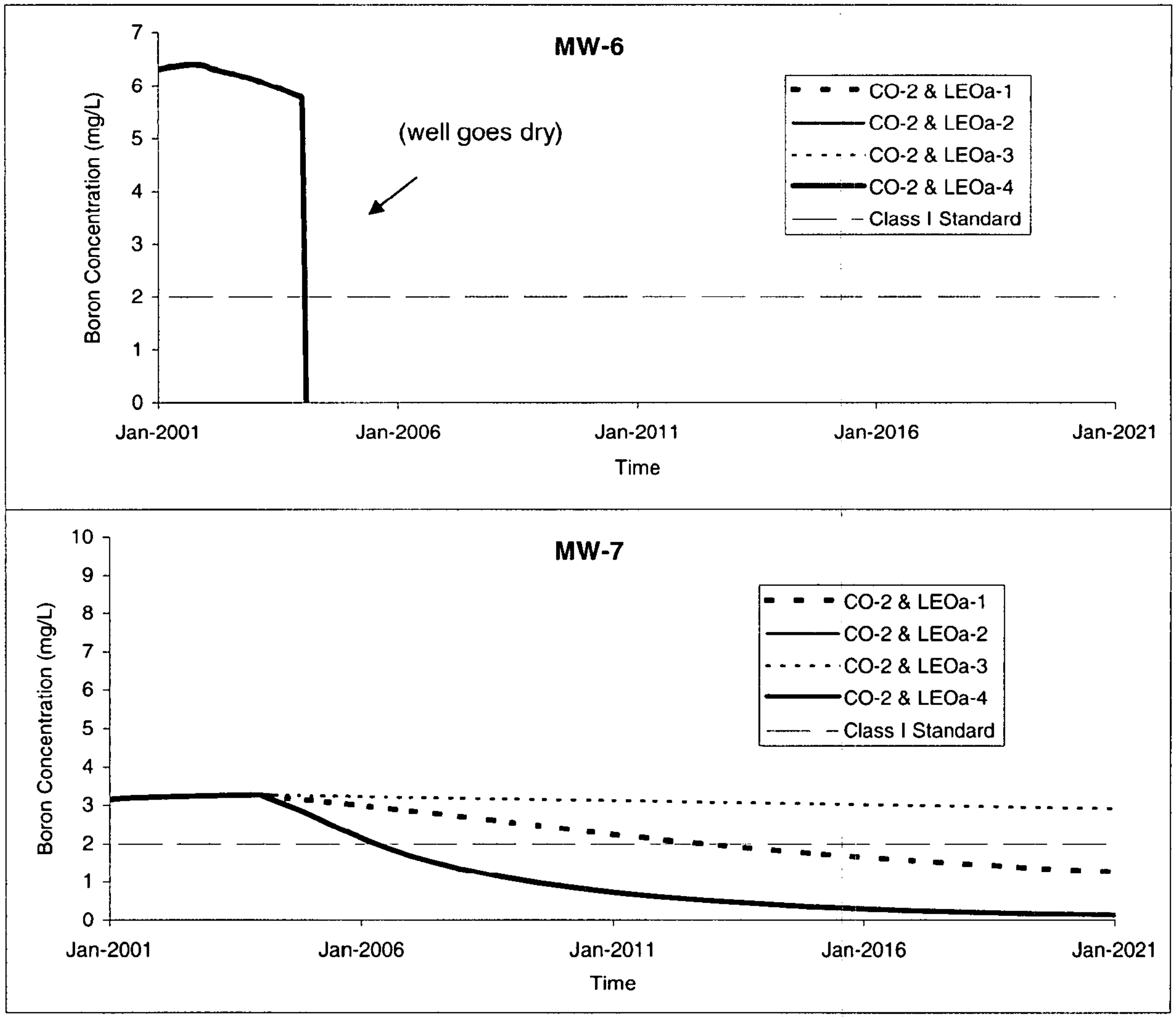


Figure D-5a. Predicted concentrations for the leachate collection scenarios.

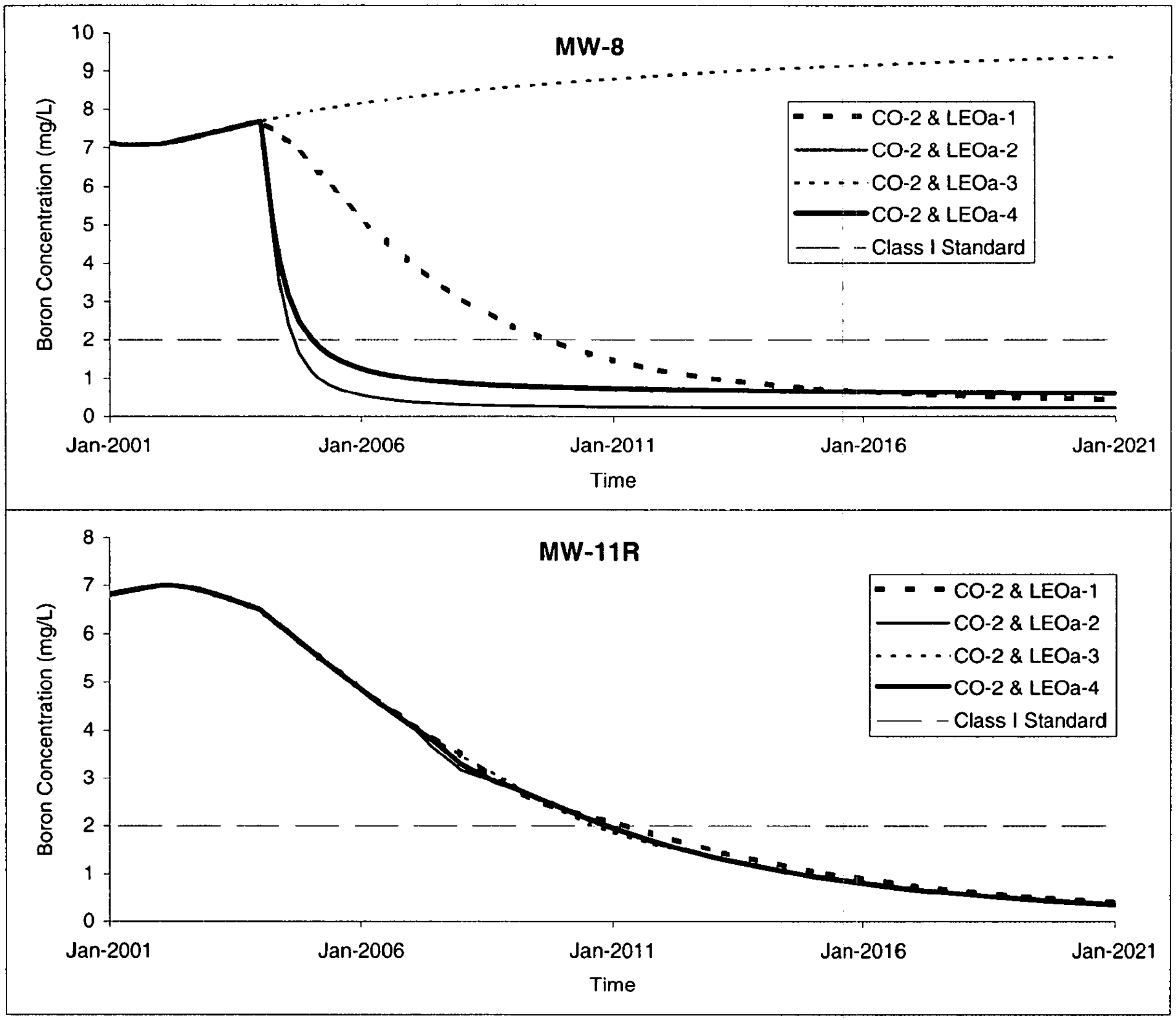


Figure D-5b. Predicted concentrations for the leachate collection scenarios.

