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October 28, 2021

Tabitha K. Bernhardt
CCR Coordinator
Illinois Environmental Protection Agency
DWPC – Permits MC #15
Attn: Part 845 Coal Combustion Residual Rule Submittal
1021 North Grand Avenue East
Springfield, IL 62794-9276

Re: City Water, Light and Power – CCR Surface Impoundments
Lakeside Ash Pond – W1671200052-01
Dallman Ash Pond – W1671200052-02
Initial Operating Permit Application

Ms. Bernhardt,

On behalf of the City of Springfield's City Water, Light and Power (CWLP) facility, Andrews Engineering submits the enclosed original and one copy of the Initial Operating Permit Application for the two existing coal combustion residual (CCR) surface impoundments subject to the Illinois EPA Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments (35 Ill. Adm. Code 845). This application has been compiled pursuant to Section 845.230(d) – Initial Operating Permit for Existing, Inactive and Inactive Closed CCR Surface Impoundments. The applicable forms, Application Form CCR1 – Coal Combustion Residual Surface Impoundment Permitting Program, and Form 2E – Initial Operating Permit for Existing or Inactive CCR Surface Impoundments That Have Not Completed an Agency-Approved Closure Before July 30, 2021 are provided in Attachment 1. As required by 35 Ill. Adm. Code 845.800(d)(1), CWLP will place in the facility's operating record a copy of the permit application submitted to the Illinois EPA.

If you have any question or require further information, please contact me at your convenience.

Sincerely

Dipanjan Ghosh

Mahlon Hewitt, L.P.G.
Project Director I

MTH:ndd

Enclosure

cc: Eric Staley – CWLP (email)
P. J. Becker – CWLP (email)
Deborah Williams – CWLP (email)
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City Water, Light & Power

CCR Impoundments – Lakeside and Dallman Ash Ponds

Springfield, Sangamon County, Illinois

Initial Operating Permit Application

October 2021

Submitted to:
Illinois Environmental Protection Agency
Bureau of Water
1021 North Grand Avenue East
Springfield, Illinois

Prepared for:
City Water, Light & Power
3100 Stevenson Drive
Springfield, Illinois 62703

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ATTACHMENTS

1. INTRODUCTION

Springfield City Water, Light and Power (CWLP) owns two existing coal combustion residual (CCR) surface impoundments subject to the Illinois EPA Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments (35 Ill. Adm. Code 845). This application has been compiled pursuant to Section 845.230(d) – Initial Operating Permit for Existing, Inactive and Inactive Closed CCR Surface Impoundments. The applicable forms, Application Form CCR1 – Coal Combustion Residual Surface Impoundment Permitting Program, and Form 2E – Initial Operating Permit for Existing or Inactive CCR Surface Impoundments That Have Not Completed an Agency-Approved Closure Before July 30, 2021 are provided in Attachment 1.

The CWLP CCR surface impoundments are located north and east of the former Lakeside Power Generating Station and Dallman Power Generating Station in the Eastern ½ of Section 12, Township 15 North, Range 5 West, in Springfield, Illinois (see Figure 1). These CCR surface impoundments are identified as the Lakeside Ash Pond and the Dallman Ash Pond (see Figure 2).

The Lakeside Ash Pond was placed into service prior to 1958 and ceased receiving ash in 2009. It has been divided into four separate ponds, three limesludge ponds and the settling pond consisting of approximately 35.0 acres. The Lakeside Ash Pond currently receives limesludge from the CWLP Drinking Water Purification Plant, scrubber wastewater treatment plant clarifier blowdown and water from miscellaneous floor drains. Construction of new lined limesludge ponds will start in spring of 2022 and be completed by no later than fall of 2023. CWLP will initiate closure of the Lakeside Ash Pond after the water purification plant limesludge ponds are relocated.

The Dallman Ash Pond was placed into service in 1976 and is approximately 34.5 acres. The Dallman Ash Pond currently receives fly ash and bottom ash, which are sluiced with raw lake water, industrial wastewater treatment plant clarifier blowdown and landfill leachate. CWLP has shut down Dallman Units 31, 32 and will be shutting down Dallman Unit 33 no later than September 15, 2023. Once these Dallman units are shutdown, all fly and bottom ash will cease being sent to the Dallman Ash pond. Once the limesludge ponds are complete in the fall of 2023, closure of the Lakeside and Dallman impoundments can begin.

The existing CCR surface impoundments fail to meet the location restrictions (Section 845.300) for distance from an aquifer and are considered unlined CCR surface impoundments (Section 845.400(f)). As a result, CWLP must initiate closure pursuant to 35 Ill. Adm. Code Subpart G.

The following narrative provides information listed in Section 845.230(d)(2). Each section below contains the information of the subparts to Section 845.230(d)(2). As provided in the Opinion and Order of the Board to R20-19, 35 Illinois Administrative Code (IAC) Part 845 rules were based on 40 CFR Part 257, Subpart D. Several of the requirements listed in Section 845.230(d)(2) were addressed and filed pursuant to the requirements of 40 CFR Part 257. As such, and where applicable, copies of those previously constructed reports/certifications have been included to address the requirements of Section 845.230(d)(2).

2. CONSTRUCTION HISTORY

Andrews Engineering, Inc. (AEI) performed an extensive review of information for purposes of addressing Section 845.230(d)(2)(A) and 845.220(a)(1), which included the following documents:

- Coal Ash Impoundment Site Assessment Final Report (May 2011)
- Historical Aerial Photographs (April 1995 – March 2014)
- Engineering Report: Proposed Embankment Modification; CWLP Ash Disposal Area
- (July 1987).
- Construction Grading Plan for the Dallman Ash Pond (August 1976)

2.1 CCR Surface Impoundment Name

CWLP owns and operates two existing unlined coal combustion residual (CCR) surface impoundments, operating as a single multi-unit system for purposes of groundwater monitoring and closure. These CCR surface impoundments are identified as the Lakeside Ash Pond and the Dallman Ash Pond and are located northeast of the power plant complex in Springfield, Illinois. The ponds are operated under National Pollutant Discharge Elimination System (NPDES) Permit Number IL0024767.

2.2 Identification number of the CCR surface impoundment (if one has been assigned by the Agency)

The facility identification numbers for the CWLP CCR surface impoundments (Lakeside Ash Pond and Dallman Ash Pond) have been assigned as follows:

Lakeside Ash Pond – W1671200052-01
Dallman Ash Pond – W1671200052-02

2.3 Description of the boundaries of the CCR surface impoundment (35 IAC 845.210(c)) Legal Description. All permit applications must contain a legal description of the facility boundary and a description of the boundaries of all units included in the facility).

The ash impoundment area is comprised of 7 parcels. The parcel identification number and accompanying legal description for each of these parcels is provided as follows:

- PIN 22120400002 - L 17-20 W CRK L 23 W1/2 SE 12-15-5
- PIN 22120400007 - SE SE 12-15-5
- PIN 22120400009 - PT E1/2 NE SE 12-15-5
- PIN 22120400010 - LOT 9 E PT N NE CORNER & ALL LOTS 12 13 16 17 & 20 E OF CREEK W1/2 SE1/4 12-15-5
- PIN 22120400011 - PT NE1/4 SE1/4 12-15-5
- PIN 22120400012 - PT N PT SE1/4 12-15-5
- PIN 22120200022 - PT NE 1/4 12-15-5

The Lakeside Ash Pond is located immediately north of Spaulding Dam at the northern end of Lake Springfield and north of East Lake Shore Drive. It is bordered to the east by forested property and the CWLP Environmental Services Offices, to the north by the Clarification Pond and the Dallman Ash Pond and to the west by Sugar Creek.

The Dallman Ash Pond is located immediately northwest of the Lakeside Ash Pond and the Clarification Pond. The Dallman Ash Pond is bordered to the east by the permitted FGDS landfill, and to the north and west by Sugar Creek. Immediately north of Sugar Creek, north of the Dallman

Ash Pond is farmed agricultural property. Immediately west of Sugar Creek, west of the Lakeside Ash Pond and the Dallman Ash Pond is uninhabited forested property and US Interstate 55.

2.4 Statement of Purpose for which the CCR Surface Impoundment is Being Used

The Lakeside Ash Pond was originally used as a settling pond for fly ash and bottom ash sluiced with raw lake water. Presently, lime-softening ponds located on the southern portion of the Lakeside Ash Pond receive water softening lime residuals from the CWLP Drinking Water Purification Plant, Flue Gas Desulfurization Waste Water Treatment Plant (FGD WWTP) clarifier blowdown sludge, and wash-down water from miscellaneous floor drains. The FGD WWTP sludge contains CCR. The other flows are non-CCR.

The Dallman Ash Pond is used as a settling pond for fly ash and bottom ash, which are sluiced with raw lake water from Dallman Power Station Units 31, 32 and 33. In addition, industrial wastewater treatment plant clarifier blowdown, landfill leachate and evaporation pond water is pumped into the Dallman Ash Pond. The evaporation water is non CCR storm water from the FGD Landfill area that collects in the eastern portion of the undeveloped area. The generating facility (GF) WWTP sludge, landfill leachate and evaporation water are non-CCR materials. All materials being sent to the Dallman Ash Pond are liquid or wet processed solids. Settled water from both the Lakeside Ash Pond and Dallman Ash Pond flow into opposite sides of a Clarification Pond for final polishing before being discharged to Sugar Creek at Outfall 004 via NPDES permit.

2.5 Length of CCR surface Impoundment Operation

The initial deposition of fly ash and bottom ash in the Lakeside Ash Pond commenced shortly after completion of the first power plant sometime in the middle 1930's. The original disposal area encompassed the two easternmost lime-softening ponds within the area delineated as the Lakeside Ash Pond.

The Dallman Ash Pond was placed into service in 1976 continues to receive CCR as fly ash and bottom ash sluiced with raw lake water.

2.6 Types of CCR Placed in the CCR Surface Impoundment

Historically, the Lakeside Ash Pond received both bottom ash and fly ash. Since 2009, the only CCR placed in the Lakeside Ash Pond is FGD WWTP sludge. The other flows to the Lakeside Ash Pond are non-CCR materials.

The Dallman Ash Pond receives both fly ash and bottom ash sluiced with raw lake water from Units 31, 32 and 33. Other flows to the Dallman Ash Pond are non-CCR.

2.7 Name and Size of Watershed within which the CCR Surface Impoundment is Located

The subject CCR surface impoundments are located within the watershed subregion defined by the United States Geological Survey (USGS) 8-digit HUC area 07130007 identified as South Fork Sangamon watershed. However, since both ash ponds were built from diked embankments, virtually no surface water flows into the surface impoundments. Therefore, the watershed area for both of the CCR surface impoundments would be roughly equal to their surface area. The Lakeside Ash Pond is approximately 35 acres and the Dallman Ash Pond is approximately 34.5 acres.

2.8 Size in acres of the Watershed within which the CCR Surface Impoundment is Located

The South Fork Sangamon watershed is comprised of 748,630 acres.

2.9 Physical and Engineering Properties of the Foundation and Abutment Materials on which the CCR Surface Impoundment is Constructed

Neither CCR surface impoundment contains foundation improvements, drainage provisions, diversion ditches, or instrumentation. No identifiable natural or manmade features that could adversely affect operation of the CCR surface impoundment due to malfunction or misoperation are known to CWLP personnel.

Historically, Sugar Creek meandered across the site, generally from the west to east with an overall flow direction to the north. The subject CCR surface impoundments were constructed upon these alluvial sediments deposited within the banks of the Sugar Creek valley. Prior to development, the upper layer of soil at the site consisted of mainly brown, light brown, and brownish-gray silty clays and clayey silts having soft to stiff consistency. This includes all eolian soils (loess) deposited near the surface, isolated pockets and lenses of fine grained silty to clayey sand at some locations and alluvial silts and silty clays.

As reported in Attachment 2, during the construction of the ash ponds, the creek was abandoned and relocated to the west of the site. As a result, much of the shallow soils were displaced during area development. The old creek bed was filled with different types of soil, ranging from cohesive soils characterized as silty clays, to granular fill characterized as poorly graded silty to clayey sands. Recompacted silty clay samples from the native soils have exhibited hydraulic conductivity values between 1×10^{-7} to 1×10^{-9} cm/sec. The in-place creek sediment's soils permeability typically range from 1×10^{-6} to 1×10^{-8} cm/sec.

Attachment 2 reports that the cohesive soils of the creek fill were tested as part of the CCR landfill permitting process. The soils exhibited the following range of index and engineering properties:

- Liquid limit = 34 to 46
- Plasticity index = 9 to 26
- Gravel content = 0 percent
- Sand content = 2 to 48 percent
- Silt/Clay content = 52 to 98 percent
- Dry density = 80 to 104 pcf
- Hydraulic conductivity 7.6×10^{-8} to 2.1×10^{-5} cm/sec

Sieve analysis on the granular fill yielded the following results:

- Gravel content = 0 to 2 percent
- Sand content = 55 to 65 percent
- Silt/Clay content = 33 to 45 percent

A July 2, 1987 Engineering Report was prepared for the proposed embankment modifications at the Lakeside Ash Pond (Attachment 3). This report includes the results of laboratory testing on samples obtained from four test borings within the Lakeside Ash Pond area. The results for each of the four borings is provided on logs provided as Figure 3 and Figure 4 in the July 2, 1987 Engineering Report.

These soil samples were tested for:

- Soil classification (ASTM D 2488);
- Moisture content (ASTM D 2216);
- Unconfined compressive strength (ASTM D 2166)

According to the construction plan drawings for the Dallman Ash Pond, dikes were constructed on areas of the old creek bed. The notes on these drawings indicate that the creek bed in these areas was over-excavated by at least 4.0 feet below the existing channel banks and bottom. These excavations were then filled in with cohesive material and compacted to at least 90 percent of optimum density as determined under AASHTO-T99 at optimum moisture.

2.10 Type, Size, Range, and Physical and Engineering Properties of the Materials Used in Constructing Each Zone or Stage of the CCR Surface Impoundment

The July 2, 1987 Engineering Report includes the results of an investigation of the embankments along the lime-softening ponds and the embankment separating the Lakeside Ash Pond from the Clarification Pond (see Attachment 3).

Although design information is limited for the surface impoundments, a stability analysis was performed by Testing Service Corporation (TSC) in 1994 for the design of the adjacent Unit 2 of the FGDS Landfill. The landfill is located in the northeastern half of the site, which is directly adjacent to the east perimeter of the Dallman Ash Pond and north of the Lakeside Ash Pond. This analysis included a review of all of the subsurface studies performed at the site (72 borings in total) as well as five additional borings drilled as part of the stability analysis study for the FGDS Landfill. Laboratory testing completed on cohesive soil samples from these five borings included analyses of moisture content, in-place dry density, unconfined compressive strength, and Atterberg limits. In addition, one sample was selected for triaxial shear testing, and another for direct shear testing.

For the Lakeside Ash Pond, a review of the historical documents found a previous geotechnical investigation and stability analysis, which was conducted prior to the upstream construction of Lakeside Ash Pond. The results of that geotechnical investigation are utilized within this assessment of the safety factors. Additionally, a literature review of technical papers was conducted to determine the geotechnical parameters for the fly ash within the impoundments. Table 1 of Attachment 17 presents highly conservative geotechnical parameters based upon the previous geotechnical investigation utilized in the static and seismic slope stability model.

Included in Appendix B of Attachment 17 are copies of the historical boring logs and cross sections that support the geotechnical parameters provided in Table 1. Technical papers supporting the ash geotechnical parameters are included in Appendix C of Attachment 17.

For the Dallman Ash Pond, a review of the historical documents revealed the original construction plans, with cross sections provided, was completed. More recent site investigations have been conducted in the area during the installation of piezometers, which provide the stratigraphic and in situ strengths of earthen materials that correlate well with the Lakeside Ash Ponds geotechnical data. The historical data have been used to develop conservative geotechnical parameters for slope stability analysis as provided in Table 2 of Attachment 17.

Included in Appendix D of Attachment 17 are copies of the boring log and cross section that support the geotechnical parameters provided in Table 2.

2.11 Method of Site Preparation and Construction of Each Zone of the CCR Surface Impoundment

During the construction of the ash ponds, the creek was abandoned and relocated to the west of the site. As a result, much of the shallow soils were displaced during area development. The old creek bed was filled with different types of soil, ranging from cohesive soils characterized as silty clays, to granular fill characterized as poorly graded silty to clayey sands.

The Lakeside Ash Pond is primarily a diked embankment with some incising along the east perimeter. The entire ash pond abuts the Lake Springfield dam to the south. The original portion of the ash pond abuts the Unit I landfill and the clarification pond to the north. The only portions of the Lakeside Ash Pond with open downstream slopes are the west dike of the original ash pond, and the vertical expansion berms, which were constructed on the east, west and south boundaries of the ash pond.

According to the July 2, 1987 Engineering Report the initial deposition of fly ash occurred in an area north of Spaulding Dam shortly after completion of the first power plant sometime in the middle 1930's. This original disposal area is within the southern portion of the Lakeside Ash Pond, encompassing the area that is now identified as the two eastern-most lime-softening ponds. The south portion of the west embankment of what would become the western-most lime-softening pond was part of the construction for the original ash disposal area.

In 1966, plans were prepared for expanding the disposal area to the north. The north embankment and the north portion of the west embankment were constructed in conjunction with this expansion. Slopes of 2.0H to 1.0V are indicated on the construction drawings, as is a crest width of 12 ft. The construction drawings note "Compact to 90% Maximum Density at Optimum Moisture." Reconstruction of the original west embankment occurred in 1971. The reconstructed downstream face contained a slope of 3.0H to 1.0V.

The clarifier pond, located immediately north of the Lakeside Ash Pond was constructed between 1971 and 1976. The construction drawings for the Dallman Ash Pond were prepared in 1976. The construction drawings included drawings for modification to the north portion of the west embankment of the Lakeside Ash Pond. These modifications include a sloped granular drainage blanket connected to an 8 in. diameter perforated pipe running the length of the embankment. Compacted material downstream of this drainage blanket flattened the downstream slope to 2.5H to 1.0V. The outlet of the drainage pipe is indicated to be north of the original west embankment (which had been reconstructed in 1971).

Based on the July 2, 1987 Engineering Report the north-south cross dikes were constructed over ponded ash material in the original disposal area subsequent to 1976 to form what are presently identified as the two eastern-most lime-softening ponds. In addition, a portion of the north embankment of the original ash disposal area, the Lakeside Ash Pond, was raised in height.

The most recent change made to the Lakeside Ash Pond system was a vertical expansion completed in 1988. The vertical expansion consisted of berms built on top and inside of the existing embankments in such a way that the toe of the outer slope of the expansion berms matches up with the top of the inner slope of the existing embankments. The berms were built on top of a stable base comprised of bottom ash on the inside of the existing berms. The vertical expansion berms are approximately ten feet in height and were constructed with compacted cohesive materials. The top and outer slopes are covered with a 6-inch topsoil layer. The top of the berms are 10 feet wide. The outer slope of the berms was built at a 2H:1V slope; the inner slope of the berms was built at a 1H:1V slopes. During the vertical expansion in 1988, the Lakeside Ash Pond was separated to create lime softening ponds on the south section of the pond. There is no as-built construction documentation available for the Lakeside Ash Pond.

The entire Dallman Ash Pond was built in 1976 and is partially incised. Material from the center of the ash pond was excavated and utilized in the construction of the dikes. The Dallman Ash Pond has not been expanded. The berms for the Dallman Ash Pond were built to a height of approximately 27 feet, using slopes of 2.5H:1V for both the inner and outer slopes. Riprap was placed at the bottom section of the outer slopes for the west and north berms. The south berm for the Dallman Ash Pond is shared by the Clarification Pond located to the south. There is no as-built construction documentation is available for the Dallman Ash Pond. Notes in the construction plan drawings do call for dike materials to be compacted to “at least 90% of the minimum density at optimum moisture as determined by AASHTO-T99.”

2.12 Dates of Construction of Each Successive Stage of Construction of the CCR Surface Impoundment

Ash placement in what is the Lakeside Ash Pond originally occurred in the middle 1930’s. The pond was built prior to 1958. The most recent change made to the Lakeside Ash Pond system was a vertical expansion completed in 1988. During the vertical expansion, the Lakeside Ash Pond was separated to create lime softening ponds on the south section of the pond.

The Dallman Ash Pond was built in 1976; it has not been expanded.

2.13 Drawing Satisfying the Requirements of 35 IAC 845.220(a)(1)(F)

The drawings listed below were included in the 2016 History of Construction Report which was completed pursuant to 40 CFR Section 257.73. The subject report is contained in Attachment 4 to this application.

- Figure 1 – Site Map identifying the location of the CCR units.
- Figure 2 – Plan View of the surface impoundments and the locations of outlets, normal operating pool elevations, maximum pool elevations, and maximum depths of each CCR unit.
- Construction Drawings – Plan Views and Cross Sections of each CCR unit.

Plan Drawings and Cross Sections of the Lakeside Ash Pond were taken from the construction design drawings included in the 1987 Proposed Embankment Modifications report by Hanson Engineers, Inc. No as-built drawings are available for either the original pond construction prior to 1958 or the expansion in 1988. The Plan Drawing shows the proposed expansion with two lime softening ponds. The third lime softening pond was constructed from the southern portion of the expanded settling pond at a later time.

The Plan Drawing of the Dallman Ash Pond was taken from the 1976 Construction Grading Plan; cross sections for the Dallman Ash Pond were created based on this Plan Drawing. No as-built drawings are available for the construction of the Dallman Ash Pond.

Neither CCR unit contains foundation improvements, drainage provisions, diversion ditches, or instrumentation. No identifiable natural or manmade features that could adversely affect operation of the CCR unit due to malfunction or mis-operation are known to CWLP personnel.

2.14 Type, Purpose, and Location of Existing Instrumentation

According to CWLP personnel, none of the CCR units maintained by CWLP contains any such unit instrumentation, which would include dedicated piezometers, pool elevation and freeboard instrumentation or more sophisticated measuring devices for measuring pressure, seepage, internal movement, slope movement, and/or vibration.

2.15 Area Capacity Curves for the CCR Impoundment.

Area capacity curves have been developed for the subject CCR surface impoundments and are included as Attachment 4 in the document CWLP 2016 History of Construction Report. Construction of the area capacity curves were based on information from the construction drawings discussed in Section 2.13.

2.16 Spillway and Diversion Design Features, Capacities and Calculations Used in their Determination

Neither ash pond have a constructed or natural spillway.

The Lakeside Ash Pond and Lime Softening Ponds have a combined approximate storage capacity of 1,330,000 cubic yards. The Dallman Ash Pond has an approximate storage capacity of 1,500,000 cubic yards. During the vertical expansion, an outlet structure was constructed through the northern berm of the Lakeside Ash Pond, which drains into the adjacent Clarification Pond. The outlet is constructed with a 24-inch diameter reinforced concrete pipe (RCP). The length of the pipe is approximately 60 feet. The pipe was bedded in compacted cohesive material and an anti-seep collar at approximately halfway through the berm. In addition, the Lakeside Ash Pond has a 14-inch diameter pipe that drains decant water from the settling pond portion of the lime ponds. This pipe is 100 feet in length and similar to the outlet structure for the Dallman Ash Pond. The outlets appears to be structurally sound with no observed signs of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, or debris

An outlet structure has also been constructed through the southern dike of the Dallman Ash Pond. This structure allows the Dallman Ash Pond to drains into the adjacent Clarification Pond. The outlet is a 24-inch diameter high-density polyethylene (HDPE) pipe. The length of the pipe is approximately 120 feet. The outlet appears to be structurally sound with no observed signs of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, or debris.

Both the Dallman Ash Pond and the Lakeside Ash Pond are diked surface impoundments built vertically above the existing grades. Both CCR units are built in a manner in which there is no surficial flow of stormwater into the pond during precipitation events. Therefore, the only water that would flow into the pond during a precipitation event is that which falls directly into the ponds. Ditches located adjacent to the south and east of the impoundments route surface water around the impoundment area ultimately discharging to the South Fork of Sugar Creek. Sugar Creek is present along the western edge and northern perimeters of ash impoundment area.

The National Oceanic and Atmospheric (NOAA) Atlas 14, Volume 2, Version 3, the 100-year, 24 hour rainfall estimate for the site location is 6.22 inches.

Both ash ponds contain at least 6.62 inches of freeboard, and therefore do not require any additional flood controls. The normal pool level for the Dallman Ash Pond is approximately 551 feet mean sea level (MSL) with a maximum design elevation of 554.0 feet, yielding a typical freeboard of 3 feet. The normal pool level for the Lakeside Ash Pond is 564.0 feet with a maximum elevation of 565.0 feet, yielding a typical freeboard of 1.0 foot.

2.17 Construction Specifications and Provisions for Surveillance, Maintenance, and Repair of the CCR Surface Impoundment

The impoundments have been inspected pursuant to 40 CFR Section 257.83, beginning in October 2015. Inspection reports are retained in the facility record and include the results of the inspections and record of any maintenance or repairs conducted as a result of the inspection. The inspection requirements are very similar to those contained in Section 845.540.

Inspection requirements for CCR surface impoundments are outlined at Section 845.540. Under Section 845.540(a) the CCR surface impoundments and appurtenances shall be inspected by a qualified person at intervals not exceeding seven days and after each 25-year, 24-hour storm. Each inspection conducted pursuant to this Section shall be documented in an inspection report that describes the condition of the CCR surface impoundment, any repairs made to the CCR surface impoundment and date of the repair. These inspection reports shall become part of the facility's operating record.

The 7-day and 25-year, 24-hour storm inspections shall note any appearances of actual or potential structural weaknesses and other conditions that are disrupting or have the potential to disrupt the operation or safety of the CCR surface impoundments; deterioration, malfunctions or improper operation of overtopping control systems; sudden drops in level of the CCR surface impoundment contents; erosion that creates rills, gullies or crevices six inches or deeper other signs of deterioration including failed or eroded vegetation in excess of 100 square feet, or cracks in dikes or other containment devices; and any visible releases. In addition, at intervals not exceeding 7-days, inspect the discharge of all outlets of hydraulic structures that pass underneath the base of the CCR surface impoundment or through the dike, of the CCR surface impoundment, for abnormal discoloration, flow or discharge of debris or sediment; and at intervals not exceeding 30-days, monitor all CCR surface impoundment instrumentation.

The annual inspection and reporting requirements are outlined under Section 845.540(b). Pursuant to Section 845.540(b), the annual inspection shall be completed by a qualified professional engineer to ensure that the design, construction, operation, and maintenance of the CCR surface impoundment is consistent recognized and generally accepted engineering standards. The inspection shall include: a review of available information regarding the status and condition of the CCR surface impoundment, including files available in the operating record (e.g., CCR surface impoundment design and construction information required by Sections 845.220(a)(1) and 845.230(d)(2)(A), previous structural stability assessments required under Section 845.450, the results of inspections by a qualified person, and results of previous annual inspections); a visual inspection of the CCR surface impoundment to identify signs of distress or malfunction of the CCR surface impoundment and appurtenant structures; a visual inspection of any hydraulic structures underlying the base of the CCR surface impoundment or passing through the dike of the CCR surface impoundment for structural integrity and continued safe and reliable operation; the annual hazard potential classification certification, if applicable (see Section 845.440); the annual structural stability assessment certification, if applicable (see Section

845.450); the annual safety factor assessment certification, if applicable (see Section 845.460); and the inflow design flood control system plan certification (see Section 845.510(c)).

Inspection reports prepared by the qualified professional engineer to document the annual inspections must address: any changes in geometry of the impounding structure since the previous annual inspection; the location and type of existing instrumentation and the maximum recorded readings of each instrument since the previous annual inspection; the approximate minimum, maximum, and present depth and elevation of the impounded water and CCR since the previous annual inspection; the storage capacity of the impounding structure at the time of the inspection; the approximate volume of the impounded water and CCR at the time of the inspection; any appearances of an actual or potential structural weakness of the CCR surface impoundment, in addition to any existing conditions that are disrupting or have the potential to disrupt the operation and safety of the CCR surface impoundment and appurtenant structures; and any other changes that may have affected the stability or operation of the impounding structure since the previous annual inspection.

Pursuant to 35 Ill. Adm. Code 845.540(b)(5) if a deficiency or release is identified during an inspection, the owner or operator must submit to the Illinois EPA documentation detailing proposed corrective measures and obtain any necessary permits from the Illinois EPA.

2.18 Record or Knowledge of Structural Instability of the CCR Surface Impoundment

Visual inspections of the CCR surface impoundments are performed on a weekly basis (minimum) in accordance with 40 CFR Section 257.83 and now Section 845.540(a)(1)(A) for the purpose of identifying appearances of actual or potential structural weaknesses and other conditions which are disrupting or have the potential to disrupt the operation or safety of the CCR surface impoundments.

Historical reports noted that signs of erosion had been periodically observed on the north and west outer berms of the Dallman Ash Pond due to storm water flow collecting at points along the top of the berm before flowing down the outer slope in concentrated streams. In the fall of 2017, the tops of the berms of the Dallman Ash Ponds were regraded with a cross slope of approximately 1/4” per foot inward towards the ponds. This has allowed the rainwater to be contained in the ponds and to not cause erosion on the slopes. At no time was there any structural instability of the impoundments.

As reported in the 2021 Annual Inspection, no visual indications of actual or potential structural weaknesses of the surface impoundments have been observed. Based on the review of historical aerial photographs completed during the 2016 Annual Inspection, there were no observed indications of mass movement on any of the constructed berms for the surface impoundments.

3. SECTION 2: ANALYSIS OF CHEMICAL CONSTITUENTS

3.1 Analysis of the Chemical Constituents Found within the CCR to be Placed in the CCR Surface Impoundments

Presently, the Lakeside Ash Pond only receives CCR containing material from the FGD WWTP. The analytical report for the FGD WWTP sludge is included as Attachment 5. Prior to 2009, the Lakeside Ash Pond received both fly ash and bottom ash. No analytical results are available of any ash (fly or bottom) that was generated from the old Lakeside Plant sluiced to the Lakeside

Ash Pond. Since CWLP has always used the same mine, it is inferred the ash produced from Units 31, 32 and 33 is representative of the fly ash and bottom ash sluiced to the Lakeside Ash Pond. The laboratory analysis for the bottom ash sluiced from Units 31, 32 and 33 to the Dallman Ash Pond (Attachment 5) is representative of the fly ash and bottom ash placed into the Lakeside Ash Pond prior to 2009.

3.2 Analysis of the Chemical Constituents of all Waste Streams, Chemical Additives and Sorbent Materials Entering or Contained in the CCR Surface Impoundment

The non-CCR placed into the Lakeside Ash Pond includes water softening lime residuals from the CWLP Drinking Water Purification Plant and wash-down water from the miscellaneous floor drains.

The non-CCR placed into the Dallman Ash Pond consist of GF WWTP clarifier blowdown sludge, landfill leachate and evaporation water (see Attachment 5).

4. DEMONSTRATIONS AND CERTIFICATIONS

4.1 Indicate whether you have attached a demonstration that the CCR surface impoundment, as built, meets, or an explanation of how the CCR surface impoundments fails to meet, the location standards:

- ***35 Ill. Adm. Code 845.300 (Placement Above the Uppermost Aquifer)***
- ***35 Ill. Adm. Code 845.310 (Wetlands)***
- ***35 Ill. Adm. Code 845.320 (Fault Areas)***
- ***35 Ill. Adm. Code 845.330 (Seismic Impact Zones)***
- ***35 Ill. Adm. Code 845.340 (Unstable Areas and Floodplains)***

An evaluation of the locations standards is provided in Attachment 6. Based upon this evaluation, the subject CCR surface impoundments comply with the wetlands (35 Ill. Adm. Code 845.310), the fault areas (35 Ill. Adm. Code 845.320), unstable areas (35 Ill. Adm. Code 845.340) and the seismic impact zone (35 Ill. Adm. Code 845.330) location restrictions; however, they do not meet the location restrictions for placement above the uppermost aquifer (35 Ill. Adm. Code 845.300) or within floodplains (35 Ill. Adm. Code 845.340).

The CCR surface impoundments are unlined (Lakeside Ash Pond and Dallman Ash Pond) and constructed directly above and within 5 feet of the high water table for the uppermost aquifer. Either it must be demonstrated that there will not be intermittent, reoccurring or sustained hydraulic connection between any portion of the base of the CCR surface impoundment and the uppermost aquifer, or cessation of disposal and closure must begin.

The CCR surface impoundments were constructed within the 100-year floodplain of Sugar Creek.

5. EVIDENCE THAT THE PERMANENT MARKERS HAVE BEEN INSTALLED

The markers required by 35 Ill. Adm. Code 845.130 were installed in April 2021. Photographs of the placed permanent markers are provided as Attachment 7.

6. DOCUMENTATION THAT THE CCR SURFACE IMPOUNDMENT, IF NOT INCISED, WILL BE OPERATED AND MAINTAINED WITH ONE OF THE FORMS OF SLOPE PROTECTION SPECIFIED IN 35 ILL. ADM. CODE 845.430

The slopes and pertinent surrounding areas of the CCR surface impoundment have been designed, constructed, operated, and maintained with slope protection as required by Section 845.430(a) that meets the performance standards of Section 845.430(b). Documentation that the CCR surface impoundments will be operated and maintained with one of the forms of slope protection specified in Section 845.430 in the Closure Plan for Coal Combustion Residuals Surface Impoundments document in Attachment 8.

Both the upstream and downstream slopes of the Lakeside Ash Pond have a vegetative cover consisting of grassy vegetation to protect the slopes against surface erosion, wave action, and adverse effects of rapid drawdown. Periodic inspections are conducted pursuant to Section 845.540 to identify the presence of any significant signs of erosion on the ash impoundment slopes. Observations of significant erosion noted during any of the weekly inspections shall be repaired in a timely manner.

The downstream slope of the Dallman Ash Pond has a vegetative cover consisting of grassy vegetation to protect the slope against surface erosion, wave action, and adverse effects of rapid drawdown. In addition, riprap has been placed on the bottom portion of the downstream slope. Ruts and gullies on the downstream slope, when observed, shall be immediately filled with soil, seeded and monitored during the weekly inspections. Any significant signs of erosion observed on any of the ash pond slopes shall be repaired in a timely manner. All maintenance and repairs will be placed into the site record.

The removal of woody vegetation with a diameter greater than ½ inch shall be directed by a person familiar with the design and operation of the CCR surface impoundment and in consideration of the complexities of removal of a tree or shrubbery. When removing woody vegetation from the slopes and pertinent surrounding areas, care shall be taken to ensure that the removal activity does not create a risk of destabilizing the CCR surface impoundment or otherwise adversely affect the stability and safety of the CCR surface impoundment or personnel undertaking the removal.

7. INITIAL EMERGENCY ACTION PLAN AND ACCOMPANYING CERTIFICATION

The Emergency Action Plan and accompanying certification are included in Attachment 9.

8. FUGITIVE DUST CONTROL PLAN AND ACCOMPANYING CERTIFICATION

The fugitive dust control plan and accompanying certification are included as Attachment 10.

9. GROUNDWATER MONITORING INFORMATION

9.1 Hydrogeologic Site Characterization

See the Hydrogeology Report and Groundwater Monitoring Program submitted in Attachment 11.

9.2 Design and Construction Plans of a Groundwater Monitoring System

See the Hydrogeology Report and Groundwater Monitoring Program submitted in Attachment 11.

9.3 A Groundwater Sampling and Analysis Program that Includes Selection of the Statistical Procedures to be Used for Evaluating Groundwater Monitoring Data

See the Hydrogeology Report and Groundwater Monitoring Program submitted in Attachment 11.

9.4 Proposed Groundwater Monitoring Program that Includes a Minimum of Eight Independent Samples for Each Background and Downgradient Well

See the Hydrogeology Report and Groundwater Monitoring Program submitted in Attachment 11.

10. PRELIMINARY WRITTEN CLOSURE PLAN

The impoundments fail to meet each of the applicable location restrictions, specifically Section 845.300 (placement above the uppermost aquifer). As such, closure will be initiated pursuant to Section 845.700. Therefore, a Preliminary Written Closure Plan is not necessary as stated in Section 845.720(a)(1).

11. INITIAL WRITTEN POST-CLOSURE CARE PLAN, IF APPLICABLE

The initial post-closure plan is included as the in Attachment 12. It must be noted that the impoundments are scheduled to be closed pursuant to Section 845.700. A Closure Alternative Analysis is in the process of being conducted, which includes an assessment of corrective measures pursuant to Section 845.660 due to exceedences of groundwater protection standards. The assessment of corrective measures will be discussed in a public meeting. A construction permit application with the selected closure alternative will be submitted to the Illinois EPA by February 1, 2022. A complete post-closure care plan will be submitted as an attachment to the subject permit application, specific to the closure alternative selected.

12. A CERTIFICATION AS SPECIFIED IN 35 ILL. ADM. CODE 845.400(H), OR A STATEMENT THAT THE CCR SURFACE IMPOUNDMENT DOES NOT HAVE A LINER THAT MEETS THE REQUIREMENTS OF 35 ILL. ADM. CODE 845.400(B) OR (C)

Both the Lakeside Ash Pond and the Dallman Ash Pond were constructed on top of in-place clayey soils. While the vertical hydraulic conductivity is generally low, soils were not compacted beneath the impoundments except for sections where the dikes of the Dallman Ash Pond were build atop the existing creek bed. No composite liner or alternate composite liner as specified in

Section 845.400(b) or Section Code 845(c), was used to line the bottom of either ash pond. A certification of the liner status was previously derived pursuant to 40 CFR Sections 257.70(b) or 257.70(c)(1). This certification is provided in Attachment 13.

13. HISTORY OF KNOWN EXCEEDANCES OF THE GROUNDWATER PROTECTION STANDARDS IN 35 ILL. ADM. CODE 845.600, AND ANY CORRECTIVE ACTION TAKEN TO REMEDIATE THE GROUNDWATER

As required by 35 Ill. Adm. Code 845.600, CWLP has prepared and placed into the facility record a Groundwater Monitoring Program for the CCR surface impoundments. The present groundwater monitoring network includes two upgradient wells (wells AP-4 and AP-5) and eleven downgradient wells (RW-3, AP-1R, AP-2A, AP-3, AP-6, AP-7, AP-8, AP-10 and AP-14).

A detection monitoring program was initiated with the first sampling event on November 9, 2017. At that time, the groundwater monitoring network was comprised of two upgradient wells (AP-4 and AP-5) and four downgradient wells (AW-3, AP-1R, AP-2A and AP-3). Eight independent samples were collected from each background and downgradient well and analyzed for the Part 257 Appendix III and Appendix IV parameters. The initial eight independent samples were collected over the second quarter 2015 through first quarter 2017.

Based on exceedances of the statistical limits (statistically significant increase or SSI) for total boron identified as part of the November 2017 semiannual sampling event, an assessment monitoring program was initiated first quarter 2018. Assessment activities based on the suspected presence of CCR in the screened interval of well AW-3 resulted in the installation of a replacement well (RW-3) within 10 feet of the original well during the first quarter 2018.

Continuance of the assessment monitoring sampling event occurred second quarter 2018 with resampling occurring third quarter 2018. The results of the resampling event confirmed the SSI for total arsenic at well RW-3. Notification of the SSI was provided later that month.

Subsequent to verification of the SSI for arsenic in well RW-3, an alternate source evaluation was conducted from third quarter 2018 to fourth quarter 2018. The evaluation included the advancement of three borings in the immediate vicinity of RW-3. Soil samples were collected at multiple depths from each boring and analyzed for four indicator parameters. Additionally, discreet groundwater samples were collected from each boring at a depth consistent with the screened interval of RW-3. The soils and groundwater analyses was conducted to evaluate whether arsenic was naturally occurring in the geologic deposits, as is typical in unconsolidated deposits within Illinois. Additionally, trace CCR material had been detected in at least one subsurface boring on the hydraulically downgradient periphery of the permitted CCR landfill, which is in close proximity to RW-3. This occurred within the shallow stratigraphy at the toe of the peripheral berm, requiring the replacement of the permitted CCR landfill monitoring point, which was approved by the Illinois EPA via permit modification. The areas directly adjacent to the containment berms contain backfill of varying thickness, placed as part of the berm construction. It is within this backfill that the trace CCR was encountered. It was suspected that the trace CCR impacted the quality of groundwater at RW-3. The alternate source evaluation indicated that the presence of arsenic in the vicinity of RW-3 was not the result of naturally occurring minerals within the local deposits, or the result of CCR material contained within the peripheral berm. Therefore, pursuant to the USEPA CCR rules an assessment of corrective measures investigation to characterize the nature and extent of arsenic concentrations exceeding background concentration at RW-3 was implemented.

Assessment of corrective measures was initiated in April 2019. The objective of the assessment of corrective measures was to characterize the nature and extent of the release. The investigation was implemented in two phases. During phase one, completed in May 2019, five direct- push borings were advanced (GP-4, GP-5, GP-6, GP-7 and GP-8) into the uppermost aquifer. One-inch diameter PVC temporary wells were installed in each of these boreholes except at GP-5. Bedrock at probe location GP-5 was very shallow and groundwater was not encountered. Groundwater samples collected from the temporary wells were turbid resulting in artificially high totals concentrations and the exceedance of background concentrations for several parameters. During the second phase, completed in July 2019, another five direct-push borings were advanced into the uppermost aquifer. The probe locations GP-1, GP-2 and GP-3 were new locations and the phase two GP-6 and GP-7 were advanced in the phase one GP-6 and GP-7 locations. To address the turbidity issues observed during the phase one investigation, pre-packed well screens were used during this phase. The well construction significantly decreased the turbidity of the groundwater samples, allowing for the collection of more representative samples. This was highlighted by comparison of the May 2019 and July 2019 analytical results. It was determined that total arsenic was not detected at six of the seven temporary wells (GP-1, GP-3, GP-4, GP-6, GP-7 and GP-8). The detection of total arsenic occurred at probe location GP-2 where the concentration was below background. Based on the results of the assessment of corrective measures investigation, a certificate of completion of corrective measures in accordance with USEPA CCR rules was entered into the facility record dated, July 2019.

The total arsenic concentrations observed at RW-3 were generally low, fluctuating around the background concentration. Total arsenic concentrations at RW-3 exhibited a decreasing trend over the preceding three consecutive sampling events, not being detected during the third quarter 2019 sampling event. Total arsenic was only detected in one other well (upgradient well AP-4) during the fourth quarter 2019 sampling event, since implementation of the groundwater monitoring program (note, RW-3 is also sampled quarterly as part of the FGDS landfill groundwater monitoring program). The groundwater analytical results for the August 1, 2019 semi-annual sampling event demonstrated compliance with the groundwater protection standards established under the USEPA CCR rules as no Appendix IV parameter exceeded a groundwater protection standard.

Groundwater samples collected first quarter 2020 (February 28, 2020) and third quarter 2020 (August 5, 2020) exhibited exceedances of the groundwater protection standard for total arsenic at well RW-3. However, assessment well AP-6, located approximately 109 feet downgradient of RW-3, and compliance boundary well AP-7, located approximately 287 feet downgradient of RW-3, exhibited no exceedance of the groundwater protection standard. The exceedances of the groundwater protection standard are believed to be a result of the elevated sample turbidity. Historically, purging and sampling for the collection of groundwater samples has been completed by the use of bailers. While the use of bailers for purging and sampling may provide accurate results where formations are relatively particulate free, in wells where the particulate matter is high, it has been shown to agitate the water column, suspending particulate matter in the well, November 2020, dedicated submersible bladder pumps have been installed in all of the CCR surface impoundment groundwater monitoring wells to allow low stress (low flow) purging and sampling.

In accordance with 35 Ill. Adm. Code 845, Subpart F (effective April 21, 2021) groundwater samples were collected quarterly commencing with the first quarter of 2021. No exceedances of the GWPS were reported during 2021 for the parameters total antimony, total barium, total cadmium, total chloride, total chromium, total cobalt, total fluoride, total lead, total lithium, total mercury, total molybdenum, pH, radium-226 + radium-228 total selenium, and total thallium. The following narrative describes the GWPS exceedances noted for the 2021 review period.

Total arsenic concentrations for the first and second quarters of 2021 at RW-3 were 0.116 mg/L and 0.119 mg/L, respectively. The GWPS for total arsenic is 0.0724 mg/L. Well RW-3 is located downgradient of the Dallman Ash Pond at the northeastern perimeter, immediately south of Sugar Creek. The concentrations of total arsenic reported for the review period at wells AP-6 and AP-7, installed immediately downgradient of RW-3 (i.e, AP-6 is south of Sugar Creek and AP-7 is north of Sugar Creek) ranged from non-detect (<0.025 mg/L) to 0.0429 mg/L. The GWPS exceedances at RW-3 are attributed to the turbid nature of the groundwater samples collected at this location. Total arsenic in background wells AP-4 and AP-5 ranged from non-detect (<0.025 mg/L) to 0.0415 mg/L during the review period. The total arsenic concentrations reported for well RW-3 have historically been sporadic with concentrations intermittently exceeding 0.1 mg/L for several sampling intervals before returning to concentrations less than 0.1 mg/L. No obvious increasing or decreasing trend is occurring.

Total boron exceeded the GWPS (2 mg/L) at wells AP-1R, AP-2A, AP-3, AP-10 and AP-14 during the review period. The boron GWPS is not exceeded at RW-3. The first and second quarter 2021 concentrations at AP-1R were 21.7 and 22.1 mg/L, at AP-2A 3.67 and 4.42 mg/L, at AP-3 16.8 and 17.1 mg/L, respectively. From north (downgradient) to south (upgradient) the wells AP-1R, AP-10, AP-2A, AP-3 and AP-14 are all located along the western perimeter of the Dallman Ash Pond and the Lakeside Ash Pond, and immediately east of Sugar Creek. The concentrations of total boron reported for the first and second quarter 2021 at wells AP-1R, AP-2A, AP-3 are consistent with historic detected concentrations. The second quarter 2021 sampling event is the first sampling event to have occurred for wells AP-10 and AP-14. The total boron, total concentrations at AP-10 and AP-14 were 3.65 and 23.2 mg/L, respectively. Total boron concentrations at background wells AP-4 and AP-5 ranged from 0.02 mg/L to 0.0996 mg/L during the review period. The total boron concentrations reported for wells AP-1R and AP-3 have consistently been in the 15 to 20 mg/L range while the concentrations at AP-2A have historically been in the 3 to 5 mg/L range. No obvious increasing or decreasing trend is occurring at AP-2A and AP-3; however, the concentrations at AP-1R appear to be trending upward.

Total calcium concentrations exceeded the GWPS (176.63 mg/L) during the review period at wells AP-1R, AP-2A and AP-14. The detected concentrations at downgradient well AP-1R are 233 mg/L and 242 mg/L for the first and second quarter 2021, respectively and for AP-2A was 202 mg/L and 289 mg/L, for the first and second quarters 2021, respectively. Total calcium concentrations at background wells AP-4 and AP-5 ranged from 0.02 mg/L to 0.0996 mg/L during the review period. Total calcium concentrations at background wells AP-4 and AP-5 ranged from 202 mg/L to 289 mg/L during the review period. The total calcium concentrations reported for wells AP1 and AP-2 have historically exceed the GWPS exhibiting sporadic concentrations. No obvious increasing or decreasing trend is occurring.

Total sulfate exceeded the GWPS (400 mg/L) at wells AP-1R, AP-2A and AP-14 during the review period. The concentrations were 976 mg/L and 721 mg/L at well AP-1R, and 367 mg/L and 660 mg/L at well AP-2A during the first and second quarter 2021 sampling events, respectively. The total sulfate concentration reported for well AP-14 was 642 mg/L. This exceedance has not been confirmed. Total sulfate concentrations at background wells AP-4 and AP-5 ranged from non-detect (<10 mg/L) to 53 mg/L during the review period. Total sulfate concentrations at background wells AP-4 and AP-5 ranged from 202 mg/L to 289 mg/L during the review period. The total sulfate concentrations reported for wells AP-1R and AP-2A have historically exceeded the GWPS. Total sulfate is trending upward in wells AP-1R, AP-2A and AP-3.

Total dissolved solids (TDS) exceeded the GWPS (1200 mg/L) at wells AP-1R, AP-2A and AP-14 during the review period. The concentrations of TDS at AP-1R are 1500 mg/L and 1450 mg/L, and at AP-2A were 1090 mg/L and 1390 mg/L, for the first and second quarters 2021, respectively. At AP-14, where only one sampling event has occurred, the concentration was 1250 mg/L. Total dissolved solids concentrations at background wells AP-4 and AP-5 ranged from 358 mg/L to 492 mg/L during the review period. The concentration trends at wells AP-1R and AP-2A have historically been sporadic.

As stated above, CWLP is currently conducting a Closure Alternatives Analysis and an assessment of corrective measures. The impoundment closure process will be the corrective action. Contaminant transport modeling conducted as part of the Closure Alternatives Analysis demonstrates the evaluated closure methodologies will facilitate achievement of the groundwater protection standards.

14. SAFETY AND HEALTH PLAN

A health and safety plan has been included as Attachment 14 of this submittal.

As required by 35 Ill. Adm. Code 845.530, those employees, contract workers, and third-party contractors who are tasked with the inspection, maintenance, and or repair of the CCR surface impoundments and appurtenances and monitoring equipment shall be informed of the CWLP Safety and Health Plan and its contents. In addition, CWLP shall conduct ongoing worker hazard analyses and ensure employees, contract workers, and third-party contractors are aware of those analyses.

The Safety and Health Plan shall be updated as needed based on the worker hazard analyses, but at least annually. The Safety and Health Plan, and all amendments to the plan, shall be placed in the facility's operating record as required by 35 Ill. Adm. Code 845.800(d)(12), and on CWLPs' publicly accessible internet site (https://www.cwlp.com/CCRCompliance.aspx).

To ensure worker safety, CWLP has prepared safety data sheets (SDS) for all chemical constituents identified in the CCR under Section 845.230(a)(15) and 845.230(d)(2)(C).

15. FOR CCR SURFACE IMPOUNDMENTS REQUIRED TO CLOSE UNDER 35 ILL. ADM. CODE 845.700, THE PROPOSED CLOSURE PRIORITY CATEGORIZATION

Pursuant to Section 845.700(g) CCR ash pond required to close under Section 845 must assign the CCR ash ponds to one of 7 categories, with the Category 1 being the highest priority for closure and Category 7, the lowest priority for closure.

The characteristics and location of the CCR ash ponds at the CWLP facility meet the criteria outlined by Category 3. Category 3 applies to an area of environmental justice concern. In accordance with Section 845.700(g)(2). Pursuant to Section 845.700(g), the CCR surface impoundments at the CWLP facility has been assigned to Category 3.

16. CERTIFICATIONS

16.1 Financial Assurance Requirements

Pursuant to Section 845.900(e), financial assurance does not apply to the CWLP surface impoundments.

16.2 Hazard Potential Classification Assessment and Accompanying Certifications

The hazard potential classification assessment and accompanying certification is provided in Attachment 15.

16.3 Structural Stability Assessment and Accompanying Certification

The structural stability assessment and accompanying certification are provided in Attachment 16.

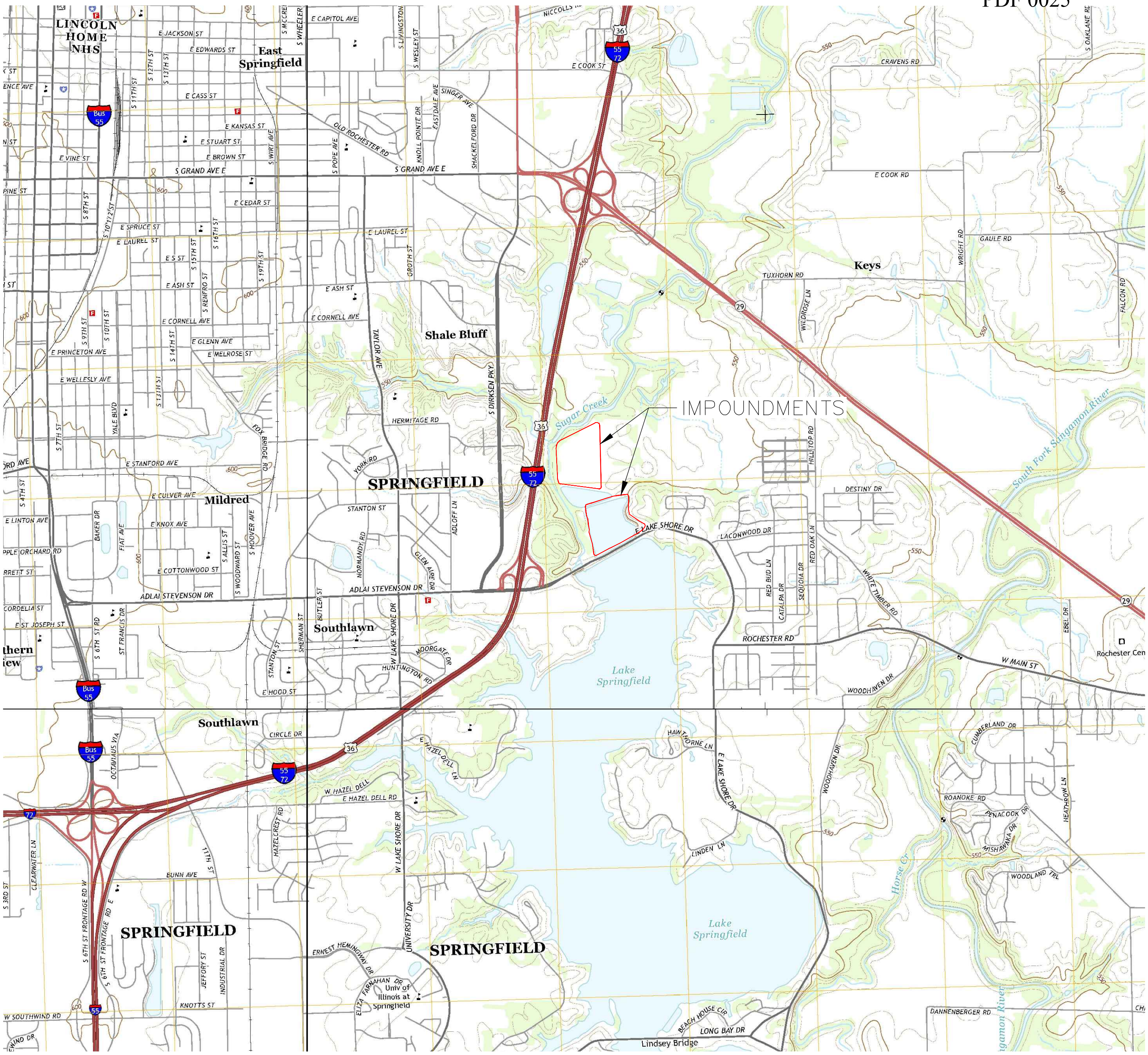
16.4 Safety Factor Assessment and Accompanying Certification

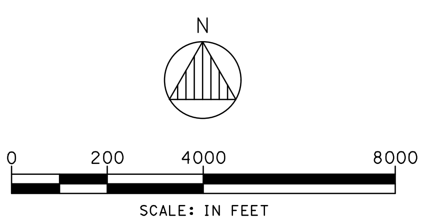
The safety factor assessment and accompanying certification are provided in Attachment 17.

16.5 Inflow Design Flood Control System Plan and Accompanying Certification

The inflow design flood control system plan and accompanying certification are provided in Attachment 18.

FIGURES





NOTE:
BACKGROUND IMAGE COURTESY OF
UNITED STATES GEOLOGICAL SURVEY.

ANDREWS ENGINEERING 3300 GINGER CREEK DRIVE SPRINGFIELD, ILLINOIS 62711-7233 PH (217) 787-2334 WWW.ANDREWS-ENG.COM PONTIAC, IL • LOMBARD, IL • INDIANAPOLIS, IN • WARRENTON, MO	SITE LOCATION	DATE: JULY 2021
	PLANS PREPARED FOR CITY, WATER, LIGHT & POWER SPRINGFIELD, SANGAMON COUNTY, ILLINOIS	PROJECT ID: 200387/0026
APPROVED BY: BJH · DESIGNED BY: BJH · DRAWN BY: MPN		SHEET NUMBER: FIGURE 1

LEGEND

CCR SURFACE IMPOUNDMENT

NOTE

IMAGE SOURCE: GOOGLE EARTH PRO, IMAGE DATE JUNE 7, 2016.

N

0 150 300 600

SCALE: IN FEET

NO.	DATE	REVISION DESCRIPTION	BY

ANDREWS ENGINEERING
3300 GINGER CREEK DRIVE
SPRINGFIELD, ILLINOIS 62711-7233
PH (217) 787-2334 WWW.ANDREWS-ENG.COM
PONTIAC, IL • LOMBARD, IL • INDIANAPOLIS, IN • WARRENTON, MO

APPROVED BY: DG DESIGNED BY: DG DRAWN BY: MPN

SITE DETAILS

PLANS PREPARED FOR
CITY, WATER, LIGHT AND POWER
SPRINGFIELD, SANGAMON COUNTY, ILLINOIS

DATE: JULY 2021

PROJECT ID: 200387/0026

SHEET NUMBER:

FIG. 2

ATTACHMENTS

ATTACHMENT 1 – FORM CCR1 AND FORM 2E

- FORM CCR1 – GENERAL PROVISIONS
- FORM CCR 2E – INITIAL OPERATING PERMIT FOR EXISTING OR INACTIVE CCR SURFACE IMPOUNDMENTS THAT HAVE NOT COMPLETED AN AGENCY-APPROVED CLOSURE BEFORE JULY 30, 2021

FORM CCR1 – GENERAL PROVISIONS

Form CCR 1

Illinois Environmental Protection Agency
CCR Surface Impoundment Permit Application
Form CCR 1 – General Provisions

Bureau of Water ID Number:
IL0024767
CCR Permit Number:

Facility Name:
City Water, Light and Power

For IEPA Use Only

SECTION 1: FACILITY, OPERATOR, AND OWNER INFORMATION (35 Ill. Adm. Code 845.210(b))

Facility, Operator, and Owner Information

1.1	Facility Name		
	City Water, Light and Power		
1.2	Illinois EPA CCR Permit Number (if applicable)		
1.3	Facility Contact Information		
	Name (first and last) Patrick Becker	Title Env. Health and Safety Mgr.	Phone Number 217.757.8610 ext. 1110
	Email address pj.becker@cwlp.com		
1.4	Facility Mailing Address		
	Street or P.O. box Regulatory Affairs, 801 E. Monroe, 4th Floor		
	City or town Springfield	State Illinois	Zip Code 62701
1.5	Facility Location		
	Street, route number, or other specific identifier 3100 Stevenson Drive		
	County name Sangamon	County code (if known) 17167	
	City or town Springfield	State Illinois	Zip Code 62712
1.6	Name of Owner/Operator		
	City of Springfield		

Facility, Operator, and Owner Info				
1.7	Owner/Operator Contact Information			
	Name (first and last) Patrick Becker	Title Env. Health and Safety Mgr.	Phone Number 217.757.8610 ext. 1110	
	Email address pj.becker@cwlp.com			
1.8	Owner/Operator Mailing Address			
	Street or P.O. box Environmental Affairs, 801 E. Monroe, 4th Floor			
	City or town Springfield	State Illinois	Zip Code 62701	

SECTION 2: LEGAL DESCRIPTION (35 Ill. Adm. Code 845.210(c))

Legal Description

2.1 Legal Description of the facility boundary

PIN 22120400002 - L 17-20 W CRK L 23 W1/2 SE 12-15-5
PIN 22120400007 - SE SE 12-15-5
PIN 22120400009 - PT E1/2 NE SE 12-15-5
PIN 22120400010 - LOT 9 E PT N NE CORNER & ALL LOTS 12 13 16 17 & 20 E OF CREEK W1/2 SE1/4 12-15-5
PIN 22120400011 - PT NE1/4 SE1/4 12-15-5
PIN 22120400012 - PT N PT SE1/4 12-15-5
PIN 22120200022 - PT NE 1/4 12-15-5

SECTION 3: PUBLICLY ACCESSIBLE INTERNET SITE REQUIREMENTS (35 Ill. Adm. Code 845.810)

Internet Site

3.1 Web Address(es) to publicly accessible internet site(s) (CCR website)

https://www.cwlp.com/IllinoisCCRCompliance.aspx

3.2 Is/are the website(s) titled "Illinois CCR Rule Compliance Data and Information"

☑ Yes ☐ No

SECTION 4: IMPOUNDMENT IDENTIFICATION

Impoundment Identification

4.1 List all the impoundment identification numbers for your facility and check the corresponding box to indicate that you have attached a written description for each impoundment.

Lakeside Ash Pond – W1671200052-01	☑	Attached written description
Dallman Ash Pond – W1671200052-02	☑	Attached written description
	☐	Attached written description
	☐	Attached written description
	☐	Attached written description
	☐	Attached written description

			☐	Attached written description
			☐	Attached written description
			☐	Attached written description
			☐	Attached written description

SECTION 5: CHECKLIST AND CERTIFICATION STATEMENT

Checklist and Certification Statement

5.1 In Column 1 below, mark the sections of Form 1 that you have completed and are submitting with your application. For each section, specify in Column 2 any attachments that you are enclosing.

Column 1		Column 2	
Section 1: Facility, Operator, and Owner Information	☑	w/attachments	☐
Section 2: Legal Description	☑	w/attachments	☐
Section 3: Publicly Accessible Internet Site Requirement	☑	w/attachments	☐
Section 4: Impoundment Identification	☑	w/attachments	☐

5.2 **Certification Statement**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name (print or type first and last name) of Owner/Operator	Official Title
Patrick J. Becker	EHS Manager
Signature	Date Signed
[signature]	10/27/2021

Attachment to Form CCR 1

Section 4: Impoundment Identification

4.1 List all the impoundment identification numbers for your facility and check the corresponding box to indicate that you have attached a written description for each impoundment.

Lakeside Ash Pond – W1671200052-01
The Lakeside Ash Pond is primarily a diked embankment with some incising along the east perimeter. The Lakeside Ash Pond consists of four separate ponds (i.e., three lime softening ponds and a settling pond) totaling approximately 35 acres. CCR ash was first placed in the Lakeside Ash Pond area in the middle 1930's. The Lakeside Ash Pond is its present configuration was placed into service prior to 1958 and ceased receiving ash in 2009. Presently, lime-softening ponds located on the southern portion of the Lakeside Ash Pond receive water softening lime residuals from the CWLP Drinking Water Purification Plant, Flue Gas Desulfurization Waste Water Treatment Plant (FGD WWTP) clarifier blowdown sludge, and wash-down water from miscellaneous floor drains.

Dallman Ash Pond – W1671200052-01
The Dallman Ash Pond is a partially incised and diked embankment placed into service in approximately 1976. The Dallman Ash Pond is one contiguous 34.5 acre pond. The Dallman Ash Pond is used as a settling pond for fly ash and bottom ash, which are sluiced with raw lake water from Dallman Power Station Units 31, 32 and 33. In addition, industrial wastewater treatment plant clarifier blowdown, landfill leachate and evaporation pond water is pumped into the Dallman Ash Pond. No expansion of the Dallman Ash Pond has occurred since its construction.

FORM CCR 2E – INITIAL OPERATING PERMIT FOR EXISTING OR INACTIVE CCR SURFACE IMPOUNDMENTS THAT HAVE NOT COMPLETED AN AGENCY-APPROVED CLOSURE BEFORE JULY 30, 2021

Form CCR 2E

Illinois Environmental Protection Agency

CCR Surface Impoundment Permit Application

Form CCR 2E – Initial Operating Permit for Existing or Inactive CCR Surface Impoundments That Have Not Completed an Agency-approved Closure Before July 30, 2021

Bureau of Water ID Number:
IL0024767

CCR Permit Number:

Facility Name:
City Water, Light and Power

For IEPA Use Only

SECTION 1: CONSTRUCTION HISTORY (35 Ill. Adm. Code 845.220 AND 35 Ill. Adm. Code 845.230)

Construction History

1.1	CCR surface impoundment name.	Lakeside Ash Pond; Dallman Ash Pond
1.2	Identification number of the CCR surface impoundment (if one has been assigned by the Agency).	W1671200052-01; W1671200052-02
1.3	Description of the boundaries of the CCR surface impoundment (35 Ill. Adm. Code 845.210(c)).	see attached
1.4	State the purpose for which the CCR surface impoundment is being used.	see attached
1.5	How long has the CCR surface impoundment been in operation?	see attached
1.6	List the types of CCR that have been placed in the CCR surface impoundment.	see attached

Construction History (Continued)

1.7	List name of the watershed within which the CCR surface impoundment is located.	
	see attached	
1.8	Size in acres of the watershed within which the CCR surface impoundment is located.	
	see attached	
1.9	Check the corresponding box to indicate that you have attached the following:	
	☑	Description of the physical and engineering properties of the foundation and abutment materials on which the CCR surface impoundment is constructed.
	☑	Description of the type, size, range, and physical and engineering properties of the materials used in constructing each zone or stage of the CCR surface impoundment.
	☑	Describe the method of site preparation and construction of each zone of the CCR surface impoundment.
	☑	A listing of the approximate dates of construction of each successive stage of construction of the CCR surface impoundment.
	☑	Drawing satisfying the requirements of 35 Ill. Adm. Code 845.220(a)(1)(F).
	☑	Description of the type, purpose, and location of existing instrumentation.
	☑	Area capacity curves for the CCR Impoundment.
	☑	Description of each spillway and diversion design features and capacities and provide the calculations used in their determination.
	☑	Construction specifications and provisions for surveillance, maintenance, and repair of the CCR surface impoundment.
1.10.1	Is there any record or knowledge of structural instability of the CCR surface impoundment?	
	☐ Yes ☑ No	
1.10.2	If you answered yes to Item 1.10.1, provide detailed explanation of the structural instability.	
	n/a	

SECTION 2: ANALYSIS OF CHEMICAL CONSTITUENTS (35 Ill. Adm. Code 845.230(d)(2)(B))

Constituents

2.1	Check the corresponding boxes to indicate you have attached the following:	
	☑	An analysis of the chemical constituents found within the CCR to be placed in the CCR surface impoundment.
	☑	An analysis of the chemical constituents of all waste streams, chemical additives and sorbent materials entering or contained in the CCR surface impoundment.

SECTION 3: DEMONSTRATIONS AND CERTIFICATIONS (35 Ill. Adm. Code 845.230(d)(2)(D))

Demonstrations

3.1 Indicate whether you have attached a demonstration that the CCR surface impoundment, as built, meets, or an explanation of how the CCR surface impoundments fails to meet, the location standards in the following sections:

35 Ill. Adm. Code 845.300 (Placement Above the Uppermost Aquifer)	☐	Demonstration	☑	Explanation
35 Ill. Adm. Code 845.310 (Wetlands)	☑	Demonstration	☐	Explanation
35 Ill. Adm. Code 845.320 (Fault Areas)	☑	Demonstration	☐	Explanation
35 Ill. Adm. Code 845.330 (Seismic Impact Zones)	☑	Demonstration	☐	Explanation
35 Ill. Adm. Code 845.340 (Unstable Areas and Floodplains)	☐	Demonstration	☑	Explanation

SECTION 4: ATTACHMENTS

Attachments

4.1 Check the corresponding boxes to indicate that you have attached the following:

☑	Evidence that the permanent markers required by 35 Ill. Adm. Code 845.130 have been installed.
☑	Documentation that the CCR surface impoundment, if not incised, will be operated and maintained with one of the forms of slope protection specified in 35 Ill. Adm. Code 845.430.
☑	Initial Emergency Action Plan and accompanying certification required by 35 Ill. Adm. Code 845.520(e).
☑	Fugitive dust control plan and accompanying certification required by 35 Ill. Adm. Code 845.500(b)(7).
☑	Preliminary written closure plan as specified in 35 Ill. Adm. Code 845.720(a).
☑	Initial written post-closure care plan as specified in 35 Ill. Adm. Code 845.780(d), if applicable.
☑	A certification as specified in 35 Ill. Adm. Code 845.400(h), or a statement that the CCR surface impoundment does not have a liner than meets the requirements of 35 Ill. Adm. Code 845.400(b) or (c).
☑	History of known exceedances of the groundwater protection standards in 35 Ill. Adm. Code 845.600, and any corrective action taken to remediate the groundwater.
☑	Safety and health plan, as required by 35 Ill. Adm. Code 845.530.
☑	For CCR surface impoundments required to close under 35 Ill. Adm. Code 845.700, the proposed closure priority categorization required by 35 Ill. Adm. Code 845.700(g).

SECTION 5: GROUNDWATER MONITORING

Groundwater

5.1 Check the corresponding boxes to indicate you have attached the following groundwater monitoring information:

☑	A hydrogeologic site characterization meeting the requirements of 35 Ill. Adm. Code 845.620.
☑	Design and construction plans of a groundwater monitoring system meeting the requirements of 35 Ill. Adm. Code 845.630.

		✔	A groundwater sampling and analysis program that includes section of the statistical procedures to be used for evaluating groundwater monitoring data, required by 35 Ill. Adm. Code 845.640.
		✔	Proposed groundwater monitoring program that includes a minimum of eight independent samples for each background and downgradient well, required by 35 Ill. Adm. Code 845.650(b).
SECTION 6: CERTIFICATIONS			
Certifications	6.1	Check the corresponding boxes to indicate you have attached the following certifications:	
		✔	A certification that the owner or operator meets the financial assurance requirements of Subpart I, as required by 35 Ill. Adm. Code 845.230(d)(2)(N).
		✔	Hazard potential classification assessment and accompanying certifications required by 35 Ill. Adm. Code 845.440(a)(2).
		✔	Structural stability assessment and accompanying certification, required by 35 Ill. Adm. Code 845.450(c).
		✔	Safety factor assessment and accompanying certification, as required by 35 Ill. Adm. Code 845.460(b).
		✔	Inflow design flood control system plan and accompanying certification, as required by 35 Ill. Adm. Code 845.510(c)(3).