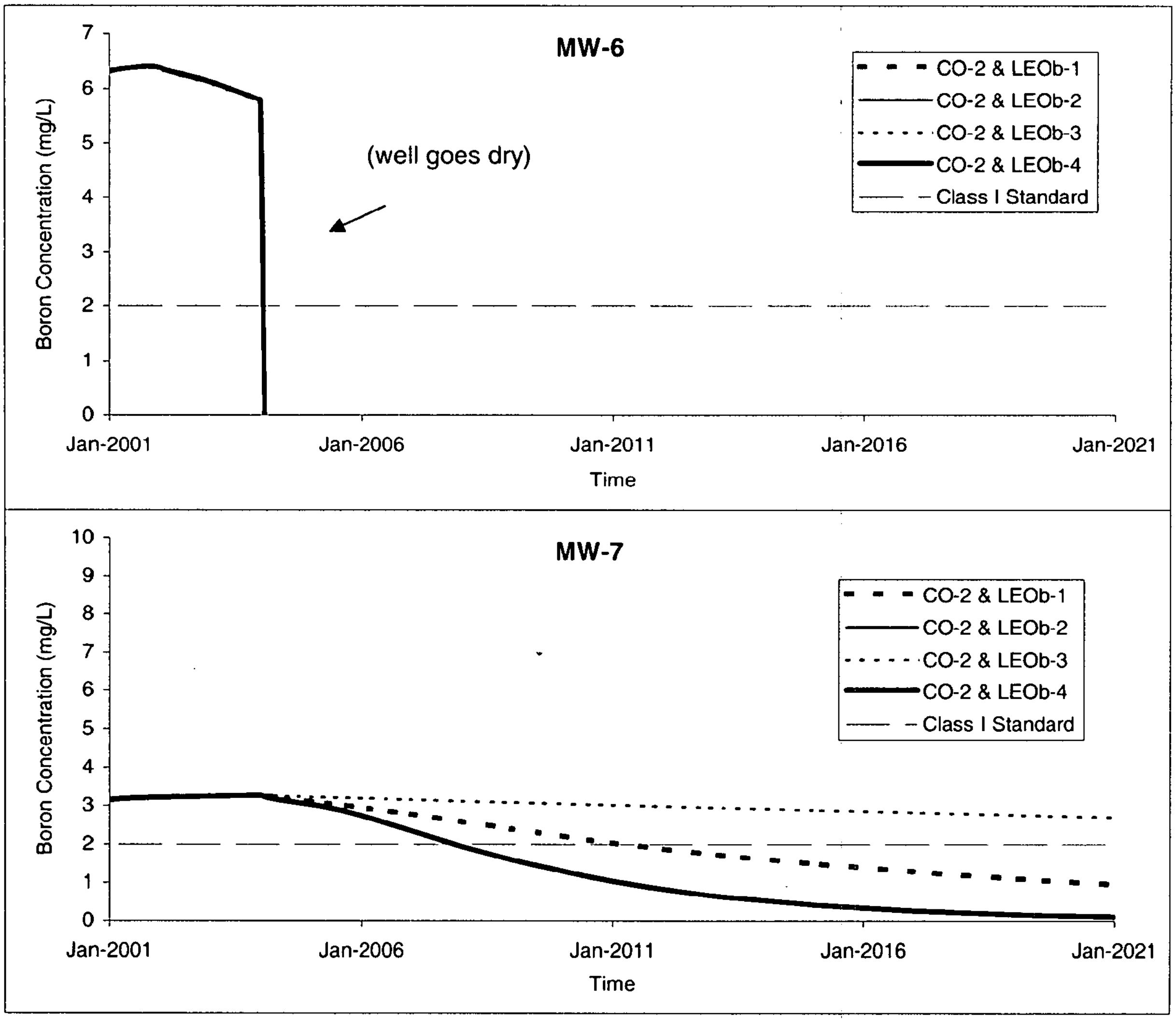


Figure D-5c. Predicted concentrations for the leachate collection scenarios.

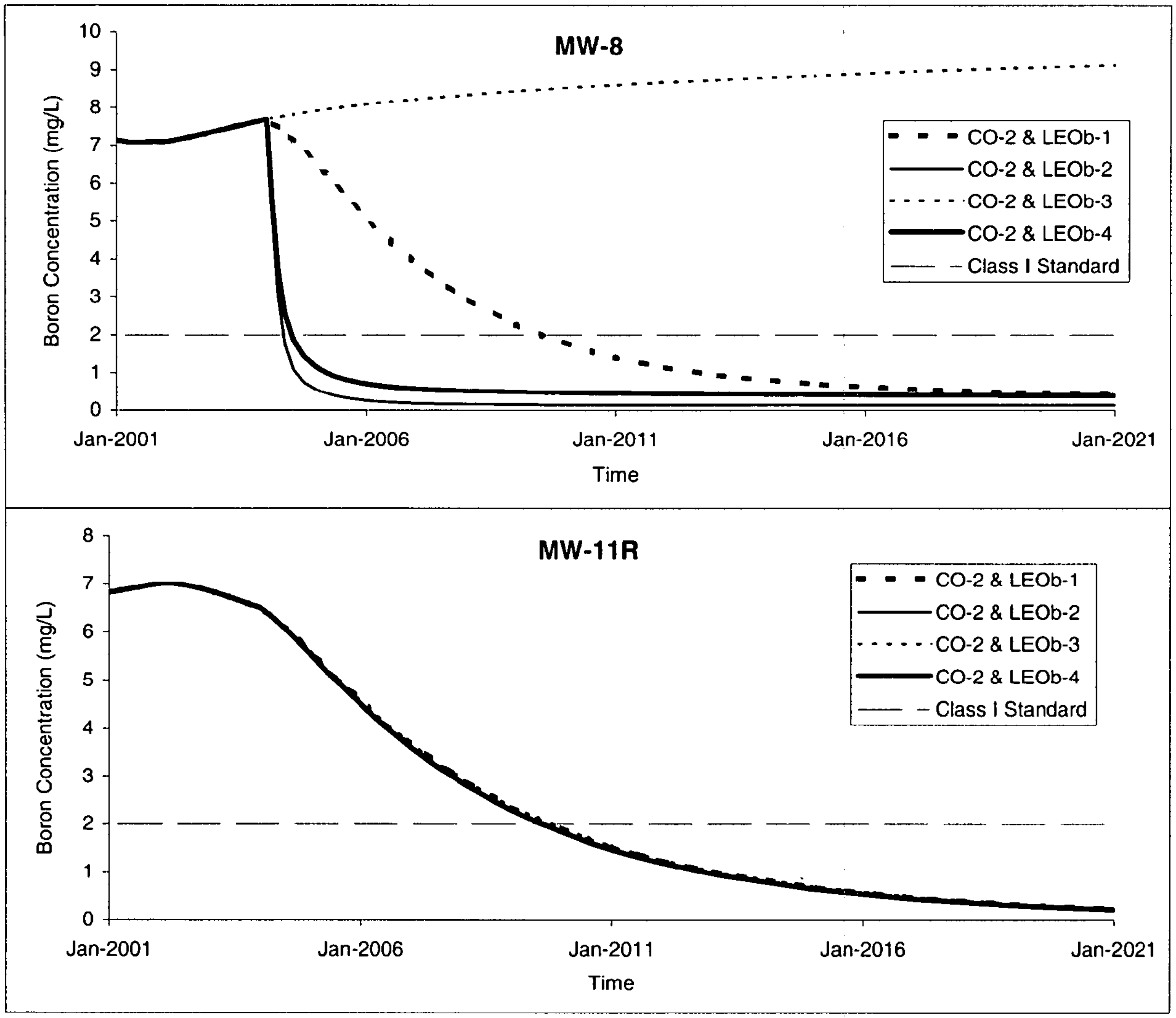


Figure D-5d. Predicted concentrations for the leachate collection scenarios.

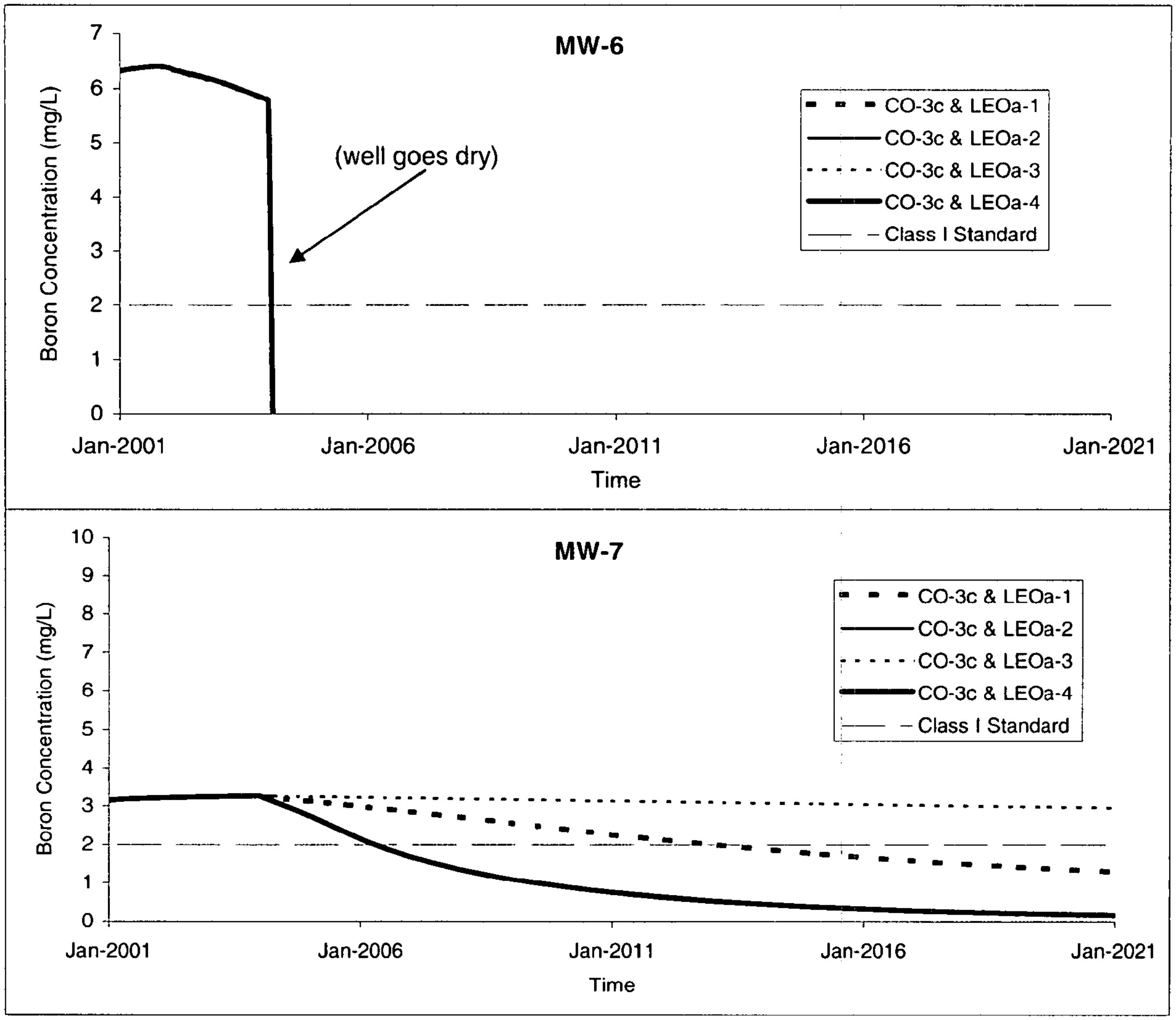


Figure D-5e. Predicted concentrations for the leachate collection scenarios.

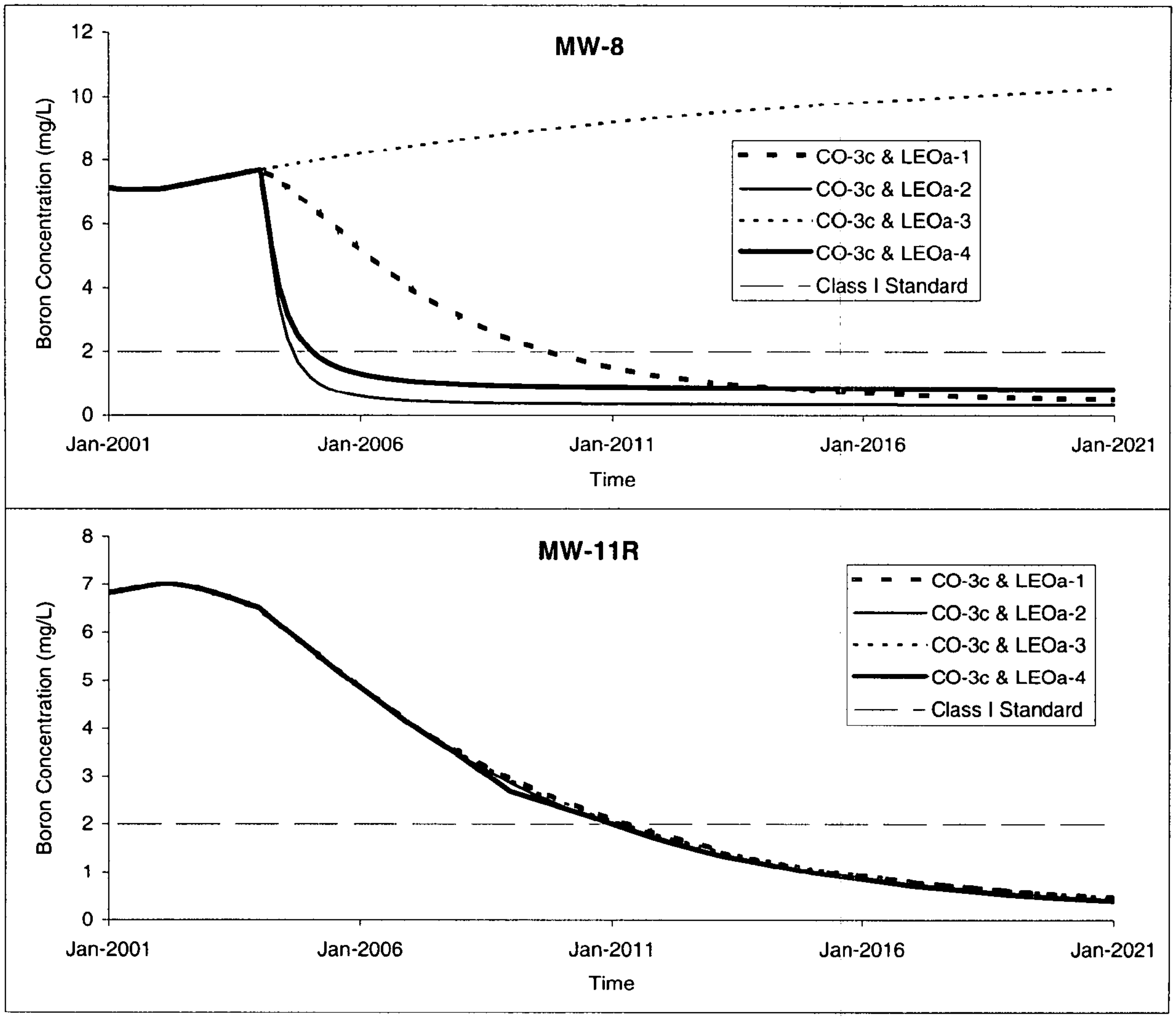


Figure D-5f. Predicted concentrations for the leachate collection scenarios.