ATTACHMENT 2 – CITY WATER, LIGHT & POWER – 35 IAC 620 ASH POND ASSESSMENT

Ash Pond Assessment

INTRODUCTION

In accordance with the Illinois Environmental Protection Agency's (IEPA) request for additional information demonstrating compliance with 35 Illinois Administrative Code (IAC) 620, City Water, Light and Power (CWLP) is providing this hydrogeological assessment of the ash ponds. CWLP operates a series of ash and lime sludge clarification or settling ponds east of the power plant complex in Springfield, Illinois. The utility is owned and operated by the City of Springfield. The ponds are operated under a National Pollutant Discharge Elimination System (NPDES) Permit Number IL0024767. The ash ponds are located north of East Lake Shore Drive, just east of Interstate 55. The site is bordered on the south by Lake Springfield, on the west and north by Sugar Creek and on the east by CWLP's permitted FGDS landfill. The facility is located in the eastern half of Range 5 west, Township 15 north, Section 12 in Sangamon County, Illinois (Springfield East Quadrangle, Illinois, USGS). The setting is depicted on Figure 1.

Beyond the areas depicted on Figure 1, to the west is Interstate 55 and at a greater distance is Dirksen Parkway that parallels the interstate. Commercial property is abundant on both sides of this street and these businesses rely on potable water delivered by CWLP. There are no known water supply wells in this area. The lake is south of the ponds along with the impoundment dam. A flood plain and clay soil borrow area for the landfill is located in the area north of the ash ponds. There is City property located directly east of the ponds that includes a flood plain along with the landfill area. Residences are located further east in several subdivisions. There residences are typically served by potable water from CWLP, as the subdivisions were built in the 1970's, 1980's and 1990's.

The FGDS Disposal facility was constructed within an old river valley which is characterized by flat topography and a meandering stream. Sugar Creek flows adjacent the site. Sugar creek receives water from both surface runoff from adjacent properties, effluent from the ash pond impoundments and discharges from the Lake Springfield Spaulding Dam. Topographically, the waste disposal area is surrounded on the southeast and southwest by higher ground which appears to be bedrock outcrops. Low lying areas are located to the north and east and are within the old river valley.

The impoundment ponds include the Dallman Ash Pond that was placed in service in approximately 1976. This pond is approximately 36 acres. The pond has an average invert elevation of 527 feet MSL from the plan sheet design. Therefore the pond is approximately 27 feet deep from the top of the perimeter roadway. Both flyash and bottom ash is sluiced to the Dallman Ash Pond with raw lake water.

The Lakeside Ash Pond was placed into service prior to 1958. The Lakeside Ash Pond has been divided into three separate ponds with the East Lime Pond being 7.3 acres in size, the west lime Pond 4.2 acres and the remaining Lakeside Ash Pond consisting of 32.3 acres.

The lime ponds receive the sludge, typically composed of lime, flocculants and lake water solids from the water treatment plant clarifiers. These ponds are typically operated one at a time. The clarified supernatant from these ponds flows into the Lakeside Ash Pond.

The Lakeside power plant has been shut down and therefore bottom and fly coal combustion ash is no longer being sluiced to the Lakeside Ash Pond with raw lake water. Efforts continue to reclaim both ash as well as lime sludge from the pond areas. The lime sludge is used to correct pH on agricultural farmland in lieu of typical lime stone application.

The settled water from both the Dallman Ash Pond and Lakeside Ash Pond flow into opposite sides of the center Clarification Pond before being discharged through permitted NPDES Outfalls 004 or 006. Outfall 004 discharges the water into Sugar Creek and alternately Outfall 006 discharges the water back to Lake Springfield. The clarification pond consists of 10 acres. The maximum permitted water flow through the pond system is approximately 7.5 MGD. The clarification pond is also thought to be approximately 27 feet deep with an average invert elevation of 527 ft MSL.

The southern area of the ash ponds and dam is bounded by Lake Springfield. The lake was made by constructing an earthen Spaulding Dam across Sugar Creek. Therefore the lake and the dam are upgradient in terms of groundwater flow direction and groundwater quality.

The adjacent landfill on the east disposes of Flue Gas Desulphurization Sludge from the electric generating facility's sulfur dioxide scrubbers. The landfill is segregated into two regulated units. Unit 1 is a closed landfill regulated by the 35 Illinois Administrative Code (IAC) 807 regulations and comprises approximately 10.5 acres. Unit 2 is north of Unit 1 and consists of 22.3 acres with only 3.5 acres currently being developed to date. This landfill is regulated by the 35 IAC 811 regulations.

Much of the ash ponds and landfill were constructed in the Sugar Creek flood plain. In fact the dam was constructed of glacial till largely consisting of silty clay to clayey silt ensuring that the reconstructed earthen dam, and pond embankments, exhibit low permeability characteristics. Recompacted silty clay samples from the native soils have exhibited permeability's in the 1×10^{-7} to 1×10^{-9} cm/sec range with relative ease and reproducibility based upon construction of the landfill's liner and final cover systems. The in-place creek sediment's soil permeability's predominantly range from 1×10^{-6} to 1×10^{-8} cm/sec.

The property on which these landfill cells and ash ponds have been constructed was originally agricultural land. Based on a 1976 USGS quadrangle map and old design drawings, Sugar Creek originally meandered through the property. The creek was abandoned when the Dallman Ash Pond was constructed and was rerouted to its present position.

The landfill cells were reportedly created by constructing berms above original grade and excavating soils within the cells. The soils excavated from the cell inverts were used to construct the perimeter berms. The total area of the landfill is approximately 25 acres.

Accordingly much is known about the east side of the ash ponds based upon the regulatory required hydrogeologic studies that have been done for the landfill. The landfill has approximately 25 monitoring wells and piezometers spread over the approximate 40 acre total area. Details regarding the specific hydrogeologic investigation in this area are available from the IEPA Bureau of Land CWLP – FGDS Landfill Facility Number 1678250020. These investigations have been summarized and augmented with the 2010 field investigation on the west side of the CWLP ash ponds.

Should the Agency require these numerous hydrogeological studies these reports they can be easily supplied by us or may be reviewed from the Bureau of Land file.

POTABLE WATER WELLS

The Illinois State Water Survey was contacted in the past and the potable water wells in a 0.5 mile radius are provided on Figure 2. This figure was prepared by Patrick Engineering, Inc. Most of these wells are likely no longer used based upon the availability of potable water from CWLP in this increasing urbanized area. The water well records are provided in Attachment A.

HYDROGEOLOGICAL INVESTIGATIONS

Six subsurface investigations have been conducted in and adjacent to the three landfill cells and ash ponds. These investigations were as follows:

1. Professional Service Industries (PSI), June, 1989. This investigation consisted of five soil borings within the east section of the south cell (Cell) 1).

2. Andrews Environmental Engineering (AEE), February, 1990. This investigation was performed for the center cell (Cell 2) and consisted of 13 soils borings. The drilling and soil testing was performed by PSI.

3. Andrews Environmental Engineering (AEE), March, 1990. This investigation was performed to install six monitoring wells at the facility. The drilling, soil testing and well construction was performed by PSI.

4. Patrick Engineering (PEI), July, 1992. This investigation was performed to further characterize the hydrogeology of the landfill setting. Approximately 44 soil boring and piezometers were installed by PEI.

5. Stabilize, Inc. (SI), December, 2008. This investigation installed three new monitoring wells as part of an assessment program for the landfill. The drilling, soil testing and well construction was performed by Reynolds Well Drilling.

6. City Water Light and Power (CWLP), April, 2010. This investigation was performed to install four piezometers on the west side of the ash ponds along Sugar Creek. The drilling, soil testing and well construction was performed by PSI.

The data from Investigations 1 through 4 was summarized, tabulated and consolidated for the landfill permitting process. This information is provided below. The findings from the assessment well and ash pond investigation are then provided to correlate the larger expanded project area with the landfill's hydrogeology findings.

GENERALIZED STRATIGRAPHY

The available landfill report data was carefully reviewed to determine the general site stratigraphy to define the complex site hydrogeologic conditions. Based on this review, there appears to be six major geologic units present at the site. The six units are as follows:

(1) Fill Materials - These materials consist of soils used for constructing the berms and the soils used for filling Sugar Creek when it was rerouted to the west. The fill materials for berms generally consisted of clayey soils. However, the materials used for filling the creek appeared to be variable ranging from silty clays to organic silty clays.

(2) Upper Cohesive Deposit - This unit consists of loess and alluvial silty clays to clayey silts.

(3) Shallow Sand - This unit, consisting of silty to clayey sand, underlies the Upper Cohesive Deposit.

(4) Lower Cohesive Deposit - This unit underlies Shallow Sand and consists of silty to sandy clays.

(5) Basal Sand - Underlying the Lower Cohesive Deposit is the Basal Sand which consists of silty to clayey sands, and sands with minor amounts of gravel.

(6) Bedrock - Bedrock is encountered below the Basal Sand and consists of Pennsylvanian shale.

REGIONAL GEOLOGY

A review of published regional geologic studies was conducted for the area immediately surrounding the project site. A thorough discussion of the regional geology has been presented by the Illinois State Geologic Survey (ISGS) in a report entitled "Geology for Planning in the Springfield-Decatur Region, Illinois". Based on the publications, the regional unconsolidated overburden is comprised of lacustrine and alluvial sands, silts and clays overlying Pennsylvanian shale. This stratigraphy is expected at the project site as the sited is located within an old river valley between bedrock outcrops. A brief summary of the regional overburden stratigraphy, bedrock stratigraphy, groundwater resources, and groundwater use in the vicinity of the project site is provided in the following sections.

Regional Overburden Stratigraphy

Available regional surface geology maps indicate that unconsolidated deposits in the area of the project site consist primarily of Cahokia Alluvium overlying the Equality Formation. Other soils such as loess, modern soils and glacial tills may deposits. The Cahokia Alluvium and Equality Formation are reported to be alluvial silt deposits. The total thickness of the unconsolidated deposits ranges from approximately 10 to 50 feet with an average thickness of about 25 feet based on water supply well within the area. The Cahokia Alluvium generally consists of fine-grained silty to clayey soils. Small discontinuous lenses of sand and gravel are commonly encountered. It has been described as ranging from yellowish brown to gray to dark in color.

The Equality Formation consists primarily of silty clays which have been deposited in quiet glacial melt water lakes. It is normally massive in appearance and commonly contains localized lenses of clay and sand.

Regional Bedrock Stratigraphy

The unconsolidated overburden deposits are underlain by Pennsylvanian shales, limestones, sandstones, and coals. Outcrops of Pennsylvanian shale are present to the west and southeast of the project site. The uppermost Pennsylvanian rocks in the region have been correlated to the Modesto Formation of the Mcleansboro Group.

The most predominant materials in the Modesto Formation are thick gray shales. The sandstone members are usually not as thick as the shales; however, there are local channel deposits which can be up to 80 feet thick. Most of the limestone and coal seams are relatively thin when compared to the shales and sandstones.

The Pennsylvanian rocks are underlain by rocks of the Mississippian, Devonian, Silurian, Ordovician and Cambrian systems. The Mississippian, Devonian, and Silurian rocks consist of limestone, dolomite, and to a lesser extent shale formations. The Ordovician Cambrian rocks are primarily dolomites and sandstones with some relatively extensive shale formations.

Springfield No. 5 Coal Mine

Illinois basin coal deposits typically occur in stratigraphic sequences called cyclothems, this is especially true for Pennsylvanian coal, such as those found in the Springfield No. 5. This coal may have been mined near the western half of the project site. Published data for the region indicates that the Springfield No. 5 coal is probably 5 to 7 feet thick, and is present at a depth of approximately 200 feet below the ground surface.

Regional Groundwater Resources

The largest groundwater yields in the Sangamon County area are obtained from large diameter wells finished in sand and gravel deposits and the upper portions of the Pennsylvanian rocks. Throughout Sangamon County, the Pennsylvanian bedrock will yield minor amount of groundwater in areas where it is fractured. Locally, sandstone lenses may also yield small amounts of water. Water supply wells are usually not extended more than 150 feet into the bedrock because the groundwater in the lower part of the Pennsylvanian rocks is highly mineralized.

Groundwater Use in the Vicinity of Project Site

The available water well logs from Illinois State Water Survey (ISWS) that are located within an approximate one mile radius of the project site were obtained. The locations of the wells in reference to the project area are shown in Figure 2. Copies of the logs are included in Appendix A. A review of these logs indicated the following:

(1) The water supply wells range in depth from 11.5 to 52 feet below the ground surface with an average depth of about 33 feet.

(2) The wells are drilled to the top of bedrock and obtain water from the overburden deposits and the upper few feet of the bedrock surface.

(3) The wells are typically about three feet in diameter due to the low yield of the formations in which they are completed.

SITE GEOLOGY

The results from each of the six different investigations were consistent with the results from previous investigation regarding the different hydrogeologic units present at the site. As discussed before, six distinct geologic units, namely: Fill Materials, Upper Cohesive Deposit, Shallow Sand, Lower Cohesive Deposit, Basal Sand, and Bedrock are present at the site. A more detailed description of all six units based on the available landfill data is presented in the following sections based upon the individual landfill investigations. Narrative regarding the latest ash pond investigation will be provided following the background information available for the adjacent landill.

Fill Materials

Two types of fill materials were encountered at the site. One being the soils used to construct the containment berms and the other being soils used to abandon the creek. Based on the borings drilled through the berms, the berms were generally constructed with silty clays which were likely obtained from within the landfill cells. The borings made along the abandoned creek locations indicate that the creek fill materials consist of variable soils ranging from silty clays to silty sands. It is noted that in some locations the containment berms were constructed directly over the creek fill.

Based on the materials encountered within the creek channel, it is apparent that the creek abandonment was not performed according to current engineering practices. The Fill Materials consist of both cohesive and granular soils. The cohesive soils are characterized as silty clays to organic silty clays organics were typically encountered. In some areas, the cohesive fill materials extended down to the top of bedrock. The granular fill materials are typically poorly graded silty to clayey sands and contain organics or wood fragments. In some areas, the granular fill materials also extended down to the top of bedrock.

The landfill laboratory testing program was concentrated on the creek fill materials. The cohesive fill materials exhibit the following range of index and engineering properties: liquid limit = 34 to 46, plasticity index = 9 to 26, gravel content = 0 %, sand content = 2% to 48%, silt/clay content = 52% to 98%, dry density = 80 pcf to 104 pcf, and laboratory hydraulic conductivity ranging from 7.6 x 10-8 cm/sec to 2.1 x 10-5 cm/sec.

Cation exchange capacity (CEC) tests indicate CEC values range from 14 to 18 meq/100 gm. The granular fill materials contain 0% to 2% gravel, 55% to 65% sand and 33% to 45% silt/clay, based on sieve analyses. One laboratory hydraulic conductivity test was performed using a Shelby tube sample obtained from berm fill at location P-9D and indicate hydraulic conductivity value of 3.3 x 10-8 cm/sec.

Upper Cohesive Deposit

The Upper Cohesive Deposit (USD) consists mainly of brown, light brown, and brownish-gray silty clays and clayey silts having soft to stiff consistency. This deposit includes all eolian soils (loess) deposited near the surface, isolated pockets and lenses of fine grained silty to clayey sand at some locations and alluvial silts and silty clays. The UCD is present in all areas of the landfill footprint except in areas where Sugar Creek cut through. The UCD was encountered either at the ground surface or below the fill materials and ranged in thickness from 2.5 to 19 feet. The thickness of the UCD was impacted significantly when the landfill bottom was excavated. In addition, recent earthwork landfill cell development activities may have caused changes in the thickness of the deposit.

Laboratory tests were performed on representative soil samples obtained from this deposit to aid in classification and correlation of the UCD between boring locations. The deposit exhibits the following range of index and engineering properties: liquid limit = 23 to 33, plasticity index = 2 to 14, gravel content = 0%, sand content = 18% to 40%, silt/clay content = 60% to 85%, dry density = 99 to 103 pcf, CEC = 10 to 16.5 meq/100 gm. It is noted that one silt sample obtained from this unit was non-plastic and it is not included in the range of values. Triaxial hydraulic conductivity tests performed on undisturbed 3-inch diameter thin-walled Shelby tube samples indicates that the vertical hydraulic conductivity of this unit ranges from 1.6 x 10-8 cm/sec to 5.2 x 10-7 cm/sec.

Shallow Sand

The Shallow Sand underlies the UCD and consists of a brown to gray silty to clayey fine sand. It contains small lenses of silty clay and clayey silt. This unit is not continuous over the entire site. Its thickness ranges from one to three feet over most of the investigated area.

Laboratory tests performed on representative samples collected from the Shallow Sand unit during this and previous investigations indicate the Shallow Sand contains 0% gravel, 50% to 52% sand, and 48% to 50% silt/clay.

Lower Cohesive Deposit

The Lower Cohesive Deposit (LCD) consists of brown, gray, and brownish gray silt clays, clayey silts and clays having very soft to stiff consistency. The LCD ranges in thickness from 0 to 22 feet with an average thickness of about 15 feet. The deposit was not encountered in isolated areas along the abandoned creek, possibly due to excessive of creek bottom in these areas.

The LCD is generally overlain by the Shallow Sand and underlain by the Basal Sand. However, within the abandoned creek area, the LCDE was encountered directly below the creek fill. In some areas the Basal Sand is not present and the LCD directly overlies the bedrock.

In some areas the soils in the LCD are very similar in color and texture to the soils in the UCD. The distinction between the two deposits was based on the presence or changes in soil consistency (as measured with a calibrated hand held penetrometer) and a marked difference in moisture content. The LCD is not exposed at the ground surface in the investigated area.

The LCD exhibits the following range of index and engineering properties: liquid limit = 23 to 71, plasticity index = 3 to 39, gravel content = 0%, sand content = 8% to 48%, silt/clay content = 52% to 95%, dry density = 78 pcf to 105 pcf, and cation exchange capacity = 6 to 11 meq/100 gm. The high plasticity clays were encountered in northeast areas of Cell 3 (CB-2, P-3D, and P-4). Hydraulic conductivity of undisturbed samples ranged from 1.3 x 10-8 cm/sec to 1.8 x 10-6 cm/sec. It is noted that three samples tested from this unit showed non-plastic characteristics and these are not included in the range of values.

Basal Sand

In general, the lower most hydrogeologic unit in the overburden stratigraphy at the project site is the Basal Sand (BS). It consists of brown to gray colored, poorly graded, silty to clayey fine sands to well graded sands with minor amounts of fine gravel. This unit was encountered in a medium dense to dense condition. The top elevation of the Basal Sand varies from elevation 491 to 513 feet, and the thickness ranges from about 0 to 12.3 feet. The unit was not encountered in a few scattered areas possibly due to excessive erosion of creek bottom.

The Basal Sand generally overlies the bedrock surface and underlies the LCD. Pockets of very hard fine-grained silty clay to clay are present overlying the bedrock in scattered areas, and the Basal Sand is present above these pockets of clayey deposits. The origin of these pockets of clayey deposits is probably weathered bedrock. The Basal Sand generally consists of 0% to 34% gravel, 50% to 91% sand, and 6% to 44% silt/clay from the numerous landfill borings.

Bedrock

The Bedrock at the project site consists of Pennsylvanian shales. The bedrock sediments are gray in color. The bedrock surface elevation varies from elevation 492 feet (in G-106) near the center of the project site to 558 in B-14, which is located on a bedrock outcrop near the southeast corner of Cell 1. In general, the bedrock surface slopes from both the east and west towards the center of the landfill Cells 2 and 3 in the landfill area.

Rock Quality Designation (RQD) measurements were performed on all core samples taken from the landfill area. RQD's measured from core samples collected during this investigation ranges from 80% to 100%. The RQD values indicate that the bedrock is not highly fractured. Two in situ hydraulic conductivity tests were performed to determine the hydraulic conductivity tests were performed to determine the hydraulic conductivity of the upper portions of the bedrock. Test results indicate the hydraulic conductivity values of the bedrock ranged from 1.8 x 10-7 cm/sec to 1.3 x 10-6 cm/sec. This shows that the bedrock encountered at the project site is relatively impermeable. There is good correlation between the lithology of the rocks tested and the hydraulic conductivity values obtained.

SITE HYDROGEOLOGY

A thorough analysis of the available data collected during the previous investigations indicates that there are three water deposits present at the landfill. These deposits are:

1) Creek Fill
2) Shallow Sand
3) Basal Sand

The creek fill materials identified during the previous landfill investigations have a significant affect on the site hydrogeologic conditions. In some areas, the fill materials, consisting of either granular soils or organic silty clays, extend from existing grade to the bedrock surface and locally interconnect all three water bearing units. The Upper and Lower Cohesive Deposits are considered to act as aquitards (where present) which restrict vertical flow into the water bearing units. Bedrock is considered to act as an aquiclude.

Creek Fill

Fill materials encountered in the landfill borings range from silty clays and organic silty clays to silty sands and clayey sands. These water level measurements indicate that groundwater flow within the creek fill materials is complicated because of the highly variable hydraulic characteristics of the fill materials and their random placement. In some areas, there appears to be direct hydraulic communication between fill materials, Shallow Sand and Basal Sand.

A total of four landfill piezometers were screened into the fill materials. Of these, one piezometer was installed into cohesive fill material and the other piezometers were installed in granular fill materials. Hydraulic conductivity of the granular fill materials based of field hydraulic conductivity tests ranged from 6.1 x 10-2 cm/sec. The hydraulic conductivity of the cohesive fill material, based on one slug test, ranged from 7.1 x 10-5 cm/sec to 1.1 x 10-4 cm/sec. These values represent the hydraulic conductivity in the horizontal direction.

Laboratory hydraulic conductivity test performed on landfill cohesive fill materials ranged from 2.1 x 10-3 cm/sec to 3.3 x 10-8 cm/sec. The higher hydraulic conductivity values are believed to be typical of soils which contain organic matter (e.g. wood fragments). The hydraulic conductivity values based on laboratory tests are generally considered to be representative of the coefficient of hydraulic conductivity in the vertical direction because of the sample configuration during testing. However, because of the randomness of the fill, it is more likely that the hydraulic conductivity is within the range of 10-5 to 10-4 cm/sec.

Upper Cohesive Deposit

The upper Cohesive Deposit has a relatively low hydraulic conductivity in the vertical direction as determined by laboratory triaxial hydraulic conductivity tests from borings taken from the landfill investigation. The hydraulic conductivity values determined from the laboratory tests ranged from 1.6 x 10-8 cm/sec to 5.2 x 10-7 cm/sec. However, the UCD is an alluvial Deposit and it is expected that the horizontal coefficient of hydraulic conductivity will be significantly greater than the vertical coefficient. Based on test results for the Lower Cohesive Deposit (see below), it is anticipated that the horizontal hydraulic conductivity for the UCD is in the range of 10-6 to 10-5 cm/sec.

Shallow Sand

Two landfill piezometers were screened in the Shallow Sand unit to provide information on piezometric levels and to perform slug tests. The hydraulic conductivity of this unit based on the slug test results is estimated to generally be within a range o 3.6 x 10-3 cm/sec to 2.9 x 10-2 cm/sec.

Lower Cohesive Deposit

The Lower Cohesive Deposit has a relatively low hydraulic conductivity. Hydraulic conductivity in the vertical direction based on triaxial hydraulic conductivity tests range from 1.3 x 10-8 to 1.8 x 10-6 cm/sec. Hydraulic conductivity in the horizontal direction based on two slug tests performed in piezometers screened in this deposit ranges from 4.6 x 10-5 cm/sec to 7.6 x 10-5 cm/sec. This variation in the vertical and horizontal conductivity is expected due to the nature in which this soil was developed.

Basal Sand

The Basal Sand was saturated in all locations where it was encountered. The measured hydraulic conductivity of this unit ranged from 5.6 x 10-4 cm/sec to 3.6 x 10-2 cm/sec in the landfill piezometers with the lower values associated with fine sands having larger silt/clay content. The groundwater is present under confined conditions based on the water level measurements obtained during this investigation.

Figure 3 shows the interpreted potentiometric surface within this unit on May 25, 2010. The potentiometric surface of the Basal Sand varies from elevation 541 – feet to elevation 527 – feet. The groundwater flow in the Basal Sand is towards the center of Cells 1 and 2 from the east, the west and the south directions, and discharge is towards Sugar Creek to the north.

Bedrock

The bedrock at the project site consists of mainly shale with isolated thin coal layers. In situ hydraulic conductivity test (slug tests) indicated that the hydraulic conductivity for the upper portions of the bedrock range from 1.8 x 10-7 cm/sec to 1.3 x 10-6 cm/sec. There appears to be good correlation between the rock lithology and the measured values of hydraulic conductivity. The bedrock over most of the site will act as an aquiclude and prevent the downward flow of groundwater flow.

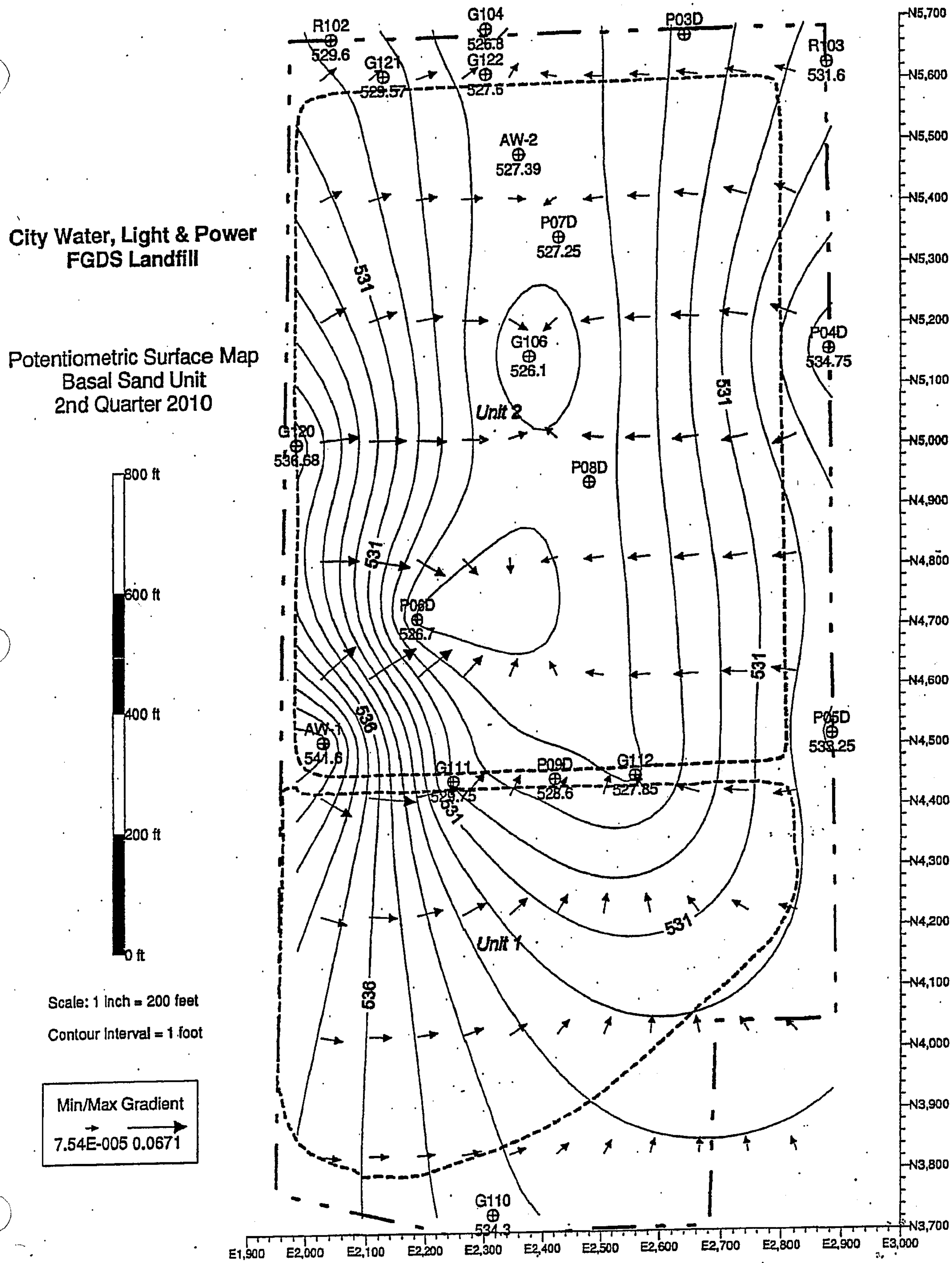

City Water, Light & Power
FGDS Landfill
Potentiometric Surface Map
Basal Sand Unit
2nd Quarter 2010
800 ft
600 ft
400 ft
200 ft
0 ft
Scale: 1 inch = 200 feet
Contour Interval = 1 foot
Min/Max Gradient
7.54E-005 0.0671
R102
529.6
G104
526.8
G121
529.57
G122
527.6
P03D
R103
531.6
AW-2
527.39
P07D
527.25
G106
526.1
P04D
534.75
Unit 2
G120
536.68
P08D
P06D
526.7
P05D
533.25
AW-1
541.6
G111
529.75
P09D
528.6
G112
527.85
Unit 1
G110
534.3
531
536
N5,700
N5,600
N5,500
N5,400
N5,300
N5,200
N5,100
N5,000
N4,900
N4,800
N4,700
N4,600
N4,500
N4,400
N4,300
N4,200
N4,100
N4,000
N3,900
N3,800
N3,700
E1,900
E2,000
E2,100
E2,200
E2,300
E2,400
E2,500
E2,600
E2,700
E2,800
E2,900
E3,000

Figure 3

2010 EXPLORATION PROGRAM

The exploration program consisted of drilling 4 borings depths ranging from 19.5 to 60 feet, installing 4 piezometers and performing 4 slug tests. The piezometers were installed to obtain groundwater level measurements and to perform slug test. The locations of all borings and piezometers are shown in the PSI report provided in Attachment B.

The goals of the exploration program were to:

1. Further delineate the six geologic units identified after reviewing the results of previous investigations on the west side of the ash pond.

2. Determine the hydraulic characteristics of the six geologic nits (Fill Materials, Upper Cohesive Deposit, Shallow sand, Lower Cohesive Deposit, Basal Sand, and Bedrock).

3. Obtain representative and undisturbed soil samples for laboratory testing.

4. Obtain one round of groundwater sampling for characterization according to the 35 IAC groundwater standards.

5. Determine index and engineering properties of the different hydrogeologic strata.

All field explorations were performed under the direction of CWLP staff without benefit of an independent consultant. The contract driller maintained the daily drilling records, logged the soil samples and rock cores, selected representative samples for laboratory testing, and supervised the installation of piezometers. The field logs together with the laboratory tests were used to develop the boring logs presented in Attachment B. The borings were logged according to the Soil Description Terminology and the locally adapted version of the Unified Soil Classification System, ASTM D 2487.

Drilling and Sampling Procedures

The borings were drilled with a Central Mine Equipment (CME) rotary drill rig mounted on an all-terrain vehicle. Boreholes were advanced utilizing either 4-1/4 inch hollow system augers to stabilize the sides of the boreholes.

The soils were sampled by driving a 2-inch O.D. standard penetration test split spoon sampler in accordance with a modified version of ASTM D 1586. Borings were sampled continuously from one foot below the ground surface to total depth. The sample method, soil type, location, and recovery for each sample interval are shown on the Boring Logs.

Representative soil samples obtained by the standard penetration method were preserved for laboratory analyses. When a break in the soil stratigraphy was logged in a split spoon sample interval, the sample was split and representative soil samples above and below the stratigraphic break were preserved. Hand held calibrated penetrometer tests were performed in the field on cohesive samples to serve as a general measure of soil consistency and to estimate unconfined compressive strengths. After sealing the jars, individual samples were labeled, boxed and transported to the PSI Laboratory for testing.

Based upon the soil borings the shallow sand is not present except in AP -4 and may have been removed as part of the realignment of sugar creek. The ash pond invert is situated in clayey silts or silty clay that act as a natural retardation to the migration of contaminants from the ash ponds. Beneath this low permeability layer is the basal sand that continues across the site and beneath the basal sand is the confining layer of shale. Boring AP-4 encountered flyash in its boring and therefore the groundwater quality from this piezometer may be suspect based upon contamination, annular space seal, etc. Figure 4 is a north south cross section showing the geology of the Borings AP-1 through AP-4 along with the ash pond data for illustrative purposes. Figure 5 contains a copy of the construction information for the Dallman Ash Pond and a portion of the clarification pond.

Piezometer Construction

Each piezometer consisted of a 2-inch I.D. PVC riser pipe connected to a ten feet long, slotted PVC screen. Silica sand filter pack was installed around the slotted well screen. Bentonite pellets or Volclay grout were installed above the filter pack to form a seal.

Piezometer Development

The piezometers were developed using a one-inch I.D. and five foot long PVC bailer. Numerous piezometer casing volumes of water removed from each well to ensure that the screens were unobstructed.

Sampling

Samples of the four piezometers on the west side of the ash ponds was done with the landfill permitted groundwater wells during the end of May and beginning of June. Samples were collected by CWLP personnel for non organic parameters of the new Ash Pond Piezometers. Sample results for AP-1, AP-2, AP-3 and AP-4, AW-3, G120 and G110 are provided in Attachment D. The Ash Pond wells were sampled for total metal concentrations in comparison to dissolved as is customary for groundwater wells. A review of site specific available data for both dissolved versus total parameters for boron and iron revealed an approximate ratio of dissolved to total concentration of 33% as indicated below and in Attachment D. Therefore the following results are note worthy in terms of the 620 standards, but are not indicative of exceedences when this correlation is used in the evaluation process.

Well ID	Potential Exceedence	Standard	Total	Dissolved
AP-1	Iron	5.0 mg/l	5.68 mg/l	
AP-2	Boron	2.0 mg/l	2.63 mg/l	
AP-3	Boron	2.0 mg/l	11.9 mg/l	
AP-3	Iron	5.0 mg/l	10.1 mg/l	
AP-4	Iron	5.0 mg/l	11.2 mg/l	
AW-3	Iron	5.0 mg/l	12 mg/l	4.23 mg/l
G-110	Iron	5.0 mg/l	6.71 mg/l	2.73 mg/l
G-120	Iron	5.0 mg/l	28.6 mg/l	19.9 mg/l

Monitoring Well G120 is down gradient from Cell 1 of the FGDS landfill and the results of the sampling there are more likely indicative of the impact of the landfill than the ash pond to the west.

Surveying

The locations and elevations of all borings and piezometers were surveyed by CWLP personnel. The locations are expressed relative to a project grid system. The elevations of all boring and piezometers are based on U.S.G.S. mean sea level datum. A summary of the survey data is presented in Table 1.

Water Level Measurements

Water levels were measured in all piezometers, monitoring wells, and surface water bodies present in the vicinity of the landfill and ash ponds by CWLP personnel on may 25, 2010. The depth to water in the measurements were then converted to elevations. The water elevations were plotted by Surfer and the potentiometric surface map is presented as Figure 5 for the combined landfill and ash pond piezometers.

Slug Tests

Slug tests were performed in all piezometers installed during this investigation to provide an estimate of the hydraulic conductivity of the soils within the screened interval. Four piezometers were tested in the Basal Sand revealing a mean hydraulic conductivity of 1.73 x 10-2 cm/sec.

SUMMARY

The site geology at the project area has been determined based on comprehensive subsurface investigations performed by numerous consultants. Based on these investigations, six major geologic units have been identified at the site. These units are: fill materials within the old abandoned creek channel, upper cohesive deposit, shallow sand, lower cohesive deposit, basal sand, and bedrock (shale).

Based on hydraulic conductivity testing, particle size distribution test, and water level measurements, the fill materials within the old creek channel, the shallow sand, and the basal sand are the water bearing units present at the site. Laboratory and field tests provide the range of hydraulic conductivity values for each of these units.

MONITORING WELL OR PIEZOMETER	POWER PLANT COORDINATES	GROUND ELEVATION	TOP OF CONCRETE BASE ELEV.	TOP OF PVC PIPE ELEV.	TOP OF WELL CASING
3D	N. 5672.4	530.5			
	E. 2644.9				
3F	N. 5672.2	530.5			
	E. 2651.4				
AP-1	N. 5133.5	532.9		537.8	
	E. 835.4				
AP-2	N. 4188.8	533.2		540.3	
	E. 723.8				
AP-3	N. 3808.0	533.7		535.6	
	E. 823.5				
AP-4	N. 2467.6	553.9		554.6	
	E. 1511.8				
AW-1	N. 4511.9		552.8		556.0
	E. 2030.4				
AW-2	N. 5480.6		526.7		529.6
	E. 2361.3				
AW-3	N. 5608.1		537.8		541.5
	E. 1744.2				
G-104	N. 5687.2	530.6		533.0	533.6
	E. 2305.9				
G-106	N. 5149.7		524.6	526.1	
	E. 2378.9				
G-121	N. 5612.8		553.7	555.6	556.0
	E. 2130.0				
G-110	N. 3728.6		555.2	557.2	557.5
	E. 2315.7				
G-112	N. 4450.9		552.6	554.8	554.9
	E. 2560.6				
G-113	N. 4510.0		534.9	537.7	537.8
	E. 2886.0				
G-120	N. 5009.4	553.1	FLUSH WITH GROUND		
	E. 1986.9				
G-122	N. 5613.2		552.6	554.4	554.9
	E. 2305.1				
P-4	N. 5156.3	536.0		539.0	
	E. 2880.7				
P-5D	N. 4516.7	534.9		537.7	
	E. 2885.0				
P-6S	N. 4725.7	524.7		527.5	
	E. 2191.4				
P-6D	N. 4717.0	524.7		534.2	
	E. 2186.8				
P-6R	N. 4708.0	524.7		531.2	
	E. 2181.0				
P-7S	N. 5340.0	526.2		528.5	
	E. 2420.0				
P-7D	N. 5345.0	526.5		528.5	
	E. 2430.0				
P-7R	N. 5327.0	525.6		528.7	
	E. 2422.0				
P-7M	N. 5337.0	526.0		528.1	
	E. 2432.8				
P-8S	not found				
P-8D	N. 4939.7	522.7		530.1	
	E. 2482.7				
P-9S	N. 4447.3	552.5		555.7	
	E. 2415.6				
P-9D	N. 4446.3	553.6		556.1	
	E. 2422.4				
R-101	N. 4049.5		544.0	546.8	547.0
	E. 2863.2				
R-102	N. 5673.8		535.9	539.2	539.4
	E. 2043.9				
R-103	N. 5625.3		536.3	538.6	538.8
	E. 2878.4				
R-111	N. 4437.4	554.0	FLUSH WITH GROUND		
	E. 2249.7				

Table 1

The fill materials and the shallow sand are not considered to be aquifers. The fill materials are variable consisting of organic, clayey and sandy soils with different hydraulic characteristics. The shallow sand consists of clayey sand and is thin and discontinuous across the site. Neither deposit could produce a sustained pumping rate such that they would be considered sources of groundwater for potable us.

The basal sand is considered the uppermost aquifer at the site. The basal sand consists of silty to clean sands to fine gravel and has a relatively high permeability. The predominant groundwater flow at the site occurs within this deposit.

The bedrock at the site generally consists of shale. In situ hydraulic conductivity tests (slug tests) had little response indicating that the shale is competent and has a low hydraulic conductivity. The bedrock will act as an aquiclude.

The sampling of the piezometers: AP - 1, AP - 2, AP - 3 AP - 4, AW - 3, G-120 and G-110 which surround the ash pond impoundment system indicate minimal exceedence of the 35 IAC 620 Class II groundwater standards. The ash ponds are located in a non-residential area with few residences. If there is any impact from inadvertent leakage of the ponds to the groundwater, it will be relatively minimal as any ash impoundment subsurface leakage will likely flow into Sugar Creek combining with that much greater water flow. Sugar Creek is the same water source that receives the effluent from the ponds after treatment of the solids and pH adjustment as well as sanitary treatment plant discharges further down stream. The clayey soils that the ash ponds are located in and constructed with should retard any migrating pollutants that might otherwise be present.

We hereby certify that the information contained herein is true to the best of our understanding based upon our experience with the City Water, Light and Power ash ponds and landfill.

R. Michael McDermont, PE, CMRS
President
Stabilize, Inc.

R. MICHAEL McDERMONT
062-47151
REGISTERED
PROFESSIONAL
ENGINEER
OF
ILLINOIS

(Seal)

Expires: 11/30/2011

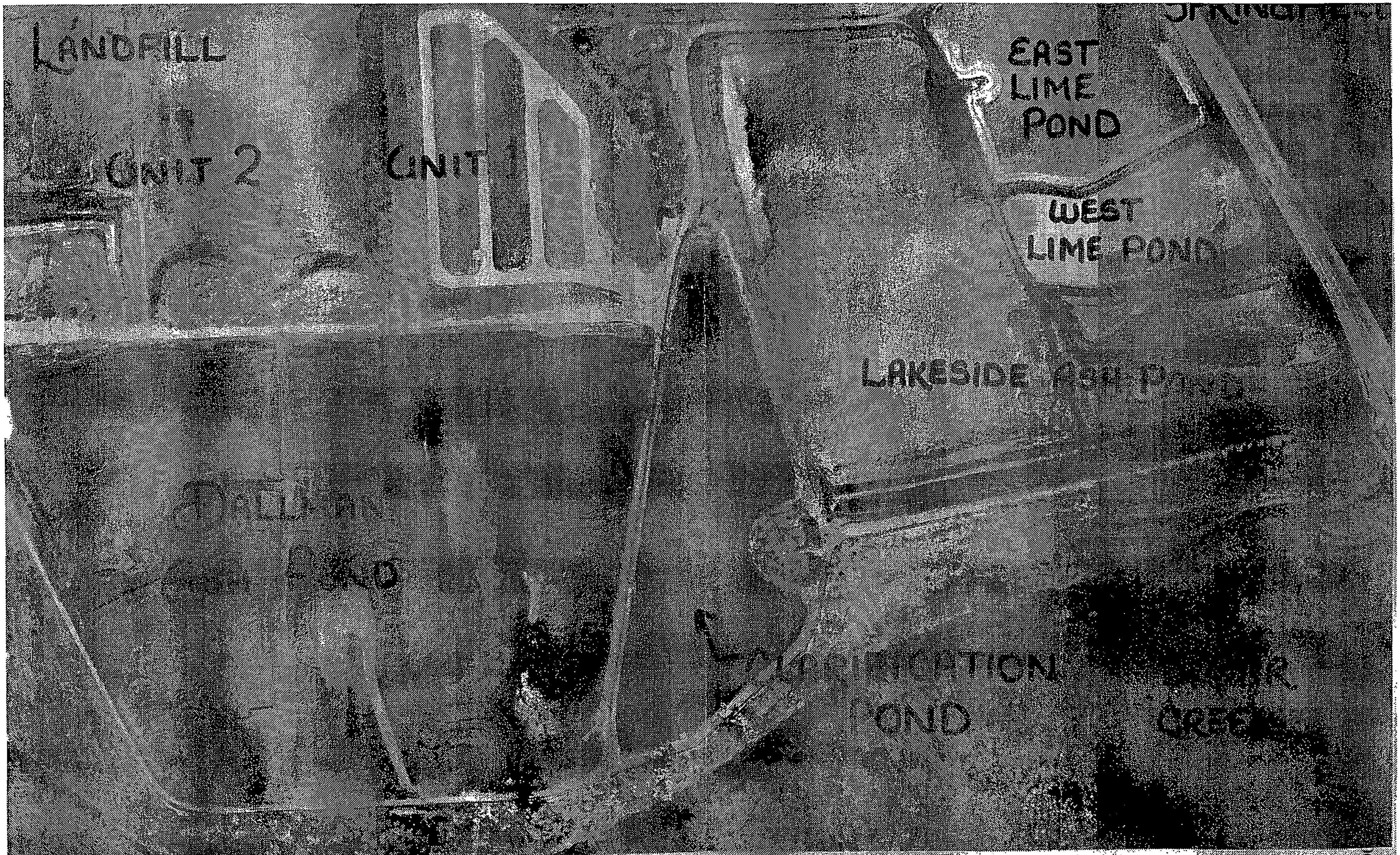
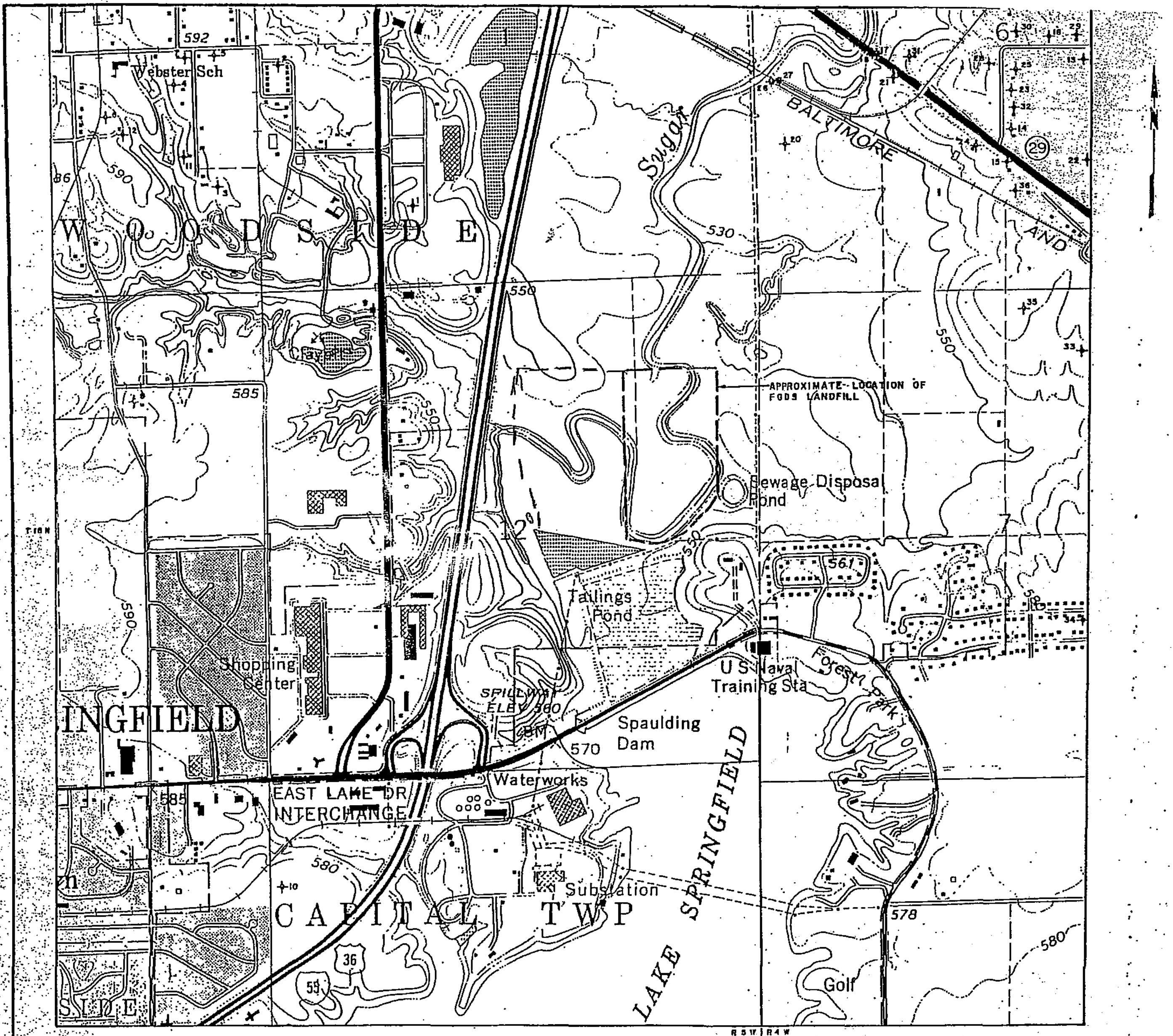

LANDFILL
UNIT 2
UNIT
EAST
LIME
POND
WEST
LIME POND
LAKESIDE
POND

FIGURE 1



LEGEND

- 1 (WELL NO.) WATER WELL
- 26 (BORING NO.) SOIL BORING

NOTES:

1. BASE MAP WAS COMPILED FROM THE SPRINGFIELD EAST, ILL. (1976) U.S.G.S. 7.5 MINUTE QUADRANGLE MAP.
2. ALL WELLS (AND BORINGS) IN THE VICINITY OF THE FGDS LANDFILL SITE FOR WHICH RECORDS ARE ON FILE WITH THE ILLINOIS STATE WATER SURVEY AS OF MARCH, 1993 HAVE BEEN PLOTTED.
3. THE TOPOGRAPHY WITHIN LANDFILL AREA HAS CHANGED DUE TO DISPOSAL FACILITY DEVELOPMENT BY CWLP.

SCALE 0 500 1000 FEET

0 1/4 1/2 MILE

REV.	DATE	DESCRIPTION	BY	APP BY

SCALE: AS SHOWN		
DATE: MARCH, 1993		
DES BY	KRR	3/26/93
DR BY	WRM	3/29/93
CHK BY	KRR	3/30/93
APP BY	JCS	4/05/93

PROJECT: HYDROGEOLOGIC INVESTIGATION FGDS LANDFILL, SPRINGFIELD, IL. CITY WATER, LIGHT & POWER

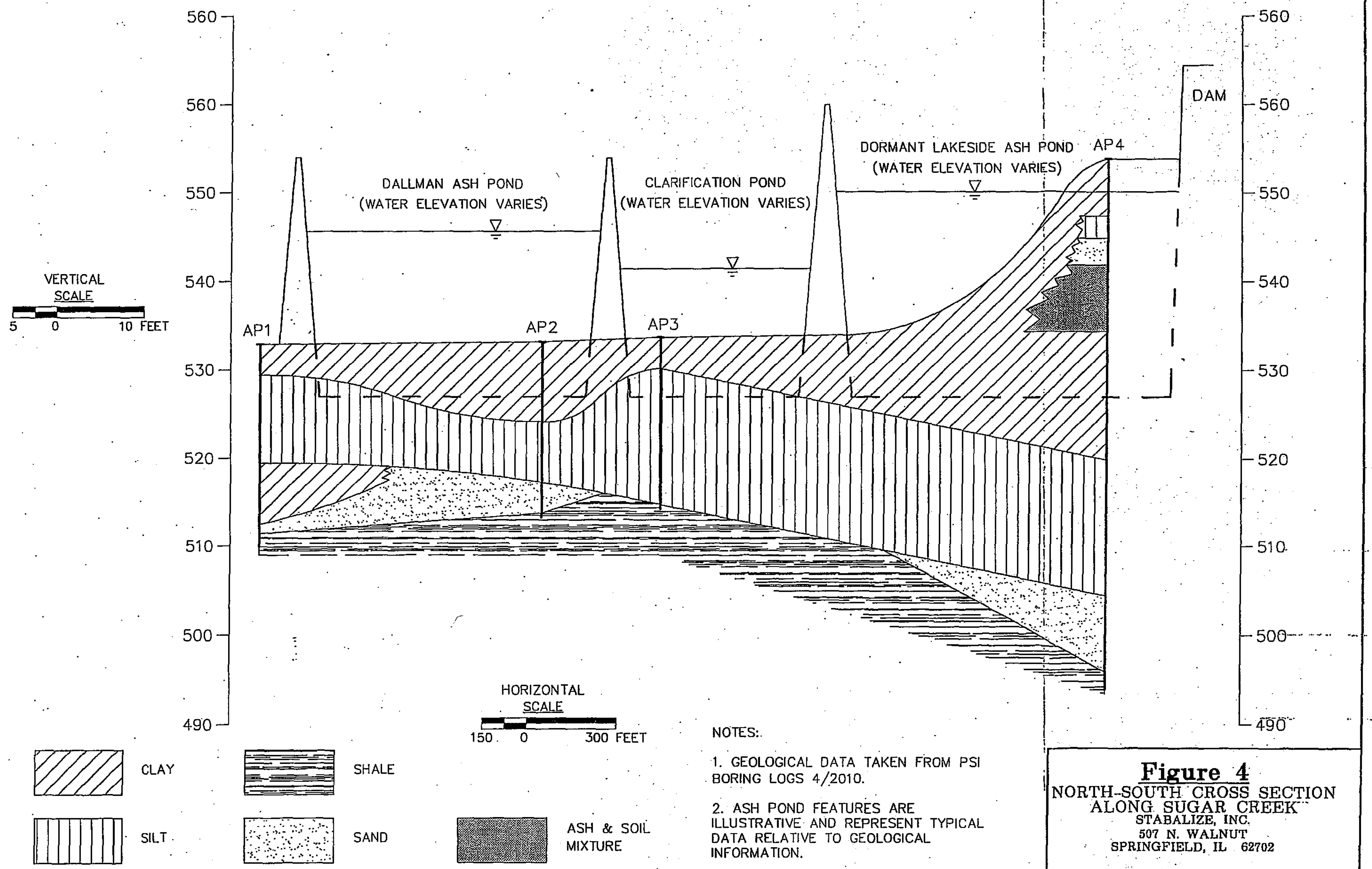
SHEET TITLE: WATER WELL LOCATION MAP

PATRICK ENGINEERING INC.
Engineers • Architects • Hydrologists
Geologists • Surveyors
Springfield, Illinois

SHEET 1 OF 1

DRAWING NO.

Figure 2



NOTES:

1. GEOLOGICAL DATA TAKEN FROM PSI BORING LOGS 4/2010.

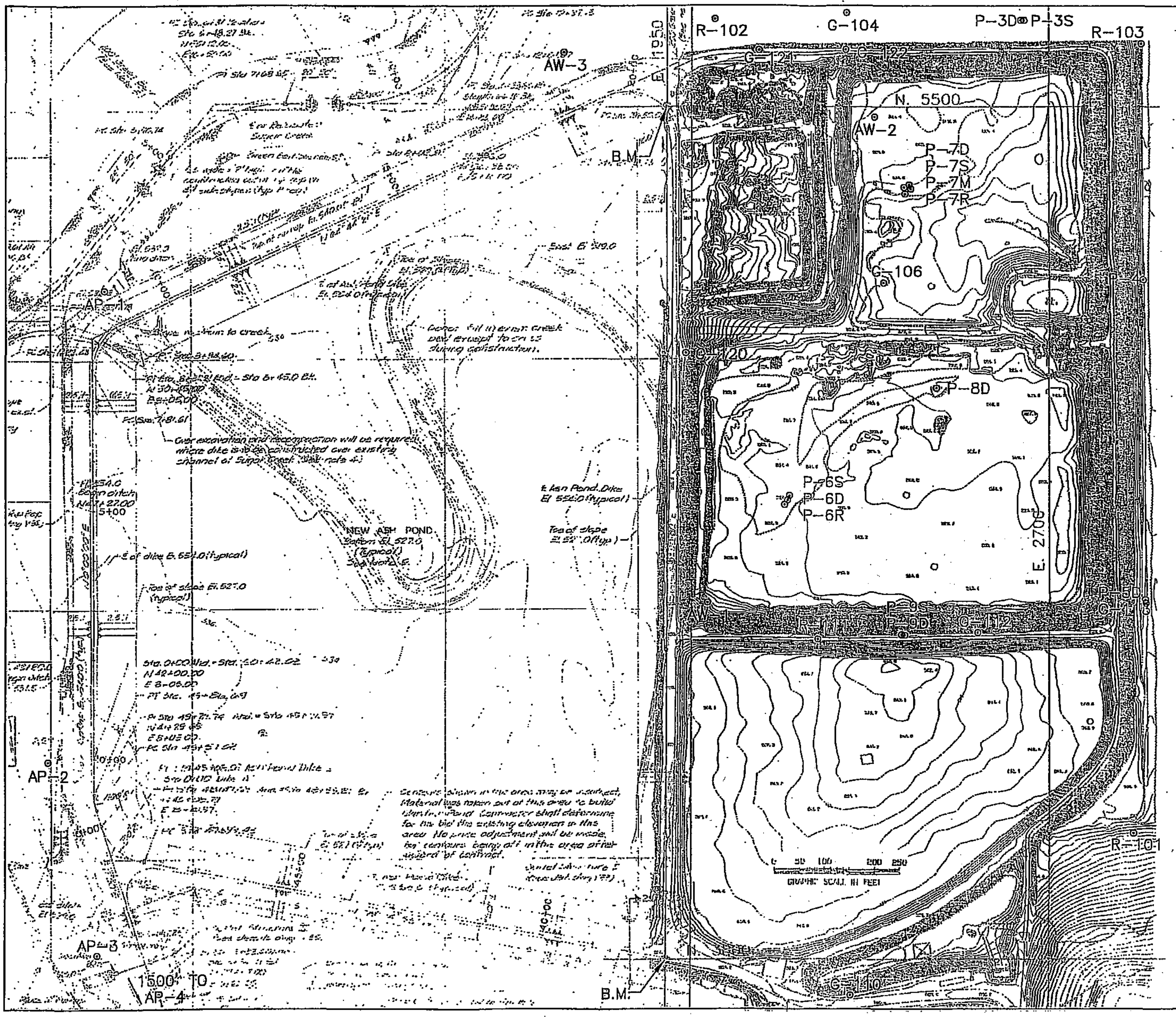
2. ASH POND FEATURES ARE ILLUSTRATIVE AND REPRESENT TYPICAL DATA RELATIVE TO GEOLOGICAL INFORMATION.

Figure 4

NORTH-SOUTH CROSS SECTION ALONG SUGAR CREEK

STABALIZE, INC.
507 N. WALNUT
SPRINGFIELD, IL 62702

PROJECT: SA06094 DRAWING: SOIL PROF DATE: 8/2010



BENCH MARK – CONCRETE MONUMENT:
POWER PLANT COORDINATES.
N. 5500 E. 1950 – ELEVATION 553.16 MSL

BENCH MARK – CONCRETE MONUMENT:
POWER PLANT COORDINATES
N. 3800 E. 1950 – ELEVATION 553.78 MSL

ELEVATION REFERENCES:

N.E. CORNER OF TOP OF CONCRETE STRUCTURE AT S.E. CORNER OF ASH POND: ELEVATION 553.70 FEET MSL.

TOP OF CONCRETE STRUCTURE AT NORTHEASTERLY SIDE OF LAKESIDE ASH POND OPPOSITE METAL STAIRS: ELEVATION 565.03 FEET MSL.

NOTES:

1) WELL AP-4 NOT SHOWN ON MAP.
2) BENCH MARKS COULD NOT BE LOCATED. SURVEY DONE WITH GPS.
3) WELL P-8D AREA INUNDATED BY WATER, NOT SURVEYED. LOCATION UNCHANGED FROM PREVIOUS SURVEY DONE IN APRIL 2008.
4) WELL R-111 IS APPROXIMATELY 8' SOUTH OF PREVIOUS WELL G-111.

N

SCALE: 1"=200'

PROFESSIONAL LAND SURVEYOR DAVID S. MIHELSIC 035-003762 SPRINGFIELD, ILLINOIS STATE OF ILLINOIS

6/02/10

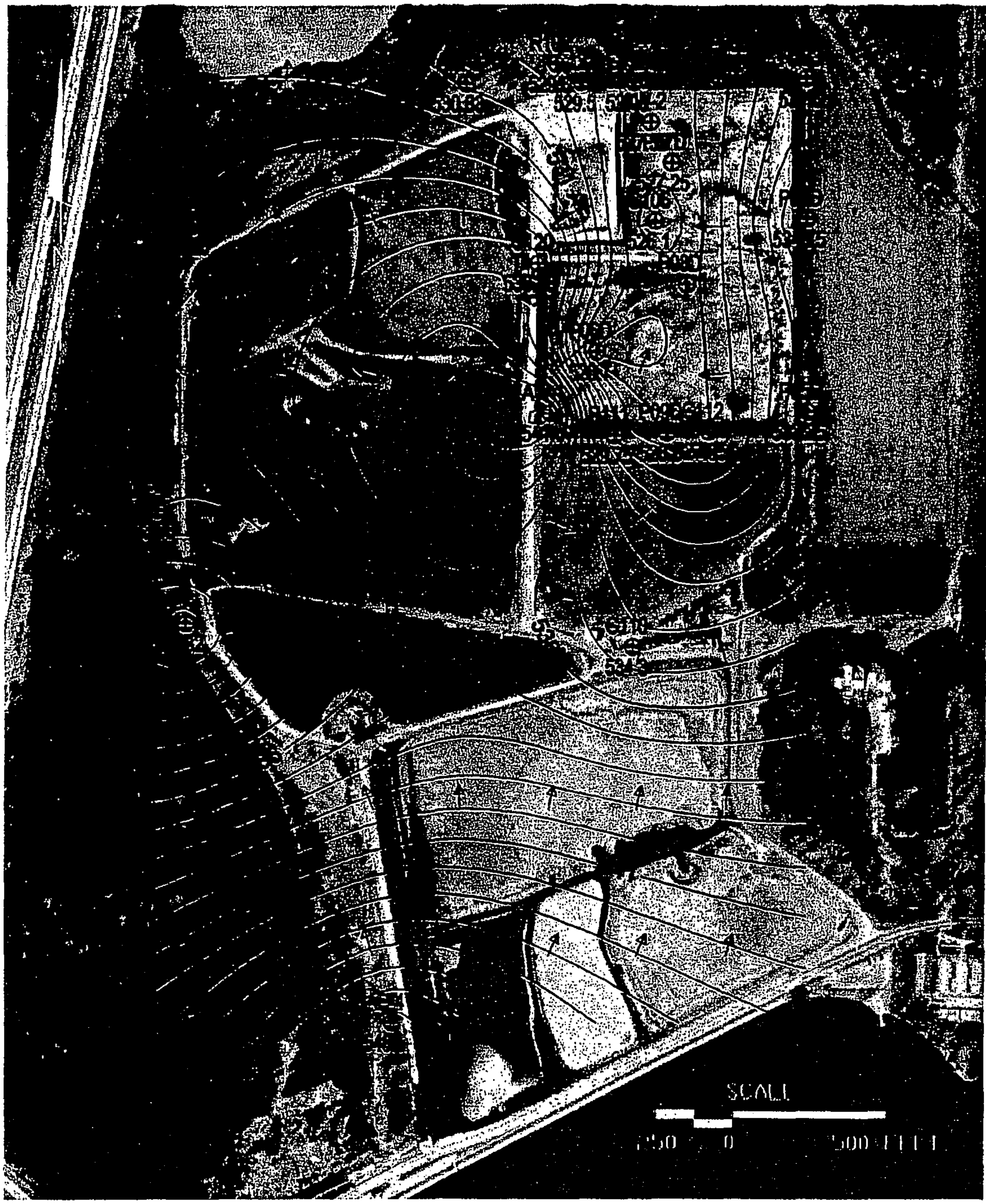
S:\row\Mihelsic\...\wells 2010

CITY WATER LIGHT & POWER
SPRINGFIELD, ILLINOIS

MONITORING WELL AND PIEZOMETER

Figure 5

DATE OF SURVEY: MAY, 2010



RAPPS
Engineering & Applied Science, Inc.

821 S. DURKIN DR. • SPRINGFIELD, IL 62704 • (217) 787-2118
P.O. BOX 925 • CARBONDALE, IL 62903 • (618) 521-0574

ILLINOIS PROFESSIONAL DESIGN FIRM No. 184-001130

Figure 6

POTENTIOMETRIC SURFACE
2ND QUARTER 2010

CITY WATER, LIGHT & POWER
FGDS DEVELOPMENT LANDFILL
SANGAMON COUNTY, ILLINOIS

PROJECT: SA06094 DRAWING: 2Q10 DATE: 8/10

ATTACHMENT A

GE[illegible]OGICAL AND WATER SURVEYS WELL RECORD

10. Property owner Pratt, R. Mr. Well No. ______
Address R. R. #7 Springfield IL
Driller Reynolds, Joseph R. License No. 092-6014
11. Permit No. 133085 Date 06/30/87
12. Water from shale 13. County Sangamon
at depth ___ to ___ ft.
14. Screen: Diam. ___ in.
Length: ___ ft. Slot ___
Sec. 1
Twp. 15 N
Rge. 5 W
Elev. ___
NW NE NE

15. Casing and Liner Pipe

Diam. (in.)	Kind and Weight	From (ft)	To (ft)
6	PLASTIC	-1	11
36	CONCRETE	11	41

16. Size hole below casing: ___ in.
17. Static level ___ ft. below casing top which is ___ ft. above ground level. Pumping level ___ ft. when pumping at ___ gpm for ___ hours.

18. Formations passed through	Thickness	Bottom
top soil	2	2
yellow clay	10	12
sandy clay	2	14
hardpan	5	19
blue clay	2	21
shale	20	41

Sangamon 12-167-24552-00 01-15N-05W

OUTSIDE

	Thickness	Top	Bottom
Top soil	3	0	3
Yellow clay	15	3	18
Brown clay	1	18	19
Hard pan	5	19	24

Finished in hard pan at 19 to 24'.

Cased with 36" Concrete from 0 to 20'.

Static level from surface 10'.

Tested capacity 20 gallons per minute.
Screen none.
Bottom set at 24'.

S.S. #52306

NO ENVELOPE

COMPANY Miles and Son
FARM Fiskas, Raymond L. NO. 1
DATE DRILLED 1965 COUNTY NO. 1481
AUTHORITY Miles and Son
ELEVATION
LOCATION 430' N line, 320' E line of NW SE SW
COUNTY SANGAMON

1-15N-5W

PEI Assigned Log No. 1

GEOLOGICAL AND WATER SURVEYS WELL RECORD

10. Property owner Tomlin, Clarence Well No. #2
Address Shale Bluffs Rd. Springfield IL
Driller Erwin, James License No. 102-2037
11. Permit No. 95882 Date 09/03/80
12. Water from clay 13. County Sangamon
at depth 24 to 25 ft. Sec. 1
14. Screen: Diam. ____ in. Twp. 15 N
Length: ____ ft. Slot ____ Rge. 5 W
Elev. ____

15. Casing and Liner Pipe NW NW SW

Diam. (in.)	Kind and Weight	From (ft)	To (ft)
6	PVC	-1	10
36	CONCRETE	10	40

16. Size hole below casing: ____ in.
17. Static level ____ ft. below casing top which is ____ ft. above ground level. Pumping level ____ ft. when pumping at ____ gpm for ____ hours.

18. Formations passed through	Thickness	Bottom
driveway, gravel	1	1
brown clay	20	21
sandy clay	3	24
gray shale	16	40

Sangamon 12-167-24103-00 01-15N-05W

PEI Assigned Log No. 2

LOG OF WATER WELL

Property owner Springfield Inspects Inc Well No. 1
Drilled by Mills & Son Year 1967

Formations passed through	Thickness	Depth of Bottom
top Soil	2	2
clay	18	20
Hard pan	3	23
Shale	3	26

Permit NF 3170
S.S. #54857
COUNTY No. 1482
Received from Strat. 11-1-67

(Continue on back if necessary)

Finished in Shale at 23 to 26 ft.
Cased with 36 inch Concrete from 0 to 26 ft.
and ____ inch ____ from ____ to ____ ft.
Size hole below casing None inch. Static level from surf. 16 ft.
Tested capacity ____ gal. per min. Temperature ____ °F.
Water lowered to ____ ft. ____ in. in ____ hrs. ____ min.
Length of test ____ hrs. ____ min. Screen ____
Slot ____ Diam. ____ Length ____ Bottom set at ____ ft.
(Show location in Section Plat)
Township name Woodside Elev. ____ Sec. 1
Description of location Lot 16 in Woods place. Sub. NW¼ of sec 1 15N 5W Twp 15N
Rge 5W
Signed Murval Mills County Sangamon
SANGAMON
Copy for Illinois State Geological Survey Index: 1-15N-5W

outside

LOG OF WATER WELL

Property owner H. Brazer Well No. 1

Drilled by E . C . Baker & Sons Year 1957

Formations passed through	Thickness	Depth of Bottom
Yellow Clay	22	22
Blue Sandy Shale	2	24

COUNTY No. 22649

[Continue on back if necessary]

Finished in ______ at ______ to ______ ft.

Cased with ______ inch ______ from 0 to ______ ft.

and ______ inch ______ from ______ to ______ ft.

Size hole below casing ______ inch. Static level from surf. ______ ft.

Tested capacity ______ gal. per min. Temperature ______ °F.

Water lowered to ______ ft. ______ in. in ______ hrs. ______ min.

Length of test ______ hrs. ______ min. Screen ______

Slot ______ Diam. ______ Length ______ Bottom set at ______ ft.

[Show location in Section Plat]

Township name WOODSIDE Elev. ______ Sec. 2

Description of location 1 Mile South Twp. 15N

East of Springfield , Ill Rge. 5W

Signed F.F. & J.C. Baker County Sangamon

SANGAMON 2-15N-5W

Copy for Illinois State Geological Survey Index:

PEI Assigned Log No. 3

GEOLOGICAL AND WATER SURVEYS WELL RECORD

10. Property owner Ushman, John Well No. ______
Address R. R. #7 Springfield IL
Driller Reynolds, Joseph R. License No. 092-6014
11. Permit No. 127235 Date 10/02/86
12. Water from sdy clay & sdy gvl 13. County Sangamon
at depth 17 to 27 ft. Sec. 1
14. Screen: Diam. ______ in. Twp. 15 N
Length: ______ ft. Slot ______ Rge. 5 W
Elev. ______
SW NE NE

15. Casing and Liner Pipe

Diam. (in.)	Kind and Weight	From (ft)	To (ft)
6	PLASTIC	-1	10
36	CONCRETE	10	36

16. Size hole below casing: ______ in.
17. Static level ______ ft. below casing top which is ______ ft. above ground level. Pumping level ______ ft. when pumping at ______ gpm for ______ hours.

18. Formations passed through	Thickness	Bottom
top soil	2	2
yellow clay	10	12
sandy clay	7	19
hardpan	4	23
blue clay	3	26
sand & gravel	1	27
blue clay	9	36

Sangamon 12-167-23817-00 01-15N-05W

OUTSIDE

Property Owner Frank Siciliano Well No. 1

Drilled by Miles & Son Year 66

Formations passed through	Thickness	Depth of Bottom
Yellow Clay Permit NF 691	15	15
Hard pan	10	25
Shale	5	30

COUNTY No. 1484

S.S. #53090

Received with samples. From R. Frame 6-7-66

[Continue on back if necessary]

Finished in Shale at 25 to 30 ft.

Cased with 36 inch Concrete from 0 to 30 ft.

and ____ inch ____ from ____ to ____ ft.

Size hole below casing none inch. Static level from surf. 12 ft.

Tested capacity ____ gal. per min. Temperature ____ °F.

Water lowered to ____ ft. ____ in. in ____ hrs. ____ min.