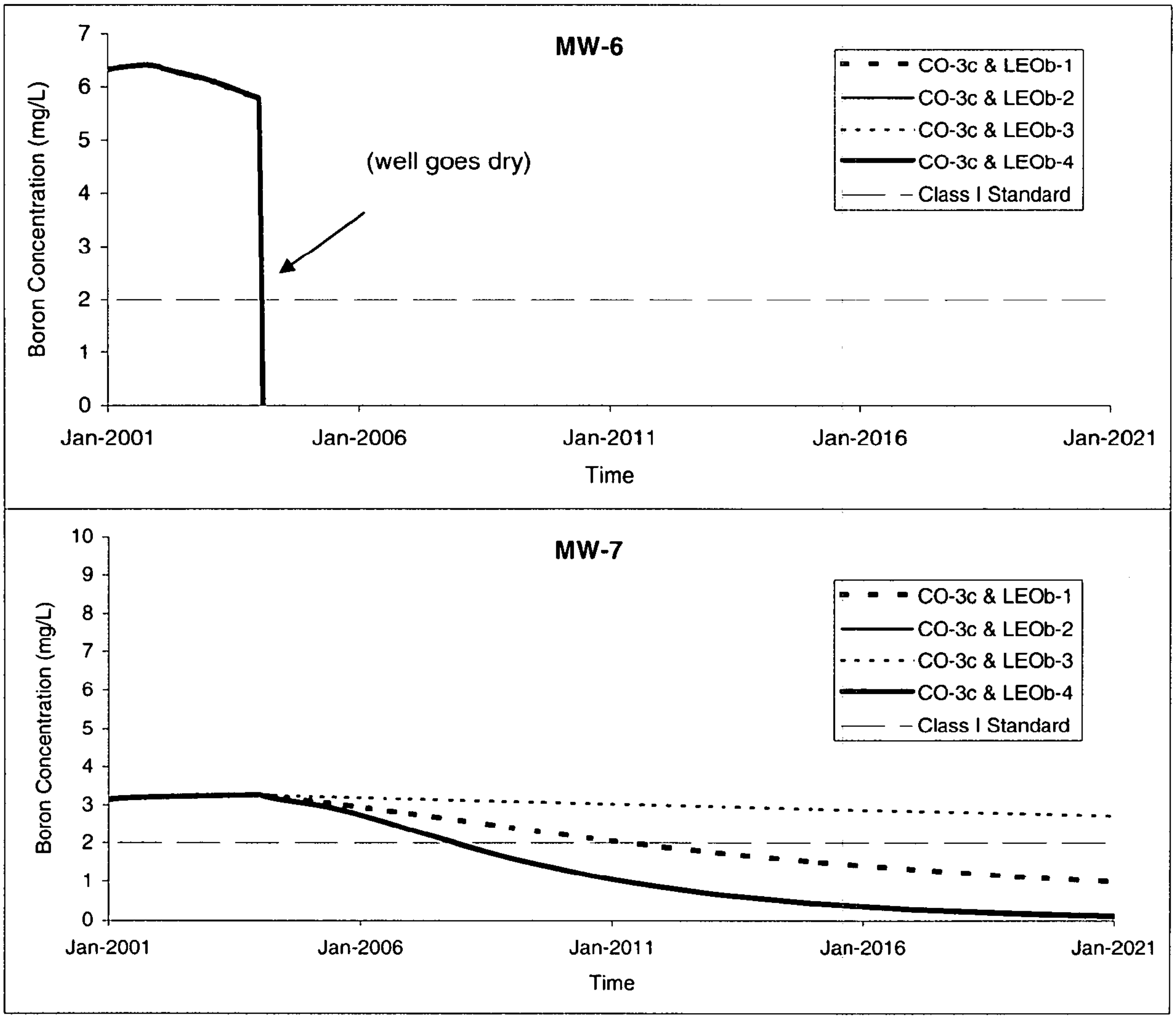


Figure D-5g. Predicted concentrations for the leachate collection scenarios.

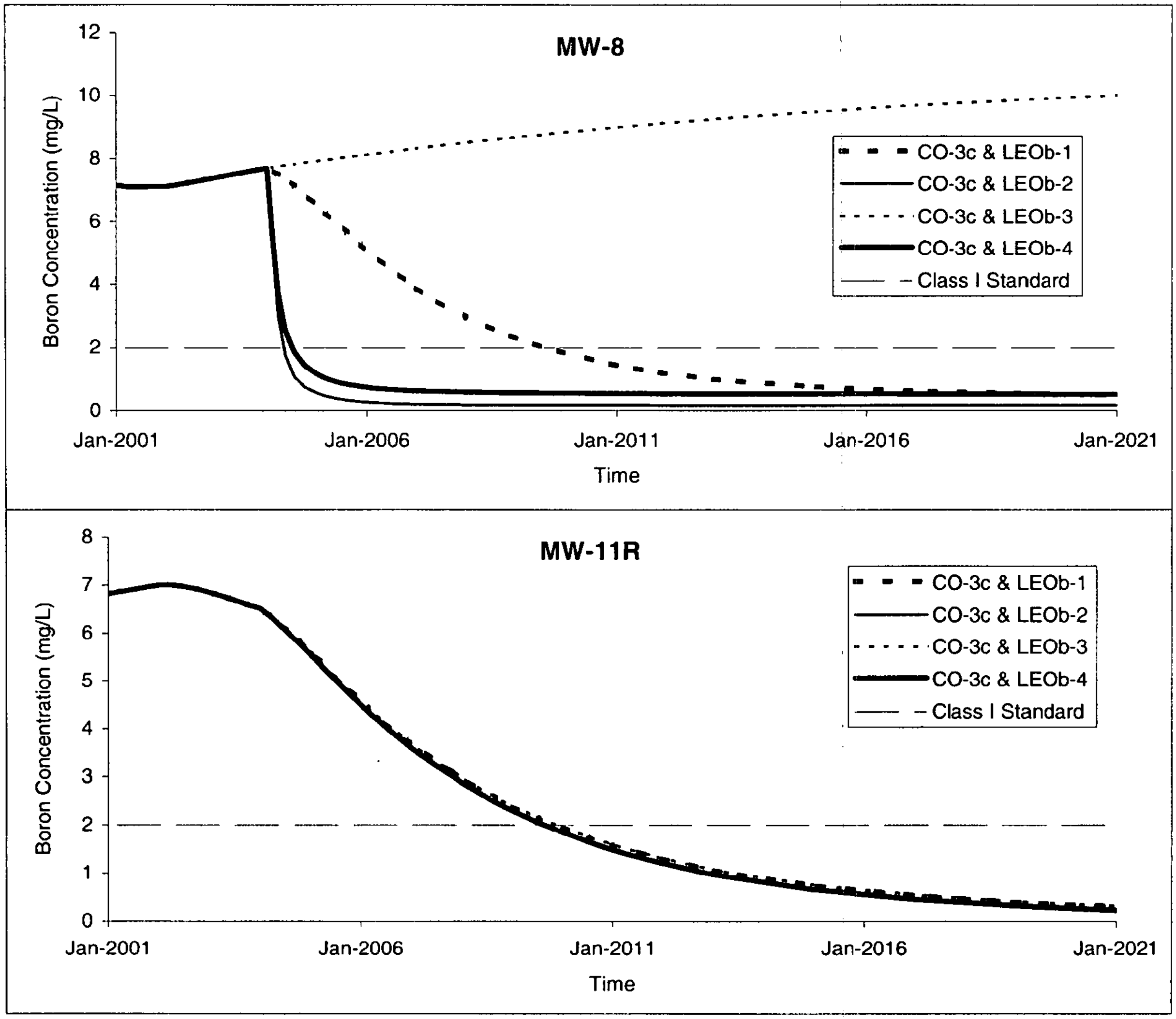


Figure D-5h. Predicted concentrations for the leachate collection scenarios.

1375 - Ameren Modeling Scenario's

The disk in the binder attached to this report contains the ASCII input files and output files used and generated by HELP, MODFLOW, and MT3D for each scenario. The files are named as follows:

HELP Model Scenarios	Layering Bottom to Top, Thickness (foot)
CO-1	3 foot Earth
CO-2	Geosynthetic Layer, 3 foot Earth
CO-3a	3 foot Pozzolonic Layer (K=1x10^{-7}), 3 foot Earth Layer
CO-3b	3 foot Pozzolonic Layer (K=1x10^{-6}), 3 foot Earth Layer
CO-3c	3 foot Pozzolonic Layer (K=1x10^{-5}), 3 foot Earth Layer

MODFLOW/MT3DMS Model Scenarios	Layering Bottom to Top, Thickness (foot)	Leachate Extraction Option (LEO)
CO-1	3 foot Earth	None
CO-2	Geosynthetic Layer, 3 foot Earth	None
CO-3a	3 foot Pozzolonic Layer (K=1x10^{-7}), 3 foot Earth Layer	None
CO-3b	3 foot Pozzolonic Layer (K=1x10^{-6}), 3 foot Earth Layer	None
CO-3c	3 foot Pozzolonic Layer (K=1x10^{-5}), 3 foot Earth Layer	None
CO-2 & LEOa-1	Geosynthetic Layer, 3 foot Earth	11 Extraction Wells (East); 1000 foot Trench (South)
CO-3c & LEOa-1	3 foot Pozzolonic Layer (K=1x10^{-5}), 3 foot Earth Layer	11 Extraction Wells (East); 1000 foot Trench (South)
CO-2 & LEOb-1	Geosynthetic Layer, 3 foot Earth	11 Extraction Wells (East); 1000 foot Trench (South)
CO-3c & LEOb-1	3 foot Pozzolonic Layer (K=1x10^{-5}), 3 foot Earth Layer	11 Extraction Wells (East); 1000 foot Trench (South)
CO-2 & LEOa-2	Geosynthetic Layer, 3 foot Earth	3200 foot Trench
CO-3c & LEOa-2	3 foot Pozzolonic Layer (K=1x10^{-5}), 3 foot Earth Layer	3200 foot Trench
CO-2 & LEOb-2	Geosynthetic Layer, 3 foot Earth	3200 foot Trench
CO-3c & LEOb-2	3 foot Pozzolonic Layer (K=1x10^{-5}), 3 foot Earth Layer	3200 foot Trench
CO-2 & LEOa-3	Geosynthetic Layer, 3 foot Earth	1000 foot Trench
CO-3c & LEOa-3	3 foot Pozzolonic Layer (K=1x10^{-5}), 3 foot Earth Layer	1000 foot Trench
CO-2 & LEOb-3	Geosynthetic Layer, 3 foot Earth	1000 foot Trench
CO-3c & LEOb-3	3 foot Pozzolonic Layer (K=1x10^{-5}), 3 foot Earth Layer	1000 foot Trench
CO-2 & LEOa-4	Geosynthetic Layer, 3 foot Earth	2500 foot Trench
CO-3c & LEOa-4	3 foot Pozzolonic Layer (K=1x10^{-5}), 3 foot Earth Layer	2500 foot Trench
CO-2 & LEOb-4	Geosynthetic Layer, 3 foot Earth	2500 foot Trench
CO-3c & LEOb-4	3 foot Pozzolonic Layer (K=1x10^{-5}), 3 foot Earth Layer	2500 foot Trench

APPENDIX E

STATISTICAL CALCULATIONS

May 4, 2005
11:46:26 AM

Hutsonville Ash Impoundment
Statistical Summary for Pooled Locations

User Supplied Information

Date Range: 01/01/1998 to 01/03/2005

Pooled Locations: MW7D, MWTW

Option for LT Pts: x 0.5

Parameter	Units	Count	Mean	Median	Maximum	Minimum	Std Dev	Sen Slope Units/yr	Normal / Log Normal	% of Non-Detects
Alkalinity, total (lab), (mg/L as Ca	mg/L	26	230.846	225.000	300.000	170.000	33.975	15.543	Yes / Yes	0.00
Boron, total	mg/L	28	0.111	0.092	0.240	0.052	0.047	0.000	No / Yes	0.00
Calcium, total	mg/L	27	76.481	77.000	96.000	56.000	9.955	-0.408	Yes / Yes	0.00
Manganese, total	mg/L	28	1.066	0.825	2.977	0.570	0.548	-0.011	No / No	0.00
pH (field)	std	18	7.595	7.457	8.440	7.300	0.348	-0.102	No / No	0.00
Sulfate, total	mg/L	28	47.571	49.500	74.000	19.000	15.557	-4.016	Yes / Yes	0.00
Total Filterable Residue (TDS)	mg/L	29	374.414	370.000	470.000	280.000	52.392	-4.276	Yes / Yes	0.00

Shapiro-Wilk Normality test performed at 0.05 significance level.

Hutsonville Ash Impoundment
Normal Tolerance Interval on Background
Background Data Pool

Probability Distribution:	One sided	**Option for LT Pts:**	x 0.5
Confidence Level:	99.00%	**Background Date Range:**	01/01/1998 to 03/16/2005
Data Transformation:	Natural Log	**Compliance Date Range:**	01/01/1998 to 03/16/2005
		Tolerance Coverage (Gamma):	95%
Compliance Locations:	MW7D, MWTW		
Background Locations:	MW7D, MWTW		

BACKGROUND

Parameter Code	Parameter Name	Units
01022	Boron, total	mg/L

Pooled Results:

Normal	Mean	StdDev	K Value	TL (Lower)	TU (Upper)
No	0.100	1.467	2.514	0.038	0.261

Location	Type	Total Pts	LT Pts	% LT Pts
MW7D	Alluvial Aq.	17	0	0.000
MWTW		13	0	0.000

Note: Confidence Level is sometimes referred to as Tolerance Coefficient.

Hutsonville Ash Impoundment
Normal Tolerance Interval on Background
Background Data Pool

Probability Distribution: One sided
Confidence Level: 99.00%
Data Transformation: None

Compliance Locations: MW7D, MWTW
Background Locations: MW7D, MWTW

Option for LT Pts: x 0.5
Background Date Range: 01/01/1998 to 03/16/2005
Compliance Date Range: 01/01/1998 to 03/16/2005
Tolerance Coverage (Gamma): 95%

BACKGROUND

Parameter Code	Parameter Name	Units
00410	**Alkalinity, total (lab), (mg/L as CACO3)**	**mg/L**

Pooled Results:

Normal	Mean	StdDev	K Value	TL (Lower)	TU (Upper)
Yes	229.000	33.636	2.557	143.006	314.994

Location	Type	Total Pts	LT Pts	% LT Pts
MW7D	Alluvial Aq.	16	0	0.000
MWTW		12	0	0.000

Note: Confidence Level is sometimes referred to as Tolerance Coefficient.

Hutsonville Ash Impoundment
Normal Tolerance Interval on Background
Background Data Pool

Probability Distribution:	**One sided**	**Option for LT Pts:**	**x 0.5**
Confidence Level:	**99.00%**	**Background Date Range:**	**01/01/1998 to 03/16/2005**
Data Transformation:	**None**	**Compliance Date Range:**	**01/01/1998 to 03/16/2005**
		Tolerance Coverage (Gamma):	**95%**
Compliance Locations:	**MW7D, MWTW**		
Background Locations:	**MW7D, MWTW**		

BACKGROUND

Parameter Code	Parameter Name	Units
00916	**Calcium, total**	**mg/L**

Pooled Results:

Normal	Mean	StdDev	K Value	TL (Lower)	TU (Upper)
Yes	75.276	10.613	2.535	48.377	102.175

Location	Type	Total Pts	LT Pts	% LT Pts
MW7D	Alluvial Aq.	17	0	0.000
MWTW		12	0	0.000

Note: Confidence Level is sometimes referred to as Tolerance Coefficient.

Hutsonville Ash Impoundment
Normal Tolerance Interval on Background
Background Data Pool

Probability Distribution:	One sided	Option for LT Pts:	x 0.5
Confidence Level:	99.00%	Background Date Range:	01/01/1998 to 03/16/2005
Data Transformation:	None	Compliance Date Range:	01/01/1998 to 03/16/2005
		Tolerance Coverage (Gamma):	95%

Compliance Locations: MW7D, MWTW
Background Locations: MW7D, MWTW

BACKGROUND

Parameter Code	Parameter Name	Units
00945	Sulfate, total	mg/L

Pooled Results:

Normal	Mean	StdDev	K Value	TL (Lower)	TU (Upper)
Yes	46.933	15.243	2.514	8.614	85.253

Location	Type	Total Pts	LT Pts	% LT Pts
MW7D	Alluvial Aq.	17	0	0.00
MWTW		13	0	0.00

Note: Confidence Level is sometimes referred to as Tolerance Coefficient.

Hutsonville Ash Impoundment
Normal Tolerance Interval on Background
Background Data Pool

Probability Distribution:	**One sided**	**Option for LT Pts:**	**x 0.5**
Confidence Level:	**99.00%**	**Background Date Range:**	**01/01/1998 to 03/16/2005**
Data Transformation:	**None**	**Compliance Date Range:**	**01/01/1998 to 03/16/2005**
		Tolerance Coverage (Gamma):	**95%**
Compliance Locations:	**MW7D, MWTW**		
Background Locations:	**MW7D, MWTW**		

BACKGROUND

Parameter Code	Parameter Name	Units
70300	Total Filterable Residue (TDS)	mg/L

Pooled Results:

Normal	Mean	StdDev	K Value	TL (Lower)	TU (Upper)
Yes	367.355	57.650	2.495	223.541	511.168

Location	Type	Total Pts	LT Pts	% LT Pts
MW7D	Alluvial Aq.	18	0	0.00
MWTW		13	0	0.00

Note: Confidence Level is sometimes referred to as Tolerance Coefficient.

Hutsonville Ash Impoundment
Statistical Summary for Pooled Background Locations MW-1 and MW-10

User Supplied Information

Date Range: 01/01/1998 to 01/03/2005
Pooled Locations: **MW1, MW10**

Option for LT Pts: x 0.5

Parameter	Units	Count	Mean	Median	Maximum	Minimum	Std Dev	Sen Slope Units/yr	Normal / Log Normal	% of Non-Detects
Alkalinity, lab	mg/L	101	226.208	240.000	332.000	98.000	63.628	4.838	No / No	0.00
B, tot	mg/L	101	0.139	0.130	0.400	0.059	0.059	-0.006	No / Yes	0.00
Ca, tot	mg/L	101	75.111	80.000	160.000	33.000	21.875	1.248	No / No	0.00
Mn, tot	mg/L	101	0.270	0.097	3.670	0.001	0.523	-0.010	No / Yes	3.96
pH (field)	std	83	7.387	7.350	7.960	7.030	0.228	-0.033	No / No	0.00
SO4, tot	mg/L	101	40.267	34.000	270.000	10.000	30.116	-1.610	No / No	0.00
TDS	mg/L	102	321.765	329.000	470.000	180.000	69.797	3.734	Yes / No	0.00

Shapiro-Wilk Normality test performed at 0.05 significance level.

Hutsonville Ash Impoundment
Normal Tolerance Interval on Background
Background Data Pool

Probability Distribution:	**One sided**	**Option for LT Pts:**	**x 0.5**
Confidence Level:	**1.00%**	**Background Date Range:**	**01/01/1998 to 01/03/2005**
Data Transformation:	**Natural Log**	**Compliance Date Range:**	**01/01/1998 to 01/03/2005**
		Tolerance Coverage (Gamma):	**95%**

Compliance Locations: **MW1, MW10**
Background Locations: **MW1, MW10**

BACKGROUND

Parameter Code	Parameter Name	Units
01022	**Boron, total**	**mg/L**

Pooled Results:

Normal	Mean	StdDev	K Value	TL (Lower)	TU (Upper)
Yes	0.139	0.059	1.925	0.061	0.270

Location	Type	Total Pts	LT Pts	% LT Pts
MW1	Upper Zone	84	0	0.000
MW10	Upper Zone	17	0	0.000

Note: Confidence Level is sometimes referred to as Tolerance Coefficient.