Length of test ____ hrs. ____ min. Screen ____

Slot ____ Diam. ____ Length ____ Bottom set at ____ ft.

[Show location in Section Plat]

Township name ____ Elev. ____ Sec. 2

Description of location 420 S 60 E Twp. 15N

NW¼ NW NE SE Rge. 5W

Signed Murray L. Miles County Sangamon

SANGAMON

Copy for Illinois State Geological Survey Index: 2-15N-5W

PEI Assigned Log No. 4

GEOLOGICAL AND WATER SURVEYS WELL RECORD

10. Property owner Scotty's Self-Service Strge Well No. #1
Address 1035 Outer Park-Suote 310 Springfield IL
Driller Erwin, James License No. 102-2037
11. Permit No. 52539 Date 09/22/76
12. Water from coarse sand 13. County Sangamon
at depth 27 to 30 ft. Sec. 2
14. Screen: Diam. ____ in. Twp. 15 N
Length: ____ ft. Slot ____ Rge. 5 W
Elev. ____

15. Casing and Liner Pipe NE NE SE

Diam. (in.)	Kind and Weight	From (ft)	To (ft)
6	PVC SCH 40	-1	10
36	CONCRETE	10	40

16. Size hole below casing: ____ in.
17. Static level 10 ft. below casing top which is 1 ft. above ground level. Pumping level ____ ft. when pumping at ____ gpm for ____ hours.

18. Formations passed through	Thickness	Bottom
no record	40	40

PEI Assigned Log No. 5

Sangamon 12-167-24104-00 02-15N-05W

GEOLOGICAL AND WATER SURVEYS WELL RECORD

10. Property owner Snyder, Henry Well No. #1
Address 2640 E. Ash Springfield IL
Driller Erwin, James License No. 102-2037
11. Permit No. 118383 Date 06/14/85
12. Water from brown sandy clay 13. County Sangamon
at depth 20 to 22 ft. Sec. 2
14. Screen: Diam. ____ in. Twp. 15 N
Length: ____ ft. Slot ____ Rge. 5 W
Elev. ____

NE NE SE

15. Casing and Liner Pipe

Diam. (in.)	Kind and Weight	From (ft)	To (ft)
6	PVC SCH 40	-1	10
36	CONCRETE	10	40

16. Size hole below casing: ____ in.
17. Static level ____ ft. below casing top which is ____ ft. above ground level. Pumping level ____ ft. when pumping at ____ gpm for ____ hours.

18. Formations passed through	Thickness	Bottom
top soil	2	2
brown clay	12	14
yl sdy strks brn c	17	31
yellow clay	3	34
ylsh, gray clay	6	40
gray till	0	40

Sangamon 12-167-23620-00 02-15N-05W

PEI Assigned Log No. 7

Property owner [illegible] Well No. ____
Drilled by [illegible] Year 66

Formations passed through Permit NE 708	Thickness	Depth of Bottom
Yellow Clay	15	15
Hard pan	10	25
Shale	5	30

COUNTY No 1485.

Received 7-12-66

[Continue on back if necessary]

Finished in Shale at 25 to 30 ft.
Cased with 36 inch Concrete from 0 to 30 ft.
and ____ inch ____ from ____ to ____ ft.
Size hole below casing None inch. Static level from surf. 12 ft.
Tested capacity ____ gal. per min. Temperature ____ °F.
Water lowered to ____ ft. ____ in. in ____ hrs. ____ min.
Length of test ____ hrs. ____ min. Screen ____
Slot ____ Diam. ____ Length ____ Bottom set at ____ ft.
[Show location in Section Plat]
Township name ____ Elev. ____ Sec. 2
Description of location 120S 150W Twp 15N
NE SE NW SE Rge 5W
Signed [illegible] County Sangamon
SANGAMON
Copy for Illinois State Geological Survey Index: 2-15N-5W

PEI Assigned Log No. 6

(3)

LOG OF WATER WELL

Property owner Charles A. Hinsey Well No. 1

Drilled by Spaulding & Clark Drilling Co. Year 1957

Formations passed through	Thickness	Depth of Bottom
Soil	3	3
Yellow clay	16	19
Yellow clay (sandy)	6	25
Blue clay	21	46
Sandstone	1	47
Shale	11	58
Coal	2	60
Underclay	3	63
Shale	2	65
Limestone	22	87
Shale	18	105

COUNTY No. 575

(Continue on back if necessary)

Finished in Limestone at 65 to 87 ft.

Cased with 3 inch Buttweld from 0 to 105 ft.

and ____ inch ____ from ____ to ____ ft.

Size hole below casing 6 inch. Static level from surf. 12 ft.

Tested capacity 4 plus gal. per min. Temperature ____ °F.

Water lowered to ____ ft. ____ in. in ____ hrs. ____ min.

Length of test ____ hrs. ____ min. Screen None

Slot ____ Diam. ____ Length ____ Bottom set at ____ ft.

(Show location in Section Plat)

Township name Woodside Elev. 599 Sec. 11

Description of location SW¼ of SW¼ Sec 11 Twp. 15N

Rge. 5W

(Section plat marked: x)

Signed [signature] County Sangamon

SANGAMON

Copy for Illinois State Geological Survey Index: 11-15N-5W

outside

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10. Property owner GEORGE HAMMONS Well No. ____
Address 800 S. 16TH Spfld, Ill
Driller ERWIN License No. 102-203

11. Permit No. 74921 Date MAY 31, 78

12. Water from CLAY (Formation) at depth 16 to 19 ft.

13. County SANGAMON
Sec. 11
Twp. 13 N
Rge. 5 W
Elev. ____

14. Screen: Diam. ____ in. Length: ____ ft. Slot ____

15. Casing and Liner Pipe

Diam. (in.)	Kind and Weight	From (Ft.)	To (Ft.)
6"	SCH 40 PLASTIC		10
36" ID	CONCRETE	10	40

SHOW LOCATION IN SECTION PLAT
SE 8.
NW 8.
NE 8.

16. Size Hole below casing: ____ in.

17. Static level 10 ft. below casing top which is 1 (permit) ft. above ground level. Pumping level ____ ft. when pumping at ____ gpm for ____ hours. Sub. pump set at 34'

18. FORMATIONS PASSED THROUGH	THICKNESS	DEPTH OF BOTTOM
TOP SOIL	2	2
BROWN CLAY	5	7
BROWN & WHITE CLAY	9	16
BROWN SANDY CLAY	3	19
SAND ROCK	1	20
BROWN SHALE	2	22
GRAY SHALE	18	40

(CONTINUE ON SEPARATE SHEET IF NECESSARY)

SIGNED James Erwin DATE 5/31/78

SANGAMON COUNTY No. 32812 11-15N-5W

PEI Assigned Log No. 8

Page 1

ILLINOIS GEOLOGICAL SURVEY, URBANA

Bridge boring #1
Section 1SB
Sta. 479+54 111' Rt. Cl. Med.

	Thickness	Top	Bottom
Clay, silty, black	1.5		1.5
Clay, silty, yellow-brown - stiff	4		5.5
Clay loam, silty, yellow & gray mottled - stiff	4		9.5
Clay, silty, gray-brown - medium	5		14.5
Clay, sandy, gray-brown - stiff	4.5		19
Clay till, sandy, brown - very stiff	3		22.
Clay till, brown - hard	6		28
			T.D.

Copy of Highway Division log filed in Groundwater Section

Typed by Engineering Geology Section

NO ENVELOPE

COMPANY Illinois Division of Highways
FARM FA 196 under GM&O RR. NO. 1
DATE DRILLED 11-9-64 COUNTY NO. 1487
AUTHORITY Log by Division of Highways
ELEVATION 607.0'
LOCATION SE¼ SW¼
COUNTY SANGAMON

outside

13-15N-5W

Page 1

ILLINOIS GEOLOGICAL SURVEY, URBANA

	Thickness	Top	Bottom
Brown silty clay, loam - frozen	1.5		1.5
Gray and brown mottled silty clay loam with some vegetation	3		4.5
Dark gray loam, organic	3		7.5
Weathered brown shale - loose fragments	3		10.5
Black shale - fissile	1		11.5
			TD

Bridge boring #1
Section 17X
Station 53+80
73' Left Center Line Med.

Copy of Highway Division Log filed in Groundwater Section

NO ENVELOPE

COMPANY Illinois Division of Highways
FARM FA 169 Culvert NO. B-1
DATE DRILLED February 4, 1966 COUNTY NO. 1486
AUTHORITY Log by Division of Highways
ELEVATION 536' G.L.
LOCATION N/2 NW
COUNTY SANGAMON

12-15N-5W

PEI Assigned Log No. 9

10. Property owner Richard Fortune Well No. 1
Address 172 E Hazel Dell - Spfld, Ill
Driller Milo L Sam License No. 92.503
11. Permit No. NE 4955 Date Sept 24 '68
12. Water from Clay (Formation) 13. County Sangamon
at depth 14 to 16 ft.
Sec. 13
14. Screen: Diam. None in. Twp. 15N
Length: ___ ft. Slot ___ Rge. 5W
Elev. ___

15. Casing and Liner Pipe

Diam. (in.)	Kind and Weight	From (Ft.)	To (Ft.)
36	Concrete	+1	20

SHOW LOCATION IN SECTION PLAT
SW NW NW
(permit)

16. Size Hole below casing: None in.
17. Static level 14 ft. below casing top which is ___ ft. above ground level. Pumping level ___ ft. when pumping at ___ gpm for ___ hours.

18.

FORMATIONS PASSED THROUGH	THICKNESS	DEPTH OF BOTTOM
Top Soil	2	2
yellow Clay	12	14
Brown - Clay	6	20

(CONTINUE ON SEPARATE SHEET IF NECESSARY)

SIGNED Murrel Miller DATE Oct 17 '68

COUNTY No. 1375

SANGAMON 13-15N-5W

PEI Assigned Log No. 10

Page 1 **ILLINOIS GEOLOGICAL SURVEY, URBANA**

Strata	Thickness	Top	Bottom
Bridge boring #4 Section 1SB Sta. 482+26, 111' Lt. CL. Med.			
Clay, silty, black	1.5		1.5
Clay loam, silty, yellow-brown - medium	5		6.5
Clay loam, silty, yellow & gray mottled - stiff	2.5		9
Clay, silty, gray-brown - medium	7.5		16.5
Clay, sandy, gray & brown mottled - medium	3		19.5
Clay, gray-brown - very stiff	4.5		24
Clay till, sandy, brown - hard	4.5		28.5
Gray limestone boulder -cored	.5		29
Clay till, gray-brown	1.5		30.5
Diorite boulder -cored			
Limestone boulder - cored; 95% recovery	2.5		33
Clay till, gray	4.5		37.5
			T.D.

Typed by Engineering Geology Section

Copy of Highway Division log filed in Groundwater Section

NO ENVELOPE

COMPANY Illinois Division of Highways
FARM FA 196 under GM&O RR. NO. 4
DATE DRILLED 11-10-64 COUNTY NO. 1488
AUTHORITY Log by Division of Highways
ELEVATION 605.5'
LOCATION SE¼ SW¼
COUNTY SANGAMON

13-15N-5W

outside

Completed 9-6-78

10. Property owner ROBERT CLARK Well No. 1
Address 1933 So. 18th
Driller ERWIN License No. 102-203
11. Permit No. 78727 Date 8-30-78
12. Water from CLAY (Formation) 13. County SANGAMON
at depth 25 to 26 ft. Sec. 2
14. Screen: Diam. ______ in. Twp. 15N
Length: ______ ft. Slot ______ Rge. 5W
Elev. ______

15. Casing and Liner Pipe

Diam. (in.)	Kind and Weight	From (Ft.)	To (Ft.)
6"	PVC SCH 40		16
36"	CONCRETE	10	45

SHOW LOCATION IN SECTION PLAT
SW NE SE (permit)

16. Size Hole below casing: ______ in.
17. Static level 20 ft. below casing top which is 1 ft. above ground level. Pumping level ______ ft. when pumping at ______ gpm for ______ hours. Sub. pump set at 40'

18. FORMATIONS PASSED THROUGH	THICKNESS	DEPTH OF BOTTOM
BROWN CLAY	20	20
BROWN HARDPAN	4	24
SANDY CLAY	2	26
BROWN HARD PAN	4	30
SHALE - GRAY	15	45

(CONTINUE ON SEPARATE SHEET IF NECESSARY)

SIGNED Jim Erwin DATE Sept 18 78

COUNTY No. 22807

SANGAMON 2-15N-5W

PEI Assigned Log No. 11

Completed [illegible]

10. Property owner [illegible] Well No. ______
Address SPRINGFIELD
Driller GEORGE COOK License No. ~~49552~~ 102-6-1
11. Permit No. 46452 Date 4-76
12. Water from SANDY CLAY (Formation) 13. County SANGAMON
at depth 14' to ______ ft. Sec. 2
14. Screen: Diam. ______ in. Twp. 15N
Length: ______ ft. Slot ______ Rge. 5W
Elev. ______

15. Casing and Liner Pipe

Diam. (in.)	Kind and Weight	From (Ft.)	To (Ft.)
6"	PLASTIC	+1	-9
36"	CONCRETE	-9	-30

SHOW LOCATION IN SECTION PLAT
NE NE NE (permit)

16. Size Hole below casing: ______ in.
17. Static level ______ ft. below casing top which is ______ ft. above ground level. Pumping level ______ ft. when pumping at ______ gpm for ______ hours.

18. FORMATIONS PASSED THROUGH	THICKNESS	DEPTH OF BOTTOM
TOP SOIL		2
YELLOW CLAY		12
SANDY CLAY		17
HARD PAN		24
BLUE CLAY		28
SHALE		30

(CONTINUE ON SEPARATE SHEET IF NECESSARY)

SIGNED George Cook DATE 4-76

COUNTY No. 22453

SANGAMON 2-15N-5W

outside

10. Property owner Harry V. Sollar [illegible] Well No. 1
Address 2158 Taylor Spfld, Ill.
Driller Miles & Sons License No. 92-503
11. Permit No NE 07143 Date Sept 26 1969
12. Water from Clay (Formation) 13. County Sangamon
at depth 29 to 30 ft. Sec. 2
14. Screen: Diam. None in. Twp. 15N
Length: ___ ft. Slot ___ Rge. 5W
Elev. ___

15. Casing and Liner Pipe

Diam. (in.)	Kind and Weight	From (Ft.)	To (Ft.)
36	Concrete	+1	39

SHOW LOCATION IN SECTION PLAT

SE/4 NW SE (permit)

16. Size Hole below casing: None in.
17. Static level 27 ft. below casing top which is 1 ft. above ground level. Pumping level ___ ft. when pumping at ___ gpm for ___ hours.

18.

FORMATIONS PASSED THROUGH	THICKNESS	DEPTH OF BOTTOM
Yellow Clay	25	25
Sandy Clay	5	30
Blue Clay	9	39

(CONTINUE ON SEPARATE SHEET IF NECESSARY)

SIGNED Murral Miles DATE Oct 12/69

COUNTY No. 1429

SANGAMON

2-15N-5W

PEI Assigned Log No. 12

LOG OF WATER WELL

Page 1

Property owner M. H. Clayton Well No. 1
Drilled by Miles & Sons Year 66

Permit NE 709

Formations passed through	Thickness	Depth of Bottom
Yellow Clay	15	15
Hard Pan	10	25
Shale	5	30

COUNTY No 1483

Received 7-12-66

(Continue on back if necessary)

Finished in Shale at 25 to 30 ft.
Cased with 36 inch Concrete from 0 to 30 ft.
and ___ inch ___ from ___ to ___ ft.
Size hole below casing None inch. Static level from surf. 12 ft.
Tested capacity ___ gal. per min. Temperature ___ °F.
Water lowered to ___ ft. ___ in. in ___ hrs. ___ min.
Length of test ___ hrs. ___ min. Screen ___
Slot ___ Diam. ___ Length ___ Bottom set at ___ ft.
(Show location in Section Plat)
Township name ___ Elev. ___ Sec. 2
Description of location 460'S 60'E
NW c. SE NW SW Twp. 15N
Rge. 5W
Signed Murral Miles County Sangamon
SANGAMON
Copy for Illinois State Geological Survey Index: 2-15N-5W

outside

10. Property owner Jack Burnstine Well No. ______
Address 16 Wood Mill Road Sherman, Il. 62684
Driller Joseph R. Reynolds License No. 92-601
11. Permit No. 86116 Date May 29, 1979
12. Water from Clay (Formation) 13. County Sangamon
at depth 16 to 27 ft. Sec. 6
14. Screen: Diam. ______ in. Twp. 15N
Length: ______ ft. Slot ______ Rge. 4W
Elev. ______

SHOW LOCATION IN SECTION PLAT
NE NW SE
(permit)

15. Casing and Liner Pipe

Diam. (in.)	Kind and Weight	From (Ft.)	To (Ft.)
10	Plastic	+1	-9
36	Concrete	-9	-27

16. Size Hole below casing: ______ in.
17. Static level ______ ft. below casing top which is ______ ft. above ground level. Pumping level ______ ft. when pumping at ______ gpm for ______ hours. Sub. pump set at 20'

18. FORMATIONS PASSED THROUGH	THICKNESS	DEPTH OF BOTTOM
Top Soil	0-3'	
Clay	20'	
Glacial Drift	27'	

(CONTINUE ON SEPARATE SHEET IF NECESSARY)

SIGNED Joseph R Reynolds DATE May 30, 1979
Cook & Reynolds Well Drilling, Inc.
R.R. 5 - 3300 Terminal Avenue
Springfield, Il. 62707
SANGAMON 23084 6-15N-4W

PEI Assigned Log No. 13

GEOLOGICAL AND WATER SURVEYS WELL RECORD

10. Property owner Bortmess, Ron Well No. ______
Address 605 South Walnut St. Rochester IL
Driller Reynolds, Joseph R. License No. 092-6014
11. Permit No. 117031 Date 03/29/85
12. Water from sandy clay 13. County Sangamon
at depth 17 to ______ ft. Sec. 6
14. Screen: Diam. ______ in. Twp. 15 N
Length: ______ ft. Slot ______ Rge. 4 W
Elev. ______

15. Casing and Liner Pipe NW NW SE

Diam. (in.)	Kind and Weight	From (ft)	To (ft)
6	PLASTIC	-1	10
36	CONCRETE	10	32

16. Size hole below casing: ______ in.
17. Static level ______ ft. below casing top which is ______ ft. above ground level. Pumping level ______ ft. when pumping at ______ gpm for ______ hours.

18. Formations passed through	Thickness	Bottom
top soil	2	2
yellow clay	10	12
sandy clay	7	19
hardpan	4	23
blue clay	5	28
shale	4	32
limestone	0	32

Sangamon 12-167-23577-00 06-15N-04W

PEI Assigned Log No. 14

GEOLOGICAL AND WATER SURVEYS WELL RECORD

10. Property owner Cheffy, Edward Well No. ______
Address 1 Linden Lane Springfield IL
Driller Reynolds, Joseph R. License No. 092-6014
11. Permit No. 117670 Date 05/07/85
12. Water from sandy clay 13. County Sangamon
at depth 18 to ____ ft. Sec. 6
14. Screen: Diam.______in. Twp. 15 N
Length:____ft. Slot ______ Rge. 4 W
Elev. ____

15. Casing and Liner Pipe NW NW SE

Diam. (in.)	Kind and Weight	From (ft)	To (ft)
6	PLASTIC	-1	11
36	CONCRETE	11	32

16. Size hole below casing: ______in.
17. Static level _____ft. below casing top which is __________ft. above ground level. Pumping level_____ft. when pumping at _____ gpm for______hours.

18. Formations passed through	Thickness	Bottom
top soil	2	2
yellow clay	12	14
sandy clay	5	19
hardpan	2	21
sandstone	2	23
shale	9	32
limestone	0	32

Sangamon 12-167-23602-00 06-15N-04W

PEI Assigned Log No. 15

GEOLOGICAL AND WATER SURVEYS WELL RECORD

10. Property owner Chastain, George Well No. #1
Address 18 Apache Drive Springfield IL
Driller Erwin, James License No. 102-2037
11. Permit No. 52461 Date 09/21/76
12. Water from clay 13. County Sangamon
at depth 18 to 19 ft. Sec. 6
14. Screen: Diam.______in. Twp. 15 N
Length:____ft. Slot ______ Rge. 4 W
Elev. ____

15. Casing and Liner Pipe SE SW NE

Diam. (in.)	Kind and Weight	From (ft)	To (ft)
6	PVC SCH 40	-1	10
36	CONCRETE	10	30

16. Size hole below casing: ______in.
17. Static level 10 ft. below casing top which is 1 ft. above ground level. Pumping level_____ft. when pumping at _____ gpm for______hours.

18. Formations passed through	Thickness	Bottom
no record	30	30

Sangamon 12-167-24055-00 06-15N-04W

PEI Assigned Log No. 16

(2540—50M—12-64)

Page 1

ILLINOIS GEOLOGICAL SURVEY, URBANA

	Thickness	Top	Bottom
Bridge boring #1 Section 8-BR-1 Sta. 61+40 12' Rt. CL NB Ln			
Clay, yellow and gray mottled - stiff	9		9
Clay, silty, yellow and gray mottled - medium	6.5		15.5
Clay, yellow and gray mottled - very stiff	4.5		20
Sandstone, shaly, light gray - 5' core-run, 80% retained	5		25 T.D.

Copy of Highway Division log
filed in Groundwater Section

Typed By Engineering Geology Section

NO ENVELOPE

COMPANY Illinois Division of Highways
FARM FA 25 over Sugar Creek NO. 1
DATE DRILLED 9-4-63 COUNTY NO. 1472
AUTHORITY log by Division of Highways
ELEVATION 545.0'
LOCATION NW SW
COUNTY SANGAMON

6-15N-4W

PEI Assigned Log No. 17

PDF 0080

GEOLOGICAL AND WATER SURVEYS WELL RECORD

10. Property owner Edwards, Ken Well No. ____
Address R. R. #7 Springfield IL
Driller Reynolds, Joseph R. License No. 092-6014
11. Permit No. 136875 Date 11/03/87
12. Water from sandy clay 13. County Sangamon
at depth ____ to ____ ft. Sec. 6
14. Screen: Diam. ____ in. Twp. 15 N
Length: ____ ft. Slot ____ Rge. 4 W
Elev. ____

15. Casing and Liner Pipe SE SE NE

Diam. (in.)	Kind and Weight	From (ft)	To (ft)
6	PLASTIC	-1	15
36	CONCRETE	15	33
24	CONCRET	31	55

16. Size hole below casing: ____ in.
17. Static level ____ ft. below casing top which is ____ ft. above ground level. Pumping level ____ ft. when pumping at ____ gpm for ____ hours.

18. Formations passed through	Thickness	Bottom
top soil	2	2
yellow clay	12	14
sandy clay	5	19
hardpan	4	23
blue clay	4	27
shale	28	55

Sangamon 12-167-24618-00 06-15N-04W

outside

Page 1 ILLINOIS GEOLOGICAL SURVEY, URBANA

Bridge boring #3
Section 8-BR-1
Sta. 59+07 Rt. CL NB Ln
22'

	Thickness	Top	Bottom
Clay, silty, light brown - soft	14		14
Clay loam, sandy, brown and gray mottled. - medium	5.5		19.5
Clay loam, gray - organic, soft, with pieces of decayed wood	4		23.5
Sand, gray - medium, loose	6		29.5
Clay loam, light gray - soft	7.5		37
Clay till, light gray, angular and sharp; fragments of rock mix ½" - very stiff	3		40
Clay, shaly, light gray - very stiff to hard	5		45
			T.D.

Typed by Engineering Geology Section
Copy of Highway Division Log
filed in Groundwater Section
NO ENVELOPE

COMPANY Illinois Division of Highways
FARM FA 25 over Sugar Creek NO. 3
DATE DRILLED 9-6-63 COUNTY NO. 1474
AUTHORITY Log by Division of Highways
ELEVATION 541.0'
LOCATION NW SW
COUNTY SANGAMON

6-15N-4W

PEI Assigned Log No. 18

Page 1 ILLINOIS GEOLOGICAL SURVEY, URBANA

Bridge boring #2
Section 8-BR-1
Sta. 60+35 CL NB Ln

	Thickness	Top	Bottom
Sandy loam, light brown	3		3
Clay, silty, gray and green mottled, with pieces of decayed wood - medium	7		10
Shale, gray-green - weak; stiff	6		16
Shale, light gray - very stiff;	3		19
core-run, 50% retained	2.5		21.5
			T.D.

Copy of Highway Division log
filed in Groundwater Section

Typed by Engineering Geology Section

NO ENVELOPE

COMPANY Illinois Division of Highways
FARM FA 25 over Sugar Creek NO. 2
DATE DRILLED 9-6-63 COUNTY NO. 1473
AUTHORITY Log by Division of Highways
ELEVATION 519.5'
LOCATION NW SW
COUNTY SANGAMON

6-15N-4W

PEI Assigned Log No. 19

Strata	Thickness	Top	Bottom
GEOLOGICAL RECORD: (Sample Data)			
Pennsylvanian System		50	555
Mississippian System		555	1538
Aux Vases sandstones, no show oil		610	652
Ste. Genevieve limestone		652	662
Rosiclare formation, no show of oil		662	670
Fredonia, St. Louis & Salem formations, undifferentiated.		670	902
Osage shales		902	
Keokuk-Burlington limestones, dolomites and shales of the Osage series, no shows of oil.		1066	1418
Choteau (Louisiana) limestone		1418	1422
Kinderhook shales		1422	1474
New Albany shale		1474	1538
Silurian System (Devonian Absent)		1538	1600
Dolomite, white to light gray, very fine sucrosic, tight, slightly porous, no shows of oil.			
Core #1: Recovered 25'. Dolomite, white and light gray grading in part to gray-greenish, fine sucrose to dense argillaceous, slight traces or porosity, no shows of oil.		1547	1572
Drilled:		1572	1600
Dolomite, light gray-greenish, tight, non-porous, no shows of oil.		1572	1590
Limestone, dolomitic, white, to light gray, slightly fossiliferous with traces of chert, no show of oil.		1590	1600
Total Depth			1600
Casing: 8 5/8" cemented at 65'. 7 7/8" hole, 65' to T.D.			

COMPANY Otto Krachik
FARM Graham, Geo. NO. 1
DATE DRILLED October 1958 COUNTY NO. 607
AUTHORITY R. F. Anderson
ELEVATION 535' DF, Company
LOCATION 330' S line, 330' W line of NW SW
COUNTY SANGAMON

6-15N-4W

PEI Assigned Log No. 20

10. Property owner Jozeek Farris III Well No. ______
Address 2072 N 7th Springfield
Driller George Cook License No. 102-61
11. Permit No. 31985 Shale Date 8-8-74
12. Water from [illegible] (Formation) 13. County Sangamon
at depth 19 to ____ ft.
14. Screen: Diam. ____ in.
Length: ____ ft. Slot ______

Sec. 6
Twp. 15N
Rge. 4W
Elev. ____

15. Casing and Liner Pipe

Diam. (in.)	Kind and Weight	From (Ft.)	To (Ft.)
6"	PLASTIC	+1	-10
36"	CONCRETE	-10	-40

SHOW LOCATION IN SECTION PLAT
300'NL, 120'WL NE SW (Permit)

16. Size Hole below casing: ______ in.
17. Static level ____ ft. below casing top which is ______ ft. above ground level. Pumping level ____ ft. when pumping at ____ gpm for ____ hours.

18.

FORMATIONS PASSED THROUGH	THICKNESS	DEPTH OF BOTTOM
Top Soil	3	3
Yellow Clay	12	15
Hard Pan	2	17
Shale	23	40

(CONTINUE ON SEPARATE SHEET IF NECESSARY)

SIGNED George Cook DATE 9-74

COUNTY No. 22078

SANGAMON 6-15N-4W

PEI Assigned Log No. 21

ILLINOIS GEOLOGICAL SURVEY, URBANA

Strata	Thickness	Top	Bottom
CORE #1 1547-1572'			
SILURIAN			
Dolomite, faint light greenish-gray, white specks, slightly chalky, mostly finely crystalline in streakd, pin head vugs in streaks	2.0		1949.C
Dolomite, light greenish-gray, white specks in streaks, a few pin head vugs scattered top 10' and calcareous bottom 4'	23.0		1572.0

COMPANY Otto Krachik
FARM Graham, George NO. 1
DATE DRILLED October, 1958 COUNTY NO. 607
AUTHORITY W. F. Meents
ELEVATION 535'DF - Company
LOCATION 330'S line, 330'W line, of NW SW
COUNTY SANGAMON CORE#3777

6-15N-4W

PEI Assigned Log No. 20

ILLINOIS GEOLOGICAL SURVEY, URBANA

Strata	Thickness	Top	Bottom
Dry and abandoned. Plugged October 15, 1958. Coal, 365-371'. Information from Plugging Affidavit.			
Electric log not run - Company			
Radio Active Survey not run - Company			
Time log filed.			
S.S.# 32858			

COUNTY Otto Krachik SANGAMON

Graham, Geo. #1
6-15N-4W

GEOLOGICAL AND WATER SURVEYS WELL RECORD

10. Property owner Hewitt, Ross Well No. ______
Address 2421 E. Griffiths Ave Springfield IL
Driller Reynolds, Joseph R. License No. 092-6014
11. Permit No. 124380 Date 06/06/86
12. Water from sandy clay 13. County Sangamon
at depth 19 to ____ ft. Sec. 6
14. Screen: Diam. ______ in. Twp. 15 N
Length: ____ ft. Slot ______ Rge. 4 W
Elev. ______

15. Casing and Liner Pipe SE NW SE

Diam. (in.)	Kind and Weight	From (ft)	To (ft)
6	PLASTIC	-1	13
36	CONCRETE	13	32

16. Size hole below casing: ______ in.
17. Static level ____ ft. below casing top which is ______ ft. above ground level. Pumping level ____ ft. when pumping at ____ gpm for ____ hours.

18. Formations passed through	Thickness	Bottom
top soil	2	2
yellow clay	10	12
sandy clay	7	19
hardpan	7	26
shale	6	32
limestone	0	32

Sangamon 12-167-23743-00 06-15N-04W

PEI Assigned Log No. 22

GEOLOGICAL WATER SURVEYS WATER WELL RECORD

Completed 7-21-68

10. Dept. Mines and Minerals permit No. NP 4429 Year 68
11. Property owner ELVIN HEISSINGER Well No. 1
Address RR #7 SPRINGFIELD ILL.
Driller MILES & SON License No. 92-323
12. Water from SAND (Formation) 13. County SANGAMON
at depth 18 to 20 ft. Sec. 6
14. Screen: Diam. ______ in. Twp. 15N
Length: ____ ft. Slot ______ Rng. 4W
Elev. ______

SHOW LOCATION IN SECTION PLAT
NW SE SE (permit)

15. Casing and Liner Pipe

Diam. (in.)	Kind and Weight	From (Ft.)	To (Ft.)
36	CONCRETE	-1	30

16. Size Hole below casing: NONE in.
17. Static level 15 ft. below casing top which is 1 ft. above ground level. Pumping level ____ ft. when pumping at ____ gpm for ____ hours.

18. FORMATIONS PASSED THROUGH	THICKNESS	DEPTH OF BOTTOM
CLAY	18	18
SAND - COARSE	2	20
SANDY LOAM	10	30
(CONTINUE ON SEPARATE SHEET IF NECESSARY).		

SIGNED Mervin C. Miles DATE July 21, 68

1318

SANGAMON 6-15N-4W

OUTSIDE

Comnleted 3-76

10. Property owner [illegible] Well No. ______
Address [illegible] SPRINGFIELD
Driller GEORGE COOK License No. [illegible]
11. Permit No. [illegible] Date 3-11-76
12. Water from SANDY CLAY (Formation) 13. County SANGAMON
at depth 12' to ______ ft.
14. Screen: Diam. ______ in.
Length: ______ ft. Slot ______

Sec. 6
Twp. 15N
Rge. 4W
Elev. ______

15. Casing and Liner Pipe

Diam. (in.)	Kind and Weight	From (Ft.)	To (Ft.)
6"	PLASTIC	+1	10
36"	CONCRETE	10	20

SHOW LOCATION IN SECTION PLAT
NW NW SE (permit)

16. Size Hole below casing: ______ in.
17. Static level ______ ft. below casing top which is ______ ft. above ground level. Pumping level ______ ft. when pumping at ______ gpm for ______ hours.

18. FORMATIONS PASSED THROUGH	THICKNESS	DEPTH OF BOTTOM
TOP SOIL		3
YELLOW CLAY		11
SANDY CLAY		19
HARD PAN [illegible] ROCK		24
YELLOW CLAY		27
ROCK		27

(CONTINUE ON SEPARATE SHEET IF NECESSARY)

SIGNED George Cook DATE 3-76

SANGAMON

COUNTY No. 23444

6-15N-4W

PEI Assigned Log No. 23[illegible]

GEOLOGICAL AND WATER SURVEYS WELL RECORD

10. Property owner Kutscher, Larry Well No. ______
Address 616 Woodland Ave. Springfield IL
Driller Reynolds, Joseph R. License No. 092-6014
11. Permit No. 120043 Date 08/30/85
12. Water from sand 13. County Sangamon
at depth ______ to 17 ft.
14. Screen: Diam. ______ in.
Length: ______ ft. Slot ______

Sec. 6
Twp. 15 N
Rge. 4 W
Elev. ______

15. Casing and Liner Pipe SE NW SE

Diam. (in.)	Kind and Weight	From (ft)	To (ft).
6	PLASTIC	-1	10
36	CONCRETE	10	22

16. Size hole below casing: ______ in.
17. Static level ______ ft. below casing top which is ______ ft. above ground level. Pumping level ______ ft. when pumping at ______ gpm for ______ hours.

18. Formations passed through	Thickness	Bottom
top soil	2	2
yellow clay	10	12
sandy clay	4	16
sand	1	17
hardpan	5	22
limestone	0	22

Sangamon 12-167-23666-00 06-15N-04W

OUTSIDE

GEOLOGICAL AND WATER SURVEYS WELL RECORD

10. Property owner Sabo, Chuck Well No. ____
Address R. R. #7 Springfield IL
Driller Reynolds, Joseph R. License No. 092-6014
11. Permit No. 133081 Date 06/30/87
12. Water from sandstone 13. County Sangamon
at depth ____ to ____ ft. Sec. 6
14. Screen: Diam. ____ in. Twp. 15 N
Length: ____ ft. Slot ____ Rge. 4 W
Elev. ____

15. Casing and Liner Pipe SE NE SW

Diam. (in.)	Kind and Weight	From (ft)	To (ft)
6	PLASTIC	-1	13
36	CONCRETE	13	22
24	CONCRETE	21	36

16. Size hole below casing: ____ in.
17. Static level ____ ft. below casing top which is ____ ft. above ground level. Pumping level ____ ft. when pumping at ____ gpm for ____ hours.

18. Formations passed through	Thickness	Bottom
top soil	2	2
yellow clay	12	14
hardpan	8	22
sandstone	14	36

Sangamon 12-167-24549-00 06-15N-04W

PEI Assigned Log No. 24

10. Property owner STEVEN LEACH Well No. ____
Address R R#1 ROCHESTER
Driller GEORGE COOK License No. 102-61
11. Permit No. 31572 Date 7-26
12. Water from SANDY CLAY (Formation) 13. County SANGAMON
at depth 17 to ____ ft. Sec. 6
14. Screen: Diam. ____ in. Twp. 15N
Length: ____ ft. Slot ____ Rge. 4W
Elev. ____

15. Casing and Liner Pipe

Diam. (in.)	Kind and Weight	From (Ft.)	To (Ft.)
6"	PLASTIC	+-	-10
36"	CONCRETE	-10	-28

SHOW LOCATION IN SECTION PLAT
NW NW SE (Permit)

16. Size Hole below casing: ____ in.
17. Static level ____ ft. below casing top which is ____ ft. above ground level. Pumping level ____ ft. when pumping at ____ gpm for ____ hours.

18. FORMATIONS PASSED THROUGH	THICKNESS	DEPTH OF BOTTOM
TOP SOIL	4	4
YELLOW CLAY	12	16
SANDY CLAY	3	19
HARD PAN	6	25
SAND STONE	3	28

(CONTINUE ON SEPARATE SHEET IF NECESSARY)

SIGNED George Cook DATE 8-74

COUNTY No. 22079

SANGAMON 6-15N-4W

PEI Assigned Log No. 25

(2840—50M—12-64)

Page 1

ILLINOIS GEOLOGICAL SURVEY, URBANA

Bridge boring #3
Section 8-B-1
Sta. 59+52 8' Rt. CL.

	Thickness	Top	Bottom
Clay loam, brown - fill	9		9
Loam, sandy, brown - medium	4		13
Loam, sandy, brown - very soft	5		18
Loam, sandy, dark gray-green, organic - very soft	5		23
Clay loam, sandy, dark gray-green, organic - soft	2.5		25.5
Clay, varved, light gray - very soft	3		28.5
Loam, silty, gray-brown, organic - medium	7		35.5
Silt, gray, organic - medium	5.5		41
Clay, silty, gray - medium	2.5		43.5
Shale, light gray - stiff	9		52.5
			T.D.

Copy of Highway Division log
filed in Groundwater Section
Typed by Engineering Geology Section

NO ENVELOPE

COMPANY Illinois Division of Highways
FARM SBI-24 over Sugar Creek NO. 3
DATE DRILLED 4-18-61 COUNTY NO. 1477
AUTHORITY Log by Highway Division
ELEVATION 536.2'
LOCATION NW SW
COUNTY SANGAMON

6-15N-4W

PEI Assigned Log No. 26

(2840—50M—)

Page 1

ILLINOIS GEOLOGICAL SURVEY, URBANA

Bridge boring #1
Section 8-B-1
Sta. 61+00 5' Lt. CL

	Thickness	Top	Bottom
Clay loam, dark brown; fill material	6		6
Clay, yellow and gray mottled, silty; very stiff	2.5		8.5
Silt, yellow and gray mottled - medium	4.5		13
Clay, shaly, blue-green and brown layered - very stiff	2.5		15.5
Shale, sandy, red-brown - very stiff	2.5		18
Shale, sandy, blue-gray; hard; core	3		21
Shale, gray - very stiff; core	18		39
			T.D.

Copy of Highway Division log
filed in Groundwater Section

Typed by Engineering Geology Section

NO ENVELOPE

COMPANY Illinois Division of Highways
FARM SBI-24 over Sugar Creek NO. 1
DATE DRILLED 4-11-61 COUNTY NO. 1476
AUTHORITY Log by Highway Division
ELEVATION 542.7'
LOCATION NW SW
COUNTY SANGAMON

6-15N-4W

PEI Assigned Log No. 27

GEOLOGICAL AND WATER SURVEYS WELL RECORD

10. Property owner Miller, Don T. Well No. ____
Address R.R. Box #296 New Berlin IL
Driller Reynolds, Joseph R. License No. 092-6014
11. Permit No. 96725 Date 10/21/80
12. Water from sandy clay 13. County Sangamon
at depth 17 to ____ ft. Sec. 6
14. Screen: Diam. ____ in. Twp. 15 N
Length: ____ ft. Slot ____ Rge. 4 W
Elev. ____

15. Casing and Liner Pipe SE NE SE

Diam. (in.)	Kind and Weight	From (ft)	To (ft)
6	PLASTIC	-1	10
36	CONCRETE	10	29

16. Size hole below casing: ____ in.
17. Static level ____ ft. below casing top which is ____ ft. above ground level. Pumping level ____ ft. when pumping at ____ gpm for ____ hours.

18. Formations passed through	Thickness	Bottom
top soil	2	2
yellow clay	10	12
sandy clay	7	19
hardpan	5	24
sandstone	5	29
rock	0	29

Sangamon 12-167-24058-00 06-15N-04W

outside

GEOLOGICAL AND WATER SURVEYS WELL RECORD

10. Property owner Luster, Orla J. Well No. #1
Address Apt. #400 Lincoln Towers Springfield IL
Driller Erwin, James License No. 102-2037
11. Permit No. 67185 Date 09/23/77
12. Water from ____ 13. County Sangamon
at depth ____ to ____ ft. Sec. 6
14. Screen: Diam. ____ in. Twp. 15 N
Length: ____ ft. Slot ____ Rge. 4 W
Elev. ____

15. Casing and Liner Pipe NE NE SW

Diam. (in.)	Kind and Weight	From (ft)	To (ft)
6	PVC SCH 40	-1	10
36	CONCRETE	10	40

16. Size hole below casing: ____ in.
17. Static level ____ ft. below casing top which is 1 ft. above ground level. Pumping level ____ ft. when pumping at ____ gpm for ____ hours.

18. Formations passed through	Thickness	Bottom
no records	40	40

Sangamon 12-167-24056-00 06-15N-04W

PEI Assigned Log No. 28

GEOLOGICAL AND WATER SURVEYS WELL RECORD

10. Property owner Sanderfield, Dennis Well No. #2
Address Springfield IL
Driller Erwin, James License No. 102-2037
11. Permit No. 89674 Date 09/18/79
12. Water from ____ 13. County Sangamon
at depth ____ to ____ ft. Sec. 6
14. Screen: Diam. ____ in. Twp. 15 N
Length: ____ ft. Slot ____ Rge. 4 W
Elev. ____

15. Casing and Liner Pipe NW NW NW

Diam. (in.)	Kind and Weight	From (ft)	To (ft)

16. Size hole below casing: ____ in.
17. Static level ____ ft. below casing top which is ____ ft. above ground level. Pumping level ____ ft. when pumping at ____ gpm for ____ hours.

18. Formations passed through	Thickness	Bottom
brown clay	18	18
brown shale	6	24
gray shale	24	48
blk slate (hd coal)	3	51
fire clay	1	52
gray shale	8	60

Sangamon 12-167-24063-00 06-15N-04W

outside

GEOLOGICAL AND WATER SURVEYS WELL RECORD

10. Property owner Requarth, Joseph Well No. #1
Address 1050 W. Calhoun Springfield IL
Driller Erwin, James License No. 102-2037
11. Permit No. 93529 Date 04/25/80
12. Water from sandy clay 13. County Sangamon
at depth 14 to 16 ft. Sec. 6
14. Screen: Diam. ____ in. Twp. 15 N
Length: ____ ft. Slot ____ Rge. 4 W
Elev. ____

15. Casing and Liner Pipe SE SW NE

Diam. (in.)	Kind and Weight	From (ft)	To (ft)
6	PVC SCH 40	-1	10
36	CONCRETE	10	31

16. Size hole below casing: ____ in.
17. Static level 10 ft. below casing top which is 1 ft. above ground level. Pumping level ____ ft. when pumping at ____ gpm for ____ hours.

18. Formations passed through	Thickness	Bottom
top soil	1	1
brown clay	6	7
brown & white clay	4	11
white & yellow clay	4	15
sandy brown clay	5	20
brown clay	11	31

Sangamon 12-167-24062-00 06-15N-04W

PEI Assigned Log No. 29

GEOLOGICAL AND WATER SURVEYS WELL RECORD

10. Property owner Springler, Tim Well No. ______
Address Springfield Il
Driller Reynolds, Joseph R. License No. 092-6014
11. Permit No. 96892 Date 10/24/80
12. Water from sandy clay 13. County Sangamon
at depth 17 to ____ ft. Sec. 6
14. Screen: Diam. ______ in. Twp. 15 N
Length: ____ ft. Slot ________ Rge. 4 W
Elev. ____

15. Casing and Liner Pipe SW NE SE

Diam. (in.)	Kind and Weight	From (ft)	To (ft)
6	PLASTIC	-1	10
36	CONCRETE	10	20

16. Size hole below casing: ______ in.
17. Static level ____ ft. below casing top which is ________ ft. above ground level. Pumping level ____ ft. when pumping at ____ gpm for ______ hours.

18. Formations passed through	Thickness	Bottom
top soil	2	2
yellow clay	10	12
sandy clay	7	19
sandstone	1	20

Sangamon 12-167-24065-00 06-15N-04W

OUTSIDE

GEOLOGICAL AND WATER SURVEYS WELL RECORD

10. Property owner Siciliano, Frank Well No. #1
Address 608 W. Highland Springfield Il
Driller Erwin, James License No. 102-2037
11. Permit No. 86808 Date 06/18/79
12. Water from sandy clay 13. County Sangamon
at depth 16 to 17 ft. Sec. 6
14. Screen: Diam. ______ in. Twp. 15 N
Length: ____ ft. Slot ________ Rge. 4 W
Elev. ____

15. Casing and Liner Pipe SW SW NE

Diam. (in.)	Kind and Weight	From (ft)	To (ft)
6	PVC SCH 40	-1	10
36	CONCRETE	10	40

16. Size hole below casing: ______ in.
17. Static level 15 ft. below casing top which is 1 ft. above ground level. Pumping level ____ ft. when pumping at ____ gpm for ______ hours.

18. Formations passed through	Thickness	Bottom
black top soil	1	1
brown clay	4	5
wh-gry c/brn yl strk	12	17
gray hardpan	4	21
gray shale	19	40

Sangamon 12-167-24064-00 06-15N-04W

PEI Assigned Log No. 30

GEOLOGICAL AND WATER SURVEYS WELL RECORD

10. Property owner Vicari, Jerry Well No. ________
Address R.R. #10 Springfield IL
Driller Reynolds, Joseph R. License No. 092-6014
11. Permit No. 115763 Date 11/14/84
12. Water from sandy clay 13. County Sangamon
at depth 19 to ____ ft. Sec. 6
14. Screen: Diam. ______ in. Twp. 15 N
Length: ______ ft. Slot ________ Rge. 4 W
Elev. ____

15. Casing and Liner Pipe NW NE SW

Diam. (in.)	Kind and Weight	From (ft)	To (ft)
6	PLASTIC	-1	12
36	CONCRETE	12	27

16. Size hole below casing: ______ in.
17. Static level ____ ft. below casing top which is ________ ft. above ground level. Pumping level ____ ft. when pumping at ____ gpm for ____ hours.

18. Formations passed through	Thickness	Bottom
top soil	2	2
yellow clay	12	14
sandy clay	5	19
hardpan	2	21
shale	6	27

Sangamon 12-167-24070-00 06-15N-04W

PEI Assigned Log No. 31

GEOLOGICAL AND WATER SURVEYS WELL RECORD

10. Property owner Turner, Robert E. Well No. ________
Address R.R. #2 Rochester IL
Driller Reynolds, Joseph R. License No. 092-6014
11. Permit No. 96350 Date 09/29/80
12. Water from sandy clay 13. County Sangamon
at depth 17 to ____ ft. Sec. 6
14. Screen: Diam. ______ in. Twp. 15 N
Length: ______ ft. Slot ________ Rge. 4 W
Elev. ____

15. Casing and Liner Pipe SE NE SE

Diam. (in.)	Kind and Weight	From (ft)	To (ft)
6	PLASTIC	-1	10
36	CONCRETE	10	31

16. Size hole below casing: ______ in.
17. Static level ____ ft. below casing top which is ________ ft. above ground level. Pumping level ____ ft. when pumping at ____ gpm for ____ hours.

18. Formations passed through	Thickness	Bottom
top soil	2	2
yellow clay	10	12
sandy clay	7	19
sandstone	8	27
shale	4	31
limestone	0	31

Sangamon 12-167-24069-00 06-15N-04W

outside

GEOLOGICAL AND WATER SURVEYS WELL RECORD

10. Property owner Bradburg, Bruce Well No. ______
Address R. R. #7 Springfield IL
Driller Reynolds, Joseph R. License No. 092-6014
11. Permit No. 127370 Date 10/08/86
12. Water from sandy clay 13. County Sangamon
at depth ____ to ____ ft. Sec. 7
14. Screen: Diam. ______ in. Twp. 15 N
Length: ____ ft. Slot ______ Rge. 4 W
Elev. ____

15. Casing and Liner Pipe NW NE SE

Diam. (in.)	Kind and Weight	From (ft)	To (ft)
6	PLASTIC	-1	13
36	CONCRETE	13	49

16. Size hole below casing: ______ in.
17. Static level ____ ft. below casing top which is ______ ft. above ground level. Pumping level ____ ft. when pumping at ____ gpm for ____ hours.

18. Formations passed through	Thickness	Bottom
top soil	2	2
yellow clay	12	14
sandy clay	5	19
hardpan	4	23
blue clay	8	31
shale	18	49

Sangamon 12-167-23828-00 07-15N-04W

OUTSIDE

GEOLOGICAL AND WATER SURVEYS WELL RECORD

10. Property owner Wojciciki, Ronald Well No. ______
Address 1743 Wildrose Dr. Springfield IL
Driller Reynolds, Joseph R. License No. 092-6014
11. Permit No. 115764 Date 11/14/84
12. Water from sand & gravel 13. County Sangamon
at depth 21 to ____ ft. Sec. 6
14. Screen: Diam. ______ in. Twp. 15 N
Length: ____ ft. Slot ______ Rge. 4 W
Elev. ____

15. Casing and Liner Pipe NW NW SE

Diam. (in.)	Kind and Weight	From (ft)	To (ft)
6	PLASTIC	-1	10
36	CONCRETE	10	31

16. Size hole below casing: ______ in.
17. Static level ____ ft. below casing top which is ______ ft. above ground level. Pumping level ____ ft. when pumping at ____ gpm for ____ hours.

18. Formations passed through	Thickness	Bottom
top soil	2	2
yellow clay	10	12
sandy clay	4	16
hardpan	5	21
sand & gravel	1	22
blue clay	9	31
rock	0	31

Sangamon 12-167-24071-00 06-15N-04W

PEI Assigned Log No. 32

Completed 6-19-68

10. Dept. Mines and Minerals permit No. W41238 Year 68
11. Property owner EDWARD J. ECK Well No.
Address 47 SPRINGFIELD ILLINOIS
Driller MILES + SON License No. 92-503
12. Water from HARD PAN (Formation) 13. County SANGAMON
at depth 18 to 24 ft.
Sec. 7
14. Screen: Diam. ___ in. Twp. 15N
Length: ___ ft. Slot ___ Rng. 4W
Elev. ___

15. Casing and Liner Pipe

Diam. (in.)	Kind and Weight	From (Ft.)	To (Ft.)
36	CONCRETE	-0	30

SHOW LOCATION IN SECTION PLAT
NW NE NE
(permit)

16. Size Hole below casing: NONE in.
17. Static level 18 ft. below casing top which is 1 ft. above ground level. Pumping level ___ ft. when pumping at ___ gpm for ___ hours.

18. FORMATIONS PASSED THROUGH	THICKNESS	DEPTH OF BOTTOM
Top Soil	2	2
CLAY	16	18
HARD PAN	6	24
BLUE CLAY	6	30
(CONTINUE ON SEPARATE SHEET IF NECESSARY)		

SIGNED Manuel Miles DATE June 19 1968

1317

SANGAMON 7-15N-4W

out side

---

10. Property owner Richard Claus Well No.
Address 57 Columbine
Driller Joe Reynolds License No. 92-601
11. Permit No. 63246 Date 7-6-77
12. Water from Sandy Clay (Formation) 13. County Sang
at depth 15' to ___ ft. Sec. 7
14. Screen: Diam. ___ in. Twp. 15N
Length: ___ ft. Slot ___ Rge. 4W
Elev. ___

15. Casing and Liner Pipe

Diam. (in.)	Kind and Weight	From (Ft.)	To (Ft.)
6"	Plastic	+1	-10
36"	Concrete	-10	-52

SHOW LOCATION IN SECTION PLAT
SE NW NE
(permit)

16. Size Hole below casing: ___ in.
17. Static level ___ ft. below casing top which is ___ ft. above ground level. Pumping level ___ ft. when pumping at ___ gpm for ___ hours.

18. FORMATIONS PASSED THROUGH	THICKNESS	DEPTH OF BOTTOM
Top Soil	2	2'
Yellow Clay	8	10'
Sandy Clay	5	15'
Hard Pan	8	23'
Shale S	29	52'

(CONTINUE ON SEPARATE SHEET IF NECESSARY)

SIGNED Joseph Reynolds DATE ___

COUNTY No. 22765

SANGAMON 7-15N-4W

PEI Assigned Log No. 33

GEOLOGICAL AND WATER SURVEYS WELL RECORD

10. Property owner Metzger, Ron Well No. ______
Address 4025 Pichsair Springfield IL
Driller Reynolds, Joseph R. License No. 092-6014
11. Permit No. 125894 Date 08/12/86
12. Water from sandy clay 13. County Sangamon
at depth ____ to ____ ft. Sec. 7
14. Screen: Diam. ____ in. Twp. 15 N
Length: ____ ft. Slot ______ Rge. 4 W
Elev. ____

15. Casing and Liner Pipe SE NW SE

Diam. (in.)	Kind and Weight	From (ft)	To (ft)
6	PLASTIC	-1	14
36	CONCRETE	14	50

16. Size hole below casing: ______ in.
17. Static level ____ ft. below casing top which is ______ ft. above ground level. Pumping level ____ ft. when pumping at ____ gpm for ____ hours.

18. Formations passed through	Thickness	Bottom
top soil	2	2
yellow clay	15	17
sandy clay	4	21
hardpan	6	27
blue clay	2	29

Sangamon 12-167-23782-00 07-15N-04W

PEI Assigned Log No. 34

Completed 11-76

10. Property owner JOHN H JARVIS Well No. ______
Address 2704 E JACKSON SFLD
Driller JOSEPH REYNOLDS License No. 92-601
11. Permit No. 54483 Date 11-8-76
12. Water from SANDY CLAY (Formation) 13. County [illegible]
at depth 19' to ____ ft. Sec. 7
14. Screen: Diam. ____ in. Twp. 15N
Length: ____ ft. Slot ______ Rge. 4W
Elev. ____

SHOW LOCATION IN SECTION PLAT

NW NW NE (permit)

15. Casing and Liner Pipe

Diam. (in.)	Kind and Weight	From (Ft.)	To (Ft.)
6"	PLASTIC	+1'	-10
36"	CONCRETE	-10	-43

16. Size Hole below casing: ______ in.
17. Static level ____ ft. below casing top which is ______ ft. above ground level. Pumping level ____ ft. when pumping at ____ gpm for ____ hours.

18. FORMATIONS PASSED THROUGH	THICKNESS	DEPTH OF BOTTOM
TOP SOIL		2
YELLOW CLAY		12
SANDY CLAY		19
HARD PAN		23
BLUE CLAY		33
SHALE		42
LIMESTONE		43

(CONTINUE ON SEPARATE SHEET IF NECESSARY)

SIGNED Joseph Reynolds DATE ______

COUNTY No. 22574

SANGAMON

7-15N-4W

PEI Assigned Log No. 35

Completed 6-24-68

10. Property owner Robert F. Bly Well No. ______
Address 1816 N. 22nd Spfld, Ill.
Driller Miles & Son License No. 92-503
11. Permit No. NE#263 Date June 21, 68
12. Water from Clay (Formation) 13. County Sangamon
at depth 24 to 28 ft. Sec. 6
14. Screen: Diam None in. Twp. 15N
Length: ___ ft. Slot ______ Rge. 4W
Elev. ______

15. Casing and Liner Pipe

Diam. (In.)	Kind and Weight	From (Ft.)	To (Ft.)
36	CONCRETE	+1	41

SHOW LOCATION IN SECTION PLAT
NW NW NW
(permit)

16. Size Hole below casing: none in.
17. Static level 24 ft. below casing top which is 1 ft. above ground level. Pumping level ___ ft. when pumping at ___ gpm for ___ hours.

18. FORMATIONS PASSED THROUGH	THICKNESS	DEPTH OF BOTTOM
Yellow Clay	8	8
Brown Clay	16	24
Sandy Clay	9	33
Boulder Clay	8	41

(CONTINUE ON SEPARATE SHEET IF NECESSARY)

SIGNED Maurice Miles DATE June 24 68

COUNTY No. 1354

SANGAMON 6-15N-4W

outside

GEOLOGICAL AND WATER SURVEYS WELL RECORD

10. Property owner Bartel, William Well No. ______
Address R. R. #7 Box 171 Springfield IL
Driller Reynolds, Joseph R. License No. 092-6014
11. Permit No. 138930 Date 12/31/87
12. Water from sandstone 13. County Sangamon
at depth ___ to ___ ft. Sec. 6
14. Screen: Diam. ___ in. Twp. 15 N
Length: ___ ft. Slot ______ Rge. 4 W
Elev. ___

15. Casing and Liner Pipe NW SW SE

Diam. (in.)	Kind and Weight	From (ft)	To (ft)
6	PLASTIC	-1	11
36	CONCRETE	10	29
24	CONCRETE	28	40

16. Size hole below casing: ___ in.
17. Static level ___ ft. below casing top which is ___ ft. above ground level. Pumping level ___ ft. when pumping at ___ gpm for ___ hours.

18. Formations passed through	Thickness	Bottom
top soil	2	2
yellow clay	12	14
sandy clay	5	19
hardpan	4	23
blue clay	4	27
shale	2	29
sandstone	11	40

Sangamon 12-167-24652-00 06-15N-04W

PEI Assigned Log No. 36

APPENDIX B
BORING LOGS

SUMMARY OF (INTERPRETED) GEOLOGIC DATA

SUMMARY OF GEOLOGIC DATA (INTERPRETED) FGDS LANDFILL SPRINGFIELD, ILLINOIS														
Boring/ Piezometer/ Monitoring Well	Coordinates		Ground Elevation	El. Top of Bedrock	El. Top of Basal Sand	Thickness of Basal Sand (ft.)	El. Top of Lower Clay (ft.)	Thickness of Lower Clay (ft.)	Top of Shallow Sand (ft.)	Thickness of Shallow Sand (ft.)	Thickness of Upper Clay (ft.)	Thickness of Fill (ft.)	Remarks
	East	North											
B-1*	2685.6	5260.5	523.2	490.2	499.2	5.0	509.2	10.0	512.8	3.6	10.4	NE	Clay overlies bedrock
B-2*	2241.0	5482.9	526.7	496.7	NE	NE	510.7	14.0	512.7	2.0	14.0	NE	
B-3*			553.0±	498.5	505.0	6.5	519.0	14.0	520.0	0.9	13.1	20.0	Located on berm Not surveyed
B-4*	2060.4	5488.2	530.1	496.6	505.6	9.0	516.1	10.5	NE	NE	14.0	NE	
B-5*	2049.3	5204.3	529.5	496.0	504.3	8.3	512.5	8.2	514.5	2.0	15.0	NE	
B-6*	2588.6	5072.9	530.8	493.3	500.8	4.5	514.8	14.0	NE	NE	11.5	NE	Clay overlies bedrock
B-7*	2684.2	4743.9	523.3	494.8	499.8	5.0	508.3	8.5	NE	1.5	2.5	12.5	
B-8*	2706.2	4565.9	523.8	494.8	501.2	6.4	513.3	12.1	NE	NE	10.5	NE	
B-9*	2506.0	4690.7	522.7	495.7	502.2	6.5	510.3	8.1	513.9	3.6	8.8	NE	
B-10*	2463.3	4589.2	523.6	498.1	499.4	1.3	516.1	16.7	NE	NE	7.5	NE	
B-11*	2391.2	4775.2	523.6	495.4	501.8	6.4	515.2	13.4	NE	NE	8.4	NE	
B-12*	2210.8	4924.2	524.9	494.9	500.4	5.5	517.4	17.0	518.9	1.5	6.0	NE	
B-13*	2275.9	4524.7	523.8	494.5	499.3	4.8	516.8	17.5	518.0	1.2	5.8	NE	

SUMMARY OF GEOLOGIC DATA (INTERPRETED)
FGDS LANDFILL
SPRINGFIELD, ILLINOIS

Boring/ Piezometer/ Monitoring Well	Coordinates East	Coordinates North	Ground Elevation	El. Top of Bedrock	El. Top of Basal Sand	Thickness of Basal Sand (ft.)	El. Top of Lower Clay (ft.)	Thickness of Lower Clay (ft.)	Top of Shallow Sand (ft.)	Thickness of Shallow Sand (ft.)	Thickness of Upper Clay (ft.)	Thickness of Fill (ft.)	Remarks
B-14*	2791.1	3763.9	572.7	553.7	NE	NE	NE	NE	NE	NE	12.5	NE	Bedrock outcrop
B-15*	1752.7	5579.6	536.7	516.7	NE	NE	523.7	7.0	527.7	4.0	9.0	NE	
CB-1*	2663.1	5559.1	527.3	495.0	507.3	12.3	NE	NE	NE	NE	NE	20.0	Creek
CB-2*	2700.9	5427.5	526.2	<496.7	503.7	4.5	506.2	2.5	NE	NE	NE	19.5	Creek
CB-3*	2542.3	5359.4	525.8	<495.8	498.8	2.0	513.8	15.0	NE	NE	NE	12.0	Creek
CB-4*	2490.4	5240.9	525.1	<503.1	ND	ND	513.3	>10.2	NE	NE	NE	11.8	Creek
CB-5*	2390.9	5197.4	523.4	<507.4	ND	ND	515.2	>7.8	515.6	0.4	7.8	NE	
CB-6*	2367.5	5079.8	527.0	494.5	501.0	6.5	518.0	17.0	518.8	0.8	8.2	NE	
CB-7*	2377.9	4938.0	523.8	<507.8	ND	ND	515.0	>7.2	NE	NE	8.8	NE	
CB-8*	2564.6	4862.3	522.7	<502.7	ND	ND	508.9	>6.2	NE	NE	NE	13.8	
CB-9*	2736.2	4799.8	525.5	<499.5	503.5	>4.0	509.3	5.8	NE	NE	NE	16.2	
P-1D*	1973.1	4806.1	553.4	501.4	504.4	3.0	513.9	9.5	NE	NE	NE	39.5	Located on berm
P-1S*	1973.9	4821.3	553.4	<511.4	ND	ND	514.7	>3.3	NE	NE	NE	ND	Located on berm
P-2D*	1975.9	5226.0	553.9	498.1	500.9	2.8	516.4	15.5	NE	NE	13.8	37.5	Located on berm

SUMMARY OF GEOLOGIC DATA (INTERPRETED)
FGDS LANDFILL
SPRINGFIELD, ILLINOIS

Boring/ Piezometer/ Monitoring Well	Coordinates		Ground Elevation	El. Top of Bedrock	El. Top of Basal Sand	Thickness of Basal Sand (ft.)	El. Top of Lower Clay (ft.)	Thickness of Lower Clay (ft.)	Top of Shallow Sand (ft.)	Thickness of Shallow Sand (ft.)	Thickness of Upper Clay (ft.)	Thickness of Fill (ft.)	Remarks
	East	North											
P-2S*	1976.3	5237.1	533.9	ND	ND	ND	ND	ND	NE	NE	ND	ND	Located on berm
P-3D*	2645.4	5672.5	530.5	497.0	502.5	5.5	517.0	14.5	NE	NE	NE	13.5	Creek
P-3S*	2651.4	5672.5	530.5	ND	ND	ND	518.5	>2.0	NE	NE	NE	ND	Not sampled continuously
P-4*	2880.7	5156.3	535.9	493.6	501.9	8.3	519.9	18.0	NE	NE	16.0	NE	
P-5D*	2885.0	4516.7	534.9	507.6	512.9	5.3	NE	NE	NE	NE	NE	22.0	Creek
P-5S*	2887.0	4510.7	534.9	ND	ND	ND	ND	ND	NE	NE	ND	ND	Not sampled continuously
P-6D*	2186.8	4717.0	524.8	493.3	497.3	4.0	517.3	20.0	518.3	1.0	6.5	NE	
P-6R*	2175.7	4719.5	524.8	492.3	ND	ND	ND	ND	ND	ND	ND	ND	Not sampled continuously
P-6S*	2191.4	4725.7	524.9	ND	ND	ND	517.4	>2.5	518.4	1.0	6.5	ND	Not sampled continuously
P-7D*	2432.5	5342.8	526.5	494.0	500.5	5.0	514.5	14.0	515.0	0.5	11.5	NE	Clay overlies bedrock
P-7M*	2432.8	5337.0	525.9	ND	ND	ND	ND	ND	ND	ND	ND	ND	Not sampled continuously

SUMMARY OF GEOLOGIC DATA (INTERPRETED)
FGDS LANDFILL
SPRINGFIELD, ILLINOIS

Boring/ Piezometer/ Monitoring Well	Coordinates		Ground Elevation	El. Top of Bedrock	El. Top of Basal Sand	Thickness of Basal Sand (ft.)	El. Top of Lower Clay (ft.)	Thickness of Lower Clay (ft.)	Top of Shallow Sand (ft.)	Thickness of Shallow Sand (ft.)	Thickness of Upper Clay (ft.)	Thickness of Fill (ft.)	Remarks
	East	North											
P-7R*	2424.5	5326.9	525.4	491.4	ND	ND	ND	ND	ND	ND	ND	ND	Not sampled continuously
P-7S*	2426.3	5337.1	526.3	ND	ND	ND	515.3	>3.0	515.8	0.5	10.5	ND	Not sampled continuously
P-8D*	2482.7	4939.7	522.7	496.2	500.7	3.5	508.7	8.0	NE	NE	NE	14.0	Clay overlies bedrock
P-8S*	2486.0	4933.1	522.8	ND	ND	ND	ND	ND	NE	NE	NE	ND	Not sampled continuously
P-9D*	2422.4	4446.3	553.2	495.7	501.2	5.5	521.2	20.0	NE	NE	5.7	NE	Located on berm
P-9S*	2415.6	4447.3	553.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	Located on berm
B-1 thru B-6**	NA	NA	NA	These borings were made in the north-east corner of Cell No. 1. These locations were not surveyed; therefore, the data from these borings was not used to interpret site conditions.									PSI (1989)
B-1**	NA	NA	525.4	502.4	NE	NE	NE	NE	NE	NE	NE	23.0	Creek
B-2**	NA	NA	525.3	496.8	NE	NE	518.0	21.2	521.5	3.5	3.8	NE	
B-3**	NA	NA	523.8	ND	500.8	>7.0	508.8	8.0	514.8	6.0	9.0	NE	
B-4**	NA	NA	522.6	495.1	502.6	3.0	514.0	11.4	NE	NE	2.5	6.0	Clay
B-5**	NA	NA	523.5	494.5	499.0	4.5	514.5	15.5	NE	NE	9.0	NE	

SUMMARY OF GEOLOGIC DATA (INTERPRETED)
FGDS LANDFILL
SPRINGFIELD, ILLINOIS

Boring/ Piezometer/ Monitoring Well	Coordinates		Ground Elevation	El. Top of Bedrock	El. Top of Basal Sand	Thickness of Basal Sand (ft.)	El. Top of Lower Clay (ft.)	Thickness of Lower Clay (ft.)	Top of Shallow Sand (ft.)	Thickness of Shallow Sand (ft.)	Thickness of Upper Clay (ft.)	Thickness of Fill (ft.)	Remarks
	East	North											
B-6**	NA	NA	522.7	495.7	500.7	5.0	NE	NE	NE	NE	NE	22.0	Creek
B-11**	NA	NA	522.5	496.5	501.5	5.0	NE	NE	NE	NE	NE	21.0	Creek
B-12**	NA	NA	522.2	494.7	NE	NE	509.2	14.5	NE	NE	NE	13.0	Creek
B-13**	NA	NA	522.2	495.2	NE	NE	512.2	17.0	NE	NE	4.0	6.0	
B-14**	NA	NA	522.3	493.8	498.3	4.5	516.3	18.0	NE	NE	6.0	NE	
B-15**	NA	NA	524.4	ND	496.4	>2.0	514.4	18.0	NE	NE	10.0	NE	
B-16**	NA	NA	523.2	495.7	497.7	2.0	508.2	10.5	NE	NE	6.0	6.0	
B-17**	NA	NA	522.5	495.5	497.5	2.0	504.5	7.0	NE	NE	NE	18.0	Creek
R-101**	2863.2	4049.5	543.8	511.8	NE	NE	530.6	18.8	530.8	0.2	13.0	NE	
R-102**	2043.9	5673.8	535.8	499.8	500.8	1.0	522.8	22.0	NE	NE	13.0	NE	
R-103**	2878.4	5625.3	536.1	506.6	NE	NE	516.6	10.0	517.1	0.5	19.0	NE	
G-104**	2305.9	5688.6	530.7	495.7	502.7	7.0	507.6	4.9	NE	NE	NE	23.0	Creek
G-105**	1994.6	5016.9	553.5	502.0	505.5	0.7	514.5	9.0	NE	NE	15.0	24.0	
G-106**	2378.9	5149.7	524.2	492.2	499.2	7.0	515.2	16.0	516.2	1.0	8.0	NE	

ND = No Data
NE = Not Encountered
NA = Not Available

* Patrick Engineering Inc.
** Professional Service Industries, Inc.

ATTACHMENT B

psi *Information To Build On*
Engineering • Consulting • Testing

August 30, 2010

City Water, Light & Power
Environmental Health & Safety
201 East Lake Shore Drive
Springfield, Illinois 62712

Attn: Ms. Sue Corcoran
Tel: 217-757-8610
Fax: 217-757-8615

Re: Piezometer Installation
CWLP Ash Ponds
East Lake Shore Drive
Springfield, Illinois
PSI Report No. 0020522-1 Rev. 1 Page 1 of 22 (including attachments)

Dear Ms. Corcoran:

In general accordance with your instructions, Professional Service Industries, Inc. (PSI) has completed the installation of four (4) temporary piezometers at the periphery of CWLP's ash pond area in Springfield, Illinois. Additionally, certain laboratory analysis was performed, as was in situ hydraulic conductivity (slug) testing. The piezometer locations are identified on the attached location plan. Boring depths and static water levels are shown in the table below.

	AP-1	AP-2	AP-3	AP-4
Date drilled	4/21/2010	4/21/2010	4/21/2010	4/20/2010
Total boring depth (ft)	31.5	20	19.5	60
Piezometer depth from top of first casing above ground surface (ft)	33.15	19.47	19.63	58.93
Piezometer depth from ground surface (ft)	28.34	17.18	17.91	58.31
Well screen length (ft)	10	10	10	10
Static water level from ground surface (5/5/2010)	4.81	3.89	5.16	5.95

The borings were drilled to depths ranging from approximately 17.2 to 58.3 feet below the existing ground surface, respectively. It is PSI's understanding that the purpose for these soil borings is to aid CWLP in assessing the groundwater quality outside the existing CWLP ash ponds. The general boring locations were determined and located in the field by CWLP personnel. With the approval of Ms. Corcoran, AP-2 was offset to the north of the clarifier pond drainage pipe. Depths on the attached boring logs are relative to the ground surface at each boring location.

Water level observations were made during and upon completion of the boring operations and are noted on the boring logs presented herewith. In addition, static water levels were observed at the time of the slug testing. In relatively impervious soils, the accurate determination of the groundwater elevation may not be possible even after several days of observation. Seasonal variations, temperature and recent rainfall conditions may influence the levels of the groundwater table and volumes of water will depend on the permeability of the soils.

Soil samples were visually classification in the field for logging purposes. The limited laboratory testing program included grain size analysis. Where soil tests are reported, they have been performed in accordance with generally acceptable or applicable standards. Sieve analysis worksheets are appended. Soil samples were conveyed to CWLP upon completion of the well installation activities.

A copy of the boring logs are appended. The stratification of the soils on the log represents the soil conditions in the actual boring location. Lines of demarcation represent the approximate boundaries between the soil types, but the transition may be gradual.

On May 5, 2010, in situ rising head hydraulic conductivity (slug) testing was performed on each of the four piezometers. Testing was conducted by rapidly removing one bailer (1 liter) of groundwater from the well while recording the rate of recovery using a Solinst 3001 level logger. Hydraulic conductivity was estimated using the Hvorslev method. Based on this method, the average hydraulic conductivity was estimated at 2.50E-02. Slug test results and hydraulic conductivity calculations are appended.

PSI appreciates the opportunity to perform these services and if we can be of further service, please contact our office at (217) 544-6663.

Respectfully submitted,
PROFESSIONAL SERVICE INDUSTRIES, INC.

James Gerloff, E.I.
Branch Manager

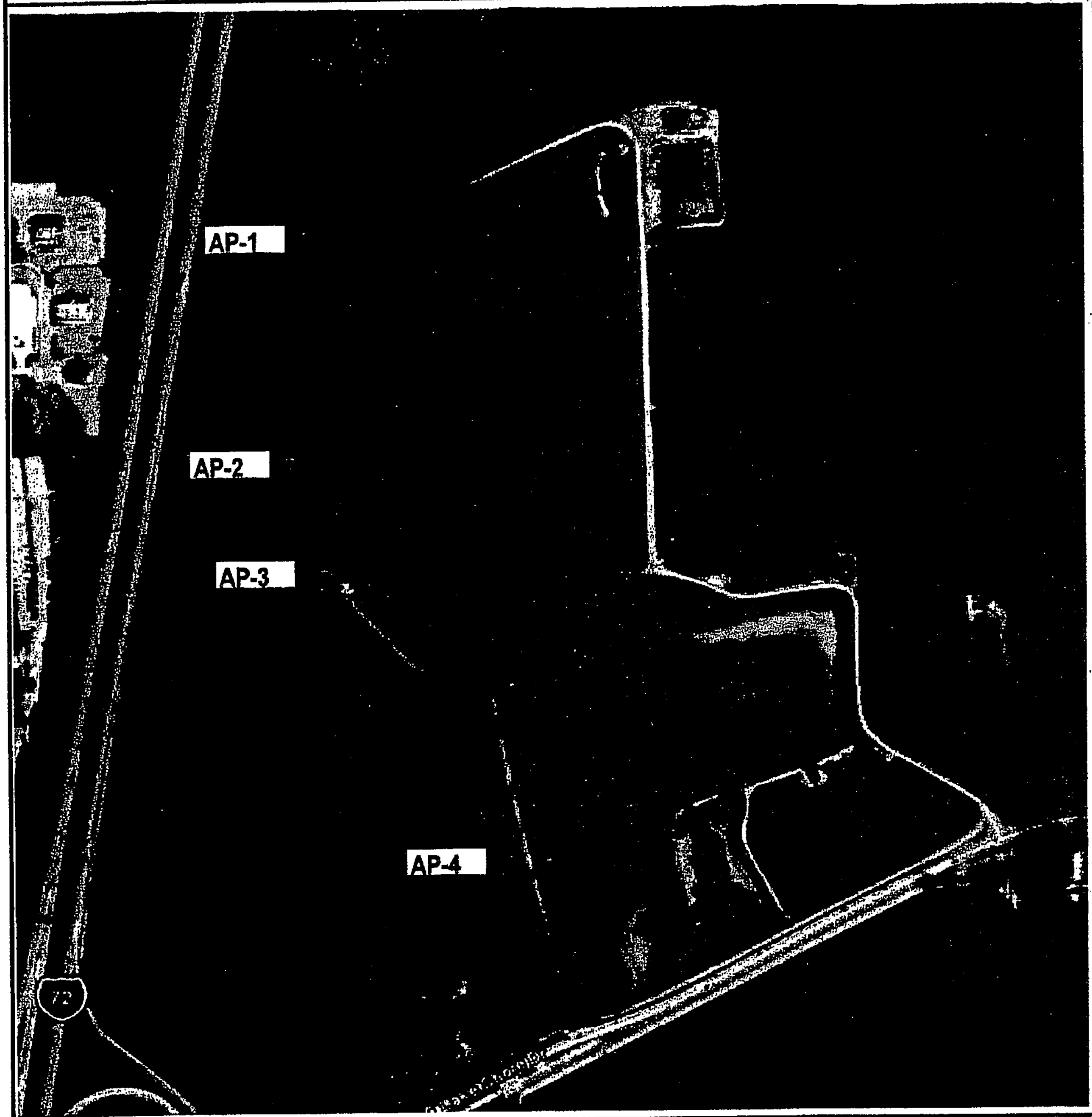
William P. Pongracz, P.E.
Vice President

Attachments:
- Key to Symbols
- Boring Logs (4 pages)
- Piezometer Location Plan
- In-Situ Hydraulic Conductivity Results (6 pages)
- Sieve Analysis Worksheets (8 pages)

Distribution: (1) above

PIEZOMETER LOCATION PLAN

SOURCE:	DATE:	SCALE:	
Google © 2010 / DigitalGlobe © 2010	Nov-05	No Scale	



psi Information To Build On
Engineering • Consulting • Testing
480 North Street, Springfield, Illinois 62704
phone 217/544-6663 fax 217/544-6148

PIEZOMETER LOCATION PLAN

PSI PROJECT No.:	0020522
Project:	Piezometer Installation
Location:	CWLP Ash Pond East Lake Shore Drive Springfield, Illinois

KEY TO SYMBOLS

Fill (made ground)

USCS Low Plasticity Clay

USCS Silt

USCS Low Plasticity Sandy Clay

USCS Clayey Sand

USCS Well-graded Sand with Silt

USCS Poorly-graded Sand

USCS Well-graded Sand

HSA = Hollow Stem Auger

CFA = Continuous Flight Auger

SPT = Standard Penetration Test

DCP = Dynamic Cone Penetrometer

SS = Split-spoon Sampler

ST = Shelby Tube Sampler

RC = Rock Core

DD = Dry Density

LL = Liquid Limit

PL = Plastic Limit

Qu = Unconfined Compressive Strength

Qp = Pocket Penetrometer

RQD = Rock Quality Designation

REC'D = Rock Core Recovery Percentage

PID = Photo Ionic Detector (ppm)

MR* = Unable to determine depth of water due to mud rotary drilling methods

The borings were advanced into the ground using hollow stem augers. At regular intervals throughout the boring depths, soil samples were obtained with either a 1.4-inch I.D., 2.0-inch O.D., split-spoon sampler or a 3-inch diameter Shelby tube. The split-spoon sampler was first seated 6-inches to penetrate any loose cuttings and then driven an additional foot where possible with blows of a 140 pound hammer falling 30-inches. The number of hammer blows required to drive the sampler each 6-inch increment is recorded in the field. The penetration resistance "N-value" is redesignated as the number of hammer blows required to drive the sampler the final foot and, when properly evaluated, is an index to cohesion for clays and relative density for sands. The split-spoon sampling procedures used during this exploration are in general accordance with ASTM Designation D 1586.

Relatively undisturbed Shelby tube samples were obtained by forcing a section of 3-inch diameter steel tubing into the soil at the desired sampling levels. This sampling procedure was in general accordance with ASTM Designation D 1587. Each tube, together with the encased soil, was carefully removed from the ground, sealed and transported to the laboratory for testing.

Professional Service Industries, Inc.
480 North Street
Springfield, Illinois 62704
Telephone: 217/544-6663
Fax: 217/544-6143

PSI Job No.: 0020522
Project: Piezometer Installation
Location: CWLP Ash Pond
East Lake Shore Drive
Springfield, Illinois

Professional Service Industries, Inc.
480 North Street
Springfield, Illinois 62704
Telephone: 217/544-6663
Fax: 217/544-6143

LOG OF BORING AP-1

Sheet 1 of 1

PSI Job No.: 0020522
Project: Piezometer Installation
Location: CWLP Ash Pond, East Lake Shore Drive, Springfield, Illinois

Drilling Method: Hollow Stem Auger
Sampling Method: Split Spoon
Hammer Type: CME Automatic; ETR = 86%
Boring Location: See attached boring location plan.

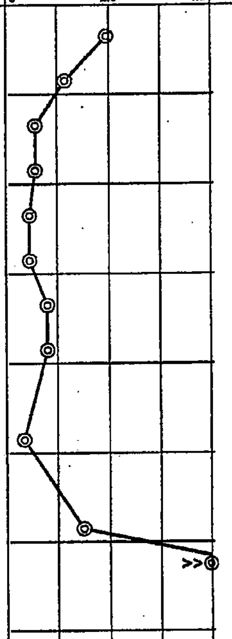
WATER LEVELS	
While Drilling	9 feet
Upon Completion	N/A
Delay	N/A

Station: N/A
Offset: N/A

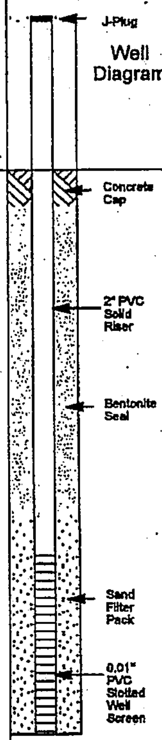
Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)
Split-Spoon	1	18	Dark brown silty CLAY, very stiff, slightly moist	CL	7-8-9 N_{60}=24
Split-Spoon	2	18	Dark brown clayey SILT, stiff, slightly moist	ML	5-5-5 N_{60}=14
Split-Spoon	3	18	Gray clayey SILT, trace brown, firm, moist	ML	2-2-3 N_{60}=7
Split-Spoon	4	18			2-2-3 N_{60}=7
Split-Spoon	5	18			1-2-2 N_{60}=6
Split-Spoon	6	18	Gray silty CLAY, few brown sand, firm, saturated	CL	1-2-2 N_{60}=6
Split-Spoon	7	18	Gray sandy CLAY, stiff, saturated	CLS	4-3-4 N_{60}=10
Split-Spoon	8	18	Blue-gray clayey SILT, soft to very stiff, moist to saturated	ML	3-3-4 N_{60}=10
Split-Spoon	9	18			1-2-1 N_{60}=4
Split-Spoon	10	18	Gray SAND with SILT, medium dense/very stiff, saturated	SW-SM	6-7-6 N_{60}=19
Split-Spoon	11	6	Gray SHALE, hard, slightly moist	CL	50/6"
			Boring terminated ay -31.5'		

Depth, (feet): 0, 5, 10, 15, 20, 25, 30, 35

STANDARD PENETRATION TEST DATA



Well Diagram



Completion Depth: 35.0 ft
Date Boring Started: 4/21/10
Date Boring Completed: 4/21/10
Logged By: Rob Preuss
Drilling Contractor: PSI, Inc.

Sample Types: Auger Cutting, Split-Spoon, Rock Core, Shelby Tube, Hand Auger, Texas Cone

Latitude:
Longitude:
Drill Rig: ATV D50
Remarks: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633. Moistures determined by visual methods

The stratification lines represent approximate boundaries. The transition may be gradual.

Professional Service Industries, Inc.
480 North Street
Springfield, Illinois 62704
Telephone: 217/544-6663
Fax: 217/544-6143

LOG OF BORING AP-2

Sheet 1 of 1

PSI Job No.:	0020522	Drilling Method:	Hollow Stem Auger
Project:	Piezometer Installation	Sampling Method:	Split Spoon
Location:	CWLP Ash Pond East Lake Shore Drive Springfield, Illinois	Hammer Type:	CME Automatic; ETR = 86%
		Boring Location:	See attached boring location plan.

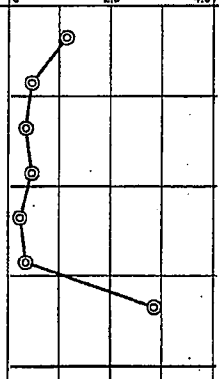
WATER LEVELS

While Drilling	9 feet
Upon Completion	N/A
Delay	N/A

Station: N/A
Offset: N/A

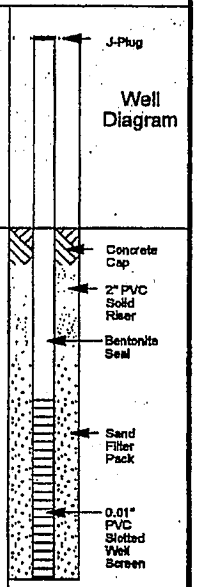
Elevation (feet)	Depth, (feet)	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %
	0	Split-Spoon	1	10	Dark brown silty CLAY, some sand, stiff, slightly moist (FILL)	CL	4-4-6 N_{60}=14	
		Split-Spoon	2	8	Dark brown silty CLAY, soft to firm, moist	CL	2-2-2 N_{60}=6	
	5	Split-Spoon	3	6	Gray silty CLAY, soft to firm, moist	CL	1-1-2 N_{60}=4	
		Split-Spoon	4	18	Gray clayey SILT, soft to firm, saturated	ML	2-2-2 N_{60}=6	
	10	Split-Spoon	5	18			2-1-1 N_{60}=3	
		Split-Spoon	6	18			2-1-2 N_{60}=4	
	15	Split-Spoon	7	18	Light gray SAND, dense, saturated	SP	4-9-16 N_{60}=36	
		Split-Spoon	8	14	Gray SHALE, hard, slightly moist	CL	19-24-50/2"	
	20				Boring terminate at -20'			

STANDARD PENETRATION TEST DATA
N in blows/ft ◎
× Moisture ◪ PL ✚ LL
0 25 50
STRENGTH, tsf
▲ Qu ✳ Qp
0 2.0 4.0



Additional Remarks

Well Diagram



Completion Depth:	20.0 ft
Date Boring Started:	4/21/10
Date Boring Completed:	4/21/10
Logged By:	Rob Preuss
Drilling Contractor:	PSI, Inc.

Sample Types:
- Auger Cutting
- Split-Spoon
- Rock Core
- Shelby Tube
- Hand Auger
- Texas Cone

Latitude:
Longitude:
Drill Rig: ATV D50
Remarks: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633. Moistures determined by visual methods.

The stratification lines represent approximate boundaries. The transition may be gradual.

Professional Service Industries, Inc.
480 North Street
Springfield, Illinois 62704
Telephone: 217/544-6663
Fax: 217/544-6143

LOG OF BORING AP-3

Sheet 1 of 1

PSI Job No.:	0020522
Project:	Piezometer Installation
Location:	CWLP Ash Pond East Lake Shore Drive Springfield, Illinois
Drilling Method:	Hollow Stem Auger
Sampling Method:	Split Spoon
Hammer Type:	CME Automatic; ETR = 86%
Boring Location:	See attached boring location plan.

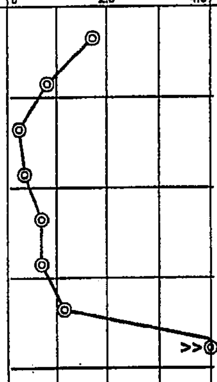
WATER LEVELS

While Drilling	None feet
Upon Completion	N/A
Delay	N/A

Station: N/A
Offset: N/A

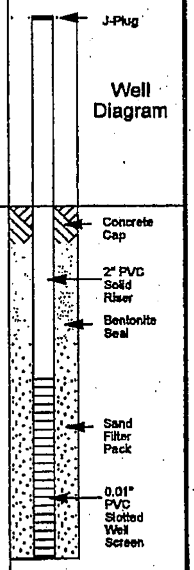
Depth (feet)	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)
0	Split-Spoon	1	18	Dark brown silty CLAY, very stiff, slightly moist	CL	6-7-8 N_{60}=21
	Split-Spoon	2	18	Gray/brown clayey SILT, soft to stiff, moist to saturated	ML	3-3-4 N_{60}=10
5	Split-Spoon	3	18			1-1-1 N_{60}=3
	Split-Spoon	4	18	Gray clayey SILT, soft to very stiff, saturated	ML	2-1-2 N_{60}=4
10	Split-Spoon	5	18			2-2-4 N_{60}=9
	Split-Spoon	6	16			2-2-4 N_{60}=9
15	Split-Spoon	7	18			4-4-6 N_{60}=14
	Split-Spoon	8	10	Gray SHALE, hard, slightly moist	CL	32-50/3"
20				Boring terminated at -19.5		

STANDARD PENETRATION TEST DATA
N in blows/ft ⊙
× Moisture ◪ PL ✚ LL
0 25 50
STRENGTH, tsf
▲ Qu ✳ Qp
0 2.0 4.0



Additional Remarks

Well Diagram



Completion Depth:	20.0 ft
Date Boring Started:	4/21/10
Date Boring Completed:	4/21/10
Logged By:	Rob Preuss
Drilling Contractor:	PSI, Inc.

Sample Types: Auger Cutting, Split-Spoon, Rock Core, Shelby Tube, Hand Auger, Texas Cone

Latitude:
Longitude:
Drill Rig: ATV D50
Remarks: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633. Moistures determined by visual methods.

The stratification lines represent approximate boundaries. The transition may be gradual.

Professional Service Industries, Inc.
480 North Street
Springfield, Illinois 62704
Telephone: 217/544-6663
Fax: 217/544-6143

LOG OF BORING AP-4

Sheet 1 of 1

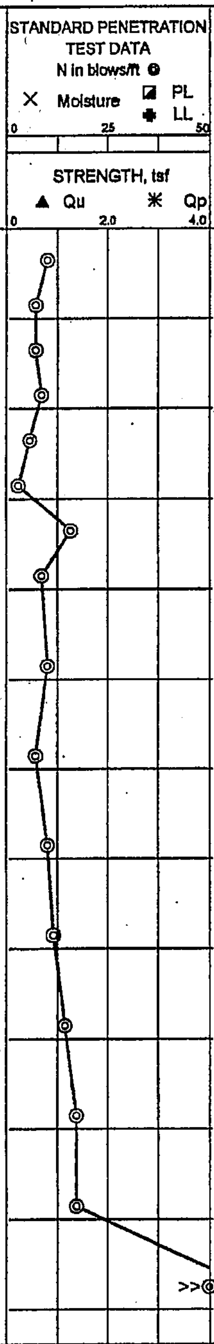
PSI Job No.:	0020522
Project:	Piezometer Installation
Location:	CWLP Ash Pond, East Lake Shore Drive, Springfield, Illinois
Drilling Method:	Hollow Stem Auger
Sampling Method:	Split Spoon
Hammer Type:	CME Automatic; ETR = 86%
Boring Location:	See attached boring location plan.

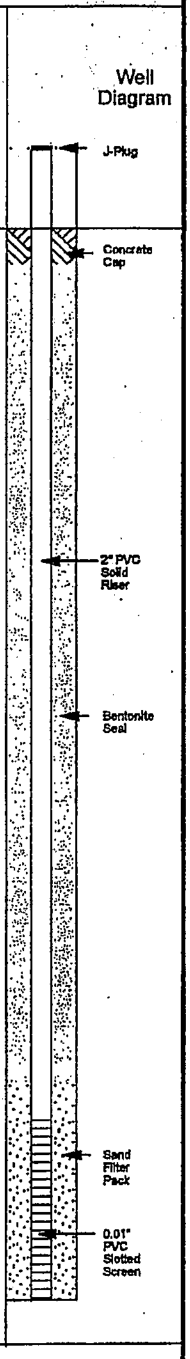
WATER LEVELS

▽ While Drilling	11 feet
▼ Upon Completion	N/A
▼ Delay	N/A

Station: N/A
Offset: N/A

Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)
1	17	Brown silty CLAY, some brown sand, firm to stiff, slightly moist (FILL)	CL	4-4-3, N_{60}=10
2	18	Brown silty CLAY, trace roots, firm to stiff, moist (FILL)	CL	4-3-2, N_{60}=7
3	10	Brown SILT, trace gray, firm to stiff, moist (FILL)	ML	6-3-2, N_{60}=7
4	12	5" Brown SAND transitioning to Black FLY ASH at 9.4', stiff to very stiff, slightly moist (FILL)	SAND/FLY ASH	2-2-4, N_{60}=9
5	18			2-2-2, N_{60}=6
6	16			2-1-1, N_{60}=3
7	16			6-6-5, N_{60}=16
8	18	Black FLY ASH, some fine sub-round gravel, stiff to very stiff, moist to saturated (FILL)	FLY ASH	3-3-3, N_{60}=9
9	1	Gray/green (organic?) CLAY, stiff, trace fine sand, moist to saturated	CL	3-3-4, N_{60}=10
10	18	Brown/gray silty CLAY, fiorm to stiff, saturated	CL	2-2-3, N_{60}=7
11	18	Gray SILT, stiff to very stiff, saturated	ML	3-3-4, N_{60}=10
12	18			4-4-4, N_{60}=11
13	18			4-4-6, N_{60}=14
14	18			4-5-7, N_{60}=17
15	18	Gray fine to coarse SAND, medium dense, saturated	SW	5-5-7, N_{60}=17
16	1	Gray SHALE, hard, moist	CL	50/1"
		Boring terminated at -60'		





Completion Depth:	60.0 ft
Date Boring Started:	4/20/10
Date Boring Completed:	4/20/10
Logged By:	Rob Preuss
Drilling Contractor:	PSI, Inc.

Sample Types: Auger Cutting, Split-Spoon, Rock Core, Shelby Tube, Hand Auger, Texas Cone

Latitude:
Longitude:
Drill Rig: ATV D50
Remarks: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633. Moistures determined by visual methods.

The stratification lines represent approximate boundaries. The transition may be gradual.

In-Situ Hydraulic Conductivity Test Analysis
Utlizing the Hvorslev Slug Test Method[1]

GOVERNING EQUATION:

$$K = (r^2 * \ln(L_e/R))/(2L_eT_o)$$

K is the hydraulic conductivity (cm/sec)
r is the radius of the well casing (cm)
R is the radius of the borehole (cm)
L_e is the length of the well screen (cm)
T_o is the time it takes for the water level to rise or fall 37% of the initial change (sec)

CWLP Ash Ponds, East Lake Shore Drive, Springfield, Illinois In-Situ Hydraulic Conductivity Analysis[2]

Test Number	Test Type	L_e (ft)	L_e (cm)	T_o (min)	T_o (sec)	K (cm/sec)
AP-4	Rising Head	10.0	304.8	0.025	1.500	7.64E-02
AP-3	Rising Head	10.0	304.8	0.083	4.980	2.30E-02
AP-2.1	Rising Head	10.0	304.8	0.150	9.000	1.27E-02
AP-2.2	Rising Head	10.0	304.8	0.167	10.020	1.14E-02
AP-1	Rising Head	10.0	304.8	1.667	100.020	1.15E-03
					AVERAGE:	**2.50E-02**

CONSTANTS

r (inch)	r (cm)	R (inch)	R (cm)
2.0	5.08	8.0	20.3

HVORSLEV CALCULATIONS

Test	L_e/R (-)	$\ln(L_e/R)$ (-)	L_eT_o (cm*sec)	K (cm/sec)		
AP-4	15.00	2.71	4.57E+02	**7.64E-02**		
AP-3	15.00	2.71	1.52E+03	**2.30E-02**		
AP-2.1	15.00	2.71	2.74E+03	1.27E-02		
AP-2.2	15.00	2.71	3.05E+03	1.14E-02	AP-2 AVG:	**1.21E-02**
AP-1	15.00	2.71	3.05E+04	**1.15E-03**		

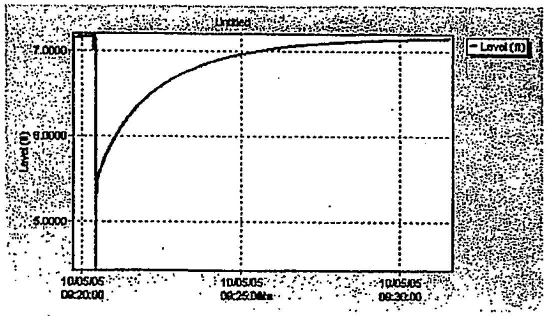
Notes:

[1] Hvorslev slug test method applied as described by C.W. Fetter in Applied Hydrology (Third Edition) published by Prentice-Hall in New Jersey in 1994 on pages 247-251.

[2] In-situ hydraulic conductivity tests conducted on monitoring wells, MW-1 thru MW-4 on May 5, 2010.

Solinst	3001	
Report generated:	5/11/2010	
Report from file:	...\mw-4.csv	
Serial number:	1032308	
Unit name:	Solinst 3001	
Test name:	AP-1	Test 1
Test defined on:	5/5/2010	
Test started on:	5/5/2010	9:20:28
Test stopped on:	5/5/2010	9:21:41
Data gathered using Linear testing		
Time between data points:	1	Seconds
Number of data samples:	75	
TOTAL DATA SAMPLES	75	
Channel number [1]		
Measurement type:	Level	
Unit	feet	
Channel number [2]		
Measurement type:	Temperature	
Unit	Deg C	
Sensor Range:		
Specific gravity:		
Mode:	TOC	
User-defined reference*:	33.15	Feet H2O
Referenced on:	test start	
Pressure head at reference:		Feet H2O

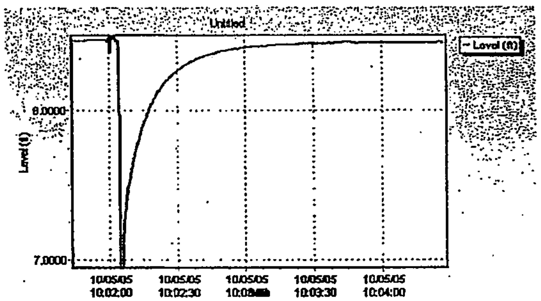
*Well depth to top of first casing terminating above ground. Does not include above ground extensions.



	Date	Time	ET (sec)	Time (min)	Test Time (min)	Temperature	Level	Water Level Bottom of well to TOC* (ft)	Change of Static Water Level (ft)	H/Ho	
1	5/5/2010	9:20:27	0	0.000		11.254	7.1703	25.980	0		TEST START
2	5/5/2010	9:20:28	1	0.017	0.000	11.252	5.298	27.852	1.8723	1	SLUG REMOVED
3	5/5/2010	9:20:29	2	0.033	0.017	11.254	5.3982	27.751	1.7711	[illegible]	
4	5/5/2010	9:20:30	3	0.050	0.033	11.254	5.4584	27.692	1.7119	[illegible]	
5	5/5/2010	9:20:31	4	0.067	0.050	11.257	5.4885	27.662	1.6818	[illegible]	
6	5/5/2010	9:20:32	5	0.083	0.067	11.255	5.519	27.631	1.6513	[illegible]	
7	5/5/2010	9:20:33	6	0.100	0.083	11.258	5.5421	27.608	1.6282	[illegible]	
8	5/5/2010	9:20:34	7	0.117	0.100	11.257	5.5658	27.584	1.6045	[illegible]	
9	5/5/2010	9:20:35	8	0.133	0.117	11.258	5.5919	27.558	1.5784	[illegible]	
10	5/5/2010	9:20:36	9	0.150	0.133	11.257	5.6074	27.543	1.5629	[illegible]	
11	5/5/2010	9:20:37	10	0.167	0.150	11.257	5.6237	27.526	1.5466	[illegible]	
12	5/5/2010	9:20:38	11	0.183	0.167	11.258	5.6423	27.508	1.528	[illegible]	
13	5/5/2010	9:20:39	12	0.200	0.183	11.259	5.6595	27.491	1.5108	[illegible]	
14	5/5/2010	9:20:40	13	0.217	0.200	11.258	5.676	27.474	1.4943	[illegible]	
15	5/5/2010	9:20:41	14	0.233	0.217	11.259	5.6922	27.458	1.4781	[illegible]	
16	5/5/2010	9:20:42	15	0.250	0.233	11.261	5.7084	27.442	1.4619	[illegible]	
17	5/5/2010	9:20:43	16	0.267	0.250	11.259	5.7226	27.427	1.4477	[illegible]	
18	5/5/2010	9:20:44	17	0.283	0.267	11.259	5.7383	27.412	1.432	[illegible]	
19	5/5/2010	9:20:45	18	0.300	0.283	11.26	5.7519	27.398	1.4184	[illegible]	
20	5/5/2010	9:20:46	19	0.317	0.300	11.259	5.766	27.384	1.4043	[illegible]	
21	5/5/2010	9:20:47	20	0.333	0.317	11.261	5.7815	27.369	1.3888	[illegible]	
22	5/5/2010	9:20:48	21	0.350	0.333	11.259	5.7955	27.355	1.3748	[illegible]	
23	5/5/2010	9:20:49	22	0.367	0.350	11.259	5.8088	27.341	1.3615	[illegible]	
24	5/5/2010	9:20:50	23	0.383	0.367	11.26	5.8224	27.328	1.3479	[illegible]	
25	5/5/2010	9:20:51	24	0.400	0.383	11.259	5.8355	27.315	1.3348	[illegible]	
26	5/5/2010	9:20:52	25	0.417	0.400	11.26	5.8489	27.301	1.3214	[illegible]	
27	5/5/2010	9:20:53	26	0.433	0.417	11.261	5.8621	27.288	1.3082	[illegible]	
28	5/5/2010	9:20:54	27	0.450	0.433	11.26	5.875	27.275	1.2953	[illegible]	
29	5/5/2010	9:20:55	28	0.467	0.450	11.261	5.8867	27.263	1.2836	[illegible]	
30	5/5/2010	9:20:56	29	0.483	0.467	11.26	5.8996	27.250	1.2707	[illegible]	
31	5/5/2010	9:20:57	30	0.500	0.150	11.259	5.9124	27.238	1.2579	[illegible]	
32	5/5/2010	9:20:58	31	0.517	0.500	11.259	5.9236	27.226	1.2467	[illegible]	
33	5/5/2010	9:20:59	32	0.533	0.517	11.259	5.9351	27.215	1.2352	[illegible]	
34	5/5/2010	9:21:00	33	0.550	0.533	11.26	5.9479	27.202	1.2224	[illegible]	
35	5/5/2010	9:21:01	34	0.567	0.550	11.259	5.9589	27.191	1.2114	[illegible]	
36	5/5/2010	9:21:02	35	0.583	0.567	11.258	5.9699	27.180	1.2004	[illegible]	
37	5/5/2010	9:21:03	36	0.600	0.583	11.259	5.9803	27.170	1.19	[illegible]	
38	5/5/2010	9:21:04	37	0.617	0.600	11.258	5.9928	27.157	1.1775	[illegible]	
39	5/5/2010	9:21:05	38	0.633	0.617	11.26	6.0028	27.147	1.1675	[illegible]	
40	5/5/2010	9:21:06	39	0.650	0.633	11.258	6.0142	27.136	1.1561	[illegible]	
41	5/5/2010	9:21:07	40	0.667	0.650	11.257	6.025	27.125	1.1453	[illegible]	
42	5/5/2010	9:21:08	41	0.683	0.667	11.259	6.0346	27.115	1.1357	[illegible]	
43	5/5/2010	9:21:09	42	0.700	0.683	11.258	6.0448	27.105	1.1255	[illegible]	
44	5/5/2010	9:21:10	43	0.717	0.700	11.259	6.0554	27.095	1.1149	[illegible]	
45	5/5/2010	9:21:11	44	0.733	0.717	11.258	6.0658	27.084	1.1045	[illegible]	
46	5/5/2010	9:21:12	45	0.750	0.733	11.259	6.0765	27.074	1.0938	[illegible]	
47	5/5/2010	9:21:13	46	0.767	0.750	11.257	6.0864	27.064	1.0839	[illegible]	
48	5/5/2010	9:21:14	47	0.783	0.767	11.257	6.096	27.054	1.0743	[illegible]	
49	5/5/2010	9:21:15	48	0.800	0.783	11.257	6.1055	27.045	1.0648	[illegible]	
50	5/5/2010	9:21:16	49	0.817	0.800	11.259	6.1144	27.036	1.0559	[illegible]	
51	5/5/2010	9:21:17	50	0.833	0.817	11.257	6.1235	27.027	1.0468	[illegible]	
52	5/5/2010	9:21:18	51	0.850	0.833	11.259	6.1332	27.017	1.0371	[illegible]	
53	5/5/2010	9:21:19	52	0.867	0.850	11.257	6.1423	27.008	1.028	[illegible]	
54	5/5/2010	9:21:20	53	0.883	0.867	11.258	6.1513	26.999	1.019	[illegible]	
55	5/5/2010	9:21:21	54	0.900	0.883	11.257	6.1613	26.989	1.009	[illegible]	
56	5/5/2010	9:21:22	55	0.917	0.900	11.258	6.1693	26.981	1.001	[illegible]	
57	5/5/2010	9:21:23	56	0.933	0.917	11.257	6.1786	26.971	0.9917	[illegible]	
58	5/5/2010	9:21:24	57	0.950	0.933	11.257	6.1869	26.963	0.9834	[illegible]	
59	5/5/2010	9:21:25	58	0.967	0.950	11.257	6.196	26.954	0.9743	[illegible]	
60	5/5/2010	9:21:26	59	0.983	0.967	11.258	6.2045	26.946	0.9658	[illegible]	
61	5/5/2010	9:21:27	60	1.000	0.983	11.257	6.213	26.937	0.9573	[illegible]	
62	5/5/2010	9:21:28	61	1.017	1.000	11.256	6.2215	26.929	0.9488	[illegible]	
63	5/5/2010	9:21:29	62	1.033	1.017	11.256	6.2287	26.921	0.9416	[illegible]	
64	5/5/2010	9:21:30	63	1.050	1.033	11.255	6.2371	26.913	0.9332	[illegible]	
65	5/5/2010	9:21:31	64	1.067	1.050	11.257	6.2466	26.903	0.9237	[illegible]	
66	5/5/2010	9:21:32	65	1.083	1.067	11.257	6.2524	26.898	0.9179	[illegible]	
67	5/5/2010	9:21:33	66	1.100	1.083	11.255	6.2615	26.889	0.9088	[illegible]	
68	5/5/2010	9:21:34	67	1.117	1.100	11.256	6.268	26.882	0.9023	[illegible]	
69	5/5/2010	9:21:35	68	1.133	1.117	11.255	6.2762	26.874	0.8941	[illegible]	
70	5/5/2010	9:21:36	69	1.150	1.133	11.255	6.2835	26.867	0.8868	[illegible]	
71	5/5/2010	9:21:37	70	1.167	1.150	11.255	6.2923	26.858	0.878	[illegible]	
72	5/5/2010	9:21:38	71	1.183	1.167	11.256	6.2979	26.852	0.8724	[illegible]	
73	5/5/2010	9:21:39	72	1.200	1.183	11.256	6.3053	26.845	0.865	[illegible]	
74	5/5/2010	9:21:40	73	1.217	1.200	11.255	6.3126	26.837	0.8577	[illegible]	
75	5/5/2010	9:21:41	74	1.233	1.217	11.254	6.3208	26.829	0.8495	[illegible]	

Solinst	3001	
Report generated:	5/11/2010	
Report from file:	...\mw-3_1.csv	
Serial number:	1032308	
Unit name:	Solinst 3001	
Test name:	AP-2	Test 1
Test defined on:	5/5/2010	
Test started on:	5/5/2010	10:02:05
Test stopped on:	5/5/2010	10:02:58
Data gathered using Linear testing		
Time between data points:	1	Seconds.
Number of data samples:	55	
TOTAL DATA SAMPLES	55	
Channel number [1]		
Measurement type:	Level	
Unit	feet	
Channel number [2]		
Measurement type:	Temperature	
Unit	Deg C	
Sensor Range:		
Specific gravity:		
Mode:	TOC	
User-defined reference*:	19.47	Feet H2O
Referenced on:	test start	
Pressure head at reference:		Feet H2O

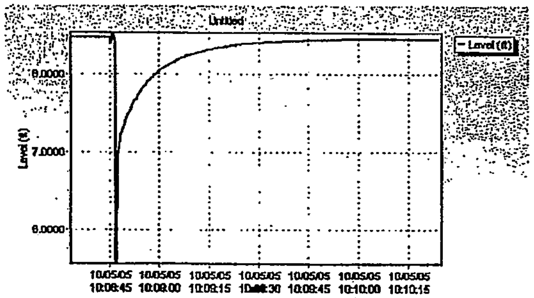
*Well depth to top of first casing terminating above ground. Does not include above ground extensions.



	Date	Time	ET (sec)	Time (min)	Test Time (min)	Temperature	Level	Water Level Bottom of well to TOC* (ft)	Change of Static Water Level (ft)	h/ho	
1	5/5/2010	10:02:04	0	0.000		11.23	8.4182	11.052	0		TEST START
2	5/5/2010	10:02:05	1	0.017	0.000	11.231	6.9143	12.556	1.5039	1	SLUG REMOVED
3	5/5/2010	10:02:06	2	0.033	0.017	11.231	7.2562	12.214	1.162	0.772657766	
4	5/5/2010	10:02:07	3	0.050	0.033	11.231	7.3727	12.097	1.0465	0.6951925	
5	5/5/2010	10:02:08	4	0.067	0.050	11.231	7.4828	11.987	0.9354	0.621982646	
6	5/5/2010	10:02:09	5	0.083	0.067	11.231	7.5707	11.899	0.8475	0.563534809	
7	5/5/2010	10:02:10	6	0.100	0.083	11.231	7.6472	11.823	0.771	0.512667066	
8	5/5/2010	10:02:11	7	0.117	0.100	11.231	7.715	11.755	0.7032	0.467584281	
9	5/5/2010	10:02:12	8	0.133	0.117	11.232	7.7747	11.695	0.6435	0.427887493	
10	5/5/2010	10:02:13	9	0.150	0.133	11.232	7.8285	11.642	0.5897	0.392113837	
11	5/5/2010	10:02:14	10	0.167	0.150	11.232	7.878	11.592	0.5402	0.359199415	
12	5/5/2010	10:02:15	11	0.183	0.167	11.231	7.9204	11.550	0.4978	0.331006051	
13	5/5/2010	10:02:16	12	0.200	0.183	11.232	7.9625	11.508	0.4557	0.303012168	
14	5/5/2010	10:02:17	13	0.217	0.200	11.232	8.0004	11.470	0.4178	0.277811025	
15	5/5/2010	10:02:18	14	0.233	0.217	11.232	8.0325	11.438	0.3857	0.256466852	
16	5/5/2010	10:02:19	15	0.250	0.233	11.232	8.0633	11.407	0.3549	0.235986435	
17	5/5/2010	10:02:20	16	0.267	0.250	11.231	8.0906	11.379	0.3276	0.217833633	
18	5/5/2010	10:02:21	17	0.283	0.267	11.23	8.1151	11.355	0.3031	0.201542655	
19	5/5/2010	10:02:22	18	0.300	0.283	11.23	8.1395	11.331	0.2787	0.185318173	
20	5/5/2010	10:02:23	19	0.317	0.300	11.23	8.1616	11.308	0.2566	0.170623047	
21	5/5/2010	10:02:24	20	0.333	0.317	11.23	8.1805	11.290	0.2377	0.158056722	
22	5/5/2010	10:02:25	21	0.350	0.333	11.229	8.2001	11.270	0.2181	0.14502294	
23	5/5/2010	10:02:26	22	0.367	0.350	11.229	8.2158	11.254	0.2024	0.134583416	
24	5/5/2010	10:02:27	23	0.383	0.367	11.229	8.2315	11.239	0.1867	0.124143893	
25	5/5/2010	10:02:28	24	0.400	0.383	11.229	8.2454	11.225	0.1728	0.114901257	
26	5/5/2010	10:02:29	25	0.417	0.400	11.228	8.2589	11.211	0.1593	0.105924596	
27	5/5/2010	10:02:30	26	0.433	0.417	11.228	8.2709	11.199	0.1473	0.097945342	
28	5/5/2010	10:02:31	27	0.450	0.433	11.227	8.2821	11.188	0.1361	0.090498038	
29	5/5/2010	10:02:32	28	0.467	0.450	11.228	8.2931	11.177	0.1251	0.083183722	
30	5/5/2010	10:02:33	29	0.483	0.467	11.227	8.3029	11.167	0.1153	0.076667332	
31	5/5/2010	10:02:34	30	0.500	0.150	11.226	8.3123	11.158	0.1059	0.070416916	
32	5/5/2010	10:02:35	31	0.617	0.500	11.226	8.3207	11.149	0.0975	0.064831438	
33	5/5/2010	10:02:36	32	0.533	0.517	11.225	8.3292	11.141	0.089	0.059178487	
34	5/5/2010	10:02:37	33	0.550	0.533	11.225	8.3355	11.135	0.0827	0.054990358	
35	5/5/2010	10:02:38	34	0.567	0.560	11.224	8.3418	11.128	0.0764	0.05080125	
36	5/5/2010	10:02:39	35	0.583	0.567	11.224	8.3491	11.121	0.0691	0.045947204	
37	5/5/2010	10:02:40	36	0.600	0.583	11.223	8.3548	11.115	0.0634	0.042157058	
38	5/5/2010	10:02:41	37	0.617	0.600	11.223	8.3615	11.109	0.0567	0.037701975	
39	5/5/2010	10:02:42	38	0.633	0.617	11.223	8.3654	11.105	0.0528	0.035108717	
40	5/5/2010	10:02:43	39	0.650	0.633	11.222	8.3729	11.097	0.0453	0.030121684	
41	5/5/2010	10:02:44	40	0.667	0.650	11.222	8.3761	11.094	0.0421	0.027993883	
42	5/5/2010	10:02:45	41	0.683	0.667	11.221	8.3803	11.090	0.0379	0.025201144	
43	5/5/2010	10:02:46	42	0.700	0.683	11.221	8.385	11.085	0.0332	0.022076936	
44	5/5/2010	10:02:47	43	0.717	0.700	11.22	8.3888	11.081	0.0294	0.019549172	
45	5/5/2010	10:02:48	44	0.733	0.717	11.22	8.3922	11.078	0.026	0.017288384	
46	5/5/2010	10:02:49	45	0.750	0.733	11.22	8.3959	11.074	0.0223	0.014828114	
47	5/5/2010	10:02:50	46	0.767	0.750	11.219	8.3983	11.072	0.0199	0.013232263	
48	5/5/2010	10:02:51	47	0.783	0.767	11.219	8.4029	11.067	0.0153	0.010173549	
49	5/5/2010	10:02:52	48	0.800	0.783	11.218	8.4042	11.066	0.014	0.00930913	
50	5/5/2010	10:02:53	49	0.817	0.800	11.218	8.4084	11.062	0.0098	0.006516391	
51	5/5/2010	10:02:54	50	0.833	0.817	11.218	8.4099	11.060	0.0083	0.005518984	
52	5/5/2010	10:02:55	51	0.850	0.833	11.218	8.4117	11.058	0.0065	0.004322096	
53	5/5/2010	10:02:56	52	0.867	0.850	11.218	8.4145	11.056	0.0037	0.00246027	
54	5/5/2010	10:02:57	53	0.883	0.867	11.217	8.416	11.054	0.0022	0.001462863	
55	5/5/2010	10:02:58	54	0.900	0.883	11.216	8.4182	11.052	0	0	

Solinst	3001	
Report generated:	5/11/2010	
Report from file:	...\mw-3_2.csv	
Serial number:	1032308	
Unit name:	Solinst 3001	
Test name:	AP-2	Test 2
Test defined on:	5/5/2010	
Test started on:	5/5/2010	10:08:48
Test stopped on:	5/5/2010	10:09:43
Data gathered using Linear testing		
Time between data points:	1	Seconds.
Number of data samples:	57	
TOTAL DATA SAMPLES	57	
Channel number [1]		
Measurement type:	Level	
Unit	feet	
Channel number [2]		
Measurement type:	Temperature	
Unit	Deg C	
Sensor Range:		
Specific gravity:		
Mode:	TOC	
User-defined reference*:	19.47	Feet H2O
Referenced on:	test start	
Pressure head at reference:		Feet H2O

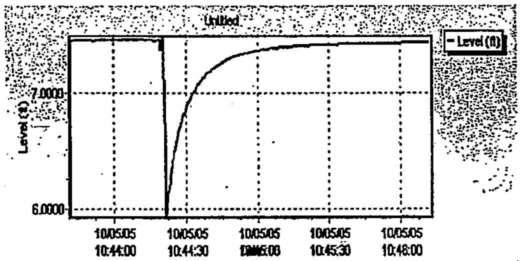
*Well depth to top of first casing terminating above ground. Does not include above ground extensions.



	Date	Time	ET (sec)	Time (min)	Test Time (min)	Temperature	Level	Water Level Bottom of well to TOC* (ft)	Change of Static Water Level (ft)	[illegible] h/ho	
1	5/5/2010	10:08:47	0	0.000		11.111	8.4246	11.045	0		TEST START
2	5/5/2010	10:08:48	1	0.017	0.000	11.114	6.9757	12.494	1.4489	[illegible]	SLUG REMOVED
3	5/5/2010	10:08:49	2	0.033	0.017	11.114	7.2067	12.263	1.2179	0.840588707	
4	5/5/2010	10:08:50	3	0.050	0.033	11.116	7.3467	12.123	1.0779	0.743943881	
5	5/5/2010	10:08:51	4	0.067	0.050	11.117	7.4619	12.008	0.9627	0.664436089	
6	5/5/2010	10:08:52	5	0.083	0.067	11.117	7.5593	11.911	0.8653	0.597211678	
7	5/5/2010	10:08:53	6	0.100	0.083	11.117	7.6431	11.827	0.7815	0.539374698	
8	5/5/2010	10:08:54	7	0.117	0.100	11.118	7.7197	11.750	0.7049	0.486507006	
9	5/5/2010	10:08:55	8	0.133	0.117	11.121	7.7838	11.686	0.6408	0.442266547	
10	5/5/2010	10:08:56	9	0.150	0.133	11.12	7.8425	11.628	0.5821	0.401763064	
11	5/5/2010	10:08:57	10	0.167	0.150	11.12	7.8942	11.576	0.5304	0.366070812	
12	5/5/2010	10:08:58	11	0.183	0.167	11.123	7.9419	11.528	0.4827	0.333149286	
13	5/5/2010	10:08:59	12	0.200	0.183	11.123	7.9837	11.486	0.4409	0.304299814	
14	5/5/2010	10:09:00	13	0.217	0.200	11.123	8.0214	11.449	0.4032	0.278280076	
15	5/5/2010	10:09:01	14	0.233	0.217	11.124	8.0533	11.417	0.3713	0.256263372	
16	5/5/2010	10:09:02	15	0.250	0.233	11.124	8.0854	11.385	0.3392	0.234108634	
17	5/5/2010	10:09:03	16	0.267	0.250	11.125	8.1137	11.356	0.3109	0.214576576	
18	5/5/2010	10:09:04	17	0.283	0.267	11.125	8.1368	11.333	0.2878	0.198633446	
19	5/5/2010	10:09:05	18	0.300	0.283	11.127	8.1636	11.306	0.261	0.180138856	
20	5/5/2010	10:09:06	19	0.317	0.300	11.126	8.1829	11.287	0.2417	0.166816205	
21	5/5/2010	10:09:07	20	0.333	0.317	11.127	8.2006	11.269	0.224	0.154600041	
22	5/5/2010	10:09:08	21	0.350	0.333	11.127	8.2186	11.251	0.206	0.142176824	
23	5/5/2010	10:09:09	22	0.367	0.350	11.126	8.2347	11.235	0.1899	0.131064946	
24	5/5/2010	10:09:10	23	0.383	0.367	11.127	8.2493	11.221	0.1753	0.120988336	
25	5/5/2010	10:09:11	24	0.400	0.383	11.128	8.2622	11.208	0.1624	0.112086603	
26	5/5/2010	10:09:12	25	0.417	0.400	11.128	8.275	11.195	0.1496	0.103250742	
27	5/5/2010	10:09:13	26	0.433	0.417	11.129	8.2863	11.184	0.1383	0.095451722	
28	5/5/2010	10:09:14	27	0.450	0.433	11.129	8.2973	11.173	0.1273	0.087859756	
29	5/5/2010	10:09:15	28	0.467	0.450	11.13	8.3084	11.162	0.1162	0.080198771	
30	5/5/2010	10:09:16	29	0.483	0.467	11.13	8.3152	11.155	0.1094	0.075505666	
31	5/5/2010	10:09:17	30	0.500	0.150	11.129	8.3253	11.145	0.0993	0.068534751	
32	5/5/2010	10:09:18	31	0.517	0.500	11.13	8.3319	11.138	0.0927	0.063979571	
33	5/5/2010	10:09:19	32	0.533	0.517	11.132	8.3386	11.131	0.086	0.059355373	
34	5/5/2010	10:09:20	33	0.550	0.533	11.132	8.3487	11.121	0.0759	0.052384566	
35	5/5/2010	10:09:21	34	0.567	0.550	11.131	8.3532	11.117	0.0714	0.049278763	
36	5/5/2010	10:09:22	35	0.583	0.567	11.132	8.3595	11.111	0.0651	0.044930637	
37	5/5/2010	10:09:23	36	0.600	0.583	11.132	8.3639	11.106	0.0607	0.041893861	
38	5/5/2010	10:09:24	37	0.617	0.600	11.133	8.3697	11.100	0.0549	0.037890614	
39	5/5/2010	10:09:25	38	0.633	0.617	11.133	8.3747	11.095	0.0499	0.034443882	
40	5/5/2010	10:09:26	39	0.650	0.633	11.133	8.3806	11.089	0.044	0.030367565	
41	5/5/2010	10:09:27	40	0.667	0.650	11.134	8.3842	11.086	0.0404	0.027883222	
42	5/5/2010	10:09:28	41	0.683	0.667	11.134	8.3879	11.082	0.0367	0.025329956	
43	5/5/2010	10:09:29	42	0.700	0.683	11.134	8.3903	11.080	0.0343	0.023673131	
44	5/5/2010	10:09:30	43	0.717	0.700	11.135	8.3943	11.076	0.0303	0.020912416	
45	5/5/2010	10:09:31	44	0.733	0.717	11.134	8.3975	11.073	0.0271	0.018703844	
46	5/5/2010	10:09:32	45	0.750	0.733	11.135	8.3985	11.072	0.0261	0.018013666	
47	5/5/2010	10:09:33	46	0.767	0.750	11.135	8.4027	11.067	0.0219	0.015114916	
48	5/5/2010	10:09:34	47	0.783	0.767	11.136	8.4058	11.064	0.0188	0.012975361	
49	5/5/2010	10:09:35	48	0.800	0.783	11.136	8.4085	11.062	0.0161	0.011111876	
50	5/5/2010	10:09:36	49	0.817	0.800	11.136	8.4115	11.059	0.0131	0.009041342	
51	5/5/2010	10:09:37	50	0.833	0.817	11.136	8.4124	11.058	0.0122	0.008420181	
52	5/5/2010	10:09:38	51	0.850	0.833	11.137	8.4148	11.055	0.0098	0.006763762	
53	5/5/2010	10:09:39	52	0.867	0.850	11.138	8.4159	11.054	0.0087	0.006004555	
54	5/5/2010	10:09:40	53	0.883	0.867	11.138	8.4178	11.052	0.0068	0.004693216	
55	5/5/2010	10:09:41	54	0.900	0.883	11.137	8.4188	11.051	0.0058	0.004003037	
56	5/5/2010	10:09:42	55	0.917	0.900	11.137	8.4221	11.048	0.0025	0.001725447	
57	5/5/2010	10:09:43	56	0.933	0.917	11.138	8.4239	11.046	0.0007	0.000483125	

Solinst	3001
Report generated:	5/11/2010
Report from file:	...\mw-2_1.csv
Serial number:	1032308
Unit name:	Solinst 3001
Test name:	AP-3 Test 1
Test defined on:	5/5/2010
Test started on:	5/5/2010 10:44:21
Test stopped on:	5/5/2010 11:45:28
Data gathered using Linear testing	
Time between data points:	1 Seconds.
Number of data samples:	69
TOTAL DATA SAMPLES	69
Channel number [1]	
Measurement type:	Level
Unit:	feet
Channel number [2]	
Measurement type:	Temperature
Unit	Deg C
Sensor Range:	
Specific gravity:	
Mode:	TOC
User-defined reference*:	19.63 Feet H2O
Referenced on:	test start
Pressure head at reference:	Feet H2O

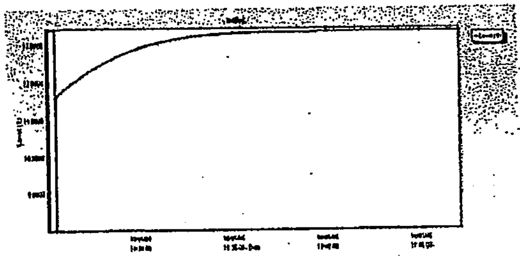
*Well depth to top of first casing terminating above ground. Does not include above ground extensions.



	Date	Time	ET (sec)	Time (min)	Test Time (min)	Temperature	Level	Water Level Bottom of well to TOC* (ft)	Change of Static Water Level (ft)	h/ho	
1	5/5/2010	10:44:20	0	0.000		11.841	7.4264	12.204	0		TEST START
2	5/5/2010	10:44:21	1	0.017	0.000	11.841	4.946	14.684	2.4804	1	SLUG REMOVED
3	5/5/2010	10:44:22	2	0.033	0.017	11.841	6.031	13.599	1.3954	0.562570563	
4	5/5/2010	10:44:23	3	0.050	0.033	11.841	6.2314	13.399	1.195	0.481777133	
5	5/5/2010	10:44:24	4	0.067	0.050	11.839	6.374	13.256	1.0524	0.424286405	
6	5/5/2010	10:44:25	5	0.083	0.067	11.841	6.4939	13.136	0.9325	0.375947428	
7	5/5/2010	10:44:26	6	0.100	0.083	11.841	6.5956	13.034	0.8308	0.334946976	
8	5/5/2010	10:44:27	7	0.117	0.100	11.84	6.6811	12.949	0.7453	0.30047573	
9	5/5/2010	10:44:28	8	0.133	0.117	11.841	6.7553	12.875	0.6711	0.27055612	
10	5/5/2010	10:44:29	9	0.150	0.133	11.84	6.8204	12.810	0.606	0.244315433	
11	5/5/2010	10:44:30	10	0.167	0.150	11.837	6.8768	12.753	0.5496	0.221577165	
12	5/5/2010	10:44:31	11	0.183	0.167	11.839	6.9267	12.703	0.4997	0.201459442	
13	5/5/2010	10:44:32	12	0.200	0.183	11.837	6.9731	12.657	0.4533	0.182752782	
14	5/5/2010	10:44:33	13	0.217	0.200	11.837	7.0111	12.619	0.4153	0.167432672	
15	5/5/2010	10:44:34	14	0.233	0.217	11.839	7.0481	12.582	0.3783	0.152515723	
16	5/5/2010	10:44:35	15	0.250	0.233	11.836	7.0792	12.551	0.3472	0.139977423	
17	5/5/2010	10:44:36	16	0.267	0.250	11.837	7.1094	12.521	0.317	0.127801967	
18	5/5/2010	10:44:37	17	0.283	0.267	11.837	7.1355	12.495	0.2909	0.117279471	
19	5/5/2010	10:44:38	18	0.300	0.283	11.837	7.1579	12.472	0.2685	0.108248667	
20	5/5/2010	10:44:39	19	0.317	0.300	11.834	7.1803	12.450	0.2461	0.099217868	
21	5/5/2010	10:44:40	20	0.333	0.317	11.834	7.1981	12.432	0.2283	0.092041606	
22	5/5/2010	10:44:41	21	0.350	0.333	11.836	7.2175	12.413	0.2089	0.084220287	
23	5/5/2010	10:44:42	22	0.367	0.350	11.834	7.2342	12.396	0.1922	0.077487502	
24	5/5/2010	10:44:43	23	0.383	0.367	11.831	7.2477	12.382	0.1787	0.072044831	
25	5/5/2010	10:44:44	24	0.400	0.383	11.833	7.2613	12.369	0.1651	0.066561845	
26	5/5/2010	10:44:45	25	0.417	0.400	11.831	7.2733	12.357	0.1531	0.061723916	
27	5/5/2010	10:44:46	26	0.433	0.417	11.83	7.2842	12.346	0.1422	0.057329463	
28	5/5/2010	10:44:47	27	0.450	0.433	11.829	7.2947	12.335	0.1317	0.053096275	
29	5/5/2010	10:44:48	28	0.467	0.450	11.829	7.3038	12.326	0.1226	0.049427512	
30	5/5/2010	10:44:49	29	0.483	0.467	11.828	7.313	12.317	0.1134	0.045718433	
31	5/5/2010	10:44:50	30	0.500	0.150	11.83	7.3204	12.310	0.106	0.042735043	
32	5/5/2010	10:44:51	31	0.517	0.500	11.83	7.3277	12.302	0.0987	0.039791969	
33	5/5/2010	10:44:52	32	0.533	0.517	11.827	7.3358	12.294	0.0906	0.036526367	
34	5/5/2010	10:44:53	33	0.550	0.533	11.828	7.3408	12.289	0.0856	0.034510563	
35	5/5/2010	10:44:54	34	0.567	0.550	11.827	7.3465	12.284	0.0799	0.032212546	
36	5/5/2010	10:44:55	35	0.583	0.567	11.827	7.3529	12.277	0.0735	0.029632317	
37	5/5/2010	10:44:56	36	0.600	0.583	11.825	7.3567	12.273	0.0697	0.028100306	
38	5/5/2010	10:44:57	37	0.617	0.600	11.826	7.3618	12.268	0.0646	0.026044186	
39	5/5/2010	10:44:58	38	0.633	0.617	11.825	7.3666	12.263	0.0598	0.024109015	
40	5/5/2010	10:44:59	39	0.650	0.633	11.823	7.3705	12.260	0.0559	0.022536688	
41	5/5/2010	10:45:00	40	0.667	0.650	11.824	7.3748	12.255	0.0516	0.020803096	
42	5/5/2010	10:45:01	41	0.683	0.667	11.823	7.3783	12.252	0.0481	0.019392034	
43	5/5/2010	10:45:02	42	0.700	0.683	11.823	7.3814	12.249	0.045	0.018142235	
44	5/5/2010	10:45:03	43	0.717	0.700	11.821	7.3848	12.246	0.0416	0.016771488	
45	5/5/2010	10:45:04	44	0.733	0.717	11.82	7.3878	12.242	0.0386	0.015562006	
46	5/5/2010	10:45:05	45	0.750	0.733	11.82	7.3908	12.239	0.0356	0.014352524	
47	5/5/2010	10:45:06	46	0.767	0.750	11.819	7.3935	12.237	0.0329	0.01326399	
48	5/5/2010	10:45:07	47	0.783	0.767	11.818	7.3943	12.236	0.0321	0.012941461	
49	5/5/2010	10:45:08	48	0.800	0.783	11.817	7.3971	12.233	0.0293	0.011812611	
50	5/5/2010	10:45:09	49	0.817	0.800	11.816	7.3997	12.230	0.0267	0.010764393	
51	5/5/2010	10:45:10	50	0.833	0.817	11.819	7.4032	12.227	0.0232	0.00935333	
52	5/5/2010	10:45:11	51	0.850	0.833	11.815	7.4038	12.226	0.0226	0.009111434	
53	5/5/2010	10:45:12	52	0.867	0.850	11.817	7.4051	12.225	0.0213	0.008587325	
54	5/5/2010	10:45:13	53	0.883	0.867	11.816	7.4083	12.222	0.0181	0.00729721	
55	5/5/2010	10:45:14	54	0.900	0.883	11.815	7.4086	12.221	0.0178	0.007176262	
56	5/5/2010	10:45:15	55	0.917	0.900	11.813	7.411	12.219	0.0154	0.006208676	
57	5/5/2010	10:45:16	56	0.933	0.917	11.815	7.4116	12.218	0.0148	0.00596678	
58	5/5/2010	10:45:17	57	0.950	0.933	11.814	7.4149	12.215	0.0115	0.004636349	
59	5/5/2010	10:45:18	58	0.967	0.950	11.813	7.4155	12.215	0.0109	0.004394453	
60	5/5/2010	10:45:19	59	0.983	0.967	11.811	7.4162	12.214	0.0102	0.00411224	
61	5/5/2010	10:45:20	60	1.000	0.983	11.811	7.4176	12.212	0.0088	0.003547815	
62	5/5/2010	10:45:21	61	1.017	1.000	11.81	7.4187	12.211	0.0077	0.003104338	
63	5/5/2010	10:45:22	62	1.033	1.017	11.81	7.4192	12.211	0.0072	0.002902758	
64	5/5/2010	10:45:23	63	1.050	1.033	11.808	7.4215	12.209	0.0049	0.001975488	
65	5/5/2010	10:45:24	64	1.067	1.050	11.809	7.4218	12.208	0.0046	0.00185454	
66	5/5/2010	10:45:25	65	1.083	1.067	11.811	7.4231	12.207	0.0033	0.001330431	
67	5/5/2010	10:45:26	66	1.100	1.083	11.81	7.4244	12.206	0.002	0.000806322	
68	5/5/2010	10:45:27	67	1.117	1.100	11.809	7.424	12.206	0.0024	0.000967586	
69	5/5/2010	10:45:28	68	1.133	1.117	11.807	7.4257	12.204	0.0007	0.000282213	
70											
71											
72											
73											
74											

Solinst	3001	
Report generated:	5/11/2010	
Report from file:	...\MW-1.lev	
Serial number:	1032308	
Unit name:	Solinst 3001	
Test name:	AP-4	
Test defined on:	5/5/2010	
Test started on:	5/5/2010	11:25:32
Test stopped on:	5/5/2010	11:25:51
Data gathered using Linear testing		
Time between data points:	0.5	Seconds
Number of data samples:	41	
TOTAL DATA SAMPLES	41	
Channel number [1]		
Measurement type:	Level	
Unit	feet	
Channel number [2]		
Measurement type:	Temperature	
Unit	Deg C	
Sensor Range:		
Specific gravity:		
Mode:	TOC	
User-defined reference*:	59.93	Feet H2O
Referenced on:	test start	
Pressure head at reference:		Feet H2O

*Well depth to top of first casing terminating above ground. Does not include above ground extensions.