Hutsonville Ash Impoundment
Normal Tolerance Interval on Background
Background Data Pool

Probability Distribution: One sided
Confidence Level: 1.00%
Data Transformation: Natural Log

Compliance Locations: MW1, MW10
Background Locations: MW1, MW10

Option for LT Pts: x 0.5
Background Date Range: 01/01/1998 to 01/03/2005
Compliance Date Range: 01/01/1998 to 01/03/2005
Tolerance Coverage (Gamma): 95%

BACKGROUND

Parameter Code	Parameter Name	Units
01055	**Manganese, total**	**mg/L**

Pooled Results:

Normal	Mean	StdDev	K Value	TL (Lower)	TU (Upper)
Yes	0.270	0.523	1.925	0.003	2.287

Location	Type	Total Pts	LT Pts	% LT Pts
MW1	Upper Zone	84	4	4.762
MW10	Upper Zone	17	0	0.000

Note: Confidence Level is sometimes referred to as Tolerance Coefficient.

Hutsonville Ash Impoundment
Normal Tolerance Interval on Background
Background Data Pool

Probability Distribution:	**One sided**	**Option for LT Pts:**	**x 0.5**
Confidence Level:	**1.00%**	**Background Date Range:**	**01/01/1998 to 01/03/2005**
Data Transformation:	**None**	**Compliance Date Range:**	**01/01/1998 to 01/03/2005**
		Tolerance Coverage (Gamma):	**95%**
Compliance Locations:	**MW1, MW10**		
Background Locations:	**MW1, MW10**		

BACKGROUND

Parameter Code	Parameter Name	Units
70300	Total Filterable Residue (TDS)	mg/L

Pooled Results:

Normal	Mean	StdDev	K Value	TL (Lower)	TU (Upper)
Yes	321.765	69.797	1.923	187.522	456.008

Location	Type	Total Pts	LT Pts	% LT Pts
MW1	Upper Zone	84	0	0.000
MW10	Upper Zone	18	0	0.000

Note: Confidence Level is sometimes referred to as Tolerance Coefficient.

Hutsonville Ash Impoundment
Data used in Background Statistical Calculations

Date Range: 01/01/1998 to 03/16/2005

Well Id	Date Sampled	Lab Id	Alkalinity, Tot, mg/L	Boron, Tot, mg/L	Calcium, Tot, mg/L	Manganese, Tot, mg/L	pH (field), std	Sulfate, Tot, mg/L
MW1	01/06/1998		228.000	0.167	82.000	<0.005	7.52	91
	02/09/1998		240.000	0.134	108.000	0.125	7.17	88
	03/24/1998		128.000	0.122	44.000	<0.005	7.55	55
	04/14/1998		116.000	0.295	44.000	<0.005	7.61	50
	05/27/1998		160.000	0.090	56.000	0.020	7.35	38
	06/24/1998		188.000	0.203	68.000	0.040	7.48	32
	07/21/1998		268.000	0.160	80.000	0.181	7.11	22
	08/31/1998		284.000	0.110	92.000	0.438	7.48	16
	09/28/1998		264.000	0.150	88.000	0.043	7.14	22
	10/26/1998		240.000	0.251	80.000	0.185	7.22	270
	11/16/1998	W98-794	222.000	0.098	80.000	0.060	7.60	26
	12/16/1998		270.000	0.079	108.000	0.582	7.06	29
	01/19/1999	W99-44	128.000	0.122	56.000	0.017	7.96	53
	02/24/1999	AC01231	100.000	0.139	44.000	0.005	7.44	47
	03/30/1999	AC01258	98.000	0.185	40.000	0.034	7.67	42
	04/30/1999	AC01681	126.000	0.256	88.000	0.155	7.90	34
	05/24/1999	AC01895	210.000	0.241	64.000	0.598	7.39	27
	06/29/1999		224.000	0.129	76.000	0.440	7.20	30
	07/26/1999		308.000	0.160	92.000	0.623	7.20	33
	08/30/1999		284.000	0.150	88.000	0.261	7.10	19
	09/28/1999		272.000	0.080	96.000	0.147	7.50	39
	10/29/1999		250.000	0.130	93.000	0.071	7.50	54
	11/30/1999		254.000	0.150	63.000	0.016	7.90	64
	12/27/1999		247.000	0.250	48.000	0.040	7.70	56
	01/28/2000		259.000	0.240	72.000	0.030	7.66	49
	02/28/2000		244.000	0.110	84.000	0.162	7.68	45
	03/31/2000		138.000	0.060	52.000	0.011	7.39	75
	04/29/2000		126.000	0.130	56.000	<0.005	7.57	48
	05/22/2000		265.000	0.100	87.000	0.397	7.25	59
	07/03/2000		290.000	0.090	80.000	0.247	7.20	40
	08/02/2000		292.000	0.110	87.000	0.228	7.40	22
	08/31/2000		260.000	0.140	73.000	0.243	7.38	21
	09/29/2000		289.000	0.120	85.000	0.113	7.35	24
	10/31/2000		251.000	0.220	77.000	1.620	7.03	30
	11/30/2000		220.000	0.100	42.000	1.239	7.29	28
	12/30/2000		169.000	0.400	58.000	1.264	7.14	25
	01/30/2001		177.000	0.240	53.300	1.047	7.42	20
	02/28/2001		164.000	0.150	52.000	0.824	7.83	27

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Hutsonville Ash Impoundment
Data used in Background Statistical Calculations

Date Range: 01/01/1998 to 03/16/2005

			Alkalinity, Tot, mg/L	Boron, Tot, mg/L	Calcium, Tot, mg/L	Manganese, Tot, mg/L	pH (field), std	Sulfate, Tot, mg/L
MW1	03/31/2001		166.000	0.130	49.900	1.088	7.57	24
	04/30/2001		202.000	0.140	56.000	1.242	7.27	17
	05/31/2001		314.000	0.060	81.000	3.670	7.40	12
	06/29/2001		302.000	0.080	88.000	2.524	7.33	10
	07/31/2001		332.000	0.090	100.000	1.014	7.39	10
	08/28/2001		296.000	0.070	89.000	0.384	7.28	28
	09/28/2001		288.000	0.100	100.000	0.196	7.34	45
	10/31/2001		224.000	0.250	88.000	0.057	7.31	117
	11/28/2001		196.000	0.170	76.000	0.135	7.29	64
	12/18/2001		176.000	0.230	69.000	0.097	7.33	53
	01/14/2002		180.000	0.170	58.000	0.180	7.30	57
	02/25/2002		140.000	0.150	44.000	0.069	7.77	43
	03/25/2002		120.000	0.150	35.000	0.098		40
	04/23/2002		110.000	0.150	33.000	0.130	7.43	37
	05/23/2002		140.000	0.170	42.000	0.420	7.38	25
	06/27/2002		250.000	0.098	74.000	0.690	7.45	24
	07/30/2002		330.000	0.110	96.000	0.091	7.41	30
	08/31/2002		300.000	0.160	96.000	0.014	7.51	63
	09/17/2002	02092695-1	290.000	0.150	99.000	0.042	7.53	68
	10/17/2002		290.000	0.310	160.000	0.019		80
	11/21/2002			0.140	90.000	0.150	7.12	
	11/25/2002		290.000				7.20	49
	12/11/2002	02122282-1	300.000	0.180	96.000	0.270	7.09	39
	01/08/2003		180.000	0.140	67.000	0.270		84
	02/05/2003		200.000	0.140	76.000	0.053	7.21	87
	03/17/2003		110.000	0.120	41.000	0.003		48
	04/07/2003		110.000	0.140	37.000	0.001		38
	05/03/2003		140.000	0.140	40.000	0.014		37
	06/02/2003		190.000	0.110	56.000	0.072		25
	07/07/2003		320.000	0.092	85.000	0.240	7.32	20
	08/04/2003		280.000	0.110	85.000	0.047		19
	09/08/2003		240.000	0.065	87.000	0.022		18
	10/06/2003		270.000	0.093	80.000	0.070		17
	11/03/2003		290.000	0.093	78.000	0.120		16
	12/01/2003		240.000	0.160	75.000	0.013		50
	01/05/2004		230.000	0.100	60.000	0.041	7.09	40
	02/09/2004		140.000	0.150	42.000	0.025	7.50	40
	03/02/2004		160.000	0.110	46.000	0.032	7.40	32