	Date	Time	ET (sec)	Time (min)	Test Time (min)	Temperature	Level	Water Level Bottom of well to TOC* (ft)	Change of Static Water Level (ft)	[illegible]	
1	5/5/2010	11:25:31	0	0.000		12.799	13.4081	45.522	0	[illegible]	TEST START
2	5/5/2010	11:25:31	0	0.000	0.000	12.789	11.9721	46.858	1.436	[illegible]	SLUG REMOVED
3	5/5/2010	11:25:32	0.5	0.008	0.008	12.794	8.02638	50.904	5.38172	[illegible]	
4	5/5/2010	11:25:32	1	0.017	0.017	12.785	11.2523	47.678	2.1558	0.400578254	
5	5/5/2010	11:25:33	1.5	0.025	0.025	12.79	11.5307	47.399	1.8774	0.34884758	
6	5/5/2010	11:25:33	2	0.033	0.033	12.781	11.5481	47.382	1.86	0.345614413	
7	5/5/2010	11:25:34	2.5	0.042	0.042	12.785	11.5979	47.332	1.8102	0.336380666	
8	5/5/2010	11:25:34	3	0.050	0.050	12.776	11.5927	47.337	1.8154	0.33732271	
9	5/5/2010	11:25:35	3.5	0.058	0.058	12.78	11.6036	47.326	1.8045	0.335301725	
10	5/5/2010	11:25:35	4	0.067	0.067	12.771	11.6202	47.310	1.7879	0.332217209	
11	5/5/2010	11:25:36	4.5	0.075	0.075	12.775	11.6344	47.296	1.7737	0.329578548	
12	5/5/2010	11:25:36	5	0.083	0.083	12.766	11.6361	47.294	1.772	0.329262764	
13	5/5/2010	11:25:37	5.5	0.092	0.092	12.771	11.6445	47.286	1.7636	0.327701924	
14	5/5/2010	11:25:37	6	0.100	0.100	12.763	11.6514	47.279	1.7567	0.326419606	
15	5/5/2010	11:25:38	6.5	0.108	0.108	12.767	11.6587	47.271	1.7494	0.325063363	
16	5/5/2010	11:25:38	7	0.117	0.117	12.758	11.6626	47.267	1.7455	0.324338687	
17	5/5/2010	11:25:39	7.5	0.125	0.125	12.762	11.669	47.261	1.7391	0.323149476	
18	5/5/2010	11:25:39	8	0.133	0.133	12.752	11.6739	47.256	1.7342	0.322238987	
19	5/5/2010	11:25:40	8.5	0.142	0.142	12.758	11.6784	47.251	1.7287	0.321217009	
20	5/5/2010	11:25:40	9	0.150	0.150	12.749	11.6836	47.246	1.7245	0.320436589	
21	5/5/2010	11:25:41	9.5	0.158	0.158	12.753	11.6884	47.242	1.7197	0.319544681	
22	5/5/2010	11:25:41	10	0.167	0.167	12.743	11.6921	47.238	1.716	0.318857168	
23	5/5/2010	11:25:42	10.5	0.175	0.175	12.748	11.6969	47.233	1.7112	0.31796525	
24	5/5/2010	11:25:42	11	0.183	0.183	12.739	11.7013	47.229	1.7068	0.317147678	
25	5/5/2010	11:25:43	11.5	0.192	0.192	12.745	11.7049	47.225	1.7032	0.316478747	
26	5/5/2010	11:25:43	12	0.200	0.200	12.735	11.7092	47.221	1.6989	0.315679748	
27	5/5/2010	11:25:44	12.5	0.208	0.208	12.74	11.7131	47.217	1.695	0.31495607	
28	5/5/2010	11:25:44	13	0.217	0.217	12.731	11.7157	47.214	1.6924	0.314471953	
29	5/5/2010	11:25:45	13.5	0.225	0.225	12.735	11.7212	47.209	1.6869	0.313449975	
30	5/5/2010	11:25:45	14	0.233	0.233	12.726	11.7248	47.205	1.6833	0.312781044	
31	5/5/2010	11:25:46	14.5	0.242	0.075	12.731	11.7288	47.201	1.6793	0.312037787	
32	5/5/2010	11:25:46	15	0.250	0.250	12.722	11.7311	47.199	1.677	0.311610415	
33	5/5/2010	11:25:47	15.5	0.258	0.258	12.727	11.7354	47.195	1.6727	0.310811413	
34	5/5/2010	11:25:47	16	0.267	0.267	12.719	11.7394	47.191	1.6687	0.310068157	
35	5/5/2010	11:25:48	16.5	0.275	0.275	12.723	11.743	47.187	1.6651	0.309399226	
36	5/5/2010	11:25:48	17	0.283	0.283	12.713	11.7467	47.183	1.6614	0.308711713	
37	5/5/2010	11:25:49	17.5	0.292	0.292	12.718	11.75	47.180	1.6581	0.308098526	
38	5/5/2010	11:25:49	18	0.300	0.300	12.709	11.7529	47.177	1.6552	0.307559665	
39	5/5/2010	11:25:50	18.5	0.308	0.308	12.714	11.7568	47.173	1.6513	0.30683489	
40	5/5/2010	11:25:50	19	0.317	0.317	12.705	11.7612	47.169	1.6489	0.306017407	
41	5/5/2010	11:25:51	19.5	0.325	0.325	12.709	11.7641	47.166	1.644	0.305478546	

SIEVE ANALYSIS WORKSHEET

CLIENT: CWLP
Environmental Health & Safety

PROJECT: Piezometer Installation
CWLP Ash Ponds
Springfield, IL

DATE: April 26, 2010

PSI REPORT NO. 0020522-1

GENERAL SAMPLE INFORMATION

SAMPLE TYPE: Clayey SILT, Some Fine to Coarse Sand	SAMPLED BY: PSI DATE SAMPLED: 4/21/2010
SAMPLE SOURCE: AP-1, 3'-7'	TESTED BY: Don Reed DATE TESTED: April 26, 2010
SPECIFICATIONS: ASTM C136	NOTES/OBSERVATIONS NP=Not Provided to PSI

SIEVE ANALYSIS DATA/RESULTS

SIEVE ANALYSIS DATA/RESULTS		TEST METHOD
Original "Wet" Sample Mass (OSM) + Pan:	996.3	ASTM C136
Pan Weight:	93.2	
Original "Wet" Sample Mass (OSM):	903.1	
Total "Dry" Sample Mass (TSM) + Pan:	820.4	
Pan Weight:	93.2	
Total "Dry" Sample Mass (TSM):	727.2	
Total "Dry" Washed Sample Mass (TWM) + Pan Wt.	182.6	
Pan Weight:	93.2	
Total "Dry" Washed Sample Mass (TWM), grams	89.4	

Sieve Size metric (English)	Individual Weight (g)	Cumulative Weight (g)	Percent Retained (%)	Percent Passing (%)	Specification
37.5 (1 1/2)	0.0	0.0	0.0	100.0	NP
25 (1)	0.0	0.0	0.0	100.0	NP
19 (3/4)	0.0	0.0	0.0	100.0	NP
16 (5/8)	0.0	0.0	0.0	100.0	NP
12.5 (1/2)	0.0	0.0	0.0	100.0	NP
9.5 (3/8)	0.0	0.0	0.0	100.0	NP
6.3 (1/4)	0.4	0.4	0.1	99.9	NP
4.75 (4)	1.2	1.6	0.2	99.8	NP
2.36 (8)	3.0	4.6	0.6	99.4	NP
1.18 (16)	2.1	6.7	0.9	99.1	NP
0.6 (30)	5.3	12.0	1.7	98.3	NP
0.425 (40)	0.0	12.0	1.7	98.3	NP
0.3 (50)	7.9	19.9	2.7	97.3	NP
0.15 (100)	27.4	47.3	6.5	93.5	NP
0.075 (200)	39.3	86.6	11.9	88.1	NP
Pan					

SIEVE ANALYSIS WORKSHEET

CLIENT: CWLP
Environmental Health & Safety

PROJECT: Piezometer Installation
CWLP Ash Ponds
Springfield, IL

DATE: April 26, 2010

PSI REPORT NO. 0020522-1

GENERAL SAMPLE INFORMATION

SAMPLE TYPE: Clayey SILT, Some Fine to Coarse Sand	SAMPLED BY: PSI DATE SAMPLED: 4/21/2010
SAMPLE SOURCE: AP-1, 10'-15'	TESTED BY: Don Reed DATE TESTED: April 26, 2010
SPECIFICATIONS: ASTM C136	NOTES/OBSERVATIONS NP=Not Provided to PSI

SIEVE ANALYSIS DATA/RESULTS

SIEVE ANALYSIS DATA/RESULTS		TEST METHOD
Original "Wet" Sample Mass (OSM) + Pan:	1030.6	ASTM C136
Pan Weight:	93.5	
Original "Wet" Sample Mass (OSM):	937.1	
Total "Dry" Sample Mass (TSM) + Pan:	814.4	
Pan Weight:	93.5	
Total "Dry" Sample Mass (TSM):	720.9	
Total "Dry" Washed Sample Mass (TWM) + Pan Wt.	247.0	
Pan Weight:	93.5	
Total "Dry" Washed Sample Mass (TWM), grams	153.5	

Sieve Size metric (English)	Individual Weight (g)	Cumulative Weight (g)	Percent Retained (%)	Percent Passing (%)	Specification
37.5 (1 1/2)	0.0	0.0	0.0	100.0	NP
25 (1)	0.0	0.0	0.0	100.0	NP
19 (3/4)	0.0	0.0	0.0	100.0	NP
16 (5/8)	0.0	0.0	0.0	100.0	NP
12.5 (1/2)	0.0	0.0	0.0	100.0	NP
9.5 (3/8)	0.9	0.9	0.1	99.9	NP
6.3 (1/4)	0.9	1.8	0.2	99.8	NP
4.75 (4)	3.1	4.9	0.7	99.3	NP
2.36 (8)	21.1	26.0	3.6	96.4	NP
1.18 (16)	40.7	66.7	9.3	90.7	NP
0.6 (30)	31.2	97.9	13.6	86.4	NP
0.425 (40)	0.0	97.9	13.6	86.4	NP
0.3 (50)	14.4	112.3	15.6	84.4	NP
0.15 (100)	14.7	127.0	17.6	82.4	NP
0.075 (200)	25.6	152.6	21.2	78.8	NP
Pan					

SIEVE ANALYSIS WORKSHEET

CLIENT: CWLP
Environmental Health & Safety

PROJECT: Piezometer Installation
CWLP Ash Ponds
Springfield, IL

DATE: April 26, 2010

PSI REPORT NO. 0020522-1

GENERAL SAMPLE INFORMATION

SAMPLE TYPE: Clayey SILT, Some Fine to Coarse Sand	SAMPLED BY: PSI DATE SAMPLED: 4/21/2010
SAMPLE SOURCE: AP-2, 3'-7'	TESTED BY: Don Reed DATE TESTED: April 26, 2010
SPECIFICATIONS: ASTM C136	NOTES/OBSERVATIONS NP=Not Provided to PSI

SIEVE ANALYSIS DATA/RESULTS

SIEVE ANALYSIS DATA/RESULTS		TEST METHOD
Original "Wet" Sample Mass (OSM) + Pan:	1706.4	ASTM C136
Pan Weight:	90.7	
Original "Wet" Sample Mass (OSM):	1615.7	
Total "Dry" Sample Mass (TSM) + Pan:	1381.0	
Pan Weight:	90.7	
Total "Dry" Sample Mass (TSM):	1290.3	
Total "Dry" Washed Sample Mass (TWM) + Pan Wt.	420.6	
Pan Weight:	90.7	
Total "Dry" Washed Sample Mass (TWM), grams	329.9	

Sieve Size metric (English)	Individual Weight (g)	Cumulative Weight (g)	Percent Retained (%)	Percent Passing (%)	Specification
37.5 (1 1/2)	0.0	0.0	0.0	100.0	NP
25 (1)	0.0	0.0	0.0	100.0	NP
19 (3/4)	0.0	0.0	0.0	100.0	NP
16 (5/8)	0.0	0.0	0.0	100.0	NP
12.5 (1/2)	0.0	0.0	0.0	100.0	NP
9.5 (3/8)	3.5	3.5	0.3	99.7	NP
6.3 (1/4)	2.3	5.8	0.4	99.6	NP
4.75 (4)	2.7	8.5	0.7	99.3	NP
2.36 (8)	6.6	15.1	1.2	98.8	NP
1.18 (16)	7.0	22.1	1.7	98.3	NP
0.6 (30)	8.0	30.1	2.3	97.7	NP
0.425 (40)	0.0	30.1	2.3	97.7	NP
0.3 (50)	18.1	48.2	3.7	96.3	NP
0.15 (100)	119.7	167.9	13.0	87.0	NP
0.075 (200)	156.2	324.1	25.1	74.9	NP
Pan					

SIEVE ANALYSIS WORKSHEET

CLIENT: CWLP Environmental Health & Safety

PROJECT: Piezometer Installation, CWLP Ash Ponds, Springfield, IL

DATE: April 26, 2010

PSI REPORT NO. 0020522-1

GENERAL SAMPLE INFORMATION

SAMPLE TYPE: Clayey SILT, Some Fine to Coarse Sand	SAMPLED BY: PSI DATE SAMPLED: 4/21/2010
SAMPLE SOURCE: AP-2, 9'-16'	TESTED BY: Don Reed DATE TESTED: April 26, 2010
SPECIFICATIONS: ASTM C136	NOTES/OBSERVATIONS NP=Not Provided to PSI

SIEVE ANALYSIS DATA/RESULTS

		TEST METHOD
Original "Wet" Sample Mass (OSM) + Pan:	1461.6	ASTM C136
Pan Weight:	173.0	
Original "Wet" Sample Mass (OSM):	1288.6	
Total "Dry" Sample Mass (TSM) + Pan:	1178.1	
Pan Weight:	173.0	
Total "Dry" Sample Mass (TSM):	1005.1	
Total "Dry" Washed Sample Mass (TWM) + Pan Wt.	319.2	
Pan Weight:	173.0	
Total "Dry" Washed Sample Mass (TWM), grams	146.2	

Sieve Size metric (English)	Individual Weight (g)	Cumulative Weight (g)	Percent Retained (%)	Percent Passing (%)	Specification
37.5 (1 1/2)	0.0	0.0	0.0	100.0	NP
25 (1)	0.0	0.0	0.0	100.0	NP
19 (3/4)	0.0	0.0	0.0	100.0	NP
16 (5/8)	0.0	0.0	0.0	100.0	NP
12.5 (1/2)	0.0	0.0	0.0	100.0	NP
9.5 (3/8)	0.0	0.0	0.0	100.0	NP
6.3 (1/4)	0.8	0.8	0.1	99.9	NP
4.75 (4)	1.2	2.0	0.2	99.8	NP
2.36 (8)	1.5	3.5	0.3	99.7	NP
1.18 (16)	2.8	6.3	0.6	99.4	NP
0.6 (30)	5.7	12.0	1.2	98.8	NP
0.425 (40)	0.0	12.0	1.2	98.8	NP
0.3 (50)	7.2	19.2	1.9	98.1	NP
0.15 (100)	42.1	61.3	6.1	93.9	NP
0.075 (200)	82.8	144.1	14.3	85.7	NP
Pan					

SIEVE ANALYSIS WORKSHEET

CLIENT: CWLP
Environmental Health & Safety

PROJECT: Piezometer Installation
CWLP Ash Ponds
Springfield, IL

DATE: April 26, 2010

PSI REPORT NO. 0020522-1

GENERAL SAMPLE INFORMATION

SAMPLE TYPE: Clayey SILT, Some Fine to Coarse Sand, Trace Subround Gravel	SAMPLED BY: PSI DATE SAMPLED: 4/21/2010
SAMPLE SOURCE: AP-3, 3'-6'	TESTED BY: Don Reed DATE TESTED: April 26, 2010
SPECIFICATIONS: ASTM C136	NOTES/OBSERVATIONS NP=Not Provided to PSI

SIEVE ANALYSIS DATA/RESULTS

SIEVE ANALYSIS DATA/RESULTS		TEST METHOD
Original "Wet" Sample Mass (OSM) + Pan:	816.4	ASTM C136
Pan Weight:	94.6	
Original "Wet" Sample Mass (OSM):	721.8	
Total "Dry" Sample Mass (TSM) + Pan:	663.7	
Pan Weight:	94.6	
Total "Dry" Sample Mass (TSM):	569.1	
Total "Dry" Washed Sample Mass (TWM) + Pan Wt.	195.2	
Pan Weight:	94.6	
Total "Dry" Washed Sample Mass (TWM), grams	100.6	

Sieve Size metric (English)	Individual Weight (g)	Cumulative Weight (g)	Percent Retained (%)	Percent Passing (%)	Specification
37.5 (1 1/2)	0.0	0.0	0.0	100.0	NP
25 (1)	0.0	0.0	0.0	100.0	NP
19 (3/4)	0.0	0.0	0.0	100.0	NP
16 (5/8)	0.0	0.0	0.0	100.0	NP
12.5 (1/2)	0.0	0.0	0.0	100.0	NP
9.5 (3/8)	2.5	2.5	0.4	99.6	NP
6.3 (1/4)	0.4	2.9	0.5	99.5	NP
4.75 (4)	0.4	3.3	0.6	99.4	NP
2.36 (8)	1.3	4.6	0.8	99.2	NP
1.18 (16)	3.6	8.2	1.4	98.6	NP
0.6 (30)	7.6	15.8	2.8	97.2	NP
0.425 (40)	0.0	15.8	2.8	97.2	NP
0.3 (50)	10.2	26.0	4.6	95.4	NP
0.15 (100)	31.7	57.7	10.1	89.9	NP
0.075 (200)	41.5	99.2	17.4	82.6	NP
Pan					

SIEVE ANALYSIS WORKSHEET

CLIENT:	CWLP Environmental Health & Safety	PROJECT:	Piezometer Installation CWLP Ash Ponds Springfield, IL
DATE:	April 26, 2010	PSI REPORT NO.	0020522-1 Page 6 of 8

GENERAL SAMPLE INFORMATION

SAMPLE TYPE: Clayey SILT, Some Fine to Coarse Sand	SAMPLED BY: PSI DATE SAMPLED: 4/21/2010
SAMPLE SOURCE: AP-3, 10'-15'	TESTED BY: Don Reed DATE TESTED: April 26, 2010
SPECIFICATIONS: ASTM C136	NOTES/OBSERVATIONS NP=Not Provided to PSI

SIEVE ANALYSIS DATA/RESULTS

SIEVE ANALYSIS DATA/RESULTS		TEST METHOD
Original "Wet" Sample Mass (OSM) + Pan:	1010.5	ASTM C136
Pan Weight:	104.2	
Original "Wet" Sample Mass (OSM):	906.3	
Total "Dry" Sample Mass (TSM) + Pan:	812.2	
Pan Weight:	104.2	
Total "Dry" Sample Mass (TSM):	708.0	
Total "Dry" Washed Sample Mass (TWM) + Pan Wt.	250.7	
Pan Weight:	104.2	
Total "Dry" Washed Sample Mass (TWM), grams	146.5	

Sieve Size metric (English)	Individual Weight (g)	Cumulative Weight (g)	Percent Retained (%)	Percent Passing (%)	Specification
37.5 (1 1/2)	0.0	0.0	0.0	100.0	NP
25 (1)	0.0	0.0	0.0	100.0	NP
19 (3/4)	0.0	0.0	0.0	100.0	NP
16 (5/8)	0.0	0.0	0.0	100.0	NP
12.5 (1/2)	0.0	0.0	0.0	100.0	NP
9.5 (3/8)	0.0	0.0	0.0	100.0	NP
6.3 (1/4)	1.8	1.8	0.3	99.7	NP
4.75 (4)	0.4	2.2	0.3	99.7	NP
2.36 (8)	3.4	5.6	0.8	99.2	NP
1.18 (16)	5.5	11.1	1.6	98.4	NP
0.6 (30)	7.4	18.5	2.6	97.4	NP
0.425 (40)	0.0	18.5	2.6	97.4	NP
0.3 (50)	16.6	35.1	5.0	95.0	NP
0.15 (100)	52.0	87.1	12.3	87.7	NP
0.075 (200)	56.8	143.9	20.3	79.7	NP
Pan					

SIEVE ANALYSIS WORKSHEET

CLIENT: CWLP
Environmental Health & Safety

PROJECT: Piezometer Installation
CWLP Ash Ponds
Springfield, IL

DATE: April 26, 2010

PSI REPORT NO. 0020522-1

GENERAL SAMPLE INFORMATION

SAMPLE TYPE: Composite of FLY ASH and Silty CLAY, With Fine to Coarse Sand, Trace Subround gravel	SAMPLED BY: PSI DATE SAMPLED: 4/20/2010
SAMPLE SOURCE: AP-4, 18'-23'	TESTED BY: Don Reed DATE TESTED: April 26, 2010
SPECIFICATIONS: ASTM C136	NOTES/OBSERVATIONS NP=Not Provided to PSI

SIEVE ANALYSIS DATA/RESULTS

SIEVE ANALYSIS DATA/RESULTS		TEST METHOD
Original "Wet" Sample Mass (OSM) + Pan:	1931.9	ASTM C136
Pan Weight:	147.6	
Original "Wet" Sample Mass (OSM):	1784.3	
Total "Dry" Sample Mass (TSM) + Pan:	1596.1	
Pan Weight:	147.6	
Total "Dry" Sample Mass (TSM):	1448.5	
Total "Dry" Washed Sample Mass (TWM) + Pan Wt.	752.6	
Pan Weight:	147.6	
Total "Dry" Washed Sample Mass (TWM), grams	605.0	

Sieve Size metric (English)	Individual Weight (g)	Cumulative Weight (g)	Percent Retained (%)	Percent Passing (%)	Specification
37.5 (1 1/2)	0.0	0.0	0.0	100.0	NP
25 (1)	0.0	0.0	0.0	100.0	NP
19 (3/4)	0.0	0.0	0.0	100.0	NP
16 (5/8)	8.2	8.2	5.6	94.4	NP
12.5 (1/2)	0.0	8.2	0.6	99.4	NP
9.5 (3/8)	2.5	10.7	0.7	99.3	NP
6.3 (1/4)	12.3	23.0	1.6	98.4	NP
4.75 (4)	10.8	33.8	2.3	97.7	NP
2.36 (8)	52.2	86.0	5.9	94.1	NP
1.18 (16)	144.3	230.3	15.9	84.1	NP
0.6 (30)	132.2	362.5	25.0	75.0	NP
0.425 (40)	0.0	362.5	25.0	75.0	NP
0.3 (50)	110.4	472.9	32.6	67.4	NP
0.15 (100)	75.1	548.0	37.8	62.2	NP
0.075 (200)	53.5	601.5	41.5	58.5	NP
Pan					

SIEVE ANALYSIS WORKSHEET

CLIENT: CWLP
Environmental Health & Safety

PROJECT: Piezometer Installation
CWLP Ash Ponds
Springfield, IL

DATE: April 26, 2010

PSI REPORT NO. 0020522-1

GENERAL SAMPLE INFORMATION

SAMPLE TYPE: Clayey SILT With Fine to Coarse Sand, Trace Subround Gravel	SAMPLED BY: PSI DATE SAMPLED: 4/20/2010
SAMPLE SOURCE: AP-4, 45'-55'	TESTED BY: Don Reed DATE TESTED: April 26, 2010
SPECIFICATIONS: ASTM C136	NOTES/OBSERVATIONS NP=Not Provided to PSI

SIEVE ANALYSIS DATA/RESULTS

		TEST METHOD
Original "Wet" Sample Mass (OSM) + Pan:	1855.4	ASTM C136
Pan Weight:	99.7	
Original "Wet" Sample Mass (OSM):	1755.7	
Total "Dry" Sample Mass (TSM) + Pan:	1509.0	
Pan Weight:	99.7	
Total "Dry" Sample Mass (TSM):	1409.3	
Total "Dry" Washed Sample Mass (TWM) + Pan Wt.	584.6	
Pan Weight:	99.7	
Total "Dry" Washed Sample Mass (TWM), grams	484.9	

Sieve Size metric (English)	Individual Weight (g)	Cumulative Weight (g)	Percent Retained (%)	Percent Passing (%)	Specification
37.5 (1 1/2)	0.0	0.0	0.0	100.0	NP
25 (1)	0.0	0.0	0.0	100.0	NP
19 (3/4)	0.0	0.0	0.0	100.0	NP
16 (5/8)	0.0	0.0	0.0	100.0	NP
12.5 (1/2)	0.0	0.0	0.0	100.0	NP
9.5 (3/8)	2.7	2.7	0.2	99.8	NP
6.3 (1/4)	6.7	9.4	0.7	99.3	NP
4.75 (4)	11.0	20.4	1.4	98.6	NP
2.36 (8)	31.4	51.8	3.7	96.3	NP
1.18 (16)	35.3	87.1	6.2	93.8	NP
0.6 (30)	55.9	143.0	10.1	89.9	NP
0.425 (40)	0.0	143.0	10.1	89.9	NP
0.3 (50)	162.8	305.8	21.7	78.3	NP
0.15 (100)	94.7	400.5	28.4	71.6	NP
0.075 (200)	82.5	483.0	34.3	65.7	NP
Pan					

ATTACHMENT C

RAPPS

ENGINEERING and APPLIED SCIENCE
821 SOUTH DURKIN – SPRINGFIELD IL 62704 – (217)787-2118

BORING LOG

Site Name: FGDS Development Landfill Boring No: AW-3

Drilling Firm: Reynolds Drilling Corp. Drilling Method: HSA Surface Elev: 537.75

Logged By: KJM Checked By: KJM Date Started: 12/30/08 Completed: 12/31/08

DEPTH	Material Description (Classification System: ______)	Sampling: Tube No.	Sampling: Type	Sampling: % Rec.	Tests: OVM (ppm)	Tests: Qu t/sf PEN	Tests: Moist	Comments	Well	DEPTH
0	Dark brown clayey silt; Moist; Firm; Organic debris & plant roots		5' CONTINUOUS SAMPLER							0
	Gray to brown mottled silty clay; Moist; Firm; Trace sand; Laminated; Fe oxidation stains	1		100						
5		2		100						5
10		3		95				Wet seam @ 11.5'		10
15	Gray sandy clay; Moist; Firm; Finely laminated	4		95				Water on rods		15
20	Dark gray sandy silt; Moist; Soft to firm; Some clay	5		80						20
25		6		30				No recovery 26.5'–30'		25
30										30

Water Level ______ after ______ hrs.

RAPPS

ENGINEERING and APPLIED SCIENCE

BORING LOG

821 SOUTH DURKIN – SPRINGFIELD IL 62704 – (217)787-2118

Site Name: FGDS Development Landfill Boring No: AW-3
Drilling Firm: Reynolds Drilling Corp. Drilling Method: HSA Surface Elev: 537.75
Logged By: KJM Checked By: KJM Date Started: 12/30/08 Completed: 12/31/08

DEPTH	Material Description (Classification System ____)	Sampling: Tube No.	Sampling: Type	Sampling: % Rec.	Tests: OVM (ppm)	Tests: Qu t/sf PEN	Tests: Moist	Comments	Well
30	Dark gray silt; Trace sand	7	5' CONTINUOUS SAMPLER	100					
35	Sandy								
	Gray fine to medium silty sand; Wet; Gravelly @ base	8		100					
40	Gray shale							Broken shale in bit No recovery past 40' Refusal	
	End of Boring @ 41.83'	9		0					
45									
50									
55									
60									

Water Level____after____hrs.

Illinois Environmental Protection Agency

Well Completion Report

Site Number: 1678250020 County: Sangamon

Well #: AW-3

Site Name: FGDS Development Landfill

State Plane Coordinate: X ____ Y ____ (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Borehole #: AW-3

Surveyed by: David Mihelsic | IL Registration #: 3762

Drilling Contractor: Reynolds Drilling Corp. | Driller: Andrew Rachford

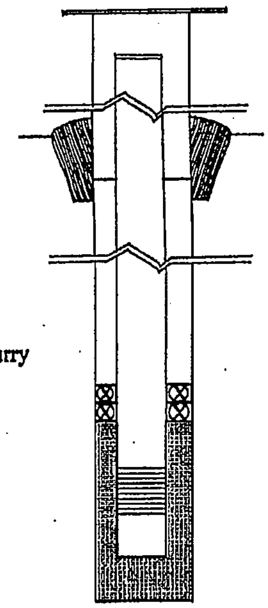
Consulting Firm: Rapps Engineering & Applied Science | Geologist: Ken Miller

Drilling Method: HSA | Drilling Fluid (Type): NA

Logged By: Ken Miller | Date Started: 12/30/08 Date Finished: 12/31/08

Report Form Completed By: Ken Miller | Date: 5/18/09

ANNULAR SPACE DETAILS



Type of Surface Seal: Cement

Type of Annular Sealant: Bentonite Chips

Installation Method: Poured

Setting Time: >24 hrs

Type of Bentonite Seal -- Granular, Pellet, Slurry (Choose One) — Pellet circled

Installation Method: Poured

Setting Time: 16 hrs

Type of Sand Pack: Quartz Sand

Grain Size: 50 (Sieve Size)

Installation Method: Poured

Type of Backfill Material: ________ (if applicable)

Installation Method: ________

Elevations (MSL)*	Depths (BGS)	(.01ft.)
		Top of Protective Casing
540.33	-2.58	Top of Riser Pipe
537.75	0	Ground Surface
534.75	3.00	Top of Annular Sealant
		Static Water Level (After Completion)
511.32	26.43	Top of Seal
508.32	29.43	Top of Sand Pack
506.32	31.43	Top of Screen
496.32	41.43	Bottom of Screen
495.92	41.83	Bottom of Well
495.92	41.83	Bottom of Borehole

* Referenced to a National Geodetic Datum

CASING MEASURMENTS

Diameter of Borehole (inches)	8.25
ID of Riser Pipe (inches)	2
Protective Casing Length (feet)	5
Riser Pipe Length (feet)	34.01
Bottom of Screen to End Cap (feet)	0.4
Screen Length (1st slot to last slot) (feet)	10
Total Length of Casing (feet)	44.41
Screen Slot Size **	0.010

**Hand-Slotted Well Screens are Unacceptable

WELL CONSTRUCTION MATERIAL

(Choose one type of material for each area)

Protective Casing	SS304, SS316, PTFE, PVC, or Other (Other circled)
Riser Pipe Above W.T.	SS304, SS316, PTFE, PVC, or Other (PVC circled)
Riser Pipe Below W.T.	SS304, SS316, PTFE, PVC, or Other (PVC circled)
Screen	SS304, SS316, PTFE, PVC, or Other (PVC circled)

White & Pink Copies:
Ill( )pt. of Public Health
Yellow Copy: Well Contractor
Golden Copy: Well Owner

See Attached For Details.

Well Construction Report

THIS FORM MUST BE COMPLETED WITHIN 30 DAYS
OF WELL COMPLETION AND SENT TO
THE ILLINOIS DEPARTMENT OF PUBLIC HEALTH
DIVISION OF ENVIRONMENTAL HEALTH
525 WEST JEFFERSON STREET
SPRINGFIELD, ILLINOIS 62761

1. Type of Well – Groundwater Monitor Well
   a. Bored X Hole Diam. 8 in. Depth 59.9 ft
      Buried Slab: Yes___ No___
   b. Driven___ Drive Pipe Diam.___in. Depth___ft
   c. Drilled___ Finished in Drift___ In Rock___
   d. Grout:

(KIND)	FROM (Ft.)	TO (Ft.)
Cement/		
Bentonite	3.0	37.0

2. Well furnishes water for human consumption? Yes___ No X
3. Date well drilled 07/12/93
4. Permanent pump installed? Yes ___ Date___ No X
   Manufacturer___ Type___
   Location___
   Capacity ___gpm. Depth of setting___ft.
5. Well top sealed? Yes X No___ Type Concrete
6. Pitless adapter installed? Yes___ No N/A
   Manufacturer___ Model No.___
   How attached to casing?___
7. Well disinfected? Yes___ No N/A
8. Pump and equipment disinfected Yes___ No N/A

IMPORTANT NOTICE

This State Agency is requesting disclosure of information that is necessary to accomplish the statutory purpose as outlined under Public Act 85-0863. Disclosiure of this information is mandatory. This form has been approved by the Forms Management Center.

PRESS FIRMLY WITH BLACK PEN OR TYPE
Do Not Use Felt Pen

IL482-0126

GEOLOGICAL AND WATER SURVEYS WELL RECORD

9. Driller AE Exploration Corporation License No. N/A
10. Well Site Address City Water, Light & Power/FGDS Landfill
11. Property Owner CWL&P/Springfield Well No. G-110
12. Permit No. N/A Date Issued___
13. Location: Site Coordinates: County Sangamon
    N 3728.6
    E 2315.7
    Sec. 12
    Twp. 15N
    Rge. 5W
    Show location in section plat
14. Water from___ at depth___ft to___ft

15. Casing and Liner Pipe

Diam.(in)	Kind and Weight	From (ft)	To (ft)
2	Stainless Steel 304	+2	44.5

16. Screen: Diam. 2 in, Length 120 in, Slot Size .01"
17. Size hole below casing N/A in. 18. Ground Elev. 554.5 ft msl.
19. Static level___ft below casing top which is___ft. above ground level. Pumping level___ft, pumping gpm for___hours.

20. Earth Materials Passed Through	Depth of Top	Depth of Bottom
Gray Silty Clay	0	38.8
Gray Silty Sand	38.8	45.5
Gray Clayey Sand	45.5	54.5
Gray Shale (massive)	54.5	59.5

Continue on separate sheet if necessary.

PDF 0130

Signed Brad J. Hunsberger Date 09/03/93
For: Andrews Environmental Engineering, Inc.

PDF 0131

Andrews Environmental Engineering, Inc.

3535 Mayflower Boulevard, Springfield, IL 62707 (217) 787-2334

Field Boring Log

Site Information:
Name: City Water, Light, and Power
Location: Springfield, IL
County: Sangamon
Site No.: 1678250020
AEEI No.: 93-118

Location:
Coord. System: Site Coordinates
Northing: 3728.6
Easting: 2315.7

Boring Information:
Boring No.: G110
Well No.: G110
Surf. Elev.: 554.5
Depth Information:
Total: 59.5
Auger: 59.5
Rotary: N/A
Dates:
Start: 7/12/93
Finish: 7/12/93

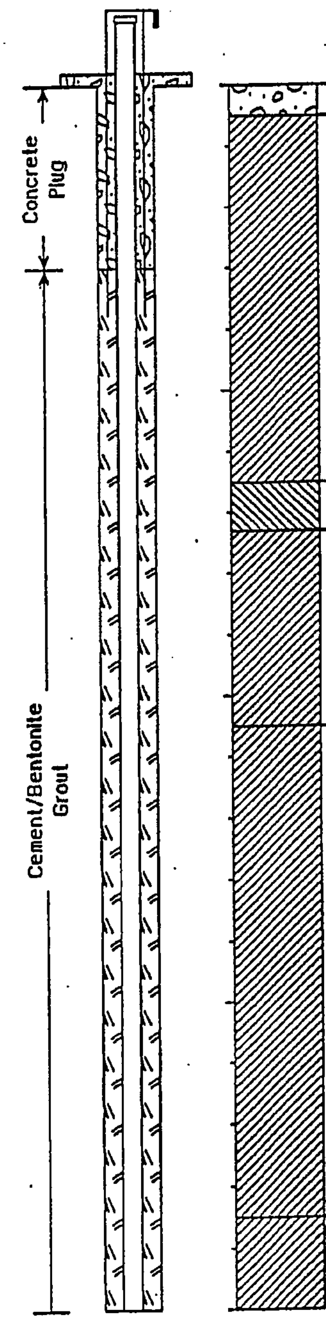
Drilling Contractor:
Name: AE Exploration Corp.
City: Springfield, IL
Equipment: CME 55

Personel:
Geologist: B. Hunsberger
Driller: M. Moore
Helper (s): R. Smith

Sample Type: – Continuous Barrel – Split Spoon – Shelby Tube – Core – Blind Drill

Run No.	Sample No.	Recov.	Blow Count	qu/[qs] (in tsf)	% Moisture
1	1A	3.2'		3.5	
2	2A, 2B, 2C	5.0'		2.75, 2.8, 2.5, 0.8	
3		1.4'			
4	4A	2.8'		0.7, 0.5, 0.65	
5	5A, 5B	4.8'		3.25, 2.75, 2.25, 2.0, 2.8, 1.8	
6				2.2, 1.8	

Depth (ft.): 0–20; Elev. (MSL): 554.5 – 534.5



Elev. (MSL)	Description/Comments	USC
554.5	Gravel backfill–*access road.*	
	Dark gray silty CLAY, little sand and gravel, with rootlets.	
549.5		
	Dark gray-black clayey SILT, some fine sand, rootlets.	
	Dark gray-black silty CLAY, soft, with rootlets, some fine sand.	
544.5		
	Dark gray, very moist silty CLAY–clayey SILT, numerous plant and wood fragments *(appears to be original grade).*	
539.5		
534.5		

NOTE: ▽ = groundwater encountered while drilling.

PDF 0132

Andrews Environmental Engineering, Inc.

3535 Mayflower Boulevard, Springfield, IL 62707 (217) 787-2334

Field Boring Log

Site Information:
Name: City Water, Light, and Power
Location: Springfield, IL
County: Sangamon
Site No.: 1678250020
AEEI No.: 93-118

Location:
Coord. System: Site Coordinates
Northing: 3728.6
Easting: 2315.7

Boring Information:
Boring No.: G110
Well No.: G110
Surf. Elev.: 554.5
Depth Information:
Total: 59.5
Auger: 59.5
Rotary: N/A
Dates:
Start: 7/12/93
Finish: 7/12/93

Drilling Contractor:
Name: AE Exploration Corp.
City: Springfield, IL
Equipment: CME 55

Personel:
Geologist: B. Hunsberger
Driller: M. Moore
Helper (s): R. Smith

Sample Type: Continuous Barrel – Split Spoon – Shelby Tube – Core – Blind Drill

Depth (ft.)	Run No.	Sample No.	Recov.	Blow Count	qu/[qs] (in tsf)	% Moisture
	6	6A			1.7	
		6B	5.0'		1.6	
25	7		2.0'			
		8A			0.7	
	8	8B			2.0, 1.2	
			3.0'		1.3	
30	9	9A			2.2, 2.2	
					2.2, 2.75	
		9B	5.0'		2.75, 1.75, 0.75	
35	10	10A			0.3, 0.2, 0.2, *, *, *	
			5.0'			
40	11	11A				

Borehole Detail: Cement/Bentonite Grout; Bentonite Seal

Description/Comments	USC	Elev. (MSL)
Dark gray silty CLAY, moist, trace fine sand, little organics.		534.5
Gray mottled light gray-brown silty CLAY, little fine sand, some plant roots.		529.5
Gray mottled brown silty CLAY, trace fine sand, little organics.		524.5
Gray clayey SILT.		
Gray CLAY, very soft, some organic clay strata present. *(* The clay was too soft for the pocket penetrometer).*		519.5
		514.5

NOTE: ▽ = groundwater encountered while drilling.

Andrews Environmental Engineering, Inc.
3535 Mayflower Boulevard, Springfield, IL 62707 (217) 787-2334

Field Boring Log

Site Information:
Name: City Water, Light, and Power
Location: Springfield, IL
County: Sangamon
Site No.: 1678250020
AEEI No.: 93-118

Location:
Coord. System: Site Coordinates
Northing: 3728.6
Easting: 2315.7

Boring Information:
Boring No.: G110
Well No.: G110
Surf. Elev.: 554.5
Depth Information:
Total: 59.5
Auger: 59.5
Rotary: N/A
Dates:
Start: 7/12/93
Finish: 7/12/93

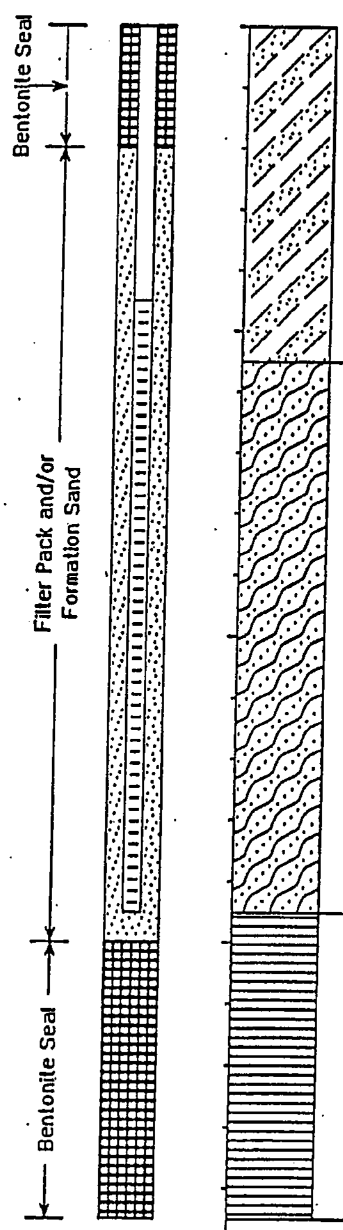
Drilling Contractor:
Name: AE Exploration Corp.
City: Springfield, IL
Equipment: CME 55

Personel:
Geologist: B. Hunsberger
Driller: M. Moore
Helper (s): R. Smith

Sample Type: – Continuous Barrel – Split Spoon – Shelby Tube – Core – Blind Drill

Run No.	Sample Type	Sample No.	Recov.	Blow Count	$q_u/[q_s]$ (in tsf)	% Moisture
11	Continuous Barrel	11B	5.0'			
12	Continuous Barrel	12A				
		12B	5.0'			
13	Continuous Barrel	13A	5.0'			
14	Continuous Barrel		0.0'			
15	Split Spoon	15A		10		
		15A	0.7'	31		

Depth (ft.): 45, 50, 55, 60



Description/Comments	Elev. (MSL)
Gray fine silty SAND, little clay.	514.5 – 509.5
Gray, fine clayey SAND, some silt.	509.5 – 504.5 – 499.5
Gray shale with muscovite mica. *(Since there was no recovery in Run # 14, the bedrock contact was determined at the depth the down pressure increased from 300 psi to 1500 psi on the auger column.)*	499.5 – 494.5

E.O.B.=59.5 feet

NOTE: ▼ = groundwater encountered while drilling.

Illinois Environmental Protection Agency

Well Completion Report

Site #: 1678250020 County Sangamon Well # G-110

Site Name: EGDS Landfill/ City Water, Light and Power Grid Coordinate: Northing 3728.6 Easting 2315.7

Drilling Contractor: AE Exploration Corporation Date Drilled Start: 07/12/93

Driller: M. Moore Geologist: B. Hunsberger Date Completed: 07/12/93

Drilling Method: Hollow Stem Auger Drilling Fluids (type): None

Annular Space Details

Type of Surface Seal: Concrete

Type of Annular Sealant: Cement/Bentonite

Amount of cement: # of bags 8 lbs. per bag 94

Amount of bentonite: # of bags 1 lbs. per bag 50

Type of Bentonite Seal (Granular, Pellet): Grout

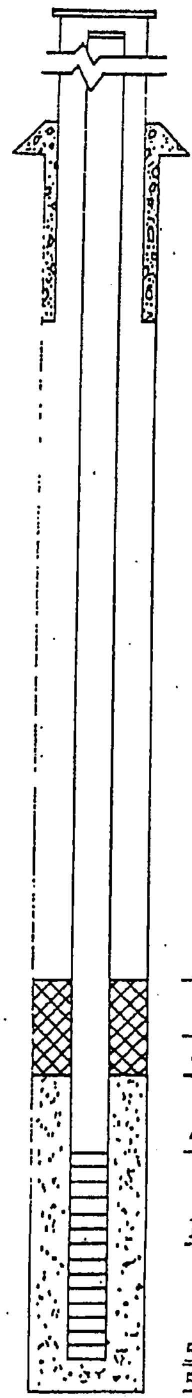
Amount of bentonite: # of Bags 1 lbs. per bag 50

Type of Sand Pack: #10-20 Silica Sand

Source of Sand: Best Environmental - Chardon, OH

Amount of Sand: # of bags 10 lbs. per bag 50

Elevations — .01 ft.



557	20	MSL Top of Protective Casing
557	11	MSL Top of Riser Pipe
2	61	ft. Casing Stickup
554	50	MSL Ground Surface
3	0	ft. Top of annular sealant
37	0	ft. Top of Seal
5	0	ft. Total Seal Interval
42	0	ft. Top of Sand
44	5	ft. Top of Screen
10	0	ft. Total Screen Interval
54	5	ft. Bottom of Screen
59	5	ft. Bottom of Borehole

Well Construction Materials

	Stainless Steel Specify Type	Teflon Specify Type	PVC Specify Type	Other Specify Type
Riser coupling joint	Flush			
Riser pipe above w.t.	304			
Riser pipe below w.t.	304			
Screen	304			
Coupling joint screen to riser	Flush			
Protective casing				Steel

Measurements

to .01 ft. (where applicable)

Riser pipe length	47.11'
Protective casing length	5.0'
Screen length	10.0'
Bottom of screen to end cap	0.21
Top of screen to first joint	0.065
Total length of casing	57.11'
Screen slot size	.01"
# of openings in screen	---
Diameter of borehole (in)	8.0"
ID of riser pipe (in)	2.0"

Completed by Brad Hunsberger Surveyed by: City Water, Light and Power Rich Davis registration # 2098

Professional Service Industries, Inc.

6105
6120

RECORD OF SUBSURFACE EXPLORATION

Boring G-105

Project Name: Monitoring Well Installations   Date of Boring: January 9, 1990

Site: CWLP Ash Disposal Facility   Project No.: 020-05001

DESCRIPTION	DEPTH	SAMPLE	N	Q_u	Q_p	M_c	REMARKS
SURFACE							
Silty clay to clayey silt, trace organics, brown (fill)		1-SS	20%				
	5	2-SS	35%				
	10	3-SS	25%				
Silty clay, drak grey to black, some organics	15						
Silty clay to clay, grey, mottled brown, trace sand		4-SS	100%				
	20	5-SS	40%				
Silty clay with sand, fine to medium, brown	25	6-SS	35%				While Drilling (water level symbol)
	30	7-SS	40%				
	35	8-SS	100%				
Silty clay, trace sand, dark grey, fine	40	9-SS	100%				
	45						

Professional Service Industries, Inc.

RECORD OF SUBSURFACE EXPLORATION

Boring G-105 (Continued)

Project Name: Monitoring Well Installations Date of Boring: January 9, 1990

Site: CWLP Ash Disposal Facility Project No.: 020-05001

DESCRIPTION	DEPTH	SAMPLE	N	Q_u	Q_p	M_c	REMARKS
Silty clay, some sand, fine, dark grey	45	10-SS	100%				
48'-48.7': Grey sand, fine to medium	50	11-SS	80%				
Shale, grey, weathered							
End of Boring							

Illinois Environmental Protection Agency

Well Completion Report

Site #: 1678250020 County Sangamon Well # G-105

Site Name: CWLP - Ash Disposal Facility Grid Coordinate. Northing 1641.61 Easting 610.10

Drilling Contractor: Professional Service Industries, Inc. Date Drilled Start: January 9, 1990

Driller: B. Williamson Geologist: -- Date Completed: January 16, 19 (Re-Drilled w/4½" I.D.)

Drilling Method: Hollow Stem Auger - 3½" I.D & 4½" I.D Drilling Fluids (type): None

Annular Space Details

Type of Surface Seal: Concrete

Type of Annular Sealant: Cement/Bentonite Grout

Amount of cement: # of bags 6 lbs. per bag 94

Amount of bentonite: # of bags 0.2 lbs. per bag 50

Type of Bentonite Seal (Granular, Pellet): Pellet

Amount of bentonite: # of Bags 0.5 lbs. per bag 50

Type of Sand Pack: Silica Sand (Marco-Sandblasting)

Source of Sand: Henry Nelch & Son Co., Springfield, IL

Amount of Sand: # of bags 1.8 lbs. per bag 100

Well Construction Materials

	Stainless Steel Specify Type	Teflon Specify Type	PVC Specify Type	Other Specify Type
Riser coupling joint			--	
Riser pipe above w.t.			2"	
Riser pipe below w.t.			2"	
Screen			2"	
Coupling joint screen to riser			--	
Protective casing				6"X5' Steel

Measurements

to .01 ft. (where applicable)

Riser pipe length	43.9
Protective casing length	Flush Mount
Screen length	6'
Bottom of screen to end cap	0.3'
Top of screen to first joint	0.3'
Total length of casing	49.9
Screen slot size	0.010
# of openings in screen	--
Diameter of borehole (in)	8
ID of riser pipe (in)	2

Elevations — .01 ft.

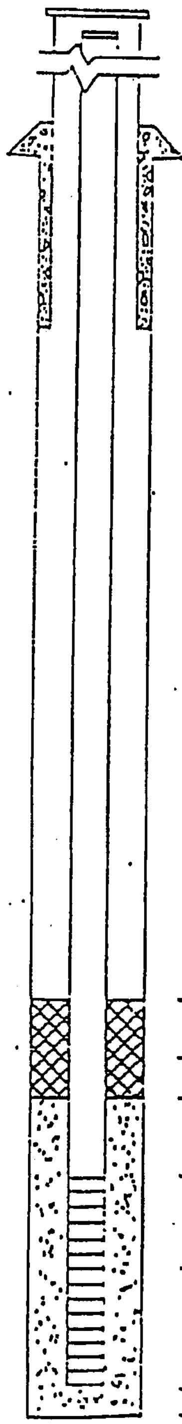
553 49 MSL Top of Protective Casing

553 25 MSL Top of Riser Pipe

+0.1 ft. Casing Stickup

553 49 MSL Ground Surface

-2.9 ft. Top of annular sealant



-40.5 ft. Top of Seal

2.0 ft. Total Seal Interval

-42.5 ft. Top of Sand

-43.8 ft. Top of Screen

6.0 ft. Total Screen Interval

-49.8 ft. Bottom of Screen

-53.0 ft. Bottom of Borehole

Completed by: Surveyed by: Ill. registration #

ATTACHMENT D

ENVIRONMENTAL MONITORING AND TECHNOLOGIES, INC.

8100 North Austin • Morton Grove, IL 60053-3203
847.967.6666 • 800.246.0663 • fax: 847.967.6735 • www.emt.com

June 29, 2010

Sue Corcoran
City, Water, Light & Power
201 East Lake Shore Drive
Springfield, IL 62707

RE CWLP FGDS 2nd Quarter Groundwater

Lab Orders:
10050637

Dear Sue Corcoran:

Enclosed are the analytical reports for the EMT Lab Order listed. Also included with this analytical report is a copy of the chain of custody associated with these samples. If you have any questions, please contact me at 847-967-6666.

Sincerely,

Joe Pavilonis
Project Manager

Approved by,

Mitchell Ostrowski
Laboratory Director

This Report Contains 140 pages

The Contents of this report apply to the sample(s) analyzed. No duplication is allowed except in its entirety.

State of Illinois Chemical Analysis in Drinking Water Accredited Lab. No. 100256
State of Wisconsin Wastewater and Hazardous Waste No. 999888890

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Report of Laboratory Analysis

CLIENT: City, Water, Light & Power
Lab Order: 10050637
Project: CWLP FGDS 2nd Quarter Groundwater
Lab ID: 10050637-01

Client Sample ID: R101
Report Date: 6/29/2010
Collection Date: 6/7/2010 7:45:00 AM
Matrix: Groundwater

Analyses	Result	EMT Reporting Limit	Units	Date Analyzed	Batch	Analyst
Ammonia as N		Method:	SM4500-NH3-B-C			
Nitrogen, Ammonia (As N)	0.78	0.16	mg/L	5/27/10	58701	TTT
Anions by Ion Chromatography		Method:	SW9056			
Chloride	79.8	2.	mg/L	5/27/10	R141304	GSB
Nitrogen, Nitrate (As N)	0.2	0.2	mg/L	5/27/10	R141304	GSB
Sulfate	306.	10.	mg/L	5/27/10	R141304	GSB
BOD, 5 Day, 20°C		Method:	SM5210 B			
Biochemical Oxygen Demand	5.	2.	mg/L	5/26/10	R141432	AM2
Chemical Oxygen Demand		Method:	HACH 8000			
Chemical Oxygen Demand	< 10.	10.	mg/L	6/1/10	R141473	VT
Cyanide, Dissolved		Method:				
Cyanide	< 0.01	0.01	mg/L	5/27/10	58666	CS2
Cyanide, Total		Method:	SW9010B/9014 BY AQUACHEM			
Cyanide	< 0.01	0.01	mg/L	5/27/10	58666	CS2
Dissolved Anions by Ion Chromatography		Method:	SW9056			
Chloride	79.5	2.	mg/L	5/26/10	R141296	GSB
Nitrogen, Nitrate (As N)	0.23	0.2	mg/L	5/26/10	R141296	GSB
Sulfate	305.	10.	mg/L	5/27/10	R141373	GSB
Fluoride		Method:	SM4500-F C			
Fluoride	< 0.5	0.5	mg/L	6/1/10	R141448	MF
Hexane Extractable Materials, (FOG)		Method:	E1664A			
Oil and Grease (HEM)	< 5.	5.	mg/L	5/27/10	R141409	TB2
Organic Carbon, Total		Method:	SM5310-C B			
Organic Carbon, Total	7.06	1.	mg/L	6/2/10	R141522	VT
Phenolics, Total		Method:	SW9065 BY AQUACHEM			
Phenolics, Total Recoverable	0.006	0.005	mg/L	5/27/10	58685	CS2
Soluble Ammonia as N		Method:	4500-NH3-B-C			

Qualifiers:
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Report of Laboratory Analysis

CLIENT:	City, Water, Light & Power	**Client Sample ID:**	R101
Lab Order:	10050637	**Report Date:**	6/29/2010
Project:	CWLP FGDS 2nd Quarter Groundwater	**Collection Date:**	6/7/2010 7:45:00 AM
Lab ID:	10050637-01	**Matrix:**	Groundwater

Analyses	Result	EMT Reporting Limit	Units	Date Analyzed	Batch	Analyst
Nitrogen, Ammonia (As N)	< 0.16	0.16	mg/L	5/27/10	58701	TTT
Total Dissolved Solids		**Method:**	**SM2540C**			
Total Dissolved Solids (Residue, Filterable)	894.	20.	mg/L	5/26/10	R141332	IR
Mercury in Groundwater, Dissolved		**Method:**	**SW7470A / HG PREP**			
Mercury	< 0.0005	0.0005	mg/L	6/4/10	58866	IG
Mercury, Total		**Method:**	**SW7470A / HG PREP**			
Mercury	< 0.0005	0.0005	mg/L	6/4/10	58863	IG
Metals, Dissolved		**Method:**	**SW6020A / SW3005A**			
Arsenic	< 0.00889	0.00889	mg/L	5/26/10 16:29	58669	AG
Boron	< 0.0556	0.0556	mg/L	5/27/10	58669	AG
Cadmium	< 0.00444	0.00444	mg/L	5/26/10 16:29	58669	AG
Chromium	0.0116	0.00889	mg/L	5/26/10 16:29	58669	AG
Iron	0.406	0.0889	mg/L	5/26/10 16:29	58669	AG
Lead	< 0.00667	0.00667	mg/L	5/26/10 16:29	58669	AG
Magnesium	64.8	1.11	mg/L	5/27/10	58669	AG
Zinc	< 0.02	0.02	mg/L	5/26/10 16:29	58669	AG
Metals, Total.		**Method:**	**SW6020A / SW3015**			
Aluminum	0.664	0.05	mg/L	5/26/10 22:02	58676	AG
Antimony	< 0.006	0.006	mg/L	5/26/10 22:02	58676	AG
Arsenic	< 0.01	0.01	mg/L	5/26/10 22:02	58676	AG
Barium	0.0333	0.02	mg/L	5/26/10 22:02	58676	AG
Beryllium	< 0.003	0.003	mg/L	5/26/10 22:02	58676	AG
Boron	0.0748	0.04	mg/L	5/26/10 22:02	58676	AG
Cadmium	< 0.001	0.001	mg/L	5/26/10 22:02	58676	AG
Calcium	190.	2.5	mg/L	5/27/10	58676	AG
Chromium	< 0.07	0.07	mg/L	5/26/10 22:02	58676	AG
Cobalt	< 0.07	0.07	mg/L	5/26/10 22:02	58676	AG
Copper	< 0.06	0.06	mg/L	5/26/10 22:02	58676	AG
Iron	1.43	0.04	mg/L	5/26/10 22:02	58676	AG
Lead	< 0.005	0.005	mg/L	5/26/10 22:02	58676	AG

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Project:	CWLP FGDS 2nd Quarter Groundwater	**Collection Date:**	6/7/2010 7:45:00 AM
Lab ID:	10050637-01	**Matrix:**	Groundwater

Analyses	Result	EMT Reporting Limit	Qual	Units	Date Analyzed	Batch	Analyst
Magnesium	76.1	1.25		mg/L	5/27/10	58676	AG
Manganese	1.08	0.01		mg/L	5/26/10 22:02	58676	AG
Nickel	< 0.05	0.05		mg/L	5/26/10 22:02	58676	AG
Potassium	0.66	0.625		mg/L	5/26/10 22:02	58676	AG
Selenium	< 0.02	0.02		mg/L	5/26/10 22:02	58676	AG
Silver	< 0.05	0.05		mg/L	5/26/10 22:02	58676	AG
Sodium	30.6	4.5		mg/L	5/27/10	58676	AG
Thallium	< 0.002	0.002		mg/L	5/26/10 22:02	58676	AG
Vanadium	< 0.0125	0.0125		mg/L	5/26/10 22:02	58676	AG
Zinc	< 0.02	0.02		mg/L	5/26/10 22:02	58676	AG
Carbamates		**Method:**	**E531.1**				
Aldicarb	< 2.	2.	C	µg/L	6/7/10	R141681	LBI
Carbofuran	< 2.	2.	C	µg/L	6/7/10	R141681	LBI
EDB, DBCP and 123TCP by GC/ECD		**Method:**	**E504.1 / E504.1**				
1,2-Dibromo-3-chloropropane	< 0.004	0.004	C	µg/L	6/2/10 13:22	58881	MNN
1,2-Dibromoethane	< 0.004	0.004	C	µg/L	6/2/10 13:22	58881	MNN
Endothal		**Method:**	**E548.1**				
Endothal	< 2.	2.		µg/L	6/3/10	R141835	OUT
Haloacetic Acids		**Method:**	**E552.2 / E552.1**				
Dalapon	< 0.5	0.5	C	µg/L	6/7/10 20:30	58894	LP
Organochlorine Pesticides		**Method:**	**SW8081A / SW3510C**				
4,4´-DDT	< 0.01	0.01		µg/L	6/2/10 23:28	58653	LP
Alachlor	< 0.01	0.01		µg/L	6/2/10 23:28	58653	LP
Aldrin	< 0.01	0.01		µg/L	6/2/10 23:28	58653	LP
Atrazine	< 0.17	0.17		µg/L	6/2/10 23:28	58653	LP
Chlordane	< 0.13	0.13		µg/L	6/2/10 23:28	58653	LP
Dieldrin	< 0.01	0.01		µg/L	6/2/10 23:28	58653	LP
Endrin	< 0.01	0.01		µg/L	6/2/10 23:28	58653	LP
gamma-BHC	< 0.01	0.01		µg/L	6/2/10 23:28	58653	LP
Heptachlor	< 0.01	0.01		µg/L	6/2/10 23:28	58653	LP
Heptachlor epoxide	< 0.01	0.01		µg/L	6/2/10 23:28	58653	LP

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Project:	CWLP FGDS 2nd Quarter Groundwater	**Collection Date:**	6/7/2010 7:45:00 AM
Lab ID:	10050637-01	**Matrix:**	Groundwater

Analyses	Result	EMT Reporting Limit		Units	Date Analyzed	Batch	Analyst
Methoxychlor	< 0.01	0.01		µg/L	6/2/10 23:28	58653	LP
Simazine	< 0.17	0.17		µg/L	6/2/10 23:28	58653	LP
Toxaphene	< 0.69	0.69		µg/L	6/2/10 23:28	58653	LP
Polychlorinated biphenyls (PCBs)		**Method:**	**SW8082 / SW3510C**				
Aroclor 1016	< 0.12	0.12		µg/L	5/28/10	58654	IP
Aroclor 1221	< 0.12	0.12		µg/L	5/28/10	58654	IP
Aroclor 1232	< 0.12	0.12		µg/L	5/28/10	58654	IP
Aroclor 1242	< 0.12	0.12		µg/L	5/28/10	58654	IP
Aroclor 1248	< 0.12	0.12		µg/L	5/28/10	58654	IP
Aroclor 1254	< 0.12	0.12		µg/L	5/28/10	58654	IP
Aroclor 1260	< 0.12	0.12		µg/L	5/28/10	58654	IP
PCB, Total	< 0.81	0.81		µg/L	5/28/10	58654	IP
Semivolatile Organic Compounds GC/MS		**Method:**	**SW8270D / SW3510C**				
Benzo(a)pyrene	< 3.32	3.32		µg/L	6/2/10 17:55	58788	MG3
Bis(2-ethylhexyl)phthalate	< 6.64	6.64		µg/L	6/2/10 17:55	58788	MG3
Bis(chloromethyl)ether	< 13.9	13.9	C	µg/L	6/2/10 17:55	58788	MG3
Butyl benzyl phthalate	< 1.33	1.33		µg/L	6/2/10 17:55	58788	MG3
Di-n-butyl phthalate	< 3.32	3.32	B	µg/L	6/2/10 17:55	58788	MG3
Diethyl phthalate	< 0.13	0.13		µg/L	6/2/10 17:55	58788	MG3
Dimethyl phthalate	< 0.13	0.13		µg/L	6/2/10 17:55	58788	MG3
Isophorone	< 0.13	0.13		µg/L	6/2/10 17:55	58788	MG3
m,p-Cresol	< 1.6	1.6		µg/L	6/2/10 17:55	58788	MG3
Naphthalene	< 0.13	0.13		µg/L	6/2/10 17:55	58788	MG3
Parathion	< 3.32	3.32	C	µg/L	6/2/10 17:55	58788	MG3
Phenol	< 1.12	1.12		µg/L	6/2/10 17:55	58788	MG3
Solvent Extractable Compounds by HPLC		**Method:**	**SW8321A / SW3510C**				
2,4,5-TP (Silvex)	< 0.19	0.19		µg/L	6/9/10	58934	LBI
2,4-D	< 0.31	0.31		µg/L	6/9/10	58934	LBI
Dinoseb	< 0.31	0.31		µg/L	6/9/10	58934	LBI
Pentachlorophenol	< 0.26	0.26	C	µg/L	6/9/10	58934	LBI
Picloram	< 0.12	0.12	C	µg/L	6/9/10	58934	LBI
Volatile Organic Compounds by GC/MS		**Method:**	**SW8260B / SW5030A**				

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Lab ID: 10050637-01

Client Sample ID: R101
Report Date: 6/29/2010
Collection Date: 6/7/2010 7:45:00 AM
Matrix: Groundwater

Analyses	Result	EMT Reporting Limit		Units	Date Analyzed	Batch	Analyst
1,1,1,2-Tetrachloroethane	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
1,1,1-Trichloroethane	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
1,1,2,2-Tetrachloroethane	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
1,1,2-Trichloroethane	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
1,1-Dichloroethane	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
1,1-Dichloroethene	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
1,2,3-Trichlorobenzene	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
1,2,3-Trichloropropane	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
1,2,4-Trimethylbenzene	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
1,2-Dibromoethane	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
1,2-Dichlorobenzene	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
1,2-Dichloroethane	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
1,2-Dichloropropane	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
1,3,5-Trimethylbenzene	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
1,3-Dichlorobenzene	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
1,3-Dichloropropane	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
1,4-Dichlorobenzene	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
2,2-Dichloropropane	< 0.4	0.4	C	µg/L	5/26/10 20:35	58868	XN
2-Butanone	< 4.	4.		µg/L	5/26/10 20:35	58868	XN
2-Chlorotoluene	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
2-Hexanone	< 4.	4.		µg/L	5/26/10 20:35	58868	XN
4-Chlorotoluene	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
4-Methyl-2-pentanone	< 4.	4.		µg/L	5/26/10 20:35	58868	XN
Acetone	< 8.	8.		µg/L	5/26/10 20:35	58868	XN
Acrolein	< 4.	4.		µg/L	5/26/10 20:35	58868	XN
Acrylonitrile	< 4.	4.		µg/L	5/26/10 20:35	58868	XN
Benzene	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
Bromobenzene	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
Bromochloromethane	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
Bromodichloromethane	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
Bromoform	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
Bromomethane	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
Carbon disulfide	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
Carbon tetrachloride	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
Chlorobenzene	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN

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J - Analyte detected below quanititation limits

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Report of Laboratory Analysis

CLIENT:	City, Water, Light & Power	**Client Sample ID:**	R101
Lab Order:	10050637	**Report Date:**	6/29/2010
Project:	CWLP FGDS 2nd Quarter Groundwater	**Collection Date:**	6/7/2010 7:45:00 AM
Lab ID:	10050637-01	**Matrix:**	Groundwater

Analyses	Result	EMT Reporting Limit		Units	Date Analyzed	Batch	Analyst
Chloroethane	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
Chloroform	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
Chloromethane	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
cis-1,2-Dichloroethene	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
cis-1,3-Dichloropropene	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
Dibromochloromethane	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
Dibromomethane	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
Dichlorodifluoromethane	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
Ethylbenzene	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
Hexachlorobutadiene	< 0.4	0.4	C	µg/L	5/26/10 20:35	58868	XN
Iodomethane	< 0.4	0.4	C	µg/L	5/26/10 20:35	58868	XN
Isopropyl Toluene	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
Isopropylbenzene	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
m,p-Xylene	< 0.8	0.8		µg/L	5/26/10 20:35	58868	XN
Methylene chloride	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
n-Butylbenzene	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
n-Propylbenzene	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
o-Xylene	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
sec-Butylbenzene	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
Styrene	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
tert-Butylbenzene	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
Tetrachloroethene	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
Tetrahydrofuran	< 4.	4.	C	µg/L	5/26/10 20:35	58868	XN
Toluene	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
trans-1,2-Dichloroethene	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
trans-1,3-Dichloropropene	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
trans-1,4-Dichloro-2-butene	< 2.	2.	C	µg/L	6/8/10 15:03	58955	XN
Trichloroethene	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
Trichlorofluoromethane	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
Vinyl acetate	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
Vinyl chloride	< 0.4	0.4		µg/L	5/26/10 20:35	58868	XN
1,3-Dichloropropene, Total	< 0.8	0.8		µg/L	5/26/10 20:35	58868	XN
Xylenes, Total	< 1.2	1.2		µg/L	5/26/10 20:35	58868	XN

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Report of Laboratory Analysis

CLIENT:	City, Water, Light & Power	**Client Sample ID:**	R101
Lab Order:	10050637	**Report Date:**	6/29/2010
Project:	CWLP FGDS 2nd Quarter Groundwater	**Collection Date:**	5/25/2010
Lab ID:	10050637-01	**Matrix:**	Groundwater

Analyses	Result	EMT Reporting Limit	Units	Date Analyzed	Batch	Analyst
Ammonia as N		**Method:**	**SM4500-NH3-B-C**			
Nitrogen, Ammonia (As N)	0.78	0.16	mg/L	5/27/10	58701	TTT
Anions by Ion Chromatography		**Method:**	**SW9056**			
Chloride	79.8	2.	mg/L	5/27/10	R141304	GSB
Nitrogen, Nitrate (As N)	0.2	0.2	mg/L	5/27/10	R141304	GSB
Sulfate	306.	10.	mg/L	5/27/10	R141304	GSB
BOD, 5 Day, 20°C		**Method:**	**SM5210 B**			
Biochemical Oxygen Demand	5.	2.	mg/L	5/26/10	R141432	AM2
Chemical Oxygen Demand		**Method:**	**HACH 8000**			
Chemical Oxygen Demand	< 10.	10.	mg/L	6/1/10	R141473	VT
Cyanide, Dissolved		**Method:**				
Cyanide	< 0.01	0.01	mg/L	5/27/10	58666	CS2
Cyanide, Total		**Method:**	**SW9010B/9014 BY AQUACHEM**			
Cyanide	< 0.01	0.01	mg/L	5/27/10	58666	CS2
Dissolved Anions by Ion Chromatography		**Method:**	**SW9056**			
Chloride	79.5	2.	mg/L	5/26/10	R141296	GSB
Nitrogen, Nitrate (As N)	0.23	0.2	mg/L	5/26/10	R141296	GSB
Sulfate	305.	10.	mg/L	5/27/10	R141373	GSB
Fluoride		**Method:**	**SM4500-F C**			
Fluoride	< 0.5	0.5	mg/L	6/1/10	R141448	MF
Hexane Extractable Materials, (FOG)		**Method:**	**E1664A**			
Oil and Grease (HEM)	< 5.	5.	mg/L	5/27/10	R141409	TB2
Organic Carbon, Total		**Method:**	**SM5310-C B**			
Organic Carbon, Total	7.06	1.	mg/L	6/2/10	R141522	VT
Phenolics, Total		**Method:**	**SW9065 BY AQUACHEM**			
Phenolics, Total Recoverable	0.006	0.005	mg/L	5/27/10	58685	CS2
Soluble Ammonia as N		**Method:**	**4500-NH3-B-C**			

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Report of Laboratory Analysis

CLIENT:	City, Water, Light & Power	**Client Sample ID:**	R101
Lab Order:	10050637	**Report Date:**	6/29/2010
Project:	CWLP FGDS 2nd Quarter Groundwater	**Collection Date:**	5/25/2010
Lab ID:	10050637-01	**Matrix:**	Groundwater

Analyses	Result	EMT Reporting Limit	Units	Date Analyzed	Batch	Analyst
Nitrogen, Ammonia (As N)	< 0.16	0.16	mg/L	5/27/10	58701	TTT
Total Dissolved Solids		**Method:**	**SM2540C**			
Total Dissolved Solids (Residue, Filterable)	894.	20.	mg/L	5/26/10	R141332	IR
Mercury in Groundwater, Dissolved		**Method:**	**SW7470A / HG PREP**			
Mercury	< 0.0005	0.0005	mg/L	6/4/10	58866	IG
Mercury, Total		**Method:**	**SW7470A / HG PREP**			
Mercury	< 0.0005	0.0005	mg/L	6/4/10	58863	IG
Metals, Dissolved		**Method:**	**SW6020A / SW3005A**			
Arsenic	< 0.00889	0.00889	mg/L	5/26/10 16:29	58669	AG
Boron	< 0.0556	0.0556	mg/L	5/27/10	58669	AG
Cadmium	< 0.00444	0.00444	mg/L	5/26/10 16:29	58669	AG
Chromium	0.0116	0.00889	mg/L	5/26/10 16:29	58669	AG
Iron	0.406	0.0889	mg/L	5/26/10 16:29	58669	AG
Lead	< 0.00667	0.00667	mg/L	5/26/10 16:29	58669	AG
Magnesium	64.8	1.11	mg/L	5/27/10	58669	AG
Zinc	< 0.02	0.02	mg/L	5/26/10 16:29	58669	AG
Metals, Total.		**Method:**	**SW6020A / SW3015**			
Aluminum	0.664	0.05	mg/L	5/26/10 22:02	58676	AG
Antimony	< 0.006	0.006	mg/L	5/26/10 22:02	58676	AG
Arsenic	< 0.01	0.01	mg/L	5/26/10 22:02	58676	AG
Barium	0.0333	0.02	mg/L	5/26/10 22:02	58676	AG
Beryllium	< 0.003	0.003	mg/L	5/26/10 22:02	58676	AG
Boron	0.0748	0.04	mg/L	5/26/10 22:02	58676	AG
Cadmium	< 0.001	0.001	mg/L	5/26/10 22:02	58676	AG
Calcium	190.	2.5	mg/L	5/27/10	58676	AG
Chromium	< 0.07	0.07	mg/L	5/26/10 22:02	58676	AG
Cobalt	< 0.07	0.07	mg/L	5/26/10 22:02	58676	AG
Copper	< 0.06	0.06	mg/L	5/26/10 22:02	58676	AG
Iron	1.43	0.04	mg/L	5/26/10 22:02	58676	AG
Lead	< 0.005	0.005	mg/L	5/26/10 22:02	58676	AG

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Report of Laboratory Analysis

CLIENT:	City, Water, Light & Power	**Client Sample ID:**	G110
Lab Order:	10050637	**Report Date:**	6/29/2010
Project:	CWLP FGDS 2nd Quarter Groundwater	**Collection Date:**	5/25/2010
Lab ID:	10050637-02	**Matrix:**	Groundwater

Analyses	Result	EMT Reporting Limit	Units	Date Analyzed	Batch	Analyst
Ammonia as N		**Method:**	**SM4500-NH3-B-C**			
Nitrogen, Ammonia (As N)	4.37	0.16	mg/L	5/27/10	58701	TTT
Anions by Ion Chromatography		**Method:**	**SW9056**			
Chloride	5.59	2.	mg/L	5/27/10	R141304	GSB
Nitrogen, Nitrate (As N)	< 0.2	0.2	mg/L	5/27/10	R141304	GSB
Sulfate	< 5.	5.	mg/L	5/27/10	R141304	GSB
BOD, 5 Day, 20°C		**Method:**	**SM5210 B**			
Biochemical Oxygen Demand	5.	2.	mg/L	5/26/10	R141432	AM2
Chemical Oxygen Demand		**Method:**	**HACH 8000**			
Chemical Oxygen Demand	< 10.	10.	mg/L	6/1/10	R141473	VT
Cyanide, Dissolved		**Method:**				
Cyanide	< 0.01	0.01	mg/L	5/27/10	58666	CS2
Cyanide, Total		**Method:**	**SW9010B/9014 BY AQUACHEM**			
Cyanide	< 0.01	0.01	mg/L	5/27/10	58666	CS2
Dissolved Anions by Ion Chromatography		**Method:**	**SW9056**			
Chloride	4.73	2.	mg/L	5/26/10	R141296	GSB
Nitrogen, Nitrate (As N)	< 0.2	0.2	mg/L	5/26/10	R141296	GSB
Sulfate	< 5.	5.	mg/L	5/26/10	R141296	GSB
Fluoride		**Method:**	**SM4500-F C**			
Fluoride	< 0.5	0.5	mg/L	6/1/10	R141448	MF
Hexane Extractable Materials, (FOG)		**Method:**	**E1664A**			
Oil and Grease (HEM)	< 5.	5.	mg/L	5/27/10	R141409	TB2
Organic Carbon, Total		**Method:**	**SM5310-C B**			
Organic Carbon, Total	9.15	1.	mg/L	6/2/10	R141522	VT
Phenolics, Total		**Method:**	**SW9065 BY AQUACHEM**			
Phenolics, Total Recoverable	< 0.005	0.005	mg/L	5/27/10	58685	CS2
Soluble Ammonia as N		**Method:**	**4500-NH3-B-C**			

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Report of Laboratory Analysis

CLIENT:	City, Water, Light & Power	**Client Sample ID:**	G110
Lab Order:	10050637	**Report Date:**	6/29/2010
Project:	CWLP FGDS 2nd Quarter Groundwater	**Collection Date:**	5/25/2010
Lab ID:	10050637-02	**Matrix:**	Groundwater

Analyses	Result	EMT Reporting Limit	Units	Date Analyzed	Batch	Analyst
Nitrogen, Ammonia (As N)	3.86	0.16	mg/L	5/27/10	58701	TTT
Total Dissolved Solids		**Method:**	**SM2540C**			
Total Dissolved Solids (Residue, Filterable)	526.	20.	mg/L	5/26/10	R141332	IR
Mercury in Groundwater, Dissolved		**Method:**	**SW7470A / HG PREP**			
Mercury	< 0.0005	0.0005	mg/L	6/4/10	58866	IG
Mercury, Total		**Method:**	**SW7470A / HG PREP**			
Mercury	< 0.0005	0.0005	mg/L	6/4/10	58863	IG
Metals, Dissolved		**Method:**	**SW6020A / SW3005A**			
Arsenic	< 0.00889	0.00889	mg/L	5/26/10 16:50	58669	AG
Boron	0.0817	0.0556	mg/L	5/27/10	58669	AG
Cadmium	< 0.00444	0.00444	mg/L	5/26/10 16:50	58669	AG
Chromium	0.0265	0.00889	mg/L	5/26/10 16:50	58669	AG
Iron	2.78	0.0889	mg/L	5/26/10 16:50	58669	AG
Lead	< 0.00667	0.00667	mg/L	5/26/10 16:50	58669	AG
Magnesium	58.6	1.11	mg/L	5/27/10	58669	AG
Zinc	< 0.02	0.02	mg/L	5/26/10 16:50	58669	AG
Metals, Total.		**Method:**	**SW6020A / SW3015**			
Aluminum	0.178	0.05	mg/L	5/26/10 22:07	58676	AG
Antimony	< 0.006	0.006	mg/L	5/26/10 22:07	58676	AG
Arsenic	< 0.01	0.01	mg/L	5/26/10 22:07	58676	AG
Barium	0.18	0.02	mg/L	5/26/10 22:07	58676	AG
Beryllium	< 0.003	0.003	mg/L	5/26/10 22:07	58676	AG
Boron	0.123	0.04	mg/L	5/26/10 22:07	58676	AG
Cadmium	0.00258	0.001	mg/L	5/26/10 22:07	58676	AG
Calcium	118.	2.5	mg/L	5/27/10	58676	AG
Chromium	< 0.07	0.07	mg/L	5/26/10 22:07	58676	AG
Cobalt	< 0.07	0.07	mg/L	5/26/10 22:07	58676	AG
Copper	< 0.06	0.06	mg/L	5/26/10 22:07	58676	AG
Iron	6.71	0.04	mg/L	5/26/10 22:07	58676	AG
Lead	< 0.005	0.005	mg/L	5/26/10 22:07	58676	AG

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Report of Laboratory Analysis

CLIENT: City, Water, Light & Power — **Client Sample ID:** G110
Lab Order: 10050637 — **Report Date:** 6/29/2010
Project: CWLP FGDS 2nd Quarter Groundwater — **Collection Date:** 5/25/2010
Lab ID: 10050637-02 — **Matrix:** Groundwater

Analyses	Result	EMT Reporting Limit	Qual	Units	Date Analyzed	Batch	Analyst
Magnesium	47.2	1.25		mg/L	5/27/10	58676	AG
Manganese	0.12	0.01		mg/L	5/26/10 22:07	58676	AG
Nickel	< 0.05	0.05		mg/L	5/26/10 22:07	58676	AG
Potassium	1.51	0.625		mg/L	5/26/10 22:07	58676	AG
Selenium	< 0.02	0.02		mg/L	5/26/10 22:07	58676	AG
Silver	< 0.05	0.05		mg/L	5/26/10 22:07	58676	AG
Sodium	17.3	4.5		mg/L	5/27/10	58676	AG
Thallium	< 0.002	0.002		mg/L	5/26/10 22:07	58676	AG
Vanadium	< 0.0125	0.0125		mg/L	5/26/10 22:07	58676	AG
Zinc	< 0.02	0.02		mg/L	5/26/10 22:07	58676	AG
Carbamates		**Method:**	**E531.1**				
Aldicarb	< 2.	2.	C	µg/L	6/7/10	R141681	LBI
Carbofuran	< 2.	2.	C	µg/L	6/7/10	R141681	LBI
EDB, DBCP and 123TCP by GC/ECD		**Method:**	**E504.1 / E504.1**				
1,2-Dibromo-3-chloropropane	< 0.004	0.004	C	µg/L	6/2/10 13:54	58881	MNN
1,2-Dibromoethane	< 0.004	0.004	C	µg/L	6/2/10 13:54	58881	MNN
Endothal		**Method:**	**E548.1**				
Endothal	< 2.	2.		µg/L	6/3/10	R141835	OUT
Haloacetic Acids		**Method:**	**E552.2 / E552.1**				
Dalapon	< 1.25	1.25	C	µg/L	6/7/10 21:14	58894	LP
Organochlorine Pesticides		**Method:**	**SW8081A / SW3510C**				
4,4'-DDT	< 0.01	0.01		µg/L	6/3/10 00:15	58653	LP
Alachlor	< 0.01	0.01		µg/L	6/3/10 00:15	58653	LP
Aldrin	< 0.01	0.01		µg/L	6/3/10 00:15	58653	LP
Atrazine	< 0.17	0.17		µg/L	6/3/10 00:15	58653	LP
Chlordane	< 0.13	0.13		µg/L	6/3/10 00:15	58653	LP
Dieldrin	< 0.01	0.01		µg/L	6/3/10 00:15	58653	LP
Endrin	< 0.01	0.01		µg/L	6/3/10 00:15	58653	LP
gamma-BHC	< 0.01	0.01		µg/L	6/3/10 00:15	58653	LP
Heptachlor	< 0.01	0.01		µg/L	6/3/10 00:15	58653	LP
Heptachlor epoxide	< 0.01	0.01		µg/L	6/3/10 00:15	58653	LP

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Report of Laboratory Analysis

CLIENT:	City, Water, Light & Power	**Client Sample ID:**	G110
Lab Order:	10050637	**Report Date:**	6/29/2010
Project:	CWLP FGDS 2nd Quarter Groundwater	**Collection Date:**	5/25/2010
Lab ID:	10050637-02	**Matrix:**	Groundwater

Analyses	Result	EMT Reporting Limit		Units	Date Analyzed	Batch	Analyst
Methoxychlor	< 0.01	0.01		µg/L	6/3/10 00:15	58653	LP
Simazine	< 0.17	0.17		µg/L	6/3/10 00:15	58653	LP
Toxaphene	< 0.7	0.7		µg/L	6/3/10 00:15	58653	LP
Polychlorinated biphenyls (PCBs)		**Method:**		**SW8082 / SW3510C**			
Aroclor 1016	< 0.12	0.12		µg/L	5/28/10	58654	IP
Aroclor 1221	< 0.12	0.12		µg/L	5/28/10	58654	IP
Aroclor 1232	< 0.12	0.12		µg/L	5/28/10	58654	IP
Aroclor 1242	< 0.12	0.12		µg/L	5/28/10	58654	IP
Aroclor 1248	< 0.12	0.12		µg/L	5/28/10	58654	IP
Aroclor 1254	< 0.12	0.12		µg/L	5/28/10	58654	IP
Aroclor 1260	< 0.12	0.12		µg/L	5/28/10	58654	IP
PCB, Total	< 0.82	0.82		µg/L	5/28/10	58654	IP
Semivolatile Organic Compounds GC/MS		**Method:**		**SW8270D / SW3510C**			
Benzo(a)pyrene	< 3.32	3.32		µg/L	6/2/10 18:37	58788	MG3
Bis(2-ethylhexyl)phthalate	< 6.64	6.64		µg/L	6/2/10 18:37	58788	MG3
Bis(chloromethyl)ether	< 13.9	13.9	C	µg/L	6/2/10 18:37	58788	MG3
Butyl benzyl phthalate	< 1.33	1.33		µg/L	6/2/10 18:37	58788	MG3
Di-n-butyl phthalate	< 3.32	3.32		µg/L	6/2/10 18:37	58788	MG3
Diethyl phthalate	< 0.13	0.13		µg/L	6/2/10 18:37	58788	MG3
Dimethyl phthalate	< 0.13	0.13		µg/L	6/2/10 18:37	58788	MG3
Isophorone	< 0.13	0.13		µg/L	6/2/10 18:37	58788	MG3
m,p-Cresol	< 1.61	1.61		µg/L	6/2/10 18:37	58788	MG3
Naphthalene	< 0.13	0.13		µg/L	6/2/10 18:37	58788	MG3
Parathion	< 3.32	3.32	C	µg/L	6/2/10 18:37	58788	MG3
Phenol	< 1.12	1.12		µg/L	6/2/10 18:37	58788	MG3
Solvent Extractable Compounds by HPLC		**Method:**		**SW8321A / SW3510C**			
2,4,5-TP (Silvex)	< 0.19	0.19		µg/L	5/30/10	58755	LBI
2,4-D	< 0.31	0.31		µg/L	5/30/10	58755	LBI
Dinoseb	< 0.31	0.31		µg/L	5/30/10	58755	LBI
Pentachlorophenol	< 0.26	0.26	C	µg/L	5/30/10	58755	LBI
Picloram	< 0.13	0.13	C	µg/L	5/30/10	58755	LBI
Volatile Organic Compounds by GC/MS		**Method:**		**SW8260B / SW5030A**			

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Report of Laboratory Analysis

CLIENT: City, Water, Light & Power
Client Sample ID: G110
Lab Order: 10050637
Report Date: 6/29/2010
Project: CWLP FGDS 2nd Quarter Groundwater
Collection Date: 5/25/2010
Lab ID: 10050637-02
Matrix: Groundwater

Analyses	Result	EMT Reporting Limit		Units	Date Analyzed	Batch	Analyst
1,1,1,2-Tetrachloroethane	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
1,1,1-Trichloroethane	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
1,1,2,2-Tetrachloroethane	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
1,1,2-Trichloroethane	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
1,1-Dichloroethane	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
1,1-Dichloroethene	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
1,2,3-Trichlorobenzene	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
1,2,3-Trichloropropane	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
1,2,4-Trimethylbenzene	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
1,2-Dibromoethane	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
1,2-Dichlorobenzene	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
1,2-Dichloroethane	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
1,2-Dichloropropane	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
1,3,5-Trimethylbenzene	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
1,3-Dichlorobenzene	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
1,3-Dichloropropane	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
1,4-Dichlorobenzene	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
2,2-Dichloropropane	< 0.4	0.4	C	µg/L	5/26/10 21:09	58868	XN
2-Butanone	< 4.	4.		µg/L	5/26/10 21:09	58868	XN
2-Chlorotoluene	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
2-Hexanone	< 4.	4.		µg/L	5/26/10 21:09	58868	XN
4-Chlorotoluene	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
4-Methyl-2-pentanone	< 4.	4.		µg/L	5/26/10 21:09	58868	XN
Acetone	< 8.	8.		µg/L	5/26/10 21:09	58868	XN
Acrolein	< 4.	4.		µg/L	5/26/10 21:09	58868	XN
Acrylonitrile	< 4.	4.		µg/L	5/26/10 21:09	58868	XN
Benzene	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
Bromobenzene	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
Bromochloromethane	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
Bromodichloromethane	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
Bromoform	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
Bromomethane	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
Carbon disulfide	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
Carbon tetrachloride	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
Chlorobenzene	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN

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Report of Laboratory Analysis

CLIENT: City, Water, Light & Power
Client Sample ID: G110
Lab Order: 10050637
Report Date: 6/29/2010
Project: CWLP FGDS 2nd Quarter Groundwater
Collection Date: 5/25/2010
Lab ID: 10050637-02
Matrix: Groundwater

Analyses	Result	EMT Reporting Limit		Units	Date Analyzed	Batch	Analyst
Chloroethane	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
Chloroform	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
Chloromethane	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
cis-1,2-Dichloroethene	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
cis-1,3-Dichloropropene	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
Dibromochloromethane	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
Dibromomethane	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
Dichlorodifluoromethane	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
Ethylbenzene	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
Hexachlorobutadiene	< 0.4	0.4	C	µg/L	5/26/10 21:09	58868	XN
Iodomethane	< 0.4	0.4	C	µg/L	5/26/10 21:09	58868	XN
Isopropyl Toluene	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
Isopropylbenzene	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
m,p-Xylene	< 0.8	0.8		µg/L	5/26/10 21:09	58868	XN
Methylene chloride	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
n-Butylbenzene	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
n-Propylbenzene	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
o-Xylene	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
sec-Butylbenzene	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
Styrene	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
tert-Butylbenzene	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
Tetrachloroethene	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
Tetrahydrofuran	< 4.	4.	C	µg/L	5/26/10 21:09	58868	XN
Toluene	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
trans-1,2-Dichloroethene	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
trans-1,3-Dichloropropene	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
trans-1,4-Dichloro-2-butene	< 2.	2.	C	µg/L	6/8/10 15:36	58955	XN
Trichloroethene	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
Trichlorofluoromethane	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
Vinyl acetate	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
Vinyl chloride	< 0.4	0.4		µg/L	5/26/10 21:09	58868	XN
1,3-Dichloropropene, Total	< 0.8	0.8		µg/L	5/26/10 21:09	58868	XN
Xylenes, Total	< 1.2	1.2		µg/L	5/26/10 21:09	58868	XN

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Report of Laboratory Analysis

CLIENT:	City, Water, Light & Power	**Client Sample ID:**	AW-3
Lab Order:	10050637	**Report Date:**	6/29/2010
Project:	CWLP FGDS 2nd Quarter Groundwater	**Collection Date:**	6/1/2010 8:00:00 AM
Lab ID:	10050637-07	**Matrix:**	Groundwater

Analyses	Result	EMT Reporting Limit		Units	Date Analyzed	Batch	Analyst
Ammonia as N		**Method:**	**SM4500-NH3-B-C**				
Nitrogen, Ammonia (As N)	3.92	0.8		mg/L	6/3/10	58839	TTT
Anions by Ion Chromatography		**Method:**	**SW9056**				
Chloride	24.4	2.		mg/L	6/2/10	R141509	MF
Nitrogen, Nitrate (As N)	< 0.5	0.5		mg/L	6/2/10	R141509	MF
Sulfate	< 5.	5.		mg/L	6/2/10	R141509	MF
BOD, 5 Day, 20°C		**Method:**	**SM5210 B**				
Biochemical Oxygen Demand	< 2.	2.	H	mg/L	6/7/10	R141957	IR
Chemical Oxygen Demand		**Method:**	**HACH 8000**				
Chemical Oxygen Demand	26.8	10.		mg/L	6/7/10	R141680	VT
Cyanide, Dissolved		**Method:**					
Cyanide	< 0.01	0.01		mg/L	6/3/10	58820	CS2
Cyanide, Total		**Method:**	**SW9010B/9014 BY AQUACHEM**				
Cyanide	< 0.01	0.01		mg/L	6/3/10	58820	CS2
Dissolved Anions by Ion Chromatography		**Method:**	**SW9056**				
Chloride	25.4	2.		mg/L	6/2/10	R141577	MF
Nitrogen, Nitrate (As N)	< 0.2	0.2		mg/L	6/2/10	R141577	MF
Sulfate	< 5.	5.		mg/L	6/2/10	R141577	MF
Fluoride		**Method:**	**SM4500-F C**				
Fluoride	0.59	0.5		mg/L	6/8/10	R141750	MF
Hexane Extractable Materials, (FOG)		**Method:**	**E1664A**				
Oil and Grease (HEM)	< 5.	5.		mg/L	6/3/10	R141649	TB2
Organic Carbon, Total		**Method:**	**SM5310-C B**				
Organic Carbon, Total	10.3	1.		mg/L	6/2/10	R141522	VT
Phenolics, Total		**Method:**	**SW9065 BY AQUACHEM**				
Phenolics, Total Recoverable	< 0.005	0.005		mg/L	6/3/10	58818	CS2
Soluble Ammonia as N		**Method:**	**4500-NH3-B-C**				

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Report of Laboratory Analysis

CLIENT: City, Water, Light & Power
Lab Order: 10050637
Project: CWLP FGDS 2nd Quarter Groundwater
Lab ID: 10050637-07

Client Sample ID: AW-3
Report Date: 6/29/2010
Collection Date: 6/1/2010 8:00:00 AM
Matrix: Groundwater

Analyses	Result	EMT Reporting Limit	Units	Date Analyzed	Batch	Analyst
Nitrogen, Ammonia (As N)	3.3	0.16	mg/L	6/3/10	58839	TTT
Total Dissolved Solids		**Method:**	**SM2540C**			
Total Dissolved Solids (Residue, Filterable)	432.	20.	mg/L	6/2/10	R141593	IR
ICP Metals, Groundwater Dissolved		**Method:**	**SW6010B / SW3005A**			
Magnesium	31.7	0.111	mg/L	6/9/10	58810	CS2
ICP Metals, Groundwater Total		**Method:**	**SW6010B / SW3015**			
Magnesium	31.4	0.125	mg/L	6/9/10	58815	CS2
Mercury in Groundwater, Dissolved		**Method:**	**SW7470A / HG PREP**			
Mercury	< 0.0005	0.0005	mg/L	6/4/10	58866	IG
Mercury, Total		**Method:**	**SW7470A / HG PREP**			
Mercury	< 0.0005	0.0005	mg/L	6/4/10	58863	IG
Metals, Dissolved		**Method:**	**SW6020A / SW3005A**			
Arsenic	0.0653	0.00889	mg/L	6/7/10 19:09	58810	AG
Boron	< 0.278	0.278	mg/L	6/9/10	58810	AG
Cadmium	< 0.00444	0.00444	mg/L	6/7/10 19:09	58810	AG
Chromium	0.0182	0.00889	mg/L	6/7/10 19:09	58810	AG
Iron	4.23	0.0889	mg/L	6/7/10 19:09	58810	AG
Lead	< 0.00667	0.00667	mg/L	6/7/10 19:09	58810	AG
Zinc	< 0.02	0.02	mg/L	6/7/10 19:09	58810	AG
Metals, Total.		**Method:**	**SW6020A / SW3015**			
Aluminum	0.343	0.05	mg/L	6/7/10 20:26	58815	AG
Antimony	< 0.006	0.006	mg/L	6/7/10 20:26	58815	AG
Arsenic	0.0879	0.01	mg/L	6/7/10 20:26	58815	AG
Barium	0.186	0.02	mg/L	6/7/10 20:26	58815	AG
Beryllium	< 0.003	0.003	mg/L	6/7/10 20:26	58815	AG
Boron	< 0:2	0.2	mg/L	6/9/10	58815	AG
Cadmium	< 0.001	0.001	mg/L	6/7/10 20:26	58815	AG
Calcium	92.1	2.5	mg/L	6/7/10 17:56	58815	AG
Chromium	< 0.07	0.07	mg/L	6/7/10 20:26	58815	AG

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Report of Laboratory Analysis

CLIENT:	City, Water, Light & Power	**Client Sample ID:**	AW-3
Lab Order:	10050637	**Report Date:**	6/29/2010
Project:	CWLP FGDS 2nd Quarter Groundwater	**Collection Date:**	6/1/2010 8:00:00 AM
Lab ID:	10050637-07	**Matrix:**	Groundwater

Analyses	Result	EMT Reporting Limit		Units	Date Analyzed	Batch	Analyst
Cobalt	< 0.07	0.07		mg/L	6/7/10 20:26	58815	AG
Copper	< 0.06	0.06		mg/L	6/7/10 20:26	58815	AG
Iron	12.	0.4		mg/L	6/7/10 17:56	58815	AG
Iron	10.9	0.04		mg/L	6/7/10 20:26	58815	AG
Lead	< 0.005	0.005		mg/L	6/7/10 20:26	58815	AG
Manganese	0.348	0.01		mg/L	6/7/10 20:26	58815	AG
Nickel	< 0.05	0.05		mg/L	6/7/10 20:26	58815	AG
Potassium	1.35	0.625		mg/L	6/7/10 20:26	58815	AG
Selenium	< 0.02	0.02		mg/L	6/7/10 20:26	58815	AG
Silver	< 0.05	0.05		mg/L	6/7/10 20:26	58815	AG
Sodium	62.1	4.5		mg/L	6/7/10 17:56	58815	AG
Thallium	< 0.002	0.002		mg/L	6/7/10 20:26	58815	AG
Vanadium	< 0.0125	0.0125		mg/L	6/7/10 20:26	58815	AG
Zinc	0.0924	0.02		mg/L	6/7/10 20:26	58815	AG
Carbamates		**Method:**	**E531.1**				
Aldicarb	< 2.	2.	C	µg/L	6/8/10	R141744	LBI
Carbofuran	< 2.	2.	C	µg/L	6/8/10	R141744	LBI
EDB, DBCP and 123TCP by GC/ECD		**Method:**	**E504.1 / E504.1**				
1,2-Dibromo-3-chloropropane	< 0.004	0.004	C	µg/L	6/8/10 19:04	58941	LP
1,2-Dibromoethane	< 0.004	0.004	C	µg/L	6/8/10 19:04	58941	LP
Endothal		**Method:**	**E548.1**				
Endothal	< 5.	5.		µg/L	6/16/10	R142139	OUT
Haloacetic Acids		**Method:**	**E552.2 / E552.1**				
Dalapon	< 1.25	1.25	C	µg/L	6/8/10 00:56	58894	LP
Organochlorine Pesticides		**Method:**	**SW8081A / SW3510C**				
4,4´-DDT	< 0.01	0.01		µg/L	6/8/10 17:37	58900	LP
Alachlor	< 0.01	0.01		µg/L	6/8/10 17:37	58900	LP
Aldrin	< 0.01	0.01		µg/L	6/8/10 17:37	58900	LP
Atrazine	< 0.17	0.17		µg/L	6/8/10 17:37	58900	LP
Chlordane	< 0.13	0.13		µg/L	6/8/10 17:37	58900	LP
Dieldrin	< 0.01	0.01		µg/L	6/8/10 17:37	58900	LP

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Report of Laboratory Analysis

CLIENT:	City, Water, Light & Power	**Client Sample ID:**	AW-3
Lab Order:	10050637	**Report Date:**	6/29/2010
Project:	CWLP FGDS 2nd Quarter Groundwater	**Collection Date:**	6/1/2010 8:00:00 AM
Lab ID:	10050637-07	**Matrix:**	Groundwater

Analyses	Result	EMT Reporting Limit		Units	Date Analyzed	Batch	Analyst
Endrin	< 0.01	0.01		µg/L	6/8/10 17:37	58900	LP
gamma-BHC	< 0.01	0.01		µg/L	6/8/10 17:37	58900	LP
Heptachlor	< 0.01	0.01		µg/L	6/8/10 17:37	58900	LP
Heptachlor epoxide	< 0.01	0.01		µg/L	6/8/10 17:37	58900	LP
Methoxychlor	< 0.01	0.01		µg/L	6/8/10 17:37	58900	LP
Simazine	< 0.17	0.17		µg/L	6/8/10 17:37	58900	LP
Toxaphene	< 0.7	0.7		µg/L	6/8/10 17:37	58900	LP
Polychlorinated biphenyls (PCBs)		**Method:**	**SW8082 / SW3510C**				
Aroclor 1016	< 0.12	0.12		µg/L	6/7/10	58902	IP
Aroclor 1221	< 0.12	0.12		µg/L	6/7/10	58902	IP
Aroclor 1232	< 0.12	0.12		µg/L	6/7/10	58902	IP
Aroclor 1242	< 0.12	0.12		µg/L	6/7/10	58902	IP
Aroclor 1248	< 0.12	0.12		µg/L	6/7/10	58902	IP
Aroclor 1254	< 0.12	0.12		µg/L	6/7/10	58902	IP
Aroclor 1260	< 0.12	0.12		µg/L	6/7/10	58902	IP
PCB, Total	< 0.82	0.82		µg/L	6/7/10	58902	IP
Semivolatile Organic Compounds GC/MS		**Method:**	**SW8270D / SW3510C**				
Benzo(a)pyrene	< 3.32	3.32		µg/L	6/7/10 18:17	58871	MG3
Bis(2-ethylhexyl)phthalate	< 6.63	6.63		µg/L	6/7/10 18:17	58871	MG3
Bis(chloromethyl)ether	< 13.9	13.9	C	µg/L	6/7/10 18:17	58871	MG3
Butyl benzyl phthalate	< 1.33	1.33		µg/L	6/7/10 18:17	58871	MG3
Di-n-butyl phthalate	< 3.32	3.32		µg/L	6/7/10 18:17	58871	MG3
Diethyl phthalate	< 0.13	0.13		µg/L	6/7/10 18:17	58871	MG3
Dimethyl phthalate	< 0.13	0.13		µg/L	6/7/10 18:17	58871	MG3
Isophorone	< 0.13	0.13		µg/L	6/7/10 18:17	58871	MG3
m,p-Cresol	< 1.6	1.6		µg/L	6/7/10 18:17	58871	MG3
Naphthalene	< 0.13	0.13		µg/L	6/7/10 18:17	58871	MG3
Parathion	< 3.32	3.32	C	µg/L	6/7/10 18:17	58871	MG3
Phenol	< 1.12	1.12		µg/L	6/7/10 18:17	58871	MG3
Solvent Extractable Compounds by HPLC		**Method:**	**SW8321A / SW3510C**				
2,4,5-TP (Silvex)	< 0.19	0.19		µg/L	6/9/10	58934	LBI
2,4-D	< 0.31	0.31		µg/L	6/9/10	58934	LBI

Qualifiers:
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Report of Laboratory Analysis

CLIENT:	City, Water, Light & Power	**Client Sample ID:**	AW-3
Lab Order:	10050637	**Report Date:**	6/29/2010
Project:	CWLP FGDS 2nd Quarter Groundwater	**Collection Date:**	6/1/2010 8:00:00 AM
Lab ID:	10050637-07	**Matrix:**	Groundwater

Analyses	Result	EMT Reporting Limit		Units	Date Analyzed	Batch	Analyst
Dinoseb	< 0.31	0.31		µg/L	6/9/10	58934	LBI
Pentachlorophenol	< 0.26	0.26	C	µg/L	6/9/10	58934	LBI
Picloram	< 0.12	0.12	C	µg/L	6/9/10	58934	LBI
Volatile Organic Compounds by GC/MS		**Method:**	**SW8260B / SW5030A**				
1,1,1,2-Tetrachloroethane	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
1,1,1-Trichloroethane	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
1,1,2,2-Tetrachloroethane	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
1,1,2-Trichloroethane	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
1,1-Dichloroethane	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
1,1-Dichloroethene	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
1,2,3-Trichlorobenzene	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
1,2,3-Trichloropropane	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
1,2,4-Trimethylbenzene	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
1,2-Dibromoethane	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
1,2-Dichlorobenzene	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
1,2-Dichloroethane	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
1,2-Dichloropropane	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
1,3,5-Trimethylbenzene	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
1,3-Dichlorobenzene	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
1,3-Dichloropropane	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
1,4-Dichlorobenzene	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
2,2-Dichloropropane	< 0.4	0.4	C	µg/L	6/5/10 23:23	58924	XN
2-Butanone	< 4.	4.		µg/L	6/5/10 23:23	58924	XN
2-Chlorotoluene	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
2-Hexanone	< 4.	4.		µg/L	6/5/10 23:23	58924	XN
4-Chlorotoluene	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
4-Methyl-2-pentanone	< 4.	4.		µg/L	6/5/10 23:23	58924	XN
Acetone	< 8.	8.		µg/L	6/5/10 23:23	58924	XN
Acrolein	< 4.	4.		µg/L	6/5/10 23:23	58924	XN
Acrylonitrile	< 4.	4.		µg/L	6/5/10 23:23	58924	XN
Benzene	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
Bromobenzene	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
Bromochloromethane	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
Bromodichloromethane	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN

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Report of Laboratory Analysis

CLIENT:	City, Water, Light & Power	**Client Sample ID:**	AW-3
Lab Order:	10050637	**Report Date:**	6/29/2010
Project:	CWLP FGDS 2nd Quarter Groundwater	**Collection Date:**	6/1/2010 8:00:00 AM
Lab ID:	10050637-07	**Matrix:**	Groundwater

Analyses	Result	EMT Reporting Limit		Units	Date Analyzed	Batch	Analyst
Bromoform	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
Bromomethane	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
Carbon disulfide	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
Carbon tetrachloride	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
Chlorobenzene	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
Chloroethane	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
Chloroform	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
Chloromethane	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
cis-1,2-Dichloroethene	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
cis-1,3-Dichloropropene	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
Dibromochloromethane	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
Dibromomethane	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
Dichlorodifluoromethane	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
Ethylbenzene	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
Hexachlorobutadiene	< 0.4	0.4	C	µg/L	6/5/10 23:23	58924	XN
Iodomethane	< 0.4	0.4	C	µg/L	6/5/10 23:23	58924	XN
Isopropyl Toluene	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
Isopropylbenzene	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
m,p-Xylene	< 0.8	0.8		µg/L	6/5/10 23:23	58924	XN
Methylene chloride	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
n-Butylbenzene	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
n-Propylbenzene	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
o-Xylene	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
sec-Butylbenzene	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
Styrene	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
tert-Butylbenzene	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
Tetrachloroethene	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
Tetrahydrofuran	< 4.	4.	C	µg/L	6/5/10 23:23	58924	XN
Toluene	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
trans-1,2-Dichloroethene	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
trans-1,3-Dichloropropene	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
trans-1,4-Dichloro-2-butene	< 2.	2.	C	µg/L	6/12/10 17:51	59033	XN
Trichloroethene	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
Trichlorofluoromethane	< 0.4	0.4		µg/L	6/5/10 23:23	58924	XN
Vinyl acetate	< 2.	2.		µg/L	6/12/10 17:51	59033	XN

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Report of Laboratory Analysis

CLIENT:	City, Water, Light & Power	**Client Sample ID:**	AW-3
Lab Order:	10050637	**Report Date:**	6/29/2010
Project:	CWLP FGDS 2nd Quarter Groundwater	**Collection Date:**	6/1/2010 8:00:00 AM
Lab ID:	10050637-07	**Matrix:**	Groundwater

Analyses	Result	EMT Reporting Limit	Units	Date Analyzed	Batch	Analyst
Vinyl chloride	< 2.	2.	µg/L	6/12/10 17:51	59033	XN
1,3-Dichloropropene, Total	< 0.8	0.8	µg/L	6/5/10 23:23	58924	XN
Xylenes, Total	< 1.2	1.2	µg/L	6/5/10 23:23	58924	XN

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Report of Laboratory Analysis

CLIENT:	City, Water, Light & Power	**Client Sample ID:**	G120
Lab Order:	10050637	**Report Date:**	6/29/2010
Project:	CWLP FGDS 2nd Quarter Groundwater	**Collection Date:**	5/25/2010
Lab ID:	10050637-09	**Matrix:**	Groundwater

Analyses	Result	EMT Reporting Limit	Units	Date Analyzed	Batch	Analyst
Ammonia as N		**Method:**	**SM4500-NH3-B-C**			
Nitrogen, Ammonia (As N)	3.53	0.16	mg/L	6/3/10	58839	TTT
Anions by Ion Chromatography		**Method:**	**SW9056**			
Chloride	26.8	2.	mg/L	5/27/10	R141304	GSB
Nitrogen, Nitrate (As N)	< 0.2	0.2	mg/L	5/27/10	R141304	GSB
Sulfate	222.	5.	mg/L	5/27/10	R141304	GSB
BOD, 5 Day, 20°C		**Method:**	**SM5210 B**			
Biochemical Oxygen Demand	4.	2.	mg/L	5/26/10	R141432	AM2
Chemical Oxygen Demand		**Method:**	**HACH 8000**			
Chemical Oxygen Demand	13.7	10.	mg/L	6/7/10	R141680	VT
Cyanide, Dissolved		**Method:**				
Cyanide	< 0.01	0.01	mg/L	5/28/10	58735	CS2
Cyanide, Total		**Method:**	**SW9010B/9014 BY AQUACHEM**			
Cyanide	< 0.01	0.01	mg/L	5/28/10	58735	CS2
Dissolved Anions by Ion Chromatography		**Method:**	**SW9056**			
Chloride	26.8	2.	mg/L	5/26/10	R141296	GSB
Nitrogen, Nitrate (As N)	< 0.2	0.2	mg/L	5/26/10	R141296	GSB
Sulfate	218.	5.	mg/L	5/26/10	R141296	GSB
Fluoride		**Method:**	**SM4500-F C**			
Fluoride	< 0.5	0.5	mg/L	6/1/10	R141448	MF
Hexane Extractable Materials, (FOG)		**Method:**	**E1664A**			
Oil and Grease (HEM)	< 5.	5.	mg/L	5/28/10	R141484	TB2
Organic Carbon, Total		**Method:**	**SM5310-C B**			
Organic Carbon, Total	7.05	1.	mg/L	6/2/10	R141522	VT
Phenolics, Total		**Method:**	**SW9065 BY AQUACHEM**			
Phenolics, Total Recoverable	0.018	0.005	mg/L	6/1/10	58758	CS2
Soluble Ammonia as N		**Method:**	**4500-NH3-B-C**			

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Report of Laboratory Analysis

CLIENT:	City, Water, Light & Power	**Client Sample ID:**	G120
Lab Order:	10050637	**Report Date:**	6/29/2010
Project:	CWLP FGDS 2nd Quarter Groundwater	**Collection Date:**	5/25/2010
Lab ID:	10050637-09	**Matrix:**	Groundwater

Analyses	Result	EMT Reporting Limit	Units	Date Analyzed	Batch	Analyst
Nitrogen, Ammonia (As N)	3.58	0.16	mg/L	6/1/10	58777	TTT
Total Dissolved Solids		**Method:**	**SM2540C**			
Total Dissolved Solids (Residue, Filterable)	872.	20.	mg/L	5/27/10	R141385	VT
Mercury in Groundwater, Dissolved		**Method:**	**SW7470A / HG PREP**			
Mercury	< 0.0005	0.0005	mg/L	6/4/10	58866	IG
Mercury, Total		**Method:**	**SW7470A / HG PREP**			
Mercury	< 0.0005	0.0005	mg/L	6/4/10	58866	IG
Metals, Dissolved		**Method:**	**SW6020A / SW3005A**			
Arsenic	0.0122	0.00889	mg/L	5/26/10 17:55	58669	AG
Boron	0.64	0.556	mg/L	5/27/10	58669	AG
Cadmium	< 0.00444	0.00444	mg/L	5/26/10 17:55	58669	AG
Chromium	< 0.00889	0.00889	mg/L	5/26/10 17:55	58669	AG
Iron	19.9	0.0889	mg/L	5/26/10 17:55	58669	AG
Lead	< 0.00667	0.00667	mg/L	5/26/10 17:55	58669	AG
Magnesium	97.4	1.11	mg/L	5/27/10	58669	AG
Zinc	< 0.02	0.02	mg/L	5/26/10 17:55	58669	AG
Metals, Total.		**Method:**	**SW6020A / SW3015**			
Aluminum	2.2	0.05	mg/L	5/26/10 22:58	58676	AG
Antimony	< 0.006	0.006	mg/L	5/26/10 22:58	58676	AG
Arsenic	0.0148	0.01	mg/L	5/26/10 22:58	58676	AG
Barium	0.546	0.02	mg/L	5/26/10 22:58	58676	AG
Beryllium	< 0.003	0.003	mg/L	5/26/10 22:58	58676	AG
Boron	0.642	0.4	mg/L	5/27/10	58676	AG
Cadmium	< 0.001	0.001	mg/L	5/26/10 22:58	58676	AG
Calcium	263.	2.5	mg/L	5/27/10	58676	AG
Chromium	< 0.07	0.07	mg/L	5/26/10 22:58	58676	AG
Cobalt	< 0.07	0.07	mg/L	5/26/10 22:58	58676	AG
Copper	< 0.06	0.06	mg/L	5/26/10 22:58	58676	AG
Iron	28.6	0.04	mg/L	5/26/10 22:58	58676	AG
Lead	< 0.005	0.005	mg/L	5/26/10 22:58	58676	AG

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CLIENT:	City, Water, Light & Power	**Client Sample ID:**	G120
Lab Order:	10050637	**Report Date:**	6/29/2010
Project:	CWLP FGDS 2nd Quarter Groundwater	**Collection Date:**	5/25/2010
Lab ID:	10050637-09	**Matrix:**	Groundwater

Analyses	Result	EMT Reporting Limit	Qual	Units	Date Analyzed	Batch	Analyst
Magnesium	110.	1.25		mg/L	5/27/10	58676	AG
Manganese	0.354	0.01		mg/L	5/26/10 22:58	58676	AG
Nickel	< 0.05	0.05		mg/L	5/26/10 22:58	58676	AG
Potassium	2.02	0.625		mg/L	5/26/10 22:58	58676	AG
Selenium	< 0.02	0.02		mg/L	5/26/10 22:58	58676	AG
Silver	< 0.05	0.05		mg/L	5/26/10 22:58	58676	AG
Sodium	52.6	4.5		mg/L	5/27/10	58676	AG
Thallium	< 0.002	0.002		mg/L	5/26/10 22:58	58676	AG
Vanadium	< 0.0125	0.0125		mg/L	5/26/10 22:58	58676	AG
Zinc	0.0214	0.02		mg/L	5/26/10 22:58	58676	AG
Carbamates		**Method:**	**E531.1**				
Aldicarb	< 2.	2.	C	µg/L	6/8/10	R141744	LBI
Carbofuran	< 2.	2.	C	µg/L	6/8/10	R141744	LBI
EDB, DBCP and 123TCP by GC/ECD		**Method:**	**E504.1 / E504.1**				
1,2-Dibromo-3-chloropropane	< 0.004	0.004	C	µg/L	6/2/10 16:57	58881	MNN
1,2-Dibromoethane	< 0.004	0.004	C	µg/L	6/2/10 16:57	58881	MNN
Endothal		**Method:**	**E548.1**				
Endothal	< 2.	2.		µg/L	6/3/10	R141835	OUT
Haloacetic Acids		**Method:**	**E552.2 / E552.1**				
Dalapon	< 1.25	1.25	C	µg/L	6/8/10 02:24	58894	LP
Organochlorine Pesticides		**Method:**	**SW8081A / SW3510C**				
4,4'-DDT	< 0.01	0.01		µg/L	6/3/10 04:12	58653	LP
Alachlor	< 0.01	0.01		µg/L	6/3/10 04:12	58653	LP
Aldrin	< 0.01	0.01		µg/L	6/3/10 04:12	58653	LP
Atrazine	< 0.17	0.17		µg/L	6/3/10 04:12	58653	LP
Chlordane	< 0.13	0.13		µg/L	6/3/10 04:12	58653	LP
Dieldrin	< 0.01	0.01		µg/L	6/3/10 04:12	58653	LP
Endrin	< 0.01	0.01		µg/L	6/3/10 04:12	58653	LP
gamma-BHC	< 0.01	0.01		µg/L	6/3/10 04:12	58653	LP
Heptachlor	< 0.01	0.01		µg/L	6/3/10 04:12	58653	LP
Heptachlor epoxide	< 0.01	0.01		µg/L	6/3/10 04:12	58653	LP

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Lab Order:	10050637	**Report Date:**	6/29/2010
Project:	CWLP FGDS 2nd Quarter Groundwater	**Collection Date:**	5/25/2010
Lab ID:	10050637-09	**Matrix:**	Groundwater

Analyses	Result	EMT Reporting Limit	Qual	Units	Date Analyzed	Batch	Analyst
Methoxychlor	< 0.01	0.01		µg/L	6/3/10 04:12	58653	LP
Simazine	< 0.17	0.17		µg/L	6/3/10 04:12	58653	LP
Toxaphene	< 0.7	0.7		µg/L	6/3/10 04:12	58653	LP
Polychlorinated biphenyls (PCBs)		**Method:**	**SW8082 / SW3510C**				
Aroclor 1016	< 0.12	0.12		µg/L	5/28/10	58654	IP
Aroclor 1221	< 0.12	0.12		µg/L	5/28/10	58654	IP
Aroclor 1232	< 0.12	0.12		µg/L	5/28/10	58654	IP
Aroclor 1242	< 0.12	0.12		µg/L	5/28/10	58654	IP
Aroclor 1248	< 0.12	0.12		µg/L	5/28/10	58654	IP
Aroclor 1254	< 0.12	0.12		µg/L	5/28/10	58654	IP
Aroclor 1260	< 0.12	0.12		µg/L	5/28/10	58654	IP
PCB, Total	< 0.82	0.82		µg/L	5/28/10	58654	IP
Semivolatile Organic Compounds GC/MS		**Method:**	**SW8270D / SW3510C**				
Benzo(a)pyrene	< 3.33	3.33		µg/L	6/2/10 22:12	58788	MG3
Bis(2-ethylhexyl)phthalate	< 6.65	6.65		µg/L	6/2/10 22:12	58788	MG3
Bis(chloromethyl)ether	< 14.	14.	C	µg/L	6/2/10 22:12	58788	MG3
Butyl benzyl phthalate	< 1.33	1.33		µg/L	6/2/10 22:12	58788	MG3
Di-n-butyl phthalate	< 3.33	3.33	B	µg/L	6/2/10 22:12	58788	MG3
Diethyl phthalate	< 0.13	0.13		µg/L	6/2/10 22:12	58788	MG3
Dimethyl phthalate	< 0.13	0.13		µg/L	6/2/10 22:12	58788	MG3
Isophorone	< 0.13	0.13		µg/L	6/2/10 22:12	58788	MG3
m,p-Cresol	< 1.61	1.61		µg/L	6/2/10 22:12	58788	MG3
Naphthalene	< 0.13	0.13		µg/L	6/2/10 22:12	58788	MG3
Parathion	< 3.33	3.33	C	µg/L	6/2/10 22:12	58788	MG3
Phenol	< 1.12	1.12		µg/L	6/2/10 22:12	58788	MG3
Solvent Extractable Compounds by HPLC		**Method:**	**SW8321A / SW3510C**				
2,4,5-TP (Silvex)	< 0.19	0.19		µg/L	5/30/10	58755	LBI
2,4-D	< 0.31	0.31		µg/L	5/30/10	58755	LBI
Dinoseb	< 0.32	0.32		µg/L	5/30/10	58755	LBI
Pentachlorophenol	< 0.27	0.27	C	µg/L	5/30/10	58755	LBI
Picloram	< 0.13	0.13	C	µg/L	5/30/10	58755	LBI
Volatile Organic Compounds by GC/MS		**Method:**	**SW8260B / SW5030A**				

Qualifiers:
B - Analyte detected in the associated Method Blank
E - Estimated
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J - Analyte detected below quanititation limits

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Report of Laboratory Analysis

CLIENT:	City, Water, Light & Power	**Client Sample ID:**	G120
Lab Order:	10050637	**Report Date:**	6/29/2010
Project:	CWLP FGDS 2nd Quarter Groundwater	**Collection Date:**	5/25/2010
Lab ID:	10050637-09	**Matrix:**	Groundwater

Analyses	Result	EMT Reporting Limit	Qual	Units	Date Analyzed	Batch	Analyst
1,1,1,2-Tetrachloroethane	< 2.	2.		µg/L	6/8/10 17:31	59023	XN
1,1,1-Trichloroethane	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
1,1,2,2-Tetrachloroethane	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
1,1,2-Trichloroethane	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
1,1-Dichloroethane	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
1,1-Dichloroethene	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
1,2,3-Trichlorobenzene	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
1,2,3-Trichloropropane	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
1,2,4-Trimethylbenzene	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
1,2-Dibromoethane	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
1,2-Dichlorobenzene	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
1,2-Dichloroethane	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
1,2-Dichloropropane	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
1,3,5-Trimethylbenzene	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
1,3-Dichlorobenzene	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
1,3-Dichloropropane	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
1,4-Dichlorobenzene	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
2,2-Dichloropropane	< 0.4	0.4	C	µg/L	5/26/10 23:58	58868	XN
2-Butanone	< 4.	4.		µg/L	5/26/10 23:58	58868	XN
2-Chlorotoluene	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
2-Hexanone	< 4.	4.		µg/L	5/26/10 23:58	58868	XN
4-Chlorotoluene	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
4-Methyl-2-pentanone	< 4.	4.		µg/L	5/26/10 23:58	58868	XN
Acetone	< 8.	8.		µg/L	5/26/10 23:58	58868	XN
Acrolein	< 4.	4.		µg/L	5/26/10 23:58	58868	XN
Acrylonitrile	< 4.	4.		µg/L	5/26/10 23:58	58868	XN
Benzene	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
Bromobenzene	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
Bromochloromethane	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
Bromodichloromethane	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
Bromoform	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
Bromomethane	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
Carbon disulfide	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
Carbon tetrachloride	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
Chlorobenzene	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN

Qualifiers:

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Report of Laboratory Analysis

CLIENT:	City, Water, Light & Power	**Client Sample ID:**	G120
Lab Order:	10050637	**Report Date:**	6/29/2010
Project:	CWLP FGDS 2nd Quarter Groundwater	**Collection Date:**	5/25/2010
Lab ID:	10050637-09	**Matrix:**	Groundwater

Analyses	Result	EMT Reporting Limit		Units	Date Analyzed	Batch	Analyst
Chloroethane	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
Chloroform	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
Chloromethane	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
cis-1,2-Dichloroethene	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
cis-1,3-Dichloropropene	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
Dibromochloromethane	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
Dibromomethane	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
Dichlorodifluoromethane	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
Ethylbenzene	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
Hexachlorobutadiene	< 0.4	0.4	C	µg/L	5/26/10 23:58	58868	XN
Iodomethane	< 0.4	0.4	C	µg/L	5/26/10 23:58	58868	XN
Isopropyl Toluene	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
Isopropylbenzene	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
m,p-Xylene	< 0.8	0.8		µg/L	5/26/10 23:58	58868	XN
Methylene chloride	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
n-Butylbenzene	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
n-Propylbenzene	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
o-Xylene	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
sec-Butylbenzene	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
Styrene	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
tert-Butylbenzene	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
Tetrachloroethene	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
Tetrahydrofuran	< 4.	4.	C	µg/L	5/26/10 23:58	58868	XN
Toluene	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
trans-1,2-Dichloroethene	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
trans-1,3-Dichloropropene	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
trans-1,4-Dichloro-2-butene	< 2.	2.	C	µg/L	6/8/10 17:31	59023	XN
Trichloroethene	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
Trichlorofluoromethane	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
Vinyl acetate	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
Vinyl chloride	< 0.4	0.4		µg/L	5/26/10 23:58	58868	XN
1,3-Dichloropropene, Total	< 0.8	0.8		µg/L	5/26/10 23:58	58868	XN
Xylenes, Total	< 1.2	1.2		µg/L	5/26/10 23:58	58868	XN

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Sue Corcoran
City, Water, Light & Power
201 East Lake Shore Drive
Springfield, IL 62707

June 30, 2010

RE CWLP Ash Pond Table 1

Lab Orders:
10050636

Dear Sue Corcoran:

Enclosed are the analytical reports for the EMT Lab Order listed. Also included with this analytical report is a copy of the chain of custody associated with these samples. If you have any questions, please contact me at 847-967-6666.

Sincerely,

Joe Pavilonis
Project Manager

Approved by,

Mitchell Ostrowski
Laboratory Director

This Report Contains 12 pages

The Contents of this report apply to the sample(s) analyzed. No duplication is allowed except in its entirety.

State of Illinois Chemical Analysis in Drinking Water Accredited Lab. No. 100256
State of Wisconsin Wastewater and Hazardous Waste No. 999888890

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CLIENT: City, Water, Light & Power **Date:** *6/30/2010*

Project: CWLP Ash Pond Table 1

Lab Order: 10050636

CASE NARRATIVE

Unless otherwise noted, samples were analyzed using the methods outlined in the following references:
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

Unless otherwise noted, all method blanks, laboratory spikes, and/or matrix spikes met quality assurance objectives.

Sample results relate only to the analytes of interest tested and to the sample received at the laboratory.

All results are reported on a wet weight basis, unless otherwise noted. Dry weight adjusted results, reporting limits, method detection limits and dilution factors are indicated by the notation "dry" in the Units column. If present, a dilution factor will adjust the method detection limits and reporting limits.

The test results contained in this report meet all of the requirements of NELAC. Accreditation by the State of Illinois or Wisconsin is not an endorsement or a guarantee of the validity of data generated. For specific information regarding EMT's scope of accreditation , please contact your EMT project manager.

The Reporting Limit listed on the Report of Laboratory Analysis is EMT's reporting limit for the analyte reported. For most test methods this reporting limit is primarily based upon the lowest point in the calibration curve.

Analyst's initials of "OUT" indicate that the analyte was analyzed by a subcontracted laboratory.

Method References:
SW=USEPA, Test Methods for Evaluating Solid Waste, SW-846.
E=USEPA Methods for the Determination of Inorganic Substances in Environmental Samples; Methods for Chemical Analysis of Water and Wastes; Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, 40 CFR Part 136, App A; methods for the Determination of Metals in Environmental Samples; Methods for the Determination of Organic Compounds in Drinking Water.
SM= APHA, Standard Methods for the Examination of Water and Wastewater.
D=ASTM, Annual Book of Standards

Batch numbers starting with a letter indicate an analytical batch while those that are exculsively numerals indicate a preparation batch.

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Report of Laboratory Analysis

CLIENT:	City, Water, Light & Power	**Client Sample ID:**	AW3
Lab Order:	10050636	**Report Date:**	6/30/2010
Project:	CWLP Ash Pond Table 1	**Collection Date:**	6/1/2010 8:00:00 AM
Lab ID:	10050636-03	**Matrix:**	Groundwater

Analyses	Result	EMT Reporting Limit	Units	Date Analyzed	Batch	Analyst
Anions by Ion Chromatography		Method:	SW9056			
Chloride	25.5	2.	mg/L	6/2/10	R141509	MF
Nitrogen, Nitrate (As N)	< 0.5	0.5	mg/L	6/2/10	R141509	MF
Sulfate	< 5.	5.	mg/L	6/2/10	R141509	MF
Cyanide, Total		Method:	SW9010B/9014 BY AQUACHEM			
Cyanide	< 0.01	0.01	mg/L	6/7/10	58890	CS2
Fluoride		Method:	SM4500-F C			
Fluoride	0.52	0.5	mg/L	6/8/10	R141750	MF
Total Dissolved Solids		Method:	SM2540C			
Total Dissolved Solids (Residue, Filterable)	< 20.	20.	mg/L	6/2/10	R141593	IR
Mercury, Total		Method:	SW7470A / HG PREP			
Mercury	< 0.0005	0.0005	mg/L	6/7/10	58908	IG
Metals, Total.		Method:	SW6020A / SW3015			
Antimony	< 0.006	0.006	mg/L	6/7/10 20:36	58815	AG
Arsenic	0.0936	0.01	mg/L	6/7/10 20:36	58815	AG
Barium	0.189	0.02	mg/L	6/7/10 20:36	58815	AG
Beryllium	< 0.003	0.003	mg/L	6/7/10 20:36	58815	AG
Boron	0.251	0.2	mg/L	6/9/10	58815	AG
Cadmium	< 0.001	0.001	mg/L	6/7/10 20:36	58815	AG
Chromium	< 0.07	0.07	mg/L	6/7/10 20:36	58815	AG
Cobalt	< 0.07	0.07	mg/L	6/7/10 20:36	58815	AG
Iron	11.2	0.04	mg/L	6/7/10 20:36	58815	AG
Lead	< 0.005	0.005	mg/L	6/7/10 20:36	58815	AG
Manganese	0.349	0.01	mg/L	6/7/10 20:36	58815	AG
Nickel	< 0.05	0.05	mg/L	6/7/10 20:36	58815	AG
Selenium	< 0.02	0.02	mg/L	6/7/10 20:36	58815	AG
Silver	< 0.05	0.05	mg/L	6/7/10 20:36	58815	AG
Thallium	< 0.002	0.002	mg/L	6/7/10 20:36	58815	AG
Zinc	< 0.02	0.02	mg/L	6/7/10 20:36	58815	AG

Qualifiers:
B - Analyte detected in the associated Method Blank
E - Estimated
H - Holding Time Exceeded
S - Spike Recovery outside accepted recovery limits
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J - Analyte detected below quanititation limits

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Report of Laboratory Analysis

CLIENT:	City, Water, Light & Power	**Client Sample ID:**	AP1
Lab Order:	10050636	**Report Date:**	6/30/2010
Project:	CWLP Ash Pond Table 1	**Collection Date:**	6/1/2010 8:15:00 AM
Lab ID:	10050636-04	**Matrix:**	Groundwater

Analyses	Result	EMT Reporting Limit	Units	Date Analyzed	Batch	Analyst
Anions by Ion Chromatography		Method:	SW9056			
Chloride	22.7	2.	mg/L	6/2/10	R141509	MF
Nitrogen, Nitrate (As N)	2.72	0.5	mg/L	6/2/10	R141509	MF
Sulfate	47.	5.	mg/L	6/2/10	R141509	MF
Cyanide, Total		Method:	SW9010B/9014 BY AQUACHEM			
Cyanide	< 0.01	0.01	mg/L	6/2/10	58804	CS2
Fluoride		Method:	SM4500-F C			
Fluoride	< 0.5	0.5	mg/L	6/8/10	R141751	MF
Total Dissolved Solids		Method:	SM2540C			
Total Dissolved Solids (Residue, Filterable)	240.	20.	mg/L	6/2/10	R141593	IR
Mercury, Total		Method:	SW7470A / HG PREP			
Mercury	< 0.0005	0.0005	mg/L	6/4/10	58863	IG
Metals, Total.		Method:	SW6020A / SW3015			
Antimony	< 0.006	0.006	mg/L	6/7/10 21:17	58815	AG
Arsenic	< 0.01	0.01	mg/L	6/7/10 21:17	58815	AG
Barium	0.112	0.02	mg/L	6/7/10 21:17	58815	AG
Beryllium	< 0.003	0.003	mg/L	6/7/10 21:17	58815	AG
Boron	0.301	0.2	mg/L	6/9/10	58815	AG
Cadmium	< 0.001	0.001	mg/L	6/7/10 21:17	58815	AG
Chromium	< 0.07	0.07	mg/L	6/7/10 21:17	58815	AG
Cobalt	< 0.07	0.07	mg/L	6/7/10 21:17	58815	AG
Iron	5.68	0.04	mg/L	6/7/10 21:17	58815	AG
Lead	< 0.005	0.005	mg/L	6/7/10 21:17	58815	AG
Manganese	0.27	0.01	mg/L	6/7/10 21:17	58815	AG
Nickel	< 0.05	0.05	mg/L	6/7/10 21:17	58815	AG
Selenium	< 0.02	0.02	mg/L	6/7/10 21:17	58815	AG
Silver	< 0.05	0.05	mg/L	6/7/10 21:17	58815	AG
Thallium	< 0.002	0.002	mg/L	6/7/10 21:17	58815	AG
Zinc	< 0.02	0.02	mg/L	6/7/10 21:17	58815	AG

Qualifiers:

- B - Analyte detected in the associated Method Blank
- E - Estimated
- H - Holding Time Exceeded
- S - Spike Recovery outside accepted recovery limits
- R - RPD outside accepted recovery limits
- J - Analyte detected below quanititation limits

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Report of Laboratory Analysis

CLIENT: City, Water, Light & Power
Client Sample ID: AP2
Lab Order: 10050636
Report Date: 6/30/2010
Project: CWLP Ash Pond Table 1
Collection Date: 6/1/2010 8:25:00 AM
Lab ID: 10050636-05
Matrix: Groundwater

Analyses	Result	EMT Reporting Limit	Units	Date Analyzed	Batch	Analyst
Anions by Ion Chromatography		Method:	SW9056			
Chloride	31.7	2.	mg/L	6/2/10	R141509	MF
Nitrogen, Nitrate (As N)	< 0.5	0.5	mg/L	6/2/10	R141509	MF
Sulfate	132.	5.	mg/L	6/2/10	R141509	MF
Cyanide, Total		Method:	SW9010B/9014 BY AQUACHEM			
Cyanide	< 0.01	0.01	mg/L	6/2/10	58804	CS2
Fluoride		Method:	SM4500-F C			
Fluoride	< 0.5	0.5	mg/L	6/8/10	R141751	MF
Total Dissolved Solids		Method:	SM2540C			
Total Dissolved Solids (Residue, Filterable)	620.	20.	mg/L	6/2/10	R141593	IR
Mercury, Total		Method:	SW7470A / HG PREP			
Mercury	< 0.0005	0.0005	mg/L	6/4/10	58863	IG
Metals, Total.		Method:	SW6020A / SW3015			
Antimony	< 0.006	0.006	mg/L	6/7/10 21:22	58815	AG
Arsenic	< 0.01	0.01	mg/L	6/7/10 21:22	58815	AG
Barium	0.109	0.02	mg/L	6/7/10 21:22	58815	AG
Beryllium	< 0.003	0.003	mg/L	6/7/10 21:22	58815	AG
Boron	2.63	0.2	mg/L	6/9/10	58815	AG
Cadmium	< 0.001	0.001	mg/L	6/7/10 21:22	58815	AG
Chromium	< 0.07	0.07	mg/L	6/7/10 21:22	58815	AG
Cobalt	< 0.07	0.07	mg/L	6/7/10 21:22	58815	AG
Iron	2.37	0.04	mg/L	6/7/10 21:22	58815	AG
Lead	< 0.005	0.005	mg/L	6/7/10 21:22	58815	AG
Manganese	2.	0.01	mg/L	6/7/10 21:22	58815	AG
Nickel	< 0.05	0.05	mg/L	6/7/10 21:22	58815	AG
Selenium	< 0.02	0.02	mg/L	6/7/10 21:22	58815	AG
Silver	< 0.05	0.05	mg/L	6/7/10 21:22	58815	AG
Thallium	< 0.002	0.002	mg/L	6/7/10 21:22	58815	AG
Zinc	0.0216	0.02	mg/L	6/7/10 21:22	58815	AG

Qualifiers:
B - Analyte detected in the associated Method Blank
E - Estimated
H - Holding Time Exceeded
S - Spike Recovery outside accepted recovery limits
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Report of Laboratory Analysis

CLIENT:	City, Water, Light & Power	**Client Sample ID:**	AP3
Lab Order:	10050636	**Report Date:**	6/30/2010
Project:	CWLP Ash Pond Table 1	**Collection Date:**	6/1/2010 8:45:00 AM
Lab ID:	10050636-06	**Matrix:**	Groundwater

Analyses	Result	EMT Reporting Limit	Units	Date Analyzed	Batch	Analyst
Anions by Ion Chromatography		**Method:**	**SW9056**			
Chloride	87.6	2.	mg/L	6/2/10	R141509	MF
Nitrogen, Nitrate (As N)	< 0.5	0.5	mg/L	6/2/10	R141509	MF
Sulfate	319.	12.5	mg/L	6/2/10	R141509	MF
Cyanide, Total		**Method:**	**SW9010B/9014 BY AQUACHEM**			
Cyanide	< 0.01	0.01	mg/L	6/2/10	58804	CS2
Fluoride		**Method:**	**SM4500-F C**			
Fluoride	< 0.5	0.5	mg/L	6/8/10	R141751	MF
Total Dissolved Solids		**Method:**	**SM2540C**			
Total Dissolved Solids (Residue, Filterable)	1090.	20.	mg/L	6/2/10	R141593	IR
Mercury, Total		**Method:**	**SW7470A / HG PREP**			
Mercury	< 0.0005	0.0005	mg/L	6/7/10	58908	IG
Metals, Total.		**Method:**	**SW6020A / SW3015**			
Antimony	< 0.006	0.006	mg/L	6/7/10 21:28	58815	AG
Arsenic	0.0144	0.01	mg/L	6/7/10 21:28	58815	AG
Barium	0.135	0.02	mg/L	6/7/10 21:28	58815	AG
Beryllium	< 0.003	0.003	mg/L	6/7/10 21:28	58815	AG
Boron	11.9	0.2	mg/L	6/9/10	58815	AG
Cadmium	< 0.001	0.001	mg/L	6/7/10 21:28	58815	AG
Chromium	< 0.07	0.07	mg/L	6/7/10 21:28	58815	AG
Cobalt	< 0.07	0.07	mg/L	6/7/10 21:28	58815	AG
Iron	10.1	0.04	mg/L	6/7/10 21:28	58815	AG
Lead	< 0.005	0.005	mg/L	6/7/10 21:28	58815	AG
Manganese	9.25	0.01	mg/L	6/7/10 21:28	58815	AG
Nickel	< 0.05	0.05	mg/L	6/7/10 21:28	58815	AG
Selenium	< 0.02	0.02	mg/L	6/7/10 21:28	58815	AG
Silver	< 0.05	0.05	mg/L	6/7/10 21:28	58815	AG
Thallium	< 0.002	0.002	mg/L	6/7/10 21:28	58815	AG
Zinc	< 0.02	0.02	mg/L	6/7/10 21:28	58815	AG

Qualifiers:

B - Analyte detected in the associated Method Blank
E - Estimated
H - Holding Time Exceeded
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
J - Analyte detected below quanititation limits

ENVIRONMENTAL MONITORING AND TECHNOLOGIES, INC.

8100 North Austin • Morton Grove, IL 60053-3203
847.967.6666 • 800.246.0663 • fax: 847.967.6735 • www.emt.com

Report of Laboratory Analysis

CLIENT:	City, Water, Light & Power	**Client Sample ID:**	AP4
Lab Order:	10050636	**Report Date:**	6/30/2010
Project:	CWLP Ash Pond Table 1	**Collection Date:**	6/1/2010 9:05:00 AM
Lab ID:	10050636-07	**Matrix:**	Groundwater

Analyses	Result	EMT Reporting Limit	Units	Date Analyzed	Batch	Analyst
Anions by Ion Chromatography		**Method:**	**SW9056**			
Chloride	13.	2.	mg/L	6/2/10	R141509	MF
Nitrogen, Nitrate (As N)	< 0.5	0.5	mg/L	6/2/10	R141509	MF
Sulfate	< 5.	5.	mg/L	6/2/10	R141509	MF
Cyanide, Total		**Method:**	**SW9010B/9014 BY AQUACHEM**			
Cyanide	< 0.01	0.01	mg/L	6/2/10	58804	CS2
Fluoride		**Method:**	**SM4500-F C**			
Fluoride	< 0.5	0.5	mg/L	6/8/10	R141751	MF
Total Dissolved Solids		**Method:**	**SM2540C**			
Total Dissolved Solids (Residue, Filterable)	522.	20.	mg/L	6/2/10	R141593	IR
Mercury, Total		**Method:**	**SW7470A / HG PREP**			
Mercury	< 0.0005	0.0005	mg/L	6/4/10	58863	IG
Metals, Total.		**Method:**	**SW6020A / SW3015**			
Antimony	< 0.006	0.006	mg/L	6/7/10 21:33	58815	AG
Arsenic	0.0225	0.01	mg/L	6/7/10 21:33	58815	AG
Barium	0.374	0.02	mg/L	6/7/10 21:33	58815	AG
Beryllium	< 0.003	0.003	mg/L	6/7/10 21:33	58815	AG
Boron	0.687	0.2	mg/L	6/9/10	58815	AG
Cadmium	< 0.001	0.001	mg/L	6/7/10 21:33	58815	AG
Chromium	< 0.07	0.07	mg/L	6/7/10 21:33	58815	AG
Cobalt	< 0.07	0.07	mg/L	6/7/10 21:33	58815	AG
Iron	11.2	0.04	mg/L	6/7/10 21:33	58815	AG
Lead	< 0.005	0.005	mg/L	6/7/10 21:33	58815	AG
Manganese	0.503	0.01	mg/L	6/7/10 21:33	58815	AG
Nickel	< 0.05	0.05	mg/L	6/7/10 21:33	58815	AG
Selenium	< 0.02	0.02	mg/L	6/7/10 21:33	58815	AG
Silver	< 0.05	0.05	mg/L	6/7/10 21:33	58815	AG
Thallium	< 0.002	0.002	mg/L	6/7/10 21:33	58815	AG
Zinc	< 0.02	0.02	mg/L	6/7/10 21:33	58815	AG

Qualifiers:
- B - Analyte detected in the associated Method Blank
- E - Estimated
- H - Holding Time Exceeded
- S - Spike Recovery outside accepted recovery limits
- R - RPD outside accepted recovery limits
- J - Analyte detected below quanititation limits

ENVIRONMENTAL MONITORING & TECHNOLOGIES, INC.

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Chain of Custody Record

Scheduled Sampling Date: 05/17/2010
Due Date: 05/24/2010

COC # 503747

Company: City, Water, Light & Power
Contact:
Address: 201 East Lake Shore Drive
Springfield, IL 62707
Phone: (217) 757-8610
P.O. #: ______ Proj. #: ______
Project /Location: CWLP Ash Pond Table 1

SAMPLE TYPE:
0. Water, 0. Process Water, 3. Soil, 6. Oil, 9. Air, 12. Groundwater, 15. Other
0. Fat, 1. DI Water, 4. Extract, 7. Sludge, 10. Chemical Waste, 13. eProduct
0. Liquid, 2. Drinking Water, 5. Wastewater, 8. Solid, 11. Wipe, 14. Groundwater(Filter)

CONTAINER TYPE:
P - Plastic, B - Tedlar Bag, V - VOC Vial, O - Other, G - Glass

PRESERVATIVE:
1. None, 4. NaOH, 7. Zn Ace, 2. H2SO4, 5. HCL, 8. Other, 3. HNO3, 6. MeOH

Analysis
1. Anions by Ion Chromatography
2. Solids, Total Dissolved (TDS)
3. Fluoride by Electrode (ISE)
4. Cyanide, Total
5. ICP MS Metals, Total
6. Mercury, Groundwater Total

EMT USE ONLY — EMT WORKORDER

Sample I.D.		Sample Type	Container Size	Container Type	Container No.	Sampling By	Sampling Date	Sampling Time	Sampling pH	Preservation Field	Preservation Lab	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Lab Sample I.D.
AP1	GRAB	12	1 liter	P	1	SR	6/1/10	8:15	7.44	1												
AP1	GRAB	5	1 liter	P	1	↓	↓	↓	↓	1												
AP1	GRAB	12	500 ml	P	1	↓	↓	↓	↓	4												
AP1	GRAB	12	500 ml	P	1	↓	↓	↓	↓	3												

Relinquished By	Date / Time	Received By	Date / Time
[signature]	Date: 6-1-10 Time: 9:45	[signature]	Date: 6-1-10 Time: 09:45
[signature]	Date: 6-1-10 Time: 17:20		Date: Time:
	Date: Time:	[signature]	Date: 6/1/10 Time: 1720

EMT USE ONLY
Client ID: SPRING
Client Contact:
EMT Project ID: CWLP Ash Pond Table 1
Jar Lot No
SAMPLE RECEIVED ON ICE
TEMPERATURE

SPECIAL INSTRUCTIONS: TEMP 68.4°F Condo 327

5/17/2010 3:06:20 PM

ENVIRONMENTAL MONITORING & TECHNOLOGIES, INC.®

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Chain of Custody Record

Scheduled Sampling Date: 05/17/2010
Due Date: 05/24/2010

COC # 503747

Company: City, Water, Light & Power
Contact:
Address: 201 East Lake Shore Drive
Springfield, IL 62707
Phone: (217) 757-8610
P.O. #: ______ **Proj. #:** ______
Project /Location: CWLP Ash Pond Table 1

SAMPLE TYPE:
0. Water, 0. Process Water, 3. Soil, 6. Oil, 9. Air, 12. Groundwater, 15. Other, 0. Fat, 1. DI Water, 4. Extract, 7. Sludge, 10. Chemical Waste, 13. eProduct, 0. Liquid, 2. Drinking Water, 5. Wastewater, 8. Solid, 11. Wipe, 14. Groundwater(Filter)

CONTAINER TYPE:
P - Plastic, B - Tedlar Bag, V - VOC Vial, O - Other, G - Glass

PRESERVATIVE:
1. None, 4. NaOH, 7. Zn Ace, 2. H2SO4, 5. HCL, 8. Other, 3. HNO3, 6. MeOH

Analysis
1. Anions by Ion Chromatography
2. Solids, Total Dissolved (TDS)
3. Fluoride by Electrode (ISE)
4. Cyanide, Total
5. ICP MS Metals, Total
6. Mercury, Groundwater Total

EMT USE ONLY
EMT WORKORDER: 1005[illegible]

Sample I.D.		Sample Type	Container Size	Container Type	No.	Sampling By	Sampling Date	Sampling Time	pH	Preservation Field	Preservation Lab	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Lab Sample I.D.
AP2	GRAB	12	1 liter	P	1	SC	6/1/10	8:25	7.89	1												[illegible]
AP2	GRAB	5	1 liter	P	1	↓	↓	↓	↓	1												[illegible]
AP2	GRAB	12	500 ml	P	1	↓	↓	↓	↓	4												[illegible]
AP2	GRAB	12	500 ml	P	1	↓	↓	↓	↓	3												[illegible]

Relinquished By:	Date / Time	Received By:	Date / Time
[signature]	Date: 6-1-10 Time: 9:45	[signature]	Date: 6-1-10 Time: 09:45
[signature]	Date: 6-1-10 Time: 17:20		Date: - - Time: : :
	Date: - - Time: : :	Marshall	Date: 6/1/10 Time: 1720

EMT USE ONLY
ClientID: SPRINO
Client Contact: [illegible]
EMT Project ID: CWLP Ash Pond Table 1
[illegible]

SAMPLE RECEIVED ON ICE
TEMPERATURE
(Must be recorded if sampling was greater than 6 hrs prior to sample receipt)

SPECIAL INSTRUCTIONS: TEMP 68.7°F Condo 742

5/17/2010 3:06:20 PM

ENVIRONMENTAL MONITORING & TECHNOLOGIES, INC.

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Chain of Custody Record

Scheduled Sampling Date: 05/17/2010
Due Date: 05/24/2010

COC # 503747

Company: City, Water, Light & Power
Contact:
Address: 201 East Lake Shore Drive
Springfield, IL 62707
Phone: (217) 757-8610
P.O. #: ______ **Proj. #:** ______
Project /Location: CWLP Ash Pond Table 1

SAMPLE TYPE:
0. Water; 0. Process Water; 3. Soil; 6. Oil; 9. Air; 12. Groundwater; 15. Other
0. Fat; 1. DI Water; 4. Extract; 7. Sludge; 10. Chemical Waste; 13. eProduct
0. Liquid; 2. Drinking Water; 5. Wastewater; 8. Solid; 11. Wipe; 14. Groundwater(Filter)

CONTAINER TYPE:
P - Plastic; B - Tedlar Bag; V - VOC Vial; O - Other; G - Glass

PRESERVATIVE:
1. None; 4. NaOH; 7. Zn Ace; 2. H2SO4; 5. HCL; 8. Other; 3. HNO3; 6. MeOH

Analysis
1. Anions by Ion Chromatography
2. Solids, Total Dissolved (TDS)
3. Fluoride by Electrode (ISE)
4. Cyanide, Total
5. ICP MS Metals, Total
6. Mercury, Groundwater Total

EMT USE ONLY
EMT WORKORDER
#1005063

Sample I.D.		Sample Type	Container Size	Container Type	No.	Sampling By	Sampling Date	Sampling Time	pH	Preservation Field	Preservation Lab	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Lab Sample I.D.
AP3	GRAB	12	1 liter	P	1	[illegible]	6/1/10	[illegible]	6.73	1												
AP3	GRAB	5	1 liter	P	1	↓	↓	↓	↓	1												
AP3	GRAB	12	500 ml	P	1	↓	↓	↓	↓	4												
AP3	GRAB	12	500 ml	P	1	↓	↓	↓	↓	3												

Relinquished By:	Date / Time	Received By:	Date / Time
[signature]	Date: 6-1-10 Time: 9:45	[signature]	Date: 6-1-10 Time: 09:45
[signature]	Date: 6-1-10 Time: 17:20		Date: - - Time: :
	Date: - - Time: :	Marriott [signature]	Date: 6-1-10 Time: 1720

EMT USE ONLY
Client ID: SPRING
Client Contact: Jim Faillons
EMT Project ID: CWLP Ash Pond Table 1
Last Lot No.:

SAMPLE RECEIVED ON ICE
TEMPERATURE
(Must be recorded if sampling was greater than 4 hours prior to sample receipt)

SPECIAL INSTRUCTIONS: TEMP 67.7°F Condo 1128

5/17/2010 3:06:20 PM

ENVIRONMENTAL MONITORING & TECHNOLOGIES, INC.
8100 North Austin Avenue Morton Grove, IL 60053-3203 (847) 967-6666 FAX:(847) 967-6735 www.emt.com

Chain of Custody Record

Scheduled Sampling Date: 05/17/2010
Due Date: 05/24/2010

COC # 503747

Company: City, Water, Light & Power
Contact:
Address: 201 East Lake Shore Drive
Springfield, IL 62707
Phone: (217) 757-8610
P.O. #: ______ Proj. #: ______
Project /Location: CWLP Ash Pond Table 1

SAMPLE TYPE:
0. Water, 0. Fat, 0. Liquid, 0. Process Water, 1. DI Water, 2. Drinking Water, 3. Soil, 4. Extract, 5. Wastewater, 6. Oil, 7. Sludge, 8. Solid, 9. Air, 10. Chemical Waste, 11. Wipe, 12. Groundwater, 13. eProduct, 14. Groundwater(Filter), 15. Other

CONTAINER TYPE:
P - Plastic, V - VOC Vial, G - Glass, B - Tedlar Bag, O - Other

PRESERVATIVE:
1. None, 2. H2SO4, 3. HNO3, 4. NaOH, 5. HCL, 6. MeOH, 7. Zn Ace, 8. Other

Analysis
1. Anions by Ion Chromatography
2. Solids, Total Dissolved (TDS)
3. Fluoride by Electrode (ISE)
4. Cyanide, Total
5. ICP MS Metals, Total
6. Mercury, Groundwater Total

EMT USE ONLY
EMT WORKORDER
#1005060310

Sample I.D.		Sample Type	Container Size	Container Type	No.	Sampling By	Sampling Date	Sampling Time	pH	Preservation Field	Preservation Lab	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Lab Sample I.D.
AP4	GRAB	12	1 liter	P	1	↑	6/1/10	9:05	6.91	1												1A
AP4	GRAB	5	1 liter	P	1	↓	↓	↓	↓	1												B
AP4	GRAB	12	500 ml	P	1					4												C
AP4	GRAB	12	500 ml	P	1	↓				3												

Relinquished By:	Date / Time	Received By:	Date / Time
[signature]	Date: 6-1-10 Time: 9:45	[signature]	Date: 6-1-10 Time: 09:45
[signature]	Date: 6-1-10 Time: 17:20		Date: Time:
	Date: Time:	[signature]	Date: 6-1-10 Time: 1920

EMT USE ONLY
Client ID: SPRING
Client Contact: [illegible]
EMT Project ID: CWLP Ash Pond Table 1
Jar Lot No.