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Hutsonville Ash Impoundment
Data used in Background Statistical Calculations

Date Range: 01/01/1998 to 03/16/2005

			Alkalinity, Tot, mg/L	Boron, Tot, mg/L	Calcium, Tot, mg/L	Manganese, Tot, mg/L	pH (field), std	Sulfate, Tot, mg/L
MW1	04/04/2004		140.000	0.120	40.000	0.044	7.50	35
	05/04/2004		210.000	0.100	55.000	0.280	7.30	15
	06/01/2004		290.000	0.067	77.000	0.220	7.30	15
	08/02/2004		290.000	0.099	86.000	0.170		15
	09/13/2004		280.000	0.098	80.000	0.100	7.60	20
	10/04/2004		300.000	0.140	85.000	0.047	7.30	18
	11/08/2004		280.000	0.110	85.000	0.130	7.20	35
	12/06/2004		240.000	0.140	84.000	0.260	7.20	51
	01/03/2005		160.000	0.170	48.000	0.180	7.30	42
MW10	11/16/1998	W98-800	108.000	0.104	80.000	0.110	7.80	30
	01/20/1999	W99-54	212.000	0.115	78.000	0.070	7.78	32
	02/26/1999	AC01242	206.000	0.099	80.000	0.101	7.18	29
	03/30/1999	AC01268	208.000	0.085	76.000	0.092	7.95	32
	04/30/1999	AC01692	224.000	0.149	80.000	0.079	7.50	27
	01/14/2002		280.000	0.160	94.000	0.017		32
	09/17/2002	02092695-7	270.000	0.098	90.000	0.100	7.11	31
	12/19/2002	02123013-5	260.000	0.200	86.000	0.004	7.06	38
	02/05/2003		230.000	0.079	76.000	0.001	7.21	38
	05/03/2003		300.000	0.076	80.000	0.002		38
	07/07/2003		240.000	0.092	89.000	0.022		44
	09/08/2003		260.000	0.059	96.000	0.013		38
	10/13/2003		220.000	0.120	100.000	0.019		36
	03/02/2004		220.000	0.064	100.000	0.008	7.10	31
	04/04/2004		230.000	0.086	100.000	0.029	7.10	29
	08/01/2004		270.000	0.130	120.000	0.045		29
	10/04/2004		330.000	0.160	110.000	0.040	7.10	31
MW7D	11/18/1998	W98-805	172.000	0.066	60.000	0.727	7.90	40
	01/19/1999	W99-52	216.000	0.093	82.000	0.996	7.51	63
	02/26/1999	AC01239	234.000	0.104	92.000	1.431	8.28	67
	03/30/1999	AC01266	240.000	0.088	96.000	2.977	8.44	74
	04/30/1999	AC01689		0.148	84.000	0.649	8.00	60
	01/15/2002		250.000	0.240	88.000	0.620		58
	09/18/2002	02092792-8	200.000	0.083	71.000	0.750	7.41	51
	12/19/2002	02123013-3	210.000	0.140	67.000	0.750	7.38	31
	03/19/2003		170.000	0.089	66.000	0.760		51
	06/02/2003		200.000	0.088	68.000	0.680		60
	08/11/2003		240.000	0.140	69.000	0.660	7.53	59
	10/13/2003		220.000	0.110	66.000	0.640		44

Hutsonville Ash Impoundment
Data used in Background Statistical Calculations

Date Range: 01/01/1998 to 03/16/2005

			Alkalinity, Tot, mg/L	Boron, Tot, mg/L	Calcium, Tot, mg/L	Manganese, Tot, mg/L	pH (field), std	Sulfate, Tot, mg/L
MW7D	02/23/2004		260.000	0.110	89.000	0.770	7.40	68
	04/19/2004		260.000	0.067	85.000	0.830	7.30	61
	08/02/2004		260.000	0.091	81.000	0.570		47
	10/04/2004		300.000	0.210	85.000	0.660	7.50	36
	03/15/2005		220.000	0.062	61.000	0.450	7.53	42
MWTW	10/03/2001			0.090		1.055	7.83	48
	01/15/2002		220.000	0.110	70.000	2.000		34
	09/19/2002	02092792-6	200.000	0.082	77.000	1.400	7.43	40
	12/19/2002	02123013-8	230.000	0.067	78.000	1.200	7.31	38
	03/17/2003		200.000	0.200	83.000	0.930		65
	06/17/2003		210.000	0.052	74.000	0.820		62
	08/11/2003		220.000	0.110	71.000	1.100	7.48	52
	10/13/2003		200.000	0.075	56.000	0.760		30
	02/23/2004		290.000	0.085	86.000	2.100	7.30	27
	04/19/2004		260.000	0.099	72.000	1.200	7.30	19
	08/01/2004		260.000	0.180	72.000	1.400		24
	10/04/2004		280.000	0.084	77.000	1.400	7.40	23
	03/16/2005		190.000	0.060	57.000	0.640	7.44	34

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Hutsonville Ash Impoundment
Data used in Background Statistical Calculations

Date Range: 01/01/1998 to 03/16/2005

Well Id	Date Sampled	Lab Id	TDS, mg/L
MW1	01/06/1998		366
	02/09/1998		408
	03/24/1998		226
	04/14/1998		224
	05/27/1998		272
	06/24/1998		290
	07/21/1998		300
	08/31/1998		350
	09/28/1998		358
	10/26/1998		316
	11/16/1998	W98-794	306
	12/16/1998		334
	01/19/1999	W99-44	254
	02/24/1999	AC01231	230
	03/30/1999	AC01258	186
	04/30/1999	AC01681	234
	05/24/1999	AC01895	280
	06/29/1999		340
	07/26/1999		396
	08/30/1999		276
	09/28/1999		376
	10/29/1999		394
	11/30/1999		394
	12/27/1999		376
	01/28/2000		398
	02/28/2000		384
	03/31/2000		286
	04/29/2000		258
	05/22/2000		384
	07/03/2000		458
	08/02/2000		372
	08/31/2000		334
	09/29/2000		342
	10/31/2000		340
	11/30/2000		314
	12/30/2000		220
	01/30/2001		246
	02/28/2001		220

Hutsonville Ash Impoundment
Data used in Background Statistical Calculations

Date Range: 01/01/1998 to 03/16/2005

			TDS, mg/L
MW1	03/31/2001		208
	04/30/2001		300
	05/31/2001		360
	06/29/2001		354
	07/31/2001		382
	08/28/2001		400
	09/28/2001		404
	10/31/2001		398
	11/28/2001		324
	12/18/2001		302
	01/14/2002		290
	02/25/2002		270
	03/25/2002		190
	04/23/2002		220
	05/23/2002		240
	06/27/2002		290
	07/30/2002		390
	08/31/2002		450
	09/17/2002	02092695-1	440
	10/17/2002		450
	11/25/2002		360
	12/11/2002	02122282-1	370
	01/08/2003		300
	02/05/2003		340
	03/17/2003		180
	04/07/2003		210
	05/03/2003		200
	06/02/2003		270
	07/07/2003		330
	08/04/2003		320
	09/08/2003		300
	10/06/2003		320
	11/03/2003		340
	12/01/2003		370
	01/05/2004		260
	02/09/2004		190
	03/02/2004		240
	04/04/2004		210

Hutsonville Ash Impoundment
Data used in Background Statistical Calculations

Date Range: 01/01/1998 to 03/16/2005

			TDS, mg/L
MW1	05/04/2004		260
	06/01/2004		290
	08/02/2004		330
	09/13/2004		370
	10/04/2004		340
	11/08/2004		360
	12/06/2004		300
	01/03/2005		260
MW10	11/16/1998	W98-800	326
	01/20/1999	W99-54	278
	02/26/1999	AC01242	330
	03/30/1999	AC01268	314
	04/30/1999	AC01692	328
	01/14/2002		370
	06/30/2002		370
	09/17/2002	02092695-7	380
	12/19/2002	02123013-5	330
	02/05/2003		310
	05/03/2003		270
	07/07/2003		340
	09/08/2003		380
	10/13/2003		450
	03/02/2004		410
	04/04/2004		390
	08/01/2004		450
	10/04/2004		470
MW7D	11/18/1998	W98-805	286
	01/19/1999	W99-52	402
	02/26/1999	AC01239	462
	03/30/1999	AC01266	432
	04/30/1999	AC01689	460
	01/15/2002		420
	07/01/2002		420
	09/18/2002	02092792-8	370
	12/19/2002	02123013-3	320
	03/19/2003		350
	06/02/2003		390
	08/11/2003		370