SAMPLE RECEIVED ON ICE
TEMPERATURE
(Must be recorded if sampling was greater than 6 hours prior to sample receipt)

SPECIAL INSTRUCTIONS: TEMP 67.9°F Condo 708

5/17/2010 3:06:21 PM

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Chain of Custody Record

Scheduled Sampling Date: 05/17/2010
Due Date: 05/24/2010

COC # 503747

Company: City, Water, Light & Power
Contact:
Address: 201 East Lake Shore Drive
Springfield, IL 62707
Phone: (217) 757-8610
P.O. #: ______ **Proj. #:** ______
Project /Location: CWLP Ash Pond Table 1

SAMPLE TYPE:
0. Water, 0. Process Water, 3. Soil, 6. Oil, 9. Air, 12. Groundwater, 15. Other
0. Fat, 1. DI Water, 4. Extract, 7. Sludge, 10. Chemical Waste, 13. eProduct
0. Liquid, 2. Drinking Water, 5. Wastewater, 8. Solid, 11. Wipe, 14. Groundwater(Filter)

CONTAINER TYPE:
P - Plastic, B - Tedlar Bag, V - VOC Vial, O - Other, G - Glass

PRESERVATIVE:
1. None, 4. NaOH, 7. Zn Ace, 2. H2SO4, 5. HCL, 8. Other, 3. HNO3, 6. MeOH

Analysis
1. Anions by Ion Chromatography
2. Solids, Total Dissolved (TDS)
3. Fluoride by Electrode (ISE)
4. Cyanide, Total
5. ICP MS Metals, Total
6. Mercury, Groundwater Total

EMT USE ONLY
EMT WORKORDER: 1005130

Sample I.D.		Sample Type	Container Size	Container Type	No.	Sampling By	Sampling Date	Sampling Time	Sampling pH	Preservation Field	Preservation Lab	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Lab Sample I.D.
AW3	GRAB	12	1 liter	P	1	SC	6/1/10	8:00	6.63	1		shaded										[illegible]
AW3	GRAB	5	1 liter	P	1	↓	↓	↓	↓	1			shaded	shaded								[illegible]
AW3	GRAB	12	500 ml	P	1	↓	↓	↓	↓	4					shaded							B
AW3	GRAB	12	500 ml	P	1	↓	↓	↓	↓	3						shaded	shaded					C

Relinquished By:	Date / Time	Received By:	Date / Time
[signature]	Date: 6-1-10 Time: 9:45	[signature]	Date: 6-1-10 Time: 09:45
[signature]	Date: 6-1-10 Time: 17:20		Date: - - Time: : :
	Date: - - Time: : :	Warnwell	Date: 6/1/10 Time: 1720

EMT USE ONLY
Client ID: SPRING
Client Contact: [illegible]
EMT Project ID: CWLP Ash Pond Table 1
Lot No.:

SAMPLE RECEIVED ON ICE
TEMPERATURE: [illegible]

SPECIAL INSTRUCTIONS: TEMP 71.1°F Condo 616

ATTACHMENT 3 – 1987 ENGINEERING REPORT

HANSON ENGINEERS
INCORPORATED

July 2, 1987

RECEIVED
JUL 10 1987
ENVIRONMENTAL AFFAIRS

City Water, Light and Power
V.Y. Dallman Power Plant
3100 Stevenson Drive
Springfield, Illinois 62703

Attn: Mr. Carl J. Saladino

Re: Engineering Report
Proposed Embankment Modifications
CWLP Ash Disposal Area
Springfield, Illinois

Dear Carl,

Enclosed are four copies of our Engineering Report for the proposed embankment modifications at your existing Lakeside ash disposal area.

Two copies of our report have been sent to the Illinois Department of Transportation, Division of Water Resources for conceptual approval of the permit application.

Please do not hesitate to call if you have any questions regarding this information.

Very truly yours,

HANSON ENGINEERS INCORPORATED

Danny L. Kerns

Danny L. Kerns, P.E.
Associate Partner

Enclosures

DLK/pb

1525 SOUTH SIXTH STREET ■ SPRINGFIELD, ILLINOIS 62703-2886 ■ 217/788-2450
SPRINGFIELD, ILLINOIS ■ PEORIA, ILLINOIS ■ ROCKFORD, ILLINOIS

HANSON ENGINEERS INCORPORATED

July 2, 1987

Mr. Martin Stralow, P.E.
Chief, Dam Safety Section
Illinois Department of Transportation
Division of Water Resources
2300 South Dirksen Parkway
Springfield, Illinois 62764

Re: Engineering Report
Proposed Embankment Modifications
CWLP Ash Disposal Area
Springfield, Illinois

Dear Mr. Stralow:

Enclosed for your review and comments are two copies of our Engineering Report for the proposed embankment modifications at the Lakeside ash disposal area in Springfield, Illinois. The report includes an application for a permit to perform the proposed modifications.

Upon receipt of conceptual approval for this project, we will prepare and submit construction drawings and specifications along with the other items required for the permitting process.

Please keep us advised of any concerns or comments which may arise during your review so that we can address them in a timely manner.

Very truly yours,

HANSON ENGINEERS INCORPORATED

Danny L. Kerns

Danny L. Kerns, P.E.
Associate Partner

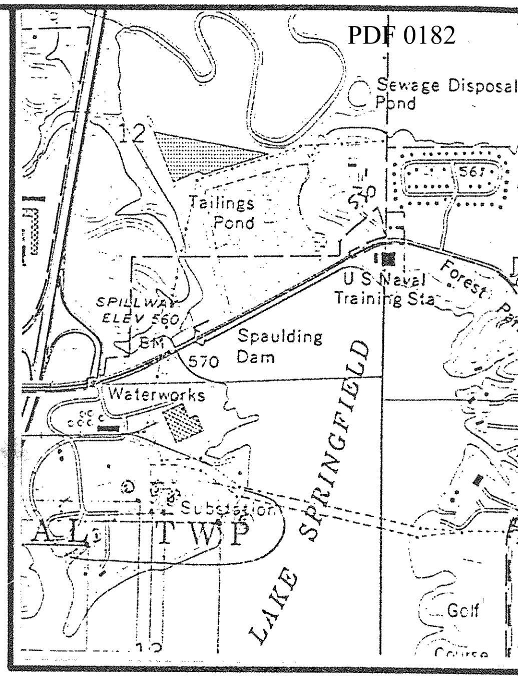
enclosures

DLK/pb

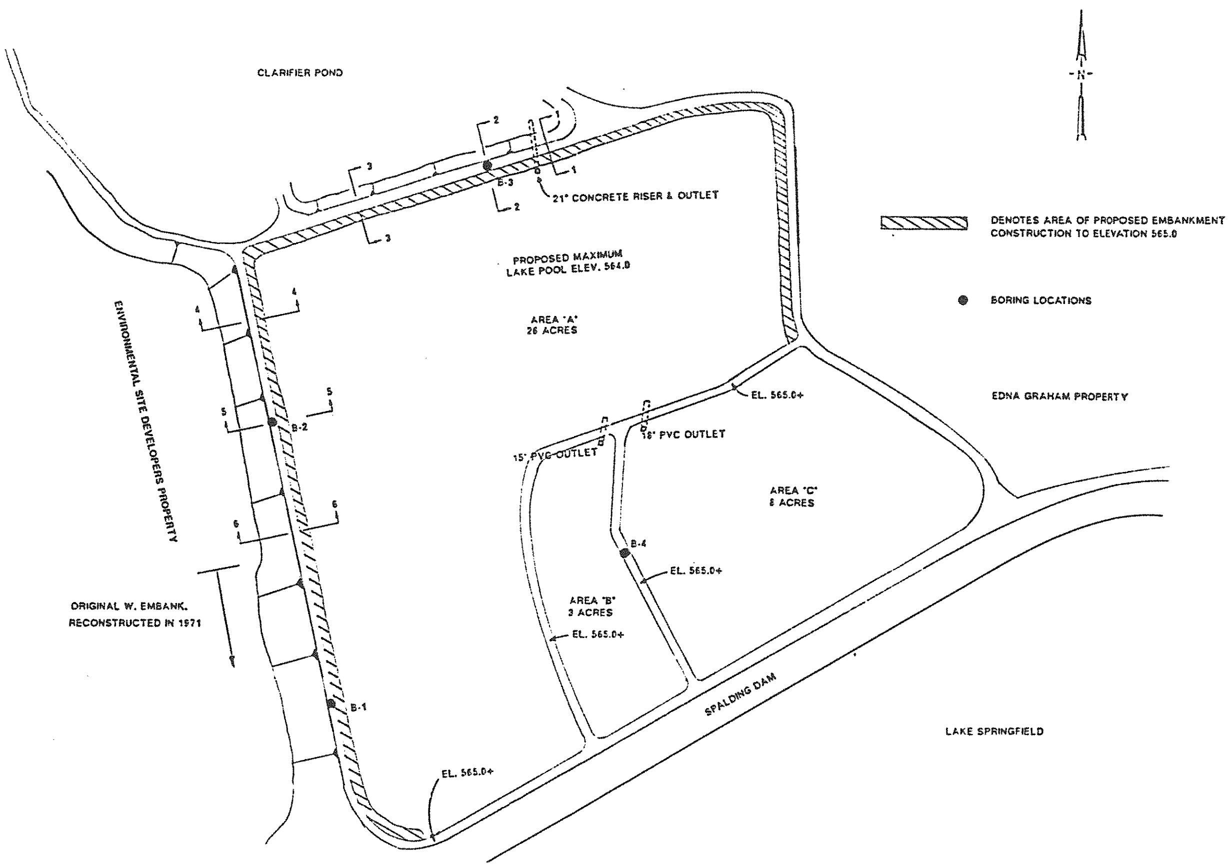
CC: Mr. Carl J. Saladino
CWLP

1525 SOUTH SIXTH STREET ■ SPRINGFIELD, ILLINOIS 62703-2886 ■ 217/788-2450
SPRINGFIELD, ILLINOIS ■ PEORIA, ILLINOIS ■ ROCKFORD, ILLINOIS

PDF 0182



VICINITY MAP



LIST OF ADJACENT PROPERTY OWNERS

NO.	NAME	ADDRESS
1.	ENVIRONMENTAL SITE DEVELOPERS INC.	195 EAST LAKE DRIVE SPRINGFIELD, IL. 62703
2.	MRS. EDNA GRAHAM	
3.		
4.		

PROJECT DESCRIPTION:

RAISE PORTION OF LAKESIDE ASH DISPOSAL EMBANKMENT A MAXIMUM OF 10 FT.

LOCATION:

SPAULDING DAM
CITY OF SPRINGFIELD
SANGAMON COUNTY

SHEET OF

NCR FORM 427
01 JUNE 81

CORPS OF ENGINEERS COPY

JOINT APPLICATION FORM

PDF 0183

1. Application Number (To be assigned by Agency)

2. Date

Day Month Year

3. For Agency use only (Date Received)

4. Name and address of applicant
City of Springfield
City Water, Light and Power
3100 Stevenson Drive
Springfield, Illinois 62703
Telephone no. during business hours
A/C (217) 786-4063
A/C ( ) ____

5. Name, address, and title of authorized agent
Hanson Engineers Incorporated
1525 South 6th Street
Springfield, Illinois 62703
Telephone no. during business hours
A/C (217) 788-2450
A/C ( ) ____

6. Describe in detail the proposed activity, its purpose, and intended use. If additional space is needed, attach additional support information to each agency application.

Raise portion of existing Lakeside Ash Disposal Area embankment a maximum of 10 ft to obtain additional storage volume for ash and filter cake slude disposal.

7. Names, addresses, and telephone numbers of all adjoining and potentially affected property owners, including the owner of subject property if different from applicant.

Environmental Site Developers, Inc., 195 East Lake Drive, Springfield, IL, 217-529-1891
Mrs. Edna Graham

8. Location of activity
Address:
City Water, Light and Power - Spaulding Dam
Street, road, or other descriptive location
Springfield
In or near city or town

County	State	Zip Code
Sangamon	Illinois	62703

Legal Description:

1/4	Sec.	Twp.	Rge.	P.M.
SE	12	T15N	R5W	3rd

Tax Assessor's Description (if known):
Map No. ____ Subdiv. No. ____ Lot No. ____
Name of waterway at location of the activity ____

9. Date activity is proposed to commence September, 1987 Date activity is expected to be completed June, 1988

10. Is any portion of the activity for which authorization is sought now complete? ___ Yes X No If answer is "Yes" give reasons in the remark section. Month and Year the activity was completed – Indicate the existing work on drawings.

11. List all approvals or certifications required by other federal, interstate, state, or local agencies for any structures, construction, discharges, deposits, or other activities described in this application. If this form is being used for concurrent application to the Corps of Engineers, Illinois Department of Transportation, and Illinois Environmental Protection Agency, these agencies need not be listed.

Issuing Agency	Type Approval	Identification No.	Date of Application	Date of Approval
–	–	–	–	–

12. Has any agency denied approval for the activity described herein or for any activity directly related to the activity described herein.
___ Yes X No (If "Yes", explain in remarks.)

13. Remarks

14. Application is hereby made for authorizations of the activities described herein. I certify that I am familiar with the information contained in the application, and that to the best of my knowledge and belief, such information is true, complete, and accurate. I further certify that I possess the authority to undertake the proposed activities.

Signature of Applicant or Authorized Agent

NCR FORM 426
01 JUNE 81

CORPS OF ENGINEERS COPY - SEE JURISDICTIONAL MAP FOR ADDRESS

ENGINEERING REPORT
PROPOSED EMBANKMENT MODIFICATIONS
CWLP ASH DISPOSAL AREA
SPRINGFIELD, ILLINOIS

HANSON ENGINEERS INCORPORATED ®

ENGINEERING REPORT
PROPOSED EMBANKMENT MODIFICATIONS
CWLP ASH DISPOSAL AREA
SPRINGFIELD, ILLINOIS

Prepared By

Hanson Engineers Incorporated
1525 South Sixth Street
Springfield, Illinois 62703-2886

Prepared For

City Water, Light and Power
3100 Stevenson Drive
Springfield, Illinois 62703

July 2, 1987

HANSON ENGINEERS
INCORPORATED

July 2, 1987

City Water, Light and Power
V.Y. Dallman Power Plant
3100 Stevenson Drive
Springfield, Illinois 62703

Attn: Mr. Carl J. Saladino

Re: Engineering Report
Proposed Embankment Modifications
CWLP Ash Disposal Area
Springfield, Illinois

Gentlemen:

Following is our Engineering Report for the proposed embankment modifications at your existing ash disposal area in Springfield, Illinois. This work was completed in accordance with our agreement for engineering services dated April 2, 1987.

Boring samples will be retained in our laboratory and disposed of after a minimum of 90 days. Please notify our office if you wish alternative disposition of the samples.

We are pleased to have had the opportunity to perform this work. If you have any questions concerning the report, or if Hanson Engineers may be of additional service to you on this project, please do not hesitate to call.

Very truly yours,

HANSON ENGINEERS INCORPORATED

Danny L. Kerns, P.E.
Associate Partner

Approved by John M. Healy, P.E., S.E.
Vice President

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- C O N T E N T S -

INTRODUCTION

This report presents the results of our investigation of the existing ash disposal area embankment and our analyses of the proposed modifications to the embankment. The purpose of this investigation was to develop specific recommendations relative to the proposed modifications and to secure field information which will be of aid during construction.

The conclusions and recommendations presented within this report have been developed directly from: (1) the results of four test borings made at the site by Central Illinois Drilling Company, (2) the results of laboratory testing on samples obtained from these borings, (3) our site inspection of existing embankment conditions, and (4) analyses of existing and proposed conditions. This report has been prepared for the exclusive use of City Water, Light and Power for specific application to this project in accordance with generally accepted engineering practices. No other warranty, expressed or implied, is made.

The locations of the borings on the site were laid out in the field by Hanson Engineers relative to existing site features with the use of a cloth tape. Elevations of the ground surface at the boring locations were determined with a level instrument utilizing the crest of the disposal area outlet pipe at elevation 554.1 as a reference datum. The locations and elevations of the borings have been determined with sufficient accuracy for the intentions of the subsurface investigation but should not be referenced for other purposes. The boring locations relative to the proposed construction are shown in Figure 2.

Detailed field logs have been prepared by the drilling foreman which record the changes encountered in the subsurface strata and summarize the field sampling completed. No attempts have been made by Hanson Engineers to modify the subsurface descriptions on these logs to conform with later classifications made in the laboratory. It is emphasized that the recommendations contained within this report are based upon the laboratory classifications of samples. A copy of the driller's field logs is contained within Appendix A of this report.

Figures 3 and 4 are Laboratory Soil Test Data sheets which contain a completed tabulation of all visual classifications and routine tests completed by Hanson Engineers for this project. A description of procedures for the routine testing is presented within a later section of this report.

HISTORY OF ASH DISPOSAL AREA

The initial deposition of fly ash was started in the original disposal area north of Spaulding Dam shortly after completion of the first power plant sometime in the middle 1930's. This original disposal area encompassed Areas B and C shown in Figure 1, as well as the south half of Area A. The south portion of the west embankment was part of the construction for the original ash disposal area.

In 1966, plans were prepared for expanding the disposal area to the north. The north embankment and the north portion of the west embankment were constructed in conjunction with this expansion. Slopes of 2.0H to 1.0V are indicated on the construction drawings, as is a crest width of 12 ft. "Compact to 90% Maximum Density at Optimum Moisture" is noted on these 1966 drawings.

A breach occurred in the south portion (original) of the west embankment in 1970. Reconstruction of the entire original west embankment included a sand drain which was placed horizontally along the embankment toe and up the embankment slope. A buttress of compacted clay (capped on its lower portion with riprap) was placed over the sand drain. The reconstructed downstream face had a slope of 3.0H to 1.0V, with a berm formed at approximately mid-slope at the top of the riprap.

Sometime between 1971 and 1976, a clarifier pond was constructed immediately north of the ash disposal area. In 1976, construction drawings were prepared for a new ash disposal area for Dallman Power Plant. These construction drawings also include drawings for modifications to the north portion of the west embankment of the existing ash disposal area. These modifications include a sloped granular drainage blanket connected to an 8 in. diameter perforated pipe running the length of the embankment. Compacted material downstream of this drainage blanket flattened the downstream slope to 2.5 H to 1.0V. The outlet of the drainage pipe is indicated to be north of the original west embankment (which had been reconstructed in 1971).

North-south cross dikes were constructed over ponded ash material in the original disposal area subsequent to 1976. In addition, a portion of the north embankment of the original ash disposal area was raised in height. This construction formed Areas B and C to their present configurations.

PROPOSED MODIFICATIONS

In order to increase the storage capacity and useful life of the existing ash disposal area, it is proposed that the perimeter embankment of Area A be raised to elevation 565. This would effectively raise the existing embankment up to 10 ft in height and bring the Area A perimeter embankment crest to the approximate elevation of the embankments surrounding Areas B and C. The proposed modifications will involve raising approximately 3,200 lineal feet of embankment, primarily along the west and north sides of Area A.

The upstream method of construction is proposed for the embankment modifications. This method was selected for two reasons. First, it allows for the continued use of the existing embankment crest roadways during construction for haul trucks to and from the scrubber sludge and Dallman ash disposal areas to the north. These roadways can be maintained at their existing grades. Second, the upstream method of construction allows the existing embankment crest roadways to be used as a berm (width varies from approximately 14 ft to 24 ft) for the proposed final embankment section. This berm will serve to effectively reduce the overall outside slope of the embankment, thereby increasing the stability of the embankment section.

The proposed embankment modification will consist of a 10 ft wide crest with a 2.0H to 1.0V downstream side slope, a 1.0H to 1.0V upstream side slope, and a 10 ft maximum height as shown in Figure 2. In order to develop a stable base for construction equipment to place and compact the cohesive embankment material, it is proposed that bottom ash material be placed for a distance of up to approximately 45 ft upstream of the existing embankment crest. The bottom ash should displace the fly ash and filter cake sludge materials that are present upstream of the crest primarily along the north embankment and the northern portion of the west embankment.

In order to reduce the development of seepage pressures at the junction between the existing embankment and the proposed extension, we propose that a filter fabric wrapped perforated pipe be installed along this area. The pipe may be trenched in and surrounded with free draining material such as bottom ash. Non-perforated outlet pipes may be used to direct collected seepage into the clarifier pond.

A new drop inlet spillway pipe will be provided near the location of the existing pipe. This new pipe will pass through the proposed embankment and will pass through the crest and along the outside face of the existing embankment into the existing clarifier pond.

FIELD INVESTIGATION

The field investigation program for this project encompassed several items of work including: exploratory borings, sampling of the subsoils, field testing of the subsoils, and visual classifications by the boring foreman of the soil materials encountered. A site inspection was also conducted by representatives of Hanson Engineers to obtain information on present embankment conditions, spillway pipe sizes, and to develop cross sections at various locations along the embankment. In addition, 15 test pits were excavated with a backhoe to better characterize the nature of the materials directly upstream of the existing embankment crest.

The test borings were made with a truck mounted rig equipped with 8 in. diameter hollow stem augers to advance the hole. To permit proper laboratory identification and classification of the subsurface strata, representative samples of the subsoil were taken at regular intervals within each boring. Boring 1 was made in the southern portion of the west embankment. This is a portion of the original embankment for the disposal area and was reconstructed after a breach occurred in 1970. Borings 2 and 3 were made in the northern portion of the west embankment and the north embankment, respectively. These embankments were constructed as part of the disposal area expansion in 1966. Boring 4 was made in a cross dike which separates Areas B and C. This cross dike was constructed on ponded fly ash and bottom ash materials. The information obtained from Boring 4 was helpful in evaluating the effectiveness of the proposed upstream method of construction, where the proposed embankment will also be constructed on ponded fly ash and bottom ash materials.

Soil samples were recovered from the borings by driving a 2 in. O.D. (1 3/8 in. I.D.) split-barrel sampler in conformance with the requirements of ASTM Standard D 1586. The recovered samples were classified by the drilling foreman, sealed in properly identified glass jars, and stored in boxes for later shipment to Hanson Engineers' laboratory.

The field testing consisted of recording the resistance of the various substrata to penetration of the split-barrel sampler in conformance with the requirements of ASTM Standard D 1586. The testing procedure consisted of dropping a 140 lb hammer from a height of 30 in. onto the drill rods guiding the sampler. The number of blows (N) necessary to produce a penetration of 1 ft was recorded as the penetration resistance. To avoid seating errors, the blows for the first 6 in. of penetration were not taken into account; those required to increase the penetration from 6 to 18 in. were recorded as the N-value.

The site inspection was performed on June 2, 1987. The west and north embankments were observed for seepage, erosion channels, undesirable vegetative growth, sloughs, and animal holes. In addition, cross sections at various locations along these embankments were developed. Fifteen test pits were excavated along the upstream crest of the north and west embankments. These test pits were spaced approximately 100 ft apart along the north embankment and approximately 200 ft apart along the west embankment. The results of the site inspection and test pit investigation are described in a subsequent section of this report.

LABORATORY INVESTIGATION

Field samples delivered to our laboratory were subjected to a program of routine laboratory testing which included: soil type classifications by visual methods as recommended in ASTM Standard D 2488, moisture content determination, according to ASTM Standard D 2216, and unconfined compressive strength measurements (of cohesive soil samples) in general conformance with ASTM Standard D 2166. The data obtained from these standard test methods are grouped by boring and recorded on the Laboratory Soil Test Data sheets (Figures 3 and 4).

The laboratory classification of soil samples consisted of assigning each sample (by visual methods) to one of three primary soil groups, and conducting a few simple manual tests for more refined identification when required. The three soil groups are: coarse-grained soils (more than half of the particles by weight are visible to the naked eye); fine-grained soils (more than half of the particles by weight are so fine that they cannot be seen with the naked eye); and organic soils (those which obtain significant quantities of organic matter). The fine-grained soil fractions are subdivided into silt and clay based on visual appearance and simple manual tests which may include dry strength, dilatancy, and plastic thread. The coarse-grained soils are identified as boulders, cobbles, gravel, or sand, based on a visual evaluation of the size of the particles making up the sample, and estimates are made on the percentage of fines present. The presence of organic matter is based upon color, odor, and visual appearance.

In the unconfined compressive strength test, a cylinder of soil having a height of 1 1/2 to 2 times the average diameter is loaded to failure, in simple compression, quickly enough that the water content of the soil does not change. The failure load (or if the sample does not fail outright, the load required to produce 20 percent strain) is expressed as the load per unit of cross sectional area, in tons per square foot. A calibrated penetrometer was also employed to provide supplemental data on consistency or to test samples unsuitable for unconfined compressive strength testing. However, the values from the penetrometer tests are considered only as approximate indicators of consistency.

The results of the unconfined compression tests on the split-barrel samples are subject to interpretation considering the disturbance inherent to the sampling procedure that is used. Generally, shear strength determinations on split-barrel samples are considered slightly to moderately conservative depending upon the sensitivity of the subsoil strata being investigated.

EXISTING EMBANKMENT CONDITIONS

The perimeter embankment of the ash disposal area consists of several distinct sections which distinguish themselves by their configuration, history of construction, or other factors. The following paragraphs describe these various embankment sections as they relate to existing conditions and the proposed construction.

The south portion of the west embankment appeared to be in very good condition. While the downstream embankment slope is relatively flat (approximately 3.0H to 1.0V), trees and brush have been allowed to grow along this portion of the embankment. Numerous swampy, wet areas are present beyond the embankment toe. These are proably the result of drainage from the sand filter and drain which was incorporated into the 1971 reconstruction of this portion of the embankment. No signs of distress were observed along the crest or downstream slope in this area. Located along the west embankment crest are two pipes which carry ash as a slurry from Dallman Power Plant to the ash disposal area located across the clarifier pond to the north. Bottom ash is generally present upstream of this portion of the embankment.

A concentrated seep was observed at the toe of the embankment near the north end of the 1971 reconstruction. Flows from this seep were clear and were estimated to be approximately 2 to 4 gallons per minute. The location of this discharge corresponds to an 8 in. diameter toe drain outlet pipe indicated on construction drawings prepared in 1976. These drawings show a rehabilitation of the northern portion of the west embankment, incorporating a granular filter drain collecting seepage water into an 8 in. diameter perforated subdrain passing along the embankment toe to the outlet location. Compacted embankment material is shown over the granular filter drain. The rehabilitation flattened the downstream slope to 2.5H to 1.0V from 2.0H to 1.0V.

The northern portion of the west embankment also appeared to be in generally good condition. Downstream slopes were measured to be approximately 2.5H to 1.0V or flatter, and the crest width varied from 22 ft to 24 ft. The ponded materials upstream of the crest become increasingly fine to the north end of this embankment. No tension cracks or other indications of distress were noted on the embankment crest.

An erosional channel (approximately 2 ft wide and up to 1 ft deep) was noted on the downstream slope of this embankment. This channel did not appear to be active. A minor surface slide was observed on the downstream face in an area in which a break in the ash line had occurred previously. Ash was present at the toe of the embankment in this area as though it had washed down the slope. A small scarp is located near the top of the embankment in this slide area, and some embankment material is piled near the bottom of the slide area, which is located about two-thirds down the slope.

At the far north end of the west embankment, the downstream toe area is very flat and swampy, with cattail growth. This swampy area follows the toe of the west embankment around to the toe of the south embankment of the adjacent clarifier pond. No concentrated seeps were noted. However, the seepage from this area is collected in a shallow ditch which runs to nearby Sugar Creek. Flows in this ditch were estimated to be approximately 2 to 3 gallons per minute. Scattered small tree and brush growth was observed along this portion of the embankment.

The north embankment is considerably more steep than the west embankment. Measurements indicate that the downstream embankment face exists at a slope ranging from 1.0H to 1.0V to 1.3H to 1.0V. The crest width is about 14 ft, and no signs of distress were observed. Fairly heavy tree and brush growth exists along the downstream slope. A clarifier pond abuts the north embankment toe along a major portion of its length. The water level in this clarifier pond is only about 7 ft or 8 ft below the water level in the ash disposal area.

Test pits along the upstream edge of the north embankment encountered fly ash in the western portion and filter cake sludge in the eastern portion. These materials are both very fine, wet, and very soft. Cattail growth is fairly heavy along the areas where fly ash is present.

As a part of our site inspection, Illinois Department of Transportation, Division of Water Resources, Dam Inspection Forms were completed. Appendix B of this report contains these completed forms.

SLOPE STABILITY

Cross sections through the north and west embankments indicating existing and proposed conditions are presented in Figures 5, 6, and 7. Two of these cross sections were taken at the locations of Borings 2 and 3. The unconfined compressive strengths (Qu) and the Standard Penetration Test N-values from these borings are plotted on these cross sections. Also indicated are the generalized subsurface profiles at the boring locations. Similar test data and subsurface profile information are presented on Figure 8 for Borings 1 and 4.

Using this cross section information and the laboratory test data for samples obtained from the borings, slope stability analyses were performed for the north and west embankments. These analyses used slope stability charts originally published by Taylor (1937), and presented by Peck, Hanson, and Thornburn (Foundation Engineering, Second Edition, 1974, pages 298-299). These slope stability analyses used conservative values for soil shear strength and indicated factors of safety consistently greater than 1.5, which is the minimum recommended value. The slope stability calculations are included in Appendix C of this report.

HYDROLOGY AND HYDRAULICS

Our studies indicate that the ash disposal area occupies a surface area of approximately 37 acres. Of this total surface area, about 26 acres are in Area A (see Figure 1). Areas B and C occupy approximately 3 acres and 8 acres, respectively. The embankments which confine Areas B and C are at or above elevation 565. This is approximately 10 ft higher than the west and north embankments of Area A. The east side of Area A is confined by natural ground. The natural ground surface slopes upward from the east end of the Area A north embankment (about elevation 555) to the east end of the north embankment confining Area C (about elevation 565). The south limits of Areas A, B, and C are defined by Spaulding Dam, which forms Lake Springfield.

Filter cake sludge material is slurried into Areas B and C from the water treatment plant located to the southwest of the site. A majority of the solids settle in Areas B and C, and the water is decanted into Area A through drop inlet pipes located at the north ends of Areas B and C. Surface water also flows from Areas B and C into Area A through the drop inlets.

Coal combustion ash is slurried into the southwest corner of Area A from nearby Lakeside Power Plant. The ash materials settle out in Area A, and the water is decanted into the clarifier pond through a 21 in. diameter drop inlet pipe. The outlet of this pipe is submerged beneath the surface of the clarifier pond. The level of the clarifier pond was at approximately elevation 547 at the time of our site visit. The clarifier pond level is controlled by stop logs in the concrete outlet structure. Flows pass over the stop logs and then discharge into Sugar Creek.

The proposed modifications include raising the embankment surrounding Area A to approximately elevation 565, a maximum height of about 10 ft. This will extend the total height of the west and north embankments to about 28 ft.

This will also increase the storage capacity of Area A by about 260 acre-ft.

According to criteria established by the Illinois Department of Transportation, Division of Water Resources, an impoundment such as this is in the small size classification and in the Class III hazard classification. Such a structure is required to pass or contain the runoff from the 100 year rainfall event with adequate freeboard. With essentially no watershed area, the spillway would be expected to pass only the rain which falls directly on the disposal area (8.4 in. for the 100 year event). Our calculations indicate that the amount of water generated by this event (approximately 25.9 acre-ft) can be discharged from the ash disposal area into the clarifier pond in less than two days.

We propose that the crest of the new inlet structure be established at a maximum elevation of 564, which is 1 ft below the proposed embankment crest. If an emergency situation necessitates lowering the ash disposal area pool, we recommend that this be accomplished with filtered sumps and pumps or siphons discharging into the clarifier pond.

Our hydrology and hydraulic calculations are included in Appendix C of this report.

CONCLUSIONS AND RECOMMENDATIONS

The results of the investigation indicate that the proposed embankment modifications are feasible from a technical standpoint. The slope stability analyses indicate that an adequate factor of safety will exist for the proposed embankment section. Information obtained from Boring 4 indicates that construction of a compacted cohesive embankment is possible over ponded fly ash and bottom ash materials. A copy of the completed construction permit Joint Application Form is included in Appendix D.

We recommend that before construction of the proposed embankment is started the existing vegetation (cattails) should be removed from the embankment area. This may be accomplished by excavating the vegetation with a backhoe or dragline, or by displacing the vegetation (and underlying fly ash) with bottom ash material as it is placed upstream of the crest to provide a stable base for construction of the embankment. Lowering of the water level in the ash disposal area may be necessary until a stable base is provided and the compacted embankment is brought above the elevation of the existing embankment. A trial and error construction approach may be necessary to find the most effective means of providing a stable construction base.

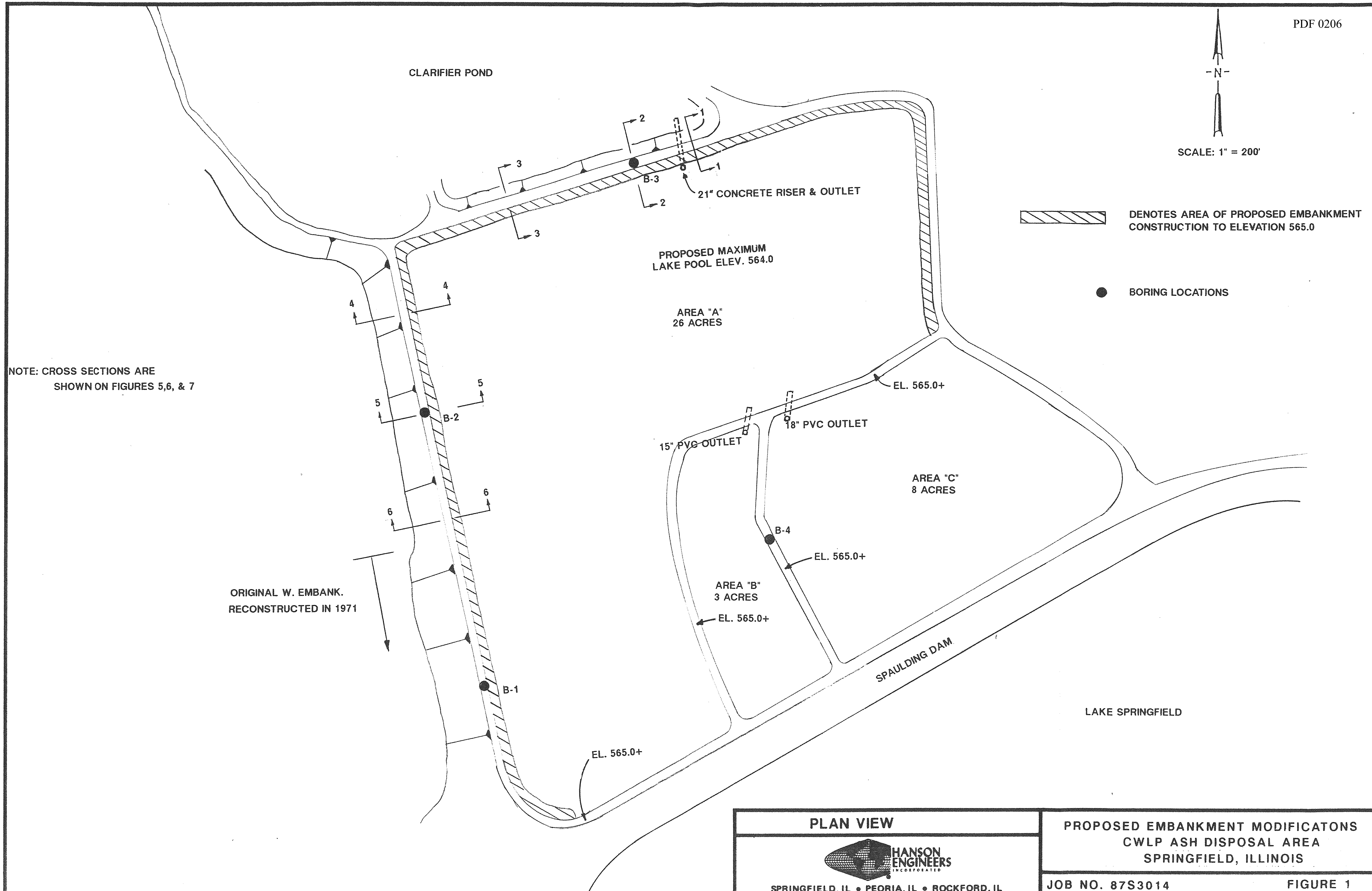
After a stable base is prepared, the cohesive embankment material should be placed in thin lifts (approximately 6 in. to 8 in. thick). The Standard Specifications for Road and Bridge Construction, adopted October 1, 1983, by Illinois Department of Transportation, should be followed for embankment construction (Section 207).

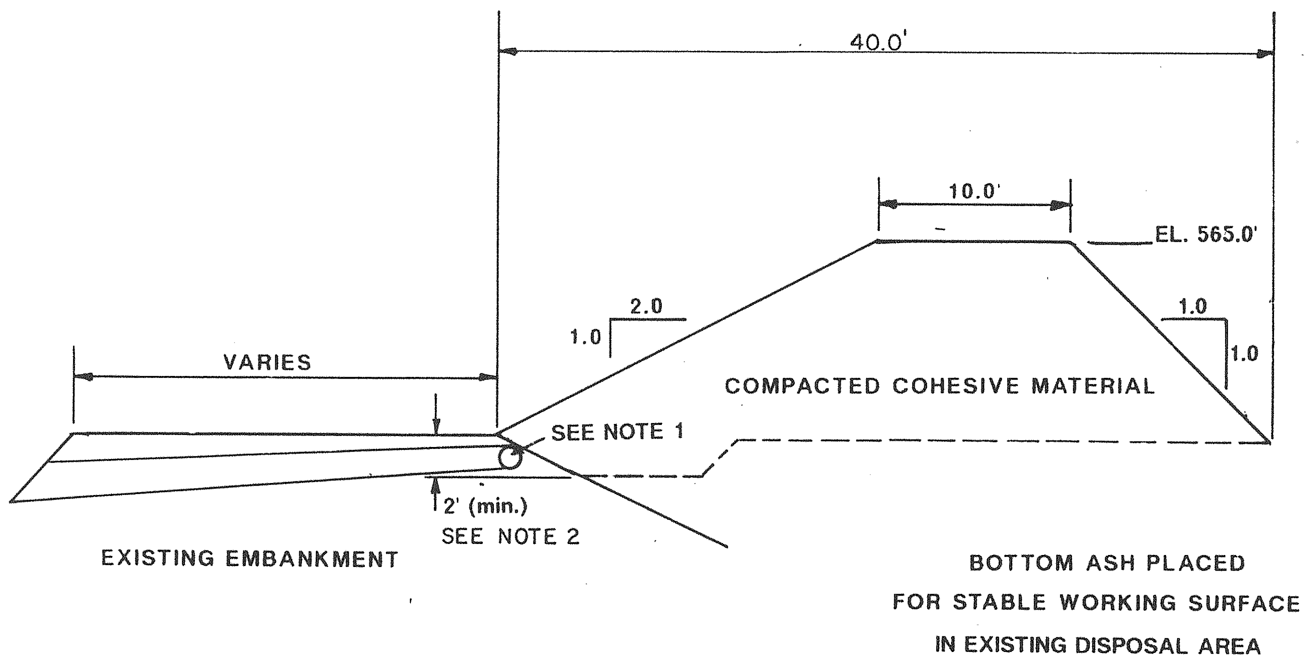
In addition to the proposed new construction, several maintenance items are proposed for the existing embankment. The trees and shrubs should be removed from the embankment faces. The downstream face of the west embankment should be dressed-up so that mowing operations can be performed. This includes repairing the minor slide area, the erosion gully, and any other areas (such as animal holes) which may obstruct mowing operations. The low, swampy areas should be sloped to drain.

The concentrated seep area should be investigated further to verify that the source of the seepage is an 8 in. diameter toe drain outlet pipe. If found, this outlet pipe should be carried farther away from the embankment toe. A headwall should be provided for the pipe so that it can be protected from mowing operations, and so that it is better identified as a drain outlet.

Although not deemed necessary for stability purposes, consideration should be given to flattening the downstream slope of the north embankment. This would be helpful for future ease of maintenance of this slope.

A Maintenance Plan for the ash disposal area embankment is included in Appendix E.


CLARIFIER POND
N
SCALE: 1" = 200'
DENOTES AREA OF PROPOSED EMBANKMENT CONSTRUCTION TO ELEVATION 565.0
BORING LOCATIONS
21" CONCRETE RISER & OUTLET
B-3
B-2
B-1
B-4
PROPOSED MAXIMUM LAKE POOL ELEV. 564.0
AREA "A" 26 ACRES
AREA "B" 3 ACRES
AREA "C" 8 ACRES
NOTE: CROSS SECTIONS ARE SHOWN ON FIGURES 5,6, & 7
EL. 565.0+
18" PVC OUTLET
15" PVC OUTLET
EL. 565.0+
EL. 565.0+
EL. 565.0+
ORIGINAL W. EMBANK. RECONSTRUCTED IN 1971
SPAULDING DAM
LAKE SPRINGFIELD
PLAN VIEW
HANSON ENGINEERS INCORPORATED
SPRINGFIELD, IL • PEORIA, IL • ROCKFORD, IL
PROPOSED EMBANKMENT MODIFICATONS
CWLP ASH DISPOSAL AREA
SPRINGFIELD, ILLINOIS
JOB NO. 87S3014
FIGURE 1



TYPICAL SECTION

NOTE: 1 - FILTER FABRIC WRAPPED PERFORATED CORRUGATED DRAINAGE PIPE WITH NON-PERFORATED OUTLETS INTO CLARIFIER POND. PIPE IS SURROUNDED WITH BED OF BOTTOM ASH

NOTE: 2 - COMPACTED COHESIVE MATERIAL "KEYED" INTO STABLE WORKING SURFACE A MINIMUM DEPTH OF 2 ft. FOR SEEPAGE CONTROL

PDF 0207

EMBANKMENT CONFIGURATION	PROPOSED EMBANKMENT MODIFICATONS CWLP ASH DISPOSAL AREA SPRINGFIELD, ILLINOIS
HANSON ENGINEERS INCORPORATED SPRINGFIELD, IL • PEORIA, IL • ROCKFORD, IL	JOB NO. 87S3014 — FIGURE 2

OPERATOR CMP

DATE June-2-1987

JOB NO.

HANSON ENGINEERS INCORPORATED

LABORATORY SOIL TEST DATA

PROJECT NAME AND LOCATION
CWL&P
Ash Pond Study
Springfield, Illinois

BOR.	SAMP	DEPTH	ELEV.	N	STRENGTH TESTS Qu	M	P	W	γw	γD	SPECIAL TESTS	SAMPLE DESCRIPTION
Ground Surface Elev=557.6												
1	1	2'6"	555.1	14				6				Bottom Ash
	2	5'0"	552.6	3				10				" "
	3	7'6"	550.1	5				31				" " / dk. gray v.f. sandy silt
	4	10'0"	547.6	1				79				Drk. gray v.f. sandy silt.
	5	12'6"	545.1	4	0.92	B	0.8	33				Gray v.f. sandy silty clay.
	6	15'0"	542.6	4			3.6	67				Gray silty f. sand. (fly ash).
	7	17'6"	540.1	9				46				Fly ash.
	8	20'0"	537.6	8				61				" ".
	9	22'6"	535.1	5	0.71	Sh	1.3	26				Yel. brn. & gray v.f. sandy silty clay / ox. spots.
	10	25'0"	532.6	15	2.27	B	1.8/3.8	21				Mix colored v.f. sandy silty clay (tr. f.-c. sand & f. gravel)
	11	27'6"	530.1	9	1.86	B	2.4	27				Drk. gray v.f. sandy silty clay.
	12	30'0"	527.6	8	0.50	B	0.6	33				" " " " " " ".
Ground Surface Elev=555.5												
2	1	2'6"	553.0	21	5.89	BSp	4.5+	14				Brn. gray v.f. sandy silty clay / ox. spots.
	2	5'0"	550.5	20	2.27	B	2.4	27				Yel. brn & gray v.f. sandy silty clay (tr. ox. spots.)
	3	7'6"	548.0	10	1.86	B	2.2	29				Grn. & drk. brn v.f. sandy silty clay (tr. ox. spots.)
	4	10'0"	545.5	12	2.68	BSh	2.4	25				Yel brn. & gray v.f. sandy silty clay / ox. spots.
	5	12'6"	543.0	13	2.68	B	2.9	27				Grn. gray clay (tr. silt & ox. spots.)
	6	15'0"	540.5	12	2.33	B	2.4	28				Brn. gray v.f. sandy silty clay / ox. spots.
	7	17'6"	538.0	15	1.94	BSh	2.6	27				Yel. brn & gray v.f. sandy silty clay (tr. chard. pts.)
	8	20'0"	535.5	14	2.27	B	2.5	28				" " & " " " " " (" " ")
	9	22'6"	533.0	15	2.68	B	2.8	28				" " & " " " " " (" " ")
	10	25'0"	530.5	9	1.16	B	1.1	26				" " & " " " " clayey silt / chard. pts.
	11	27'6"	528.0	8	0.54	B	0.6	23				" " & " " " " silt (tr. chard pts.)
	12	30'0"	525.5	6	0.89	B	0.7	24				" " & " " " " " / chard pts.
	13	35'0"	520.5	5	0.78	B	0.8	23				" " & " " " " " & brn. f.-m. sand
	14	40'0"	515.5	19				14				Brn. gray f.-m. sand.
	14A	40'	515.5	19				29				Gray shaley clay.

PDF 0208

Figure 8

OPERATOR CMP

DATE June-2-1987

JOB NO.

HANSON ENGINEERS INCORPORATED

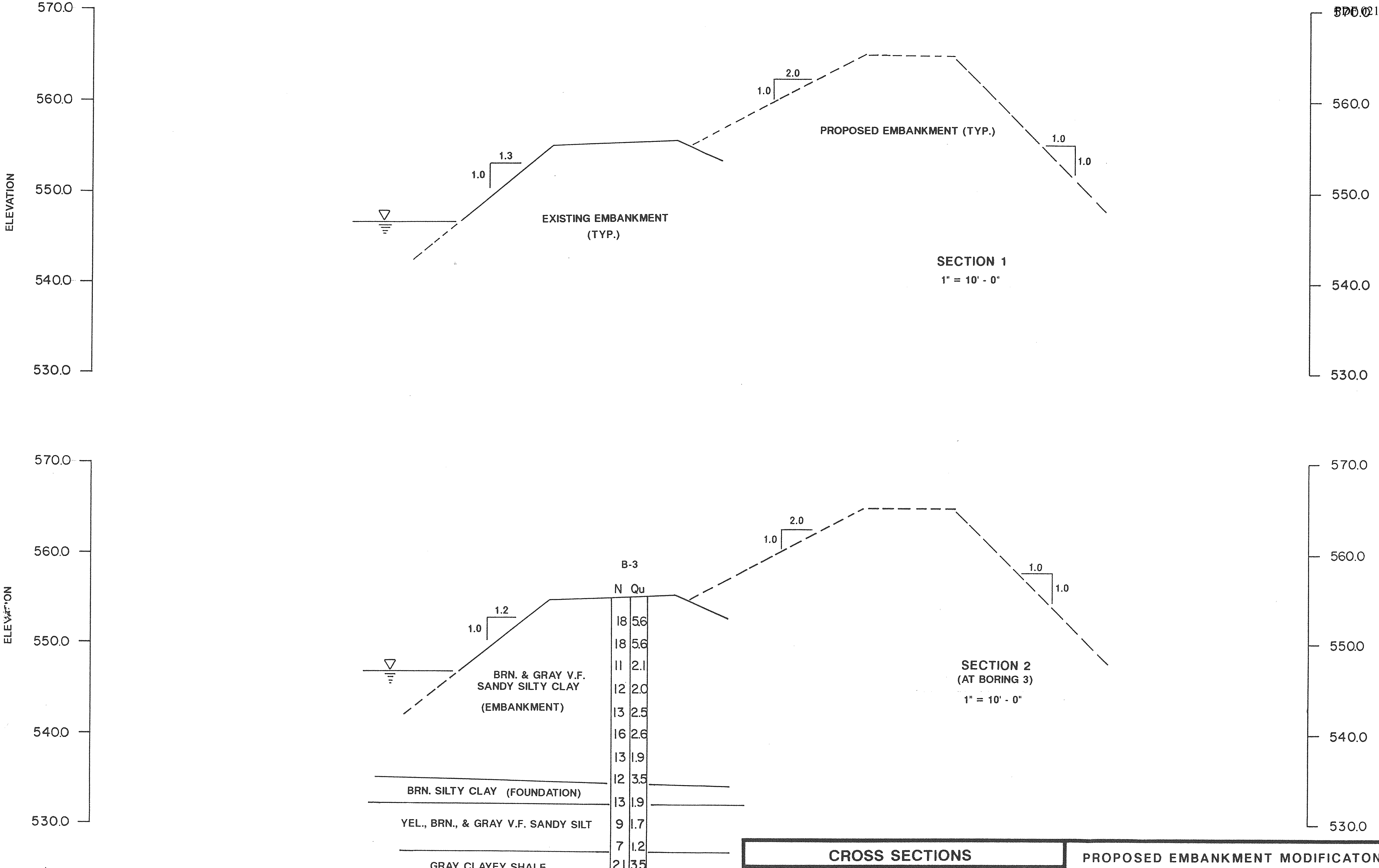
LABORATORY SOIL TEST DATA

PROJECT NAME AND LOCATION
CWL&P
Ash Pond Study
Springfield, Illinois

BOR.	SAMP.	DEPTH	ELEV.	N	STRENGTH TESTS Qu	M	P	W	γW	γD	SPECIAL TESTS	SAMPLE DESCRIPTION
	Ground Surface Elev=555.2											
3	1	2'6"	552.7	18	5.56	BSh	4.5+	21				Brn.&drk.brn.v.f.sandy silty clay (tr.chard.pts.&sm.roots)
	2	5'0"	550.2	18	5.62	BSp	4.5+	22				Drk.gray clay (tr.chard.pts.&sm.roots.)
	3	7'6"	547.7	11	2.13	BSh	2.4	26				Yel.brn.&gray.v.f.sandy silty clay (tr.chard.pts.)
	4	10'0"	545.2	12	1.94	BSh	2.1	29				" " &drk.gray clay (tr.ox.spots.)
	5	12'6"	542.7	13	2.52	B	2.6	25				" " &gray v.f.sandy silty clay (tr.chard.pts.)
	6	15'0"	540.2	16	2.62	B	2.6	26				Drk.gray v.f.sandy silty clay.
	7	17'6"	537.7	13	1.86	B	1.6	28				Yel.brn.&gray v.f.sandy silty clay (tr.chard.pts.)
	8	20'0"	535.2	12	3.50	BSh	3.0/4.5+	21				Drk.gray v.f.sandy silty clay.
	9	22'6"	532.7	13	1.94	B	2.2	28				Yel brn &gray v.f. sandy silty clay &clayey silt/chard.pts
	10	25'0"	530.2	9	1.71	B	1.7	26				" " & " " " " silt/chard.pts.
	11	27'6"	527.7	7	1.24	B	1.2	27				" " & " " " " " / " ".
	12	30'0"	525.2	21	3.49	B	3.6	26				Brn.gray clay.
	Ground Surface Elev=566.2											
4	1	2'6"	563.7	5	3.05	Sh	2.8	20				Yel.brn.&gray v.f.sandy silt.
	2	5'0"	561.2	11	1.71	Sp	2.7	25				" " & " " " " " &fly ash.
	3	7'6"	558.7	7	1.65	BSh	2.2	13				" " & " v.f.-m.sandy silt (tr.c.sand.)
	4	10'0"	556.2	10	1.47	BSh	1.9	22				" " & " clay/brn.silty f.sand (tr.fly ash.)
	5	12'6"	553.7	8				18				Fly ash.
	6	15'0"	551.2	7				27				" ".
	7	17'6"	548.7	1				94				Drk.gray silty v.f.sand (fly ash)
	8	20'0"	546.2	2				108				" " " " " " (" ")
	9	25'0"	541.2	1				129				" " " " " " (" ")
	10	30'0"	536.2	16	2.68	B	2.3	31				" " v.f. sandy silty clay.

PDF 0209

Figure 4



CROSS SECTIONS

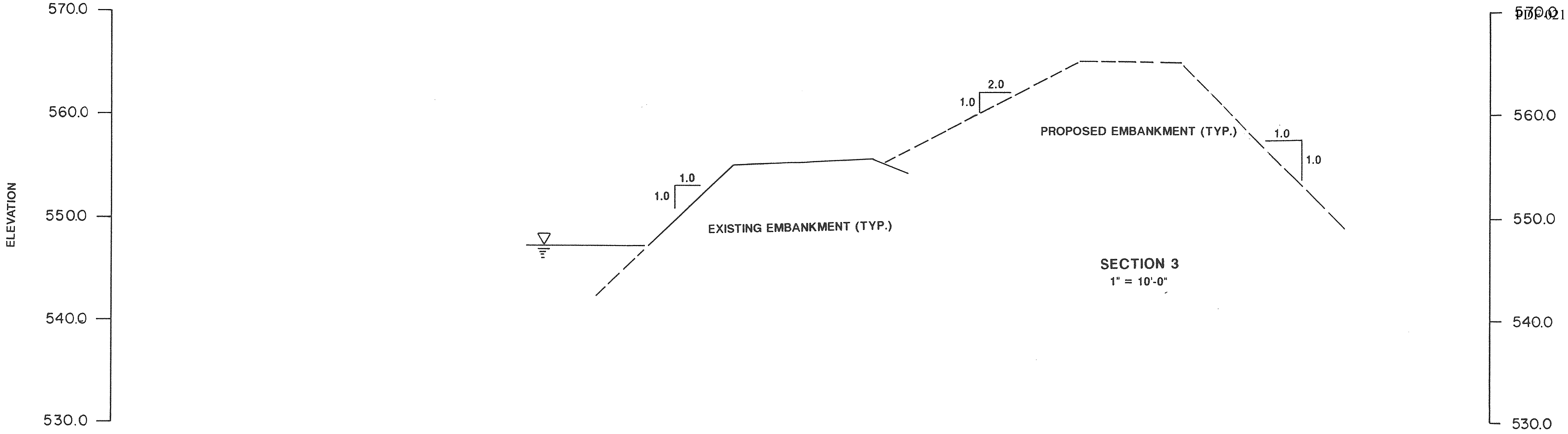
HANSON ENGINEERS INCORPORATED

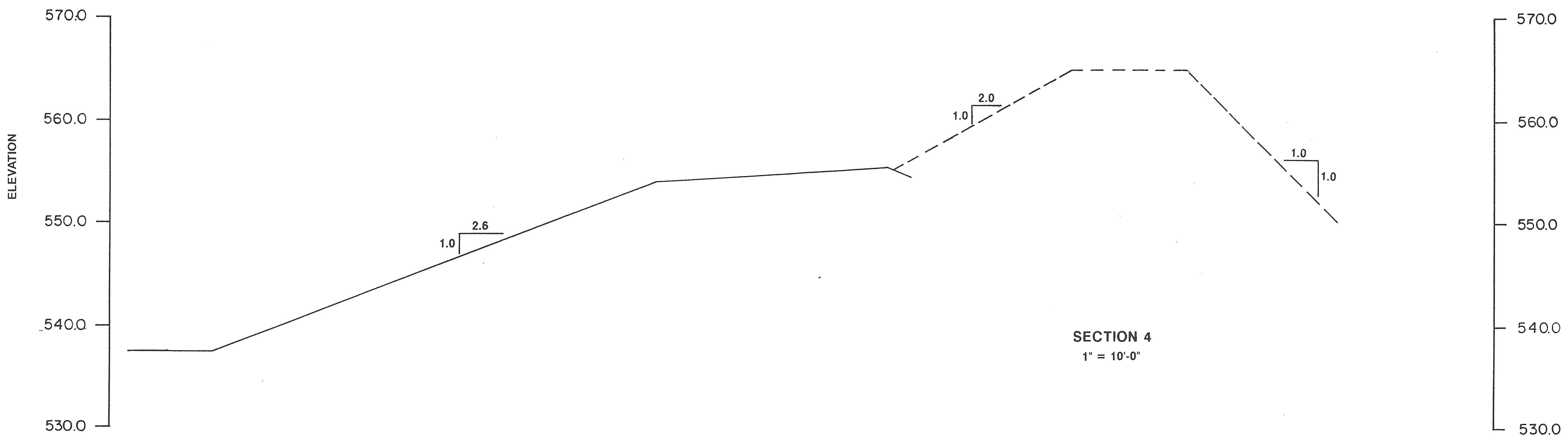
SPRINGFIELD, IL • PEORIA, IL • ROCKFORD, IL

PROPOSED EMBANKMENT MODIFICATONS
CWLP ASH DISPOSAL AREA
SPRINGFIELD, ILLINOIS

JOB NO. 87S3014

FIGURE 5





CROSS SECTIONS

HANSON ENGINEERS INCORPORATED

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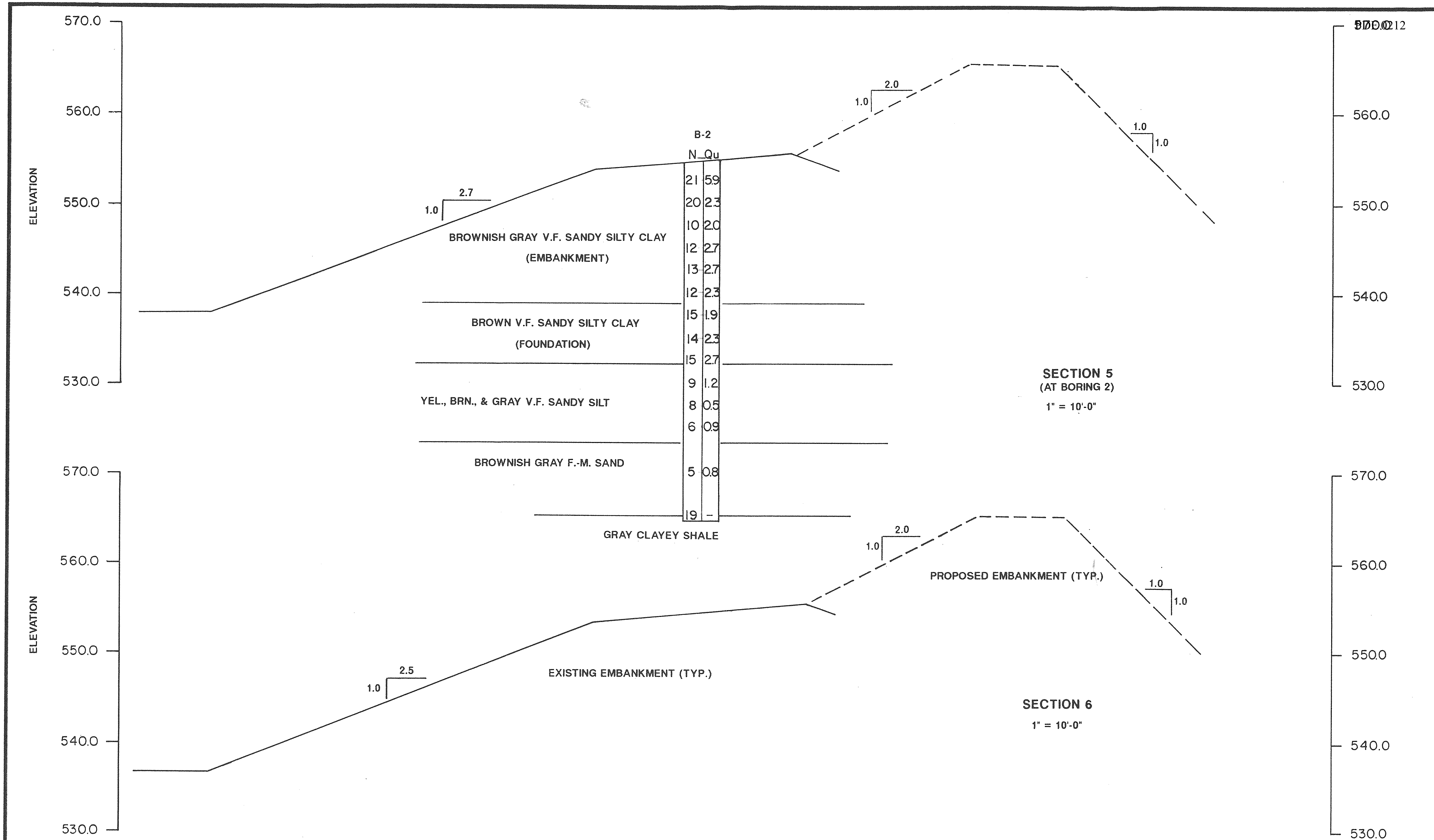
PROPOSED EMBANKMENT MODIFICATONS
CWLP ASH DISPOSAL AREA
SPRINGFIELD, ILLINOIS

JOB NO. 87S3014

FIGURE 6



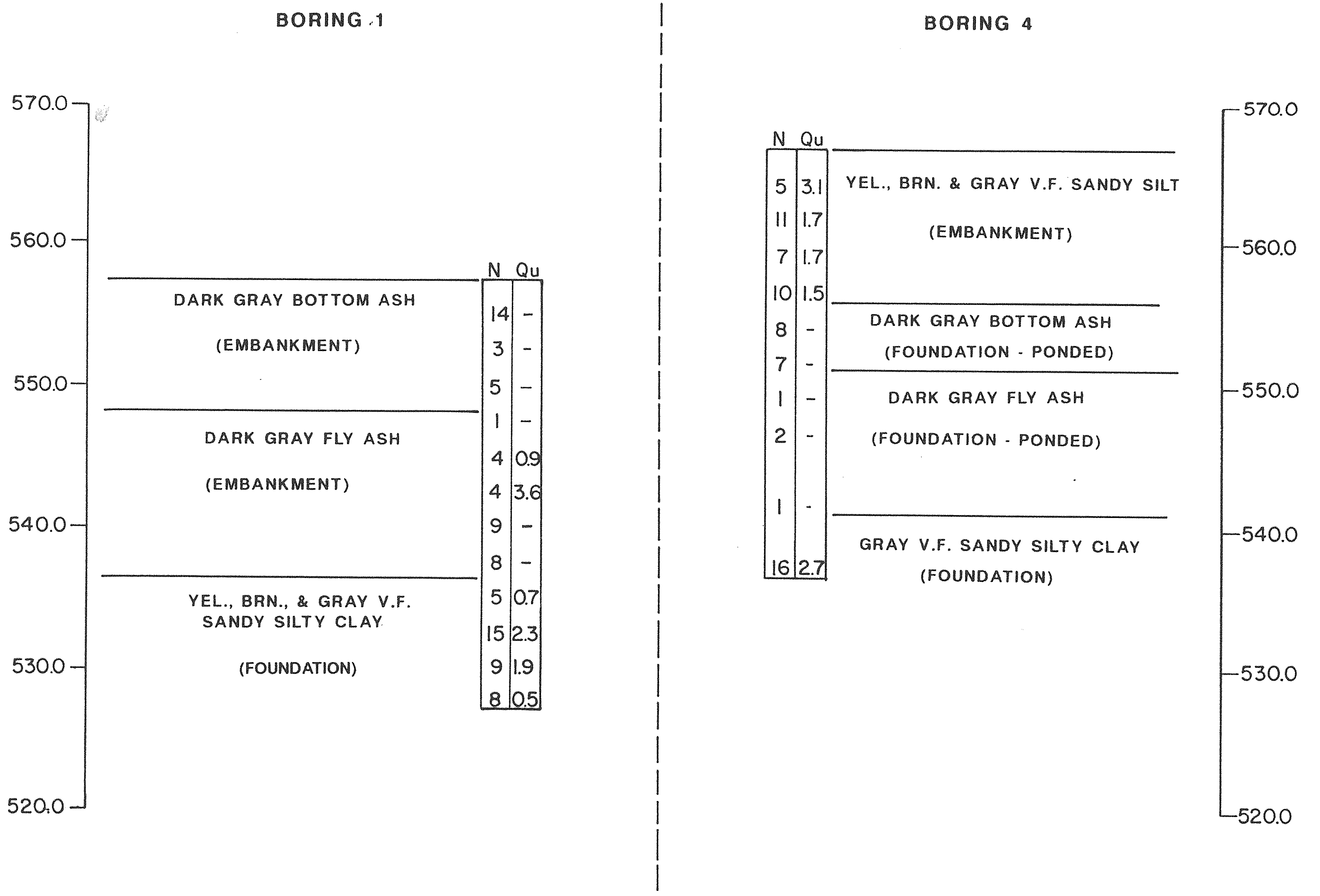
CROSS SECTIONS

HANSON ENGINEERS INCORPORATED

SPRINGFIELD, IL • PEORIA, IL • ROCKFORD, IL

PROPOSED EMBANKMENT MODIFICATONS
CWLP ASH DISPOSAL AREA
SPRINGFIELD, ILLINOIS

JOB NO. 87S3014 | FIGURE 7



BORING PROFILES

HANSON ENGINEERS INCORPORATED

SPRINGFIELD, IL • PEORIA, IL • ROCKFORD, IL

PROPOSED EMBANKMENT MODIFICATONS
CWLP ASH DISPOSAL AREA
SPRINGFIELD, ILLINOIS

JOB NO. 87S3014

FIGURE 8

APPENDIX A

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

PDF 0215

LOG OF BORING

CONTRACTED WITH HANSON ENGINEERS BORING NO. B-1
PROJECT NAME CWLP ASH POND CONTRACT NO.
LOCATION PER PLAN
DATUM HAMMER WT. 140# HAMMER DROP 30" HOLE DIA. 6"
SURFACE ELEV. CORE DIA. CASING
DATE STARTED 5-18-87 COMPLETED 5-18-87 DRILLING METHOD HSA

ELEV.	DESCRIPTION	STRATA DEPTH	DEPTH SCALE	BLOWS FT.	NO.	TYPE	RECOV.	QP		NOTES
		0.0	30							
	Blk. bot. ash, tr. f. gravel			6-7-7	1	ss	14"	--		
	fill moist-wet		5	3-2-1	2	ss	8	--		
				3-2-3	3	ss	10	--		WATER 5-18-87 DD 5.0' 8:45am BAR 20.5' 10:15am AAR 4.6' 10:35am DWL 4.0' 6:35pm
		9.2		2-1-0	4	ss	12	--		
	Blk. fly ash		10	2-2-2	5	ss	15	0.8		
	wet		15	6-2-2	6	ss	14	0.9		
				4-4-5	7	ss	18	--		
			20	3-5-3	8	ss	18	--		

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LOG OF BORING

CONTRACTED WITH HANSON ENGINEERS BORING NO. B-1
PROJECT NAME CWLP ASH POND CONTRACT NO.
LOCATION PER PLAN
DATUM HAMMER WT. 140# HAMMER DROP 30" HOLE DIA. 6"
SURFACE ELEV. CORE DIA. CASING
DATE STARTED 5-18-87 COMPLETED 5-18-87 DRILLING METHOD HSA

ELEV.	DESCRIPTION	STRATA DEPTH	DEPTH SCALE	SAMPLES BLOWS FT.	NO.	TYPE	RECOV.	QP		NOTES
		0.0	30							
		23.1		3-2-3	9	ss	18"	1.2		
	Green gray silty clay, tr. f.m. sand, tr. f. gravel moist	25.7	25	6-8-7	10	ss	18	4.5+		
	Dk. gray silty clay moist	30.0	30	4-4- 3-4-4	11 12	ss ss	18 18	3.1 2.0		
	END OF BORING 30.0'									

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LOG OF BORING

CONTRACTED WITH HANSON ENGINEERS BORING NO. B-2
PROJECT NAME CWLP ASH POND CONTRACT NO.
LOCATION
DATUM HAMMER WT. 140# HAMMER DROP 30" HOLE DIA. 6"
SURFACE ELEV. CORE DIA. CASING
DATE STARTED 5-18-87 COMPLETED 5-18-87 DRILLING METHOD HSA

ELEV.	DESCRIPTION	STRATA DEPTH	DEPTH SCALE	BLOWS FT.	NO.	TYPE	RECOV.	QP		NOTES
		0.0	30							
	10" white rock, brn. gray silty clay fill moist	3.3		8-10-11	1	ss	15"	4.5+		
	Light brn. silty clay fill moist	5.8	5	8-9-11	2	ss	16	3.0		
	Brn. green blk. silty clay fill moist			3-5-5	3	ss	15	2.1		WATER 5-18-87
			10	3-5-7	4	ss	16	2.4		DD 28.5' 12:00pm BAR 18.5' 1:55pm AAR WCI 15.0' 2:
				3-6-7	5	ss	13	2.0		Dwl 14.0' 6:30pm
			15	3-5-7	6	ss	18	1.7		
				5-6-9	7	ss	18	3.2		
			20	5-6-8	8	ss	18	3.2		

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LOG OF BORING

CONTRACTED WITH HANSON ENGINEERS BORING NO. B-2
PROJECT NAME CWLP ASH POND CONTRACT NO.
LOCATION PER PLAN
DATUM HAMMER WT. 140# HAMMER DROP 30" HOLE DIA. 6"
SURFACE ELEV. CORE DIA. CASING
DATE STARTED 5-18-87 COMPLETED 5-18-87 DRILLING METHOD HSA

ELEV.	DESCRIPTION	STRATA DEPTH	DEPTH SCALE	SAMPLES BLOWS FT.	NO.	TYPE	RECOV.	QP		NOTES
		0.0	30							
		22.7		4-6-9	9	ss	18"	3.5		
	Brn. gray silty clay, tr. f. sand moist	25.4	25	3-3-6	10	ss	18	1.8		
	Brn. gray clayey silt, some f. sand, occas. 1-3" f. sand seams a wet			3-4-4	11	ss	18	1.5		
		31.5	30	2-3-3	12	ss	18	0.5		
	Brn. f.m. sand wet		35	2-2-3	13	ss	18	1.2		
		39.8								
	~~Brn. f.m. sand wet~~	~~40.0~~	40	11-11-12	14	ss	18	2.5		
	END OF BORING 40.0'									

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LOG OF BORING

CONTRACTED WITH HANSON ENGINEERS BORING NO. B-3
PROJECT NAME CWLP ASH POND CONTRACT NO.
LOCATION PLAN
DATUM HAMMER WT. 140# HAMMER DROP 30" HOLE DIA. 6"
SURFACE ELEV. CORE DIA. CASING
DATE STARTED 5-18-87 COMPLETED 5-18-87 DRILLING METHOD HSA

ELEV.	DESCRIPTION	STRATA DEPTH	DEPTH SCALE	SAMPLES BLOWS FT.	NO.	TYPE	RECOV.	QP		NOTES
		0.0	30							
	5" white rock, brn. gray blk. silty clay fill moist	4.5		7-6-12	1	ss	14"	4.5+		
				6-9-9	2	ss	18	4.5+		
	Blk. silty clay fill moist	8.3	5	5-5-6	3	ss	16	1.7		WATER 5-18-87 DD 24.0' 3:50pm BAR 12.4' 4:05pm AAR 10.0' 4:25pm DWL 9.5' 6:45pm
	Brn. green blk. silty clay fill moist	17.9	10	3-4-8	4	ss	17	2.5		
				3-6-7	5	ss	18	2.2		
	Blk. gray silty clay fill moist	20.6	15	3-6-8	6	ss	18	2.4		
				5-6-7	7	ss	18	2.3		
			20	3-4-8	8	ss	18	3.0		

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(309) 662-5968

LOG OF BORING

CONTRACTED WITH HANSON ENGINEERS
BORING NO. B-3
PROJECT NAME CWLP ASH POND
CONTRACT NO.
LOCATION PER PLAN
DATUM
HAMMER WT. 140#
HAMMER DROP 30"
HOLE DIA. 6"
SURFACE ELEV.
CORE DIA.
CASING
DATE STARTED 5-18-87
COMPLETED 5-18-87
DRILLING METHOD HSA

ELEV.	DESCRIPTION	STRATA DEPTH	DEPTH SCALE	SAMPLES BLOWS FT.	NO.	TYPE	RECOV.	QP		NOTES
		0.0	30							
	Brn. gray silty clay moist-wet			5-6-9	9	ss	18"	2.0		
			25	3-4-5	10	ss	18	2.0		
		28.2		3-3-4	11	ss	18	1.6		
	Gray brn. clay, little silt moist	30.0	30	6-9-12	12	ss	18	3.8		
	END OF BORING 30.0'									

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(309) 662-5968

FDL 0221

LOG OF BORING

CONTRACTED WITH HANSON ENGINEERS BORING NO. B-4
PROJECT NAME CWLP ASH POND CONTRACT NO.
LOCATION PER PLAN
DATUM HAMMER WT. 140# HAMMER DROP 30" HOLE DIA. 6"
SURFACE ELEV. CORE DIA. CASING
DATE STARTED 5-18-87 COMPLETED 5-18-87 DRILLING METHOD HSA

ELEV.	DESCRIPTION	STRATA DEPTH	DEPTH SCALE	BLOWS FT.	NO.	TYPE	RECOV.	QP		NOTES
		0.0	30							
	Brn. silty clay			3-3-2	1	ss	10"	3.5		
	fill moist	4.0								
	Brn. gray blk. silty clay			4-5-6	2	ss	12	3.2		
			5							
	fill moist			3-3-4	3	ss	10	2.5		WATER 5-18-87
										DD 11.0' 5:15pm BAR 22.0' 6:00pm AAR 9.8' 6:30pm
		10.5	10	3-5-5	4	ss	13	2.5		DWL 9.5' 6:50pm
	Blk. bot, ash									
	fill wet			5-4-4	5	ss	18	--		
		15.2	15	5-4-3	6	ss	16	--		
	Blk. fly ash			1-1-0	7	ss	18	0.2		
	fill wet			0-0-2	8	ss	.8	0.2		
			20							

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LOG OF BORING

CONTRACTED WITH: HANSON ENGINEERS — BORING NO.: B-4
PROJECT NAME: CWLP ASH POND — CONTRACT NO.:
LOCATION: PER PLAN
DATUM: — HAMMER WT.: 140# — HAMMER DROP: 30" — HOLE DIA.: 6"
SURFACE ELEV.: — CORE DIA.: — CASING:
DATE STARTED: 5-18-87 — COMPLETED: 5-18-87 — DRILLING METHOD: HSA

ELEV.	DESCRIPTION	STRATA DEPTH	DEPTH SCALE	SAMPLES BLOWS FT.	NO.	TYPE	RECOV.	QP		NOTES
		0.0	30							
		25.5	~~25~~	1-0-1	9	ss	18"	0.5		
	Blk. gray clay, tr. silt moist	30.0	30	4-6-10	10	ss	18	3.3		
	END OF BORING 30.0'									

APPENDIX B

DAM INSPECTION REPORT

NAME OF DAM CWLP LAKESIDE ASH DISPOSAL AREA DAM COUNTY SANGAMON

LOCATION RANGE ______ TOWNSHIP ______ SECTION ______

OWNER CITY WATER, LIGHT & POWER
NAME

217-787-4063
TELEPHONE NO.
(Day & Night Nos.)