Hutsonville Ash Impoundment
Data used in Background Statistical Calculations

Date Range: 01/01/1998 to 03/16/2005

			TDS, mg/L
MW7D	10/13/2003		320
	02/23/2004		430
	04/19/2004		440
	08/02/2004		360
	10/04/2004		420
	03/15/2005		280
MWTW	10/03/2001		376
	01/15/2002		340
	09/19/2002	02092792-6	340
	12/19/2002	02123013-8	340
	03/17/2003		340
	06/17/2003		370
	08/11/2003		310
	10/13/2003		280
	02/23/2004		470
	04/19/2004		340
	08/01/2004		350
	10/04/2004		350
	03/16/2005		250

Hutsonville Ash Impoundment
Mann-Kendall Trend Analysis
Jan 97 through Jan 01

User Supplied Information

Location ID:	**MW1**	**Parameter Code:**	**01022**
Location Class:	**Background**	**Parameter:**	**Boron, total**
Location Type:	**Upper Zone**	**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**3 month(s)**
		Limit Name:	**State Std**
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line		
Slope (fitted to data):	-0.000028	mg/L per day
R-Squared error of fit:	0.111613	
Sen's Non-parametric estimate of the slope (two-tailed test)		
Median Slope:	-0.000021	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.000034	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.000000	mg/L per day
Non-parametric Mann-Kendall Test for Trend		
S Statistic:	-1,075.000	
Z test:	-3.405	
At the 95.0 % Confidence Level (two-tailed test):	This trend is non-zero.	

Hutsonville Ash Impoundment
Mann-Kendall Trend Analysis
Jan 98 through Jan 01

User Supplied Information

Location ID:	**MW1**	**Parameter Code:**	**01022**
Location Class:	**Background**	**Parameter:**	**Boron, total**
Location Type:	**Upper Zone**	**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**3 month(s)**
		Limit Name:	**State Std**
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line		
Slope (fitted to data):	-0.000018	mg/L per day
R-Squared error of fit:	0.048962	
Sen's Non-parametric estimate of the slope (two-tailed test)		
Median Slope:	-0.000013	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.000028	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.000000	mg/L per day
Non-parametric Mann-Kendall Test for Trend		
S Statistic:	-496.000	
Z test:	-1.917	
At the 95.0 % Confidence Level (two-tailed test):	This trend is zero.	

Hutsonville Ash Impoundment
Mann-Kendall Trend Analysis
Jan 98 through Jan 01

User Supplied Information

Location ID:	**MW1**	**Parameter Code:**	**00410**
Location Class:	**Background**	**Parameter:**	**Alkalinity, total (lab)**
Location Type:	**Upper Zone**	**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**3 month(s)**
		Limit Name:	**State Std**
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line		
Slope (fitted to data):	0.010109	mg/L per day
R-Squared error of fit:	0.012746	
Sen's Non-parametric estimate of the slope (two-tailed test)		
Median Slope:	0.009509	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.008647	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.027739	mg/L per day
Non-parametric Mann-Kendall Test for Trend		
S Statistic:	283.000	
Z test:	1.090	
At the 95.0 % Confidence Level (two-tailed test):	This trend is zero.	

Hutsonville Ash Impoundment
Mann-Kendall Trend Analysis
Jan 98 through Jan 01

User Supplied Information

Location ID:	MW1	**Parameter Code:**	00916
Location Class:	Background	**Parameter:**	Calcium, total
Location Type:	Upper Zone	**Units:**	mg/L
Confidence Level:	95.00%	**Period Length:**	3 month(s)
		Limit Name:	State Std
		Averaged:	No

Trend Analysis

Trend of the least squares straight line		
Slope (fitted to data):	-0.001554	mg/L per day
R-Squared error of fit:	0.002704	
Sen's Non-parametric estimate of the slope (two-tailed test)		
Median Slope:	-0.001773	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.007660	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.003308	mg/L per day
Non-parametric Mann-Kendall Test for Trend		
S Statistic:	-203.000	
Z test:	-0.781	
At the 95.0 % Confidence Level (two-tailed test):	This trend is zero.	

Hutsonville Ash Impoundment
Mann-Kendall Trend Analysis
Jan 98 through Jan 01

User Supplied Information

Location ID:	**MW1**	**Parameter Code:**	**01055**
Location Class:	**Background**	**Parameter:**	**Manganese, total**
Location Type:	**Upper Zone**	**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**3 month(s)**
		Limit Name:	**State Std**
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line

Slope (fitted to data):	-0.000050	mg/L per day
R-Squared error of fit:	0.004394	

Sen's Non-parametric estimate of the slope (two-tailed test)

Median Slope:	0.000000	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.000055	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.000029	mg/L per day

Non-parametric Mann-Kendall Test for Trend

S Statistic:	-42.000
Z test:	-0.158
At the 95.0 % Confidence Level (two-tailed test):	This trend is zero.

Hutsonville Ash Impoundment
Mann-Kendall Trend Analysis
Jan 98 through Jan 01

User Supplied Information

Location ID:	MW1	**Parameter Code:**	00400
Location Class:	Background	**Parameter:**	pH (field)
Location Type:	Upper Zone	**Units:**	std
Confidence Level:	95.00%	**Period Length:**	3 month(s)
		Limit Name:	State Std
		Averaged:	No

Trend Analysis

Trend of the least squares straight line		
Slope (fitted to data):	-0.000057	std per day
R-Squared error of fit:	0.039521	
Sen's Non-parametric estimate of the slope (two-tailed test)		
Median Slope:	-0.000059	std per day
Lower Confidence Limit of Slope, M1:	-0.000124	std per day
Upper Confidence Limit of Slope, M2+1:	0.000000	std per day
Non-parametric Mann-Kendall Test for Trend		
S Statistic:	-331.000	
Z test:	-1.605	
At the 95.0 % Confidence Level (two-tailed test):	This trend is zero.	

Hutsonville Ash Impoundment
Mann-Kendall Trend Analysis
Jan 98 through Jan 01

User Supplied Information

Location ID:	**MW1**	**Parameter Code:**	**00945**
Location Class:	**Background**	**Parameter:**	**Sulfate, total**
Location Type:	**Upper Zone**	**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**3 month(s)**
		Limit Name:	**State Std**
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line		
Slope (fitted to data):	-0.009142	mg/L per day
R-Squared error of fit:	0.042442	
Sen's Non-parametric estimate of the slope (two-tailed test)		
Median Slope:	-0.005285	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.010330	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.000000	mg/L per day
Non-parametric Mann-Kendall Test for Trend		
S Statistic:	-495.000	
Z test:	-1.909	
At the 95.0 % Confidence Level (two-tailed test):	This trend is zero.	

Hutsonville Ash Impoundment
Mann-Kendall Trend Analysis
Jan 98 through Jan 01

User Supplied Information

Location ID:	**MW1**	**Parameter Code:**	**70300**
Location Class:	**Background**	**Parameter:**	**Total Filterable Residue (TDS)**
Location Type:	**Upper Zone**	**Units:**	**mg/L**
Confidence Level:	**95.00%**	**Period Length:**	**3 month(s)**
		Limit Name:	**State Std**
		Averaged:	**No**

Trend Analysis

Trend of the least squares straight line		
Slope (fitted to data):	-0.007135	mg/L per day
R-Squared error of fit:	0.005745	
Sen's Non-parametric estimate of the slope (two-tailed test)		
Median Slope:	-0.008418	mg/L per day
Lower Confidence Limit of Slope, M1:	-0.029491	mg/L per day
Upper Confidence Limit of Slope, M2+1:	0.013858	mg/L per day
Non-parametric Mann-Kendall Test for Trend		
S Statistic:	-204.000	
Z test:	-0.785	
At the 95.0 % Confidence Level (two-tailed test):	This trend is zero.	

APPENDIX F

GROUNDWATER VELOCITY CALCULATION

Appendix F - Groundwater Velocity Calculation

Leachate Management and Final Cover Alternatives Report
Hutsonville Ash Management Facility - Unlined Ash Impoundment (Pond D) Closure
Ameren Energy Generating - Hutsonville, Illinois

$$V = K\,i\ /\ n_e$$

V = Groundwater Velocity
K = Hydraulic Conductivity
i = Hydraulic Gradient (unitless value)
n_e = Effective Porosity

Nov-04

Contours	**426**	**to**	**425**	**TW-117**	Elevation		Distance	
K =	6.83E+03	ft/yr.			Change		Change	
i =	0.002	between contours identified above			(ft)		(ft)	
n_e =	20	%			1	/	520	0.002

$$V = \frac{6.83E+03 \quad * \quad 1.92E-03}{0.20}$$

V = 66 feet/year