3100 STEVENSON DRIVE
STREET

SPRINGFIELD, IL 62703
CITY ZIP

PERMIT NO. — CLASS OF DAM III

TYPE OF DAM EARTH FILL

TYPE OF SPILLWAY DROP INLET

DATE(S) INSPECTED JUNE 2, 1987

WEATHER WHEN INSPECTED DRY, CLEAR

TEMPERATURE WHEN INSPECTED ±90°F

POOL ELEVATION WHEN INSPECTED 554.3

TAILWATER ELEVATION WHEN INSPECTED 546.8

INSPECTION PERSONNEL:

DANNY L. KERNS, P.E. GEOTECHNICAL ENG. — ASSOC. PARTNER
NAME TITLE

GENE WERTEPNEY HYDRAULICS ENG. — ASSOCIATE
NAME TITLE

NAME TITLE

NAME TITLE

SEAL

CONDITION CODES

N.E. - No evidence of problem

G.C. - Good condition

M.M. - Item needing minor repairs within the year. Safety integrity not yet imperiled

I.M. - Item needing immediate maintenance to restore or insure present safety integrity

E.C. - Emergency condition which if not immediately repaired or other appropriate measures taken could lead to breach of dam

O.B. - Condition requires regular observation to insure condition does not become worse

N.A. - Not applicable to this dam

N.I. - Not inspected/list reason for non-inspection under deficiencies

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Surface Cracks	N.E.	NONE NOTED	—
Vertical & Horizontal Alignment of Crest	G.C.	NONE NOTED	—
Unusual Movement or Cracking At or Beyond Toe	N.E.	NONE NOTED	—
Sloughing or Erosion of Embankment and Abutment Slopes	M.M.	MINOR SURFACE SLOUGH ON WEST EMBANKMENT AS RESULT OF ASH LINE BREAK. ALSO, EROSION CHANNEL DOWN WEST EMBANKMENT.	WEST EMBANKMENT SHOULD BE "DRESSED UP" TO SMOOTH THE SLOUGHED AREA AND FILL THE EROSIONAL CHANNEL.
Upstream Face Slope Protection	N.I.	DISPOSAL AREA IS FILLED WITH ASH AND FILTER CAKE SLUDGE. GENERALLY, NO PONDED WATER, OR VERY SHALLOW. UPSTREAM SLOPE NOT VISIBLE.	—
Seepage	M.M.	SEEPAGE AREA NOTED AT NORTH END OF WEST EMBANKMENT. NO CONCENTRATED FLOW. CATTAIL GROWTH.	REMOVE CATTAILS, INSTALL DRAINAGE SYSTEM TO PICK UP SEEPAGE AND DIVERT TO SUGAR CREEK.
Filter & Filter Drains	N.I.	DRAINS COVERED WITH COMPACTED CLAY. OUTLET PIPE OPERATING, BUT NOT EXPOSED.	EXPOSE OUTLET PIPE, EXTEND FARTHER FROM EMBANKMENT, PROTECT WITH HEADWALL.

EARTH EMBANKMENT
(Continued)

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Animal Damage	N.E.	NONE NOTED	—
Embankment Drainage Ditches	G.C.	—	—
Vegetative Cover	M.M.	TREES AND BRUSH ON EMBANKMENT, PRIMARILY ON SOUTH PORTION OF WEST EMBANKMENT AND ON NORTH EMBANKMENT.	REMOVE TREES AND BRUSH. GRADE SLOPE SO THAT IT CAN BE MOWED.
Other (Name) STEEPNESS OF NORTH EMBANKMENT SLOPE	M.M.	NORTH EMBANKMENT SLOPE IS TOO STEEP FOR PROPER MAINTENANCE.	RECOMMEND FLATTENING NORTH EMBANKMENT SLOPE FOR PROPER MAINTENANCE.
Other —	—	—	—
Other —	—	—	—

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Seepage	N.A.	—	—
Structure to Abutment/ Embankment Junctions	N.A.	—	—
Water Passages	N.A.	—	—
Foundation	N.A.	—	—
Surface Cracks in Concrete Surfaces	N.A.	—	—
Structural Cracking	N.A.	—	—

CONCRETE OR MASONARY DAMS
(Continued)

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Vertical and Horizontal Alignment	N.A.	—	—
Monolith Joints	N.A.	—	—
Construction Joints	N.A.	—	—
Spalling of Concrete	N.A.	—	—
Filters, Drains, etc.	N.A.	—	—
Riprap	N.A.	—	—
Other (Name)	N.A.	—	—

IF DAM IS GATED-Fill out portion of Principal Spillway Form Related to Gated Spillways

PRINCIPAL SP 'WAY APPROACH CH. .EL

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Debris	N.E.	NONE NOTED	—
Side Slope Stability	N.A.	—	—
Slope Protection	N.A.	—	—
Other (Name)	N.A.	—	—
Other	—	—	—
Other	—	—	—
Other	—	—	—

[X] Drop Inlet Structure [ ] Overflow Spillway Structure [ ] Gated

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Erosion, Spalling, Cavitation	N.A.	—	—
Structure to Embankment Junction	N.I.	DROP INLET IS NOT CONNECTED TO EMBANKMENT AT WATER LEVEL	—
Drains	N.A.	—	—
Seepage Around or Into Structure	N.E.	NONE NOTED	—
Surface Cracks	N.A.	—	—
Structural Cracks	N.A.	—	—

IF SPILLWAY IS GATED FILL OUT GATES SECTION

PRINCIPAL SPILLWAY
(Continued)

[X] Drop Inlet Structure [ ] Overflow Spillway Structure [ ] Gated

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Alignment of Abutment Walls	N.A.	—	—
Construction Joints	N.I.	PIPE IS 21 IN. Ø DROP INLET WITH SUBMERGED OUTLET	—
Filter and Filter Drains	N.A.	—	—
Trash Racks	N.A.	—	—
Bridge & Piers	N.A.	—	—
Differential Settlement	N.A.	—	—
Other (Name)	N.A.	—	—

IF SPILLWAY IS GATED FILL OUT GATES SECTION

PRINCIPAL SPILLWAY
(Continued)

[X] Conduit [ ] Gated

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Erosion, Spalling, Cavitation	N.I.	SPILLWAY PIPE IS SUBMERGED.	—
Joint Separation	N.I.	"	—
Seepage Around or Into Conduit	N.I.	"	—
Surface Cracks	N.I.	"	—
Structural Cracks	N.I.	"	—
Trash Racks	N.I.	"	—
Differential Settlement	N.I.	"	—
Alignment	N.I.	"	—
Other (Name)	—	—	—

IF SPILLWAY IS GATED FILL OUT GATES SECTION

CIP SPIL Y
(Cont ed)

☐ Chute

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Erosion, Cavitation, Spalling	N.A.	—	—
Structure to Embankment Junction	N.A.	—	—
Construction Joints	N.A.	—	—
Expansion & Contraction Joints	N.A.	—	—
Differential Settlement	N.A.	—	—
Surface Cracks	N.A.	—	—
Structural Cracks	N.A.	—	—
Wall Alignment	N.A.	—	—
Other (Name)	N.A.	—	—

IF SPILLWAY IS GATED FILL OUT GATES SECTION

GATES

☐ Principal Spillway ☐ Dewatering ☐ Other:

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Gate Sill	N.A.	—	—
Gate Seals	N.A.	—	—
Gate and Frame	N.A.	—	—
Operating Machinery	N.A.	—	—
Emergency Operating Machinery	N.A.	—	—
Other (Name)	N.A.	—	—
Other	N.A.	—	—

ET S
(IF SEPARATE FROM PRINCIPA PILLWAY STRUCTURE)

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Erosion, Spalling, Cavitation	N.A.	—	—
Joint Separation	N.A.	—	—
Seepage Around or Into Conduit	N.A.	—	—
Intake Structure	N.A.	—	—
Outlet Structure	N.A.	—	—
Outlet Channel	N.A.	—	—

OUTLET WORKS
(Contin[illegible])

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Riprap	N.A.	—	—
Other (Name)	N.A.	—	—
Other	N.A.	—	—
Other	N.A.	—	—

ENERGY DISSIPATOR

[ ] Principal Spillway   [ ] Outlet Works
Type:

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Erosion, Spalling, Cavitation	N.I.	SPILLWAY OUTLET IS SUBMERGED AND DISCHARGES INTO CLARIFIER POND	—
Structure to Embankment Junction	N.I.	"	—
Construction Joints	N.I.	"	—
Surface Cracks	N.I.	"	—
Structural Cracks	N.I.	"	—
Differential Settlement	N.I.	"	—
Expansion & Contraction Joints	N.I.	"	—

ENL... DI... PATC
(Contin...)

[ ] Principal Spillway   [ ] Outlet Works

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Riprap	N-I-	SEE PREVIOUS PAGE	—
Outlet Channel	N-I-	"	—
Debris	N-I-	"	—
Other (Name)	N-I-	"	—

EMERGENCY SPILLWAY

[ ] Earth [ ] Other: Name ____________

ITEM	CONDITION	DEFICIENCIES	RECOMMENDED REMEDIAL MEASURES AND IMPLEMENTATION SCHEDULE
Erosion	N.A.	—	—
Weeds, Logs, Other Obstructions	N-A-	—	—
Side Slope Sloughing	N.A.	—	—
Vegetation	N.A.	—	—
Sedimentation	N.A.	—	—
Riprap	N.A.	—	—
Settlement of Crest	N.A.	—	—
Downstream Channel	N.A.	—	—
Other (Name)	N.A.	—	—

SUMMARY OF MAINTENANCE DONE AND/OR

REPAIRS MADE SINCE LAST INSPECTION

DATE OF PRESENT INSPECTION June 2, 1987

DATE OF LAST INSPECTION UNKNOWN

1. EARTH EMBANKMENT

UNKNOWN

2. CONCRETE MASONRY DAMS

N.A.

3. PRINCIPAL SPILLWAY

UNKNOWN

4. OUTLET WORKS

UNKNOWN

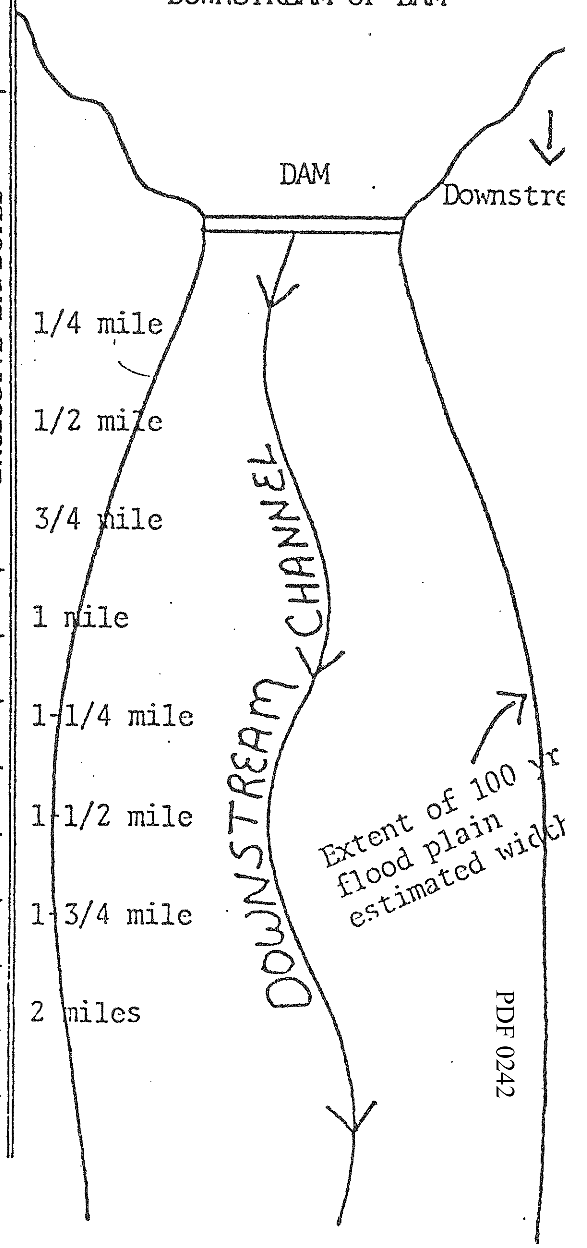
5. EMERGENCY SPILLWAY

N.A.

DOWNSTREAM DEVELOPMENT
APPROXIMATE WIDTH OF AFFECTED FLOOD PLAIN __________ MILES

MILES DOWNSTREAM FROM DAM	Downstream Development													Loss of Life Poten-tial			Economic Loss Poten-tial		
	OCCUPIED HOMES	UNOCCUPIED HOMES	AGRICULTURAL BUILDINGS	INDUSTRIAL BUILDINGS	COMMERCIAL BUILDINGS	SCHOOLS	HOSPITALS	ROADS & BRIDGES	RAILROADS & R.R. BRIDGES	DAMS	OVERHEAD UTILITIES	OTHER DEVELOPMENT (Name)	OTHER DEVELOPMENT (Name)	NONE	1 TO 10	OVER 10	MINIMAL EXPECTED	APPRECIABLE EXPECTED	EXCESSIVE EXPECTED
0 to 1/4														X			X		
1/4 to 1/2														X			X		
1/2 to 3/4														X			X		
3/4 to 1														X			X		
1 to 1-1/4														X			X		
1-1/4 to 1-1/2														X			X		
1-1/2 to 1-3/4														X			X		
1-3/4 to 2														X			X		
2 to --									/										

SKETCH IN DEVELOPMENTS DOWNSTREAM OF DAM



OWNER'S MAINTENANCE STATEMENT

I, ______________________________, owner of ______________________ dam, am maintaining the dam in accordance with the accepted maintenance plan which is part of ~~Permit~~ Number ______________. N.A.

____
Signature

APPENDIX C

BY DLK DATE 6-15-87

CHKD. BY ______ DATE ______

HANSON ENGINEERS, INC.
ENGINEERS — CONSULTANTS
SPRINGFIELD, PEORIA & ROCKFORD, ILLINOIS

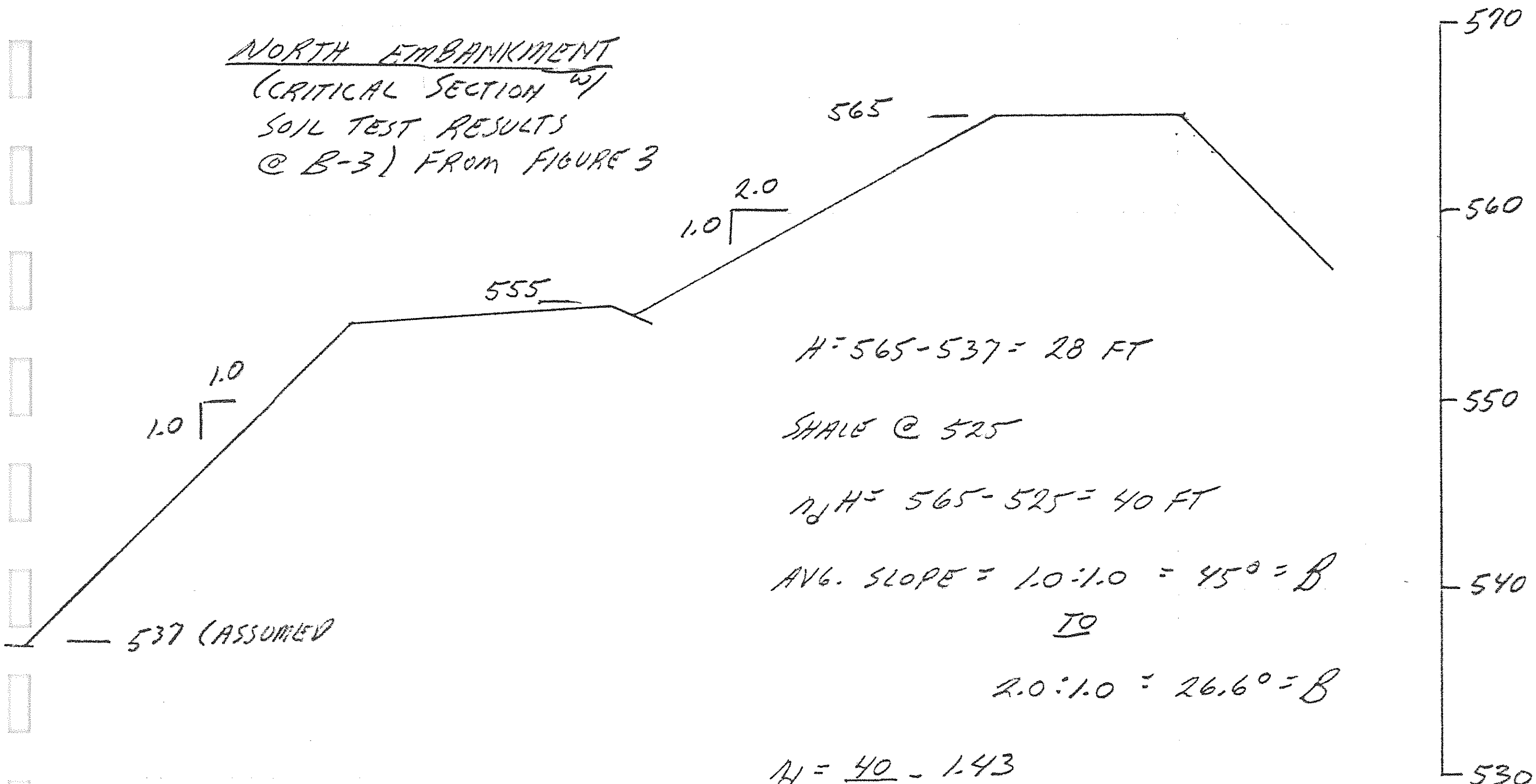
SHEET NO. 1 OF ____

JOB NO. 8753014

SLOPE STABILITY - CWLP ASH POND

USE TAYLOR'S CHART AS PRESENTED IN PECK, HANSON, AND THORNBURN, "FOUNDATION ENGINEERING", SECOND EDITION, 1974, FIGS. 18.12 & 18.13, PAGE 299

NORTH EMBANKMENT
(CRITICAL SECTION W/ SOIL TEST RESULTS @ B-3) FROM FIGURE 3



$H = 565 - 537 = 28$ FT

SHALE @ 525

$n_d H = 565 - 525 = 40$ FT

AVG. SLOPE = 1.0:1.0 = 45° = β
TO
2.0:1.0 = 26.6° = β

$n_d = \frac{40}{28} = 1.43$

ASSUME: $\gamma = 120$ PCF

$c = 1.0$ KSF = 1,000 PSF (CONSERVATIVE, AS $c_{AVG} = 2.84$ KSF)

FOR $\beta = 45°$: $N_s = 5.7 = \frac{\gamma H_c}{c} = \frac{(120)(H_c)}{1{,}000}$ $H_c = 47.5$ FT

$\frac{H_c}{H} = \frac{47.5}{28} = \underline{\underline{1.7}}$

FOR $\beta = 26.6°$: $N_s = 6.3 = \frac{\gamma H_c}{c} = \frac{(120)(H_c)}{1{,}000}$ $H_c = 52.5$ $\frac{H_c}{H} = \underline{\underline{1.9}}$

SLOPE STABILITY - CWLP ASH POND

IF USE $C = 2.84$ KSF (AVG VALUE FROM B-3), THEN:

$\frac{H_c}{H} = \underline{\underline{4.82}}$ FOR 45° AVG SLOPE

$\frac{H_c}{H} = \underline{\underline{5.32}}$ FOR 26.6° AVG SLOPE

WEST EMBANKMENT:
(CRITICAL SECTION
W/ SOIL TEST RESULTS
@ B-2)

SEE FIGURE 7 FOR CROSS SECTION.

$H = 28$ FT

SHALE @ 515.5

$n_d H = 49.5$ FT $\quad n_d = \frac{49.5}{28} = 1.77$

AVG. SLOPE = 2.5:1.0 = 21.8° = B
TO
3.0:1.0 = 18.2° = B

ASSUME $\gamma = 120$ PCF

$c = 1{,}000$ PSF (AVG $c = 2.17$ KSF IN B-2)

FOR $B = 21.8°$, $N_s = 6.2 = \frac{\gamma H_c}{c} = \frac{(120)(H_c)}{1{,}000}$ $\quad H_c = 51.7$ $\quad \frac{H_c}{H} = \underline{\underline{1.85}}$

FOR $B = 18.2°$, $N_s = 6.5 = \frac{\gamma H_c}{c} = \frac{(120)(H_c)}{1{,}000}$ $\quad H_c = 54.2$ $\quad \frac{H_c}{H} = \underline{\underline{1.94}}$

BY DLK DATE 6-15-87

CHKD. BY ______ DATE ______

HANSON ENGINEERS, INC.
ENGINEERS — CONSULTANTS
SPRINGFIELD, PEORIA & ROCKFORD, ILLINOIS

SHEET NO. 3 OF ______

JOB NO. 8753014

SLOPE STABILITY - CWLP ASH POND

IF USE $C = 2.17$ KSF (AVG. VALUE FROM B-2), THEN:

$\frac{H_c}{H} = \underline{\underline{4.0}}$ FOR 21.8° AVG SLOPE

$\frac{H_c}{H} = \underline{\underline{4.2}}$ FOR 18.2° AVG SLOPE

SLOPE STABILITY - CWLP ASH POND

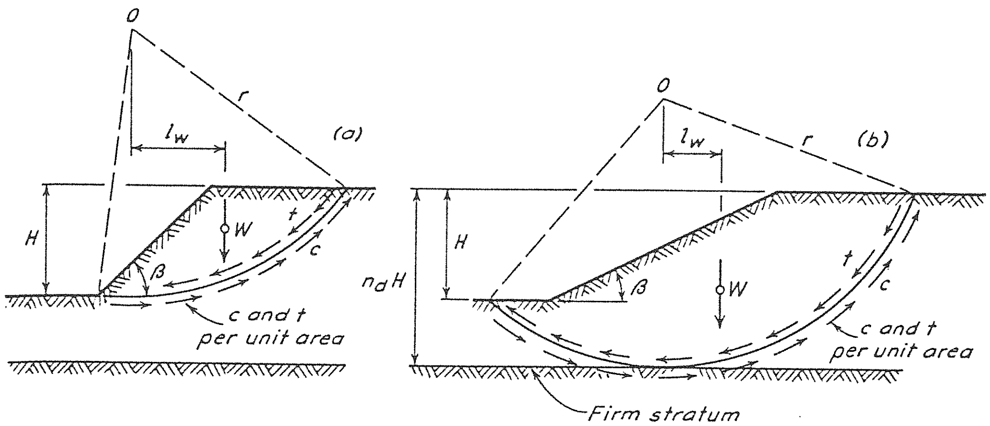


FIGURE 18.12. Position of failure surfaces. (*a*) Toe circle. (*b*) Base circle.

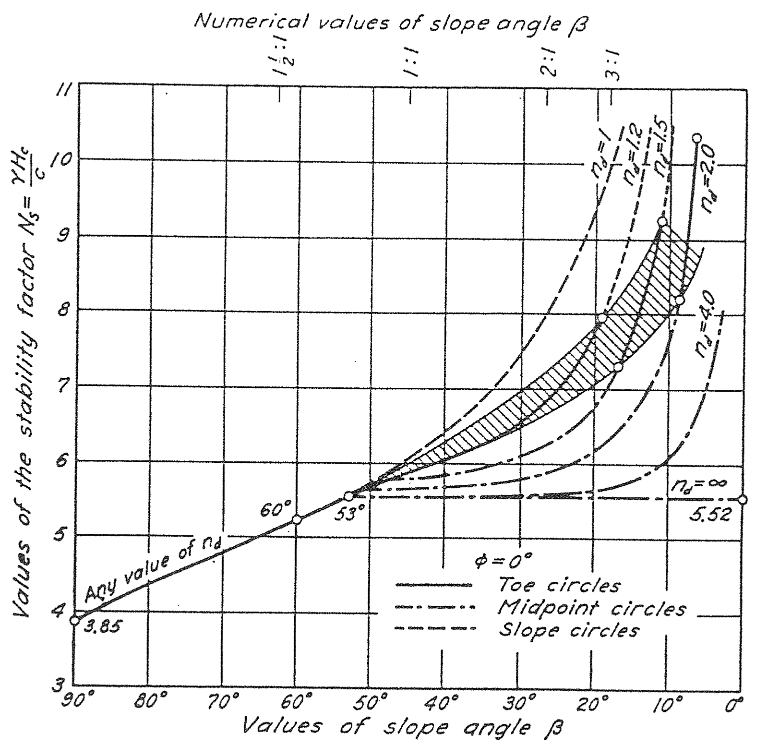


FIGURE 18.13. Relation for frictionless material between slope angle β and stability factor N_s, for different values of depth factor n_d (after Taylor, 1937).

FROM PECK, HANSON, & THORNBURN, PAGE 299

GRW

CITY WATER LIGHT & POWER
ASH DISPOSAL AREA

DAM CLASSIFICATION (SMALL DAM)

1. DRAINAGE AREA.

AREA	ACRES
A	26
B	3
C	8
TOTAL	37

2. LEVEE HEIGHT 565 - 537 = 28'

3 STORAGE VOLUME (AREA A)

ASSUME ORIGINAL - 24 X 18' 432 AC. FT.

ASSUME AV. WIDTH 25AC - 25 X 10 250

APPROXIMATELY 682 AC. FT.

HAZARD CLASSIFICATION

INSPECTION OF THE AREA DOWNSTREAM OF THE ASH POND INDICATES THAT THE BREACH OF THE ASH POND WILL NOT RESULT IN LOSS OF LIFE OR SUBSTANTIAL ECONOMIC LOSS. THIS EMBANKMENT IS THEREFORE CLASSIFIED IN THE LOW HAZARD POTENTIAL CATEGORY.

MINIMUM DESIGN

A DAM OR LEVEE EMBANKMENT LESS THAN 40 FT HIGH AND 1000 AC. FT. OF STORAGE IS CONSIDERED TO BE A SMALL DAM. A SMALL DAM WITH A LOW HAZARD POTENTIAL IS CONSIDERED TO BE A CLASS III DAM.

A CLASS III DAM PRINCIPAL SPILLWAY SHOULD BE DESIGN TO PASS THE 100-YR 24 HOUR RAINFALL EVENT OF 8.4" (0.7') ACCORDING TO THE RAINFALL FOR NORTH CENTRAL ILLINOIS.

GRW

6 7

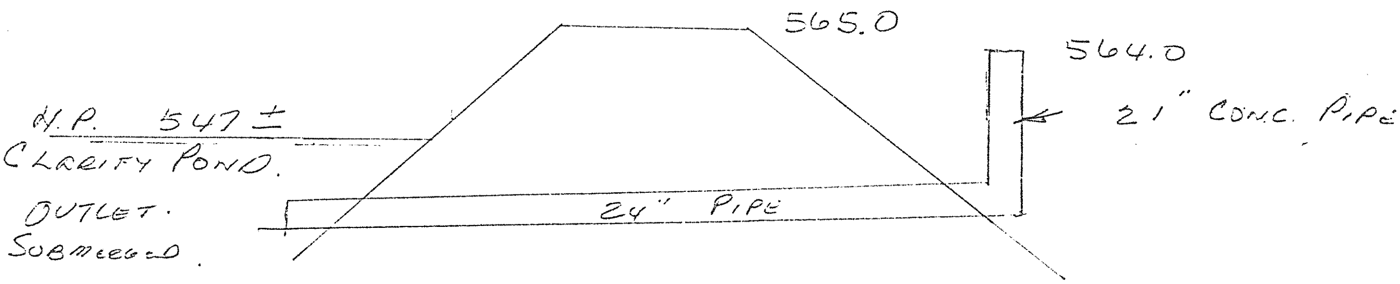
PROVISION SHOULD BE MADE TO DRAWDOWN 50 PERCENT OF THE TOTAL VOLUME OF WATER STORAGE IN 80 DAYS FOR A CLASS III DAM. SINCE THE MAJORITY OF THIS STORAGE VOLUME IS FLY ASH WE RECOMMEND THAT LARGE PORTABLE PUMPS OR SIPHON SYSTEM BE USED TO LOWER THE ASH POND POOL DURING EMERGENCIES

EVERY FIVE YEARS THE ASH POND WILL BE INSPECTED BY A PROFESSIONAL ENGINEER OR OTHER QUALIFIED PERSONNEL. A REPORT WILL BE SUBMITTED TO THE DIVISION OF WATER RESOURCES OUTLINING ANY DEFICIENCIES FOUND AND WILL DETAIL THE REMEDIAL MEASURES NECESSARY AND THE METHOD AND TIME WHICH WILL BE USED TO CORRECT THE DEFICIENCIES.

6RW

7 7

Primary Spillway Outlet Structure



Rating Curve

a) Weir Condition

$Q = CLH^{3/2}$ Weir Length $\pi D = 3.14 \times 1.75 = 5.5'$

$Q = 5.5\ CH^{1.5}$ $Q/D^{5/2} > 4$

H/D	C	H (FT)	Q cfs	Res Elev.
0	0	0		
.1	1.05	.175	0.4	
.2	2.40	.350	2.7	
.3	2.94	.525	6.2	
.4	3.22	.700	9.3	564.7
.5	3.38	.875	15.2	
.6	3.50			
.7	3.56			

Volume 100 Yr Rainfall 8.4" (.7 × 36 = 25.2 Ac. Ft)
(Area A + B + C = 36 Ac)

1 cfs = 2 Ac. Ft.

$25.2 / \left(\frac{15.2 \times 2}{2} \right) = 1.66$ Days Less than 2 Days OK

Freeboard Over Final Pool Elev. of 1.0' Is Recommended Since This Is An Ash Pond Where Very Small Wave Action Can Be Expected.

APPENDIX D

JOINT APPLICATION FORM

1. Application Number (To be assigned by Agency)

2. Date

Day . Month Year

3. For Agency use only (Date Received) PDF 0253

4. Name and address of applicant
City of Springfield
City Water, Light and Power
3100 Stevenson Drive
Springfield, Illinois 62703
Telephone no. during business hours
A/C (217) 786-4063
A/C ( )

5. Name, address, and title of authorized agent
Hanson Engineers Incorporated
1525 South 6th Street
Springfield, Illinois 62703
Telephone no. during business hours
A/C (217) 788-2450
A/C ( )

6. Describe in detail the proposed activity, its purpose, and intended use. If additional space is needed, attach additional support information to each agency application.

Raise portion of existing Lakeside Ash Disposal Area embankment a maximum of 10 ft to obtain additional storage volume for ash and filter cake slude disposal.

7. Names, addresses, and telephone numbers of all adjoining and potentially affected property owners, including the owner of subject property if different from applicant.

City of Springfield

8. Location of activity
Address:
City Water, Light and Power - Spaulding Dam
Street, road, or other descriptive location
Springfield
In or near city or town
Sangamon — Illinois — 62703
County — State — Zip Code

Legal Description:

1/4	Sec.	Twp.	Rge.	P.M.
SE	12	T15N	R5W	3rd

Tax Assessor's Description (if known):

Map No. ____ Subdiv. No. ____ Lot No. ____

Name of waterway at location of the activity

9. Date activity is proposed to commence September, 1987 Date activity is expected to be completed June, 1988

10. Is any portion of the activity for which authorization is sought now complete? ___ Yes X No If answer is "Yes" give reasons in the remark section. Month and Year the activity was completed – Indicate the existing work on drawings.

11. List all approvals or certifications required by other federal, interstate, state, or local agencies for any structures, construction, discharges, deposits, or other activities described in this application. If this form is being used for concurrent application to the Corps of Engineers, Illinois Department of Transportation, and Illinois Environmental Protection Agency, these agencies need not be listed.

Issuing Agency	Type Approval	Identification No.	Date of Application	Date of Approval
–	–	–	–	–

12. Has any agency denied approval for the activity described herein or for any activity directly related to the activity described herein.
___ Yes X No (If "Yes", explain in remarks.)

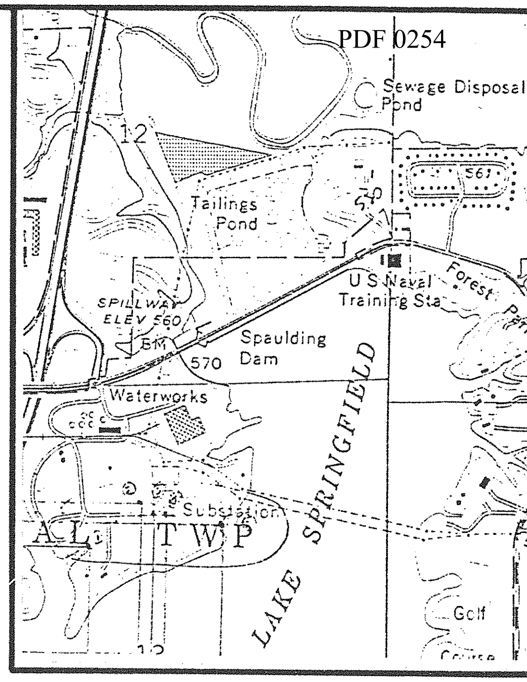
13. Remarks

14. Application is hereby made for authorizations of the activities described herein. I certify that I am familiar with the information contained in the application, and that to the best of my knowledge and belief, such information is true, complete, and accurate. I further certify that I possess the authority to undertake the proposed activities.

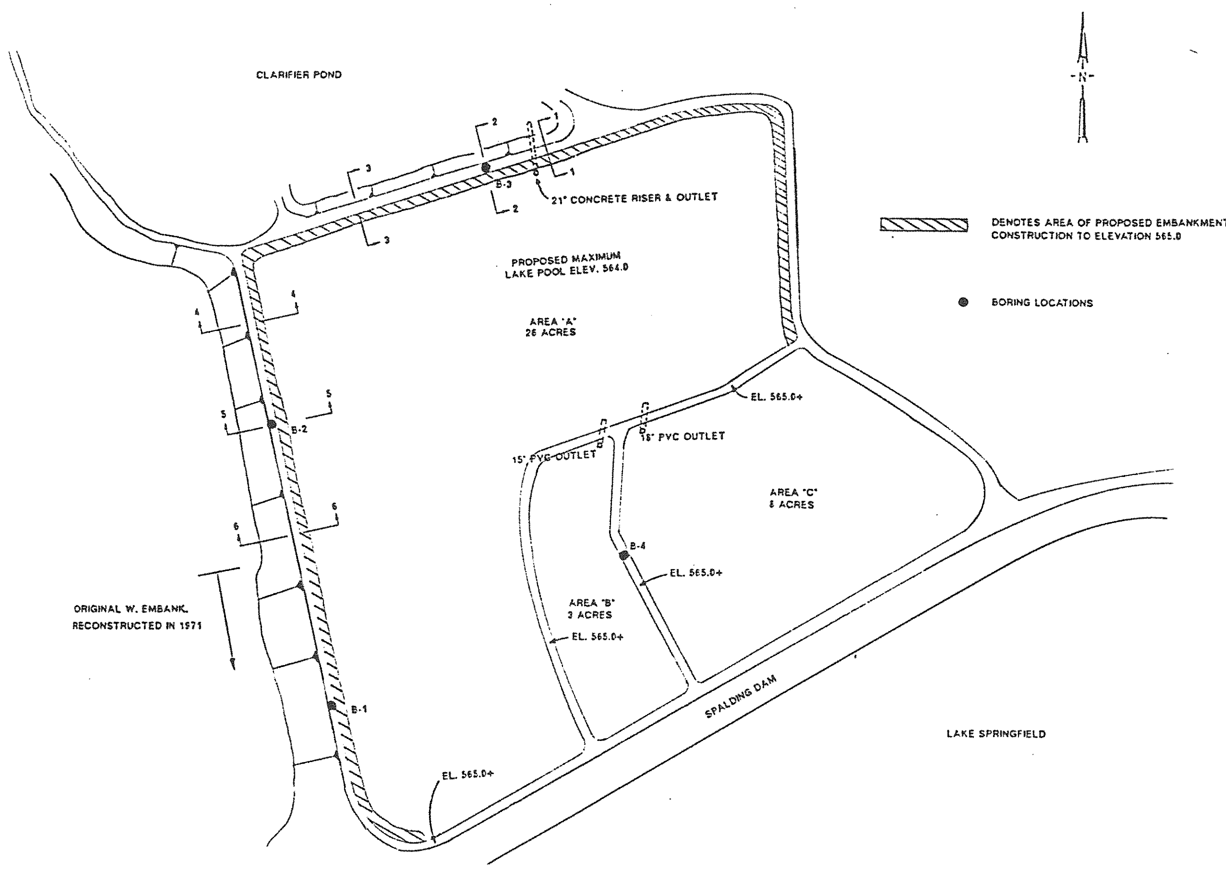
Signature of Applicant or Authorized Agent

NCR FORM 426
01 JUNE 81

CORPS OF ENGINEERS COPY - SEE JURISDICTIONAL MAP FOR ADDRESS



VICINITY MAP



LIST OF ADJACENT PROPERTY OWNERS

NO.	NAME	ADDRESS
1.		
2.	CITY OF SPRINGFIELD	
3.		
4.		

PROJECT DESCRIPTION:

RAISE PORTION OF LAKESIDE ASH DISPOSAL EMBANKMENT A MAXIMUM OF 10 FT.

LOCATION:

SPAULDING DAM
CITY OF SPRINGFIELD
SANGAMON COUNTY

SHEET OF

NCR FORM 427
01 JUNE 81

CORPS OF ENGINEERS COPY

APPENDIX E

CITY WATER, LIGHT AND POWER
LAKESIDE ASH POND DAM

MAINTENANCE PLAN

PREPARED FOR:

CITY OF SPRINGFIELD, ILLINOIS

PREPARED BY:

HANSON ENGINEERS INCORPORATED
1525 SOUTH SIXTH STREET
SPRINGFIELD, ILLINOIS

JUNE 1987

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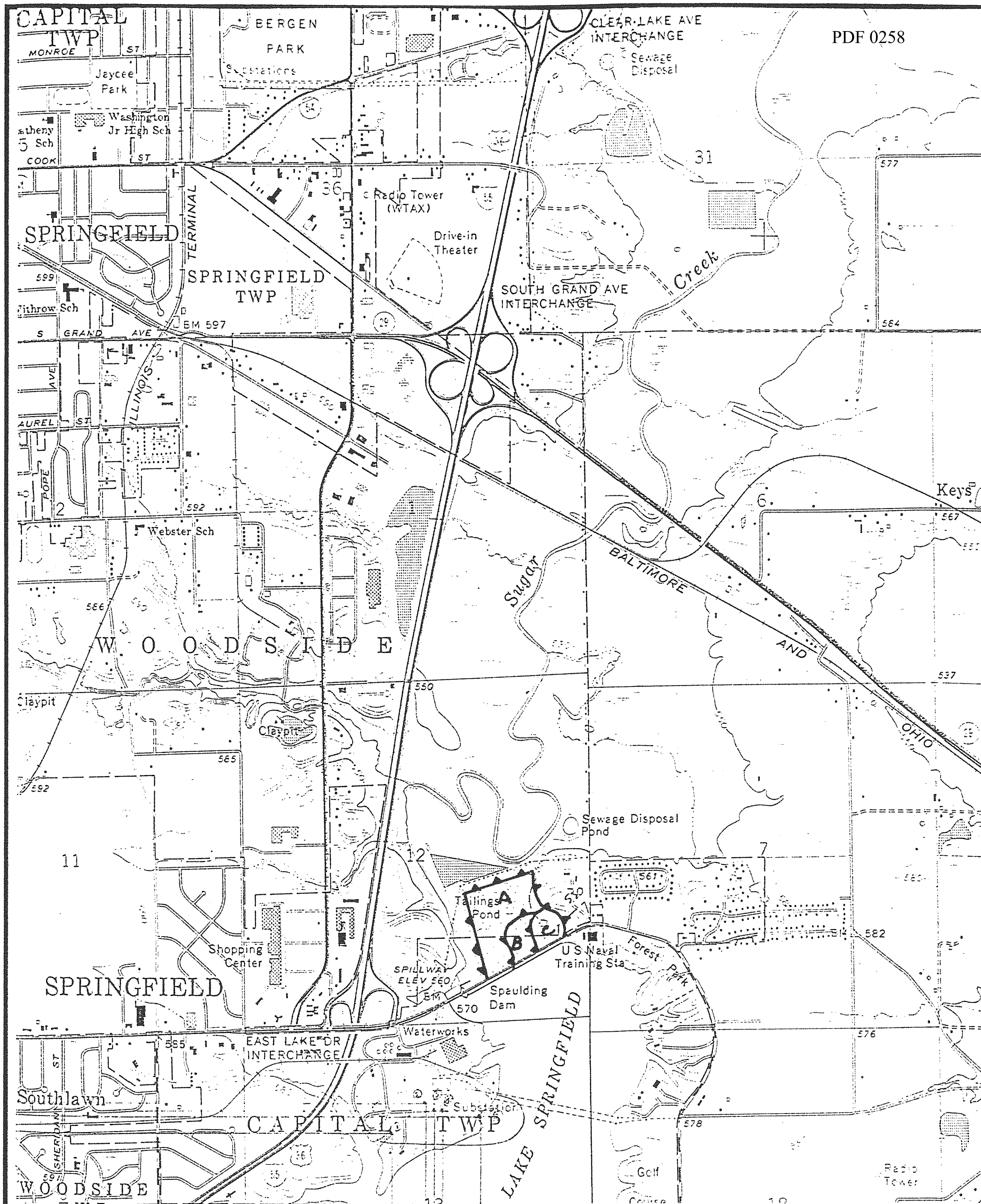

HANSON ENGINEERS INCORPORATED

SPRINGFIELD, IL • PEORIA, IL • ROCKFORD, IL

LAKESIDE FLY ASH POND
CITY WATER LIGHT AND POWER

GENERAL DESCRIPTION

The existing Lakeside Ash Disposal surface area of about 37 acres is located north of Spaulding Dam at Lake Springfield. Of this total surface area, about 26 acres are in Area A (see Figure 1). Areas B and C occupy approximately 3 acres and 8 acres, respectively. The embankments which confine Areas B and C are at or above elevation 565. This is approximately 10 ft higher than the west and north embankments of Area A. The east side of Area A is confined by natural ground. The natural ground surface slopes upward from the east end of the Area A north embankment (about elevation 555) to the east end of the north embankment confining Area C (about elevation 565). The south limits of Areas A, B, and C are defined by Spaulding Dam, which forms Lake Springfield.

The proposed modifications include raising the embankment surrounding Area A for a distance of about 3,200 ft to elevation 565, a maximum height of 10 ft above the existing embankment. This will extend the total height of the west and north embankments to about 28 ft. This will also increase the storage capacity of Area A by about 260 acre ft.

OPERATION

Filter cake sludge material is slurried into Areas B and C from the water treatment plant located to the southwest of the site. A majority of the solids settle in Areas B and C, and the water is decanted into Area A through drop inlet pipes located at the north ends of Areas B and C. Surface water also flows from Areas B and C into Area A through the drop inlets.

Coal combustion ash is slurried into the southwest corner of Area A from nearby Lakeside Power Plant. The ash materials settle out in Area A, and the water is decanted into the clarifier pond through a 21 in. diameter drop inlet pipe. The outlet of this pipe is submerged beneath the surface of the clarifier pond. The level of the clarifier pond is maintained at about elevation 547 ft.

The elevation of the existing ash pond is about 555 ft. After the ash pond embankment is raised to elevation 565 ft, the pool level in the ash pond will be raised to a maximum elevation of 564 ft. This will allow 1 ft of freeboard between the final pond elevation and the top of the embankment. The pond level will be controlled by the 21 in. outlet struture located at the north end of the ash pond. Flows from this structure will be by gravity into the clarifier pond and then discharge into Sugar Creek.

The ash pond outlet structure will not be equipped with a dewatering facility. If an emergency situation warrants lowering the ash disposal area pool, we recommend that this be accomplished with filtered sumps or siphons discharging into the clarifier pond.

The contact at City Water, Light and Power for emergency operations will be ____________________, telephone #_______________.

SECTION 1.0
MAINTENANCE

Certain maintenance procedures must be followed in order to maintain the dam and appurtenances in sound operating conditions. Some procedures must be addressed on a continuous basis, and others will become apparent as a result of site inspections.

1.1 Vegetation

Regular maintenance of vegetation, and replacement of vegetation on damaged or repaired areas is necessary to control erosion on the dam, abutments, and emergency spillways. If, during the regular inspection or following flood conditions, inadequacies are noted, certain procedures must be followed to maintain proper vegetative cover.

1. Preparation of seedbed.

   Fill eroded areas with topsoil. Remove stones larger than 4 in. and other debris. Apply lime and fertilizer, and work the seedbed to a depth of 3 in.

2. Lime.

   Commercial agricultural limestone will be applied according to soil test.

3. Fertilizer.

   The following amounts of fertilizer per acre will be applied:

Nitrogen (N)	120 pounds
Phosphorus (P)	180 pounds P_2O_5
Potassium (K)	180 pounds K_2O_5

4. Seed.

Seed mixture shall comply with Class I requirements of the prevailing edition of "Standard Specifications for Road and Bridge Construction," issued by the State of Illinois, Department of Transportation.

5. Time of Seeding.

Seeding should be done from early spring to June 1, or during August.

6. Sowing.

The seed will be broadcast and covered approximately 1/4 in. to 1/2 in. deep with a light harrow, culti-packer, or other suitable equipment. Seeding may also be done by drilling and culti-packing or using a culti-packer seeder.

7. Mulching.

Mulching will be applied immediately after seeding at the rate of 2 tons of hay or straw mulch per acre. Mulch applied on back slopes or side slopes must be anchored by plastic netting or other means adequate to hold mulch in place.

If inspections reveal that certain areas of standing vegetation require fertilizer, it should be applied at the following rates per acre:

Nitrogen	-	60 pounds
Phosphorus	-	60 pounds
Potassium	-	60 pounds

1.2 Brush Control

The slopes of the dam shall be kept free of brush. Regular mowing or chemical spraying around the dam will control brush and weeds.

1.3 Rodent Control

Rodent holes occurring in the dam will be filled and revegetated. If the rodent population becomes a problem, a controlled program of trapping or other means as approved by the Illinois Department of Conservation will be initiated.

1.4 Obstructions

Obstructions in the form of trash, debris, logs, or excess vegetation can interrupt the normal operation of the dam if blockages occur at certain locations.

1. Primary Spillway.

   a. Spillway structure must be maintained free from obstructions. Any debris that is obstructing it must be removed.

Inspection reports as required by the Division of Water Resources shall be submitted as per the requirements set forth in Section 702.40 (b)(5)(A) of the "Rules for Construction and Maintenance of Dams," as revised February 1, 1987 by the Department of Transportation, Division of Water Resources.

RIGHT OF ACCESS STATEMENT

WHEREAS, the City of Springfield has applied for Operation and Maintenance Permit for Lakeside Ash Pond Dam, Inventory Number ____ from the Illinois Department of Transportation Division of Water Resources and,

WHEREAS, in compliance with Section 702.40(b) of the Department's "Rules for Construction and Maintenance of Dams,"

NOW THEREFORE, be it resolved by the City Council of the City of Springfield that right of access to the dam and immediate vicinity is granted to authorized personnel of the Department upon prior notice to the City of same.

Resolved this ____________ day of ________________________, 19___.

NAME: ________________________________

TITLE: Mayor, City of Springfield
Commissioner, City Water, Light and Power

Certified to be a true and accurate copy, passed and adopted on the above date.

NAME: ________________________________

TITLE: City Clerk

(SEAL)

ATTACHMENT 4 – 2016 HISTORY OF CONSTRUCTION REPORT

City Water, Light & Power
Ash Impoundments
Springfield, Sangamon County, Illinois

History of Construction Report for Coal Combustion Residuals Surface Impoundments

October 2021

Prepared for:
City Water, Light & Power
3100 Stevenson Drive
Springfield, Illinois 62703

ANDREWS ENGINEERING

3300 Ginger Creek Drive, Springfield, IL 62711 | 217.787.2334

ILLINOIS | MISSOURI | INDIANA

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APPENDICES

1. INTRODUCTION

City Water, Light and Power (CWLP) Lakeside Ash Pond and Dallman Ash Pond are coal combustion residuals (CCR) surface impoundments. A review of the construction history for the CCR surface impoundments was conducted as required by 40 IAC Part 845.220(a)(1):

Andrews Engineering, Inc. (AEI) performed the review of information, which included the following documents:

- Coal Ash Impoundment Site Assessment Final Report (May 2011)
- Historical Aerial Photographs (April 1995 – March 2014)
- Engineering Report: Proposed Embankment Modification; CWLP Ash Disposal Area (July 1987).
- Construction Grading Plan for the Dallman Ash Pond (August 1976)

2. CCR UNIT INFORMATION

Both the Lakeside Ash Pond and the Dallman Ash Pond are owned and operated by CWLP. The CWLP main office is located at 4th Floor, Municipal Center East, 800 E. Monroe Street, Springfield, IL 62757. The ponds are operated under National Pollutant Discharge Elimination System (NPDES) Permit Number IL0024767.

3. LOCATION

The Lakeside Ash Pond and the Dallman Ash Pond are located north of East Lake Shore Drive, just east of Interstate 55. The CCR units are located in the eastern half of Range 5 West, Township 15 North, Section 12 in Sangamon County, Illinois (Springfield East Quadrangle, Illinois, USGS). The locations of the CCR units are shown in Figure 1 of this report.

4. PURPOSE

The Lakeside Ash Pond is primarily a diked embankment with some incising along the east perimeter and was placed into service prior to 1958. The original Lakeside Ash Pond was been divided into four separate ponds since it was expanded vertically in 1988: three lime softening ponds and the settling pond. The current Lakeside Ash Pond is approximately 27.6 acres and ceased receiving ash in 2009.

The Dallman Ash Pond was placed into service in approximately 1976 and is approximately 34.5 acres. Fly ash and bottom ash from the CWLP power plant are sluiced to the Dallman Ash Pond with raw lake water.

Settled water from both the Dallman Ash Pond and Lakeside Ash Pond flow into opposite sides of a Clarification Pond before being discharged to Sugar Creek at Outfall 004.

5. WATERSHED AREA

The site is located within the South Fork Sangamon Watershed (USGS 07130007). However, since both ash ponds were built from diked embankments, virtually no surface water flows into the surface impoundments. Therefore, the watershed area for both of the ash ponds would be roughly equal to their surface area. The Dallman Ash Pond is approximately 34.5 acres. The Lakeside Ash Pond is approximately 27.6 acres.

6. FOUNDATION

The Sugar Creek historically meandered across the site, generally from the west to east with an overall flow direction to the north. During the construction of the ash ponds, the creek was abandoned and relocated to the west of the site. The old creek bed was filled with different types of soil, ranging from cohesive soils characterized as silty clays, to granular fill characterized as poorly graded silty to clayey sands. Most of the soil analysis was performed during hydrogeological investigations performed for the east adjacent CCR landfill.

The cohesive soils of the creek fill were tested as part of the CCR landfill permitting process. The landfill location is shown in Figure 1. The soils exhibited the following range of index and engineering properties:

- Liquid limit = 34 to 46
- Plasticity index = 9 to 26
- Gravel content = 0 percent
- Sand content = 2 to 48 percent
- Silt/Clay content = 52 to 98 percent
- Dry density = 80 to 104 pcf
- Hydraulic conductivity 7.6 x 10^{-8} to 2.1 x 10^{-5} cm/sec

Sieve analysis on the granular fill yielded the following results:

- Gravel content = 0 to 2 percent
- Sand content = 55 to 65 percent
- Silt/Clay content = 33 to 45 percent

Prior to the area development, the upper layer of soil at the site consisted of mainly brown, light brown, and brownish-gray silty clays and clayey silts having soft to stiff consistency. This includes all eolian soils (loess) deposited near the surface, isolated pockets and lenses of fine grained silty to clayey sand at some locations and alluvial silts and silty clays. Recompacted silty clay samples from the native soils have exhibited hydraulic conductivity values between 1 x 10^{-7} to 1 x 10^{-9} cm/sec. The in-place creek sediment's soils permeability typically range from 1 x 10^{-6} to 1 x 10^{-8} cm/sec. Much of the shallow soils were displaced during area development.

7. CONSTRUCTION

7.1 Lakeside Ash Pond

The Lakeside Ash Pond is a diked pond. The pond was built prior to 1958 and was bounded by the Lake Springfield Spaulding Dam to the south. The original pond was approximately 44 acres. The soil berms comprising the east, north, and west boundaries were built approximately 18 to 20 feet above the inside bottom elevation, with side slopes ranging between 2.5 to 3.0H:1.0V.

The Lakeside Ash Pond system was expanded vertically in 1988. The vertical expansion consists of berms built on top and inside of the existing embankments in such a way that the toe of the outer slope of the expansion berms matches up with the top of the inner slope of the existing embankments. The berms were built on top of a stable base comprised of bottom ash on the inside of the existing berms. The vertical expansion berms are approximately ten feet in height. The berms were constructed with compacted cohesive materials. The top and outer slopes are covered with a 6-inch topsoil layer. The top of the berms are 10 feet wide. The outer slope of the berms was built at a 2H:1V slope. The inner slope of the berms was built at a 1H:1V slopes. During the vertical expansion in 1988, the Lakeside Ash Pond was separated to create lime softening ponds on the south section of the pond.

7.2 Dallman Ash Pond

The Dallman Ash Pond was built 1976; it has not been expanded. The berms for the Dallman Ash Pond were built to a height of approximately 27 feet, using slopes of 2.5H:1V for both the inner and outer slopes. Riprap was placed at the bottom section of the outer slopes for the west and north berms. The south berm for the Dallman Ash Pond is shared by the Clarification Pond located to the south.

8. DRAWINGS

The following drawings are included in Appendix A of this report:

- Figure 1 – Site Map identifying the location of the CCR units.
- Figure 2 – Plan View of the surface impoundments and the locations of outlets, normal operating pool elevations, maximum pool elevations, and maximum depths of each CCR unit.
- Construction Drawings – Plan Views and Cross Sections of each CCR unit.

Plan Drawings and Cross Sections of the Lakeside Ash Pond are taken from the construction design drawings included in the 1987 Proposed Embankment Modifications report by Hanson Engineers, Inc. No as-built drawings are available for either the original pond construction prior to 1958 or the expansion in 1988. No construction design drawings are available for the original pond construction. The Plan Drawing shows the proposed expansion with two lime softening ponds. The third lime softening pond was constructed from the southern portion of the expanded settling pond at a later time.

The Plan Drawing of the Dallman Ash Pond is taken from the 1976 Construction Grading Plan. Cross Sections for the Dallman Ash Pond have been created based on this Plan Drawing. No as-built drawings are available for the construction of the Dallman Ash Pond.

Neither CCR unit contains foundation improvements, drainage provisions, diversion ditches, or instrumentation. No identifiable natural or manmade features that could adversely affect operation of the CCR unit due to malfunction or misoperation are known to CWLP personnel.

9. INSTRUMENTATION

According to CWLP personnel, none of the CCR units contains any such unit instrumentation, which would include dedicated piezometers, pool elevation and freeboard instrumentation or more sophisticated measuring devices for measuring pressure, seepage, internal movement, slope movement, and/or vibration. Due to the limited extent of the impoundments, such instrumentation was deemed unnecessary.

10. AREA-CAPACITY CURVES

Area-capacity curves for the CCR units are included in Appendix B of this report. Area-capacity curves for the CCR units are calculated based on information from the construction drawings discussed in Section 8 of this report.

11. SPILLWAYS

Neither ash pond has constructed or natural spillways.

12. SURVEILLANCE, MAINTENANCE, AND REPAIR

Visual inspections of the CCR units are performed on a weekly basis for the purpose of identifying appearances of actual or potential structural weaknesses and other conditions that are disrupting or have the potential to disrupt the operation or safety of the CCR units or appurtenant structures. Erosional features, such as ruts or gullies, are promptly filled with soil and seeded. Any repairs completed as part of maintenance are specifically monitored during the weekly inspections for future occurrences. Because of the limited extent of the impoundments, only minimal maintenance is necessary.

13. STRUCTURAL CONDITION OF CCR UNITS

Signs of erosion have been periodically observed on the north and west outer berms of the Dallman Ash Pond in the forms of ruts and gullies that typically range from 6 to 24 inches deep. The erosion appears to be caused by stormwater flow collecting at points along the top of the berm before flowing down the outer slope in concentrated streams. Ruts and gullies are routinely filled with soil and monitored in the observed locations. Erosion of similar severity was discussed in the 2011 Site Assessment Final Report, which recommended that the erosion be repaired on an as-needed basis.

Indications of seepage have been observed on outer berms of the Lakeside Ash Pond and lime softening ponds, between the top of the original pond berms and the vertical expansion berms. These range from staining or dampness to areas with noticeable drainage. Signs of seepage have been observed along the west berm, as well as isolated portions on the east and west portions of the north berm of the Lakeside Ash Pond. This seepage is discussed in the 2011 Site Assessment Final Report.

As reported in the 2021 Annual Inspection, no visual indications of actual or potential structural weaknesses of the surface impoundments have been observed. Based on the review of historical aerial photographs completed during the 2016 Annual Inspection, there were no observed indications of mass movement on any of the constructed berms for the surface impoundments.

14. STATEMENT

This History of Construction Report for Coal Combustion Residuals Surface Impoundments was completed for CWLP by Andrews Engineering, Inc. in accordance with the requirements under 35 IAC Part 845.220 (a)(1).

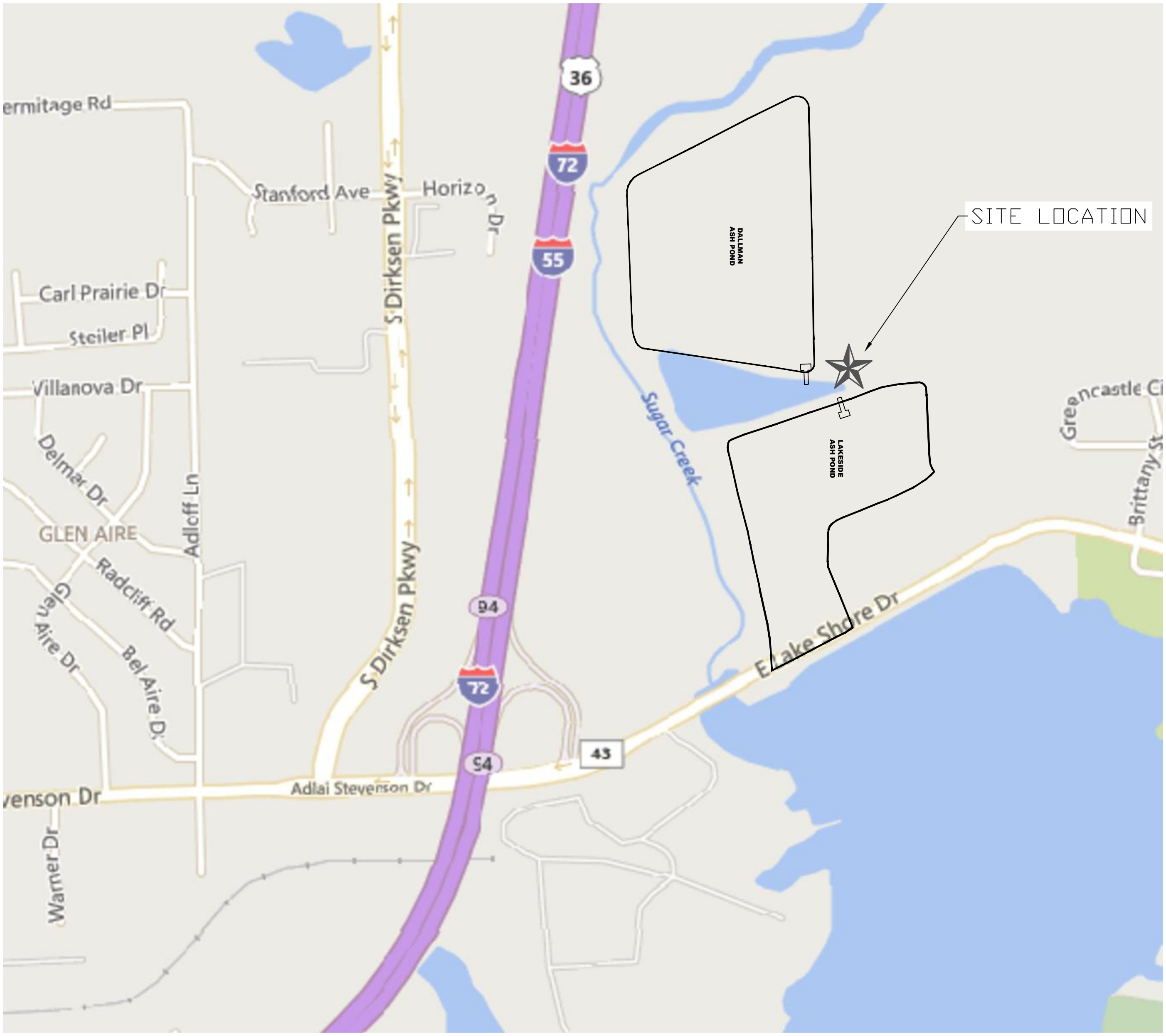
10-20-21

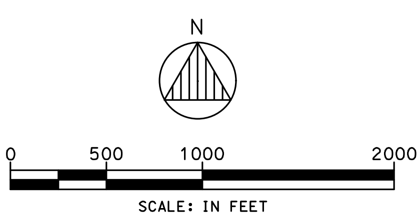
Paul M. Van Metre, P.E. Date

STATE OF ILLINOIS
PAUL
VAN METRE
062-064175
REGISTERED
PROFESSIONAL ENGINEER

APPENDIX A

Figures





NOTE:
BASE IMAGE DERIVED FROM BING

SITE LOCATION

ANDREWS ENGINEERING, INC.
3300 Ginger Creek Drive, Springfield, IL 62711-7233
Tel (217) 787-2334 Fax (217) 787-9495
Pontiac, IL • Naperville, IL • Indianapolis, IN • Warrenton, MO
Professional Design Engineering and Land Surveying Firm #184-001541

APPROVED BY: PMV	DESIGNED BY: PMV	DRAWN BY: RMC

SITE LOCATION MAP

PLANS PREPARED FOR

CWLP

SPRINGFIELD, SANGAMON COUNTY, ILLINOIS

DATE:	OCTOBER 2016
PROJECT ID:	150077/0011
SHEET NUMBER:	FIG. 1

REVISIONS			
NO.	DATE	DESCRIPTION	BY

ANDREWS
ENGINEERING, INC.
3300 GINGER CREEK DRIVE
SPRINGFIELD, ILLINOIS 62711-7233
PH (217) 787-2334 FAX (217) 787-9495
PONTIAC, IL • LOMBARD, IL • INDIANAPOLIS, IN • WARRENTON, MO
PROFESSIONAL DESIGN ENGINEERING AND LAND SURVEYING FIRM #184001541

APPROVED BY: PMV DESIGNED BY: PMV DRAWN BY: MPN

CWLP COAL COMBUSTION RESIDUALS SURFACE IMPOUNDMENTS

PLANS PREPARED FOR
CITY, WATER, LIGHT & POWER
SPRINGFIELD, SANGAMON COUNTY, ILLINOIS

DATE: OCTOBER 2016

PROJECT ID: 150077/0011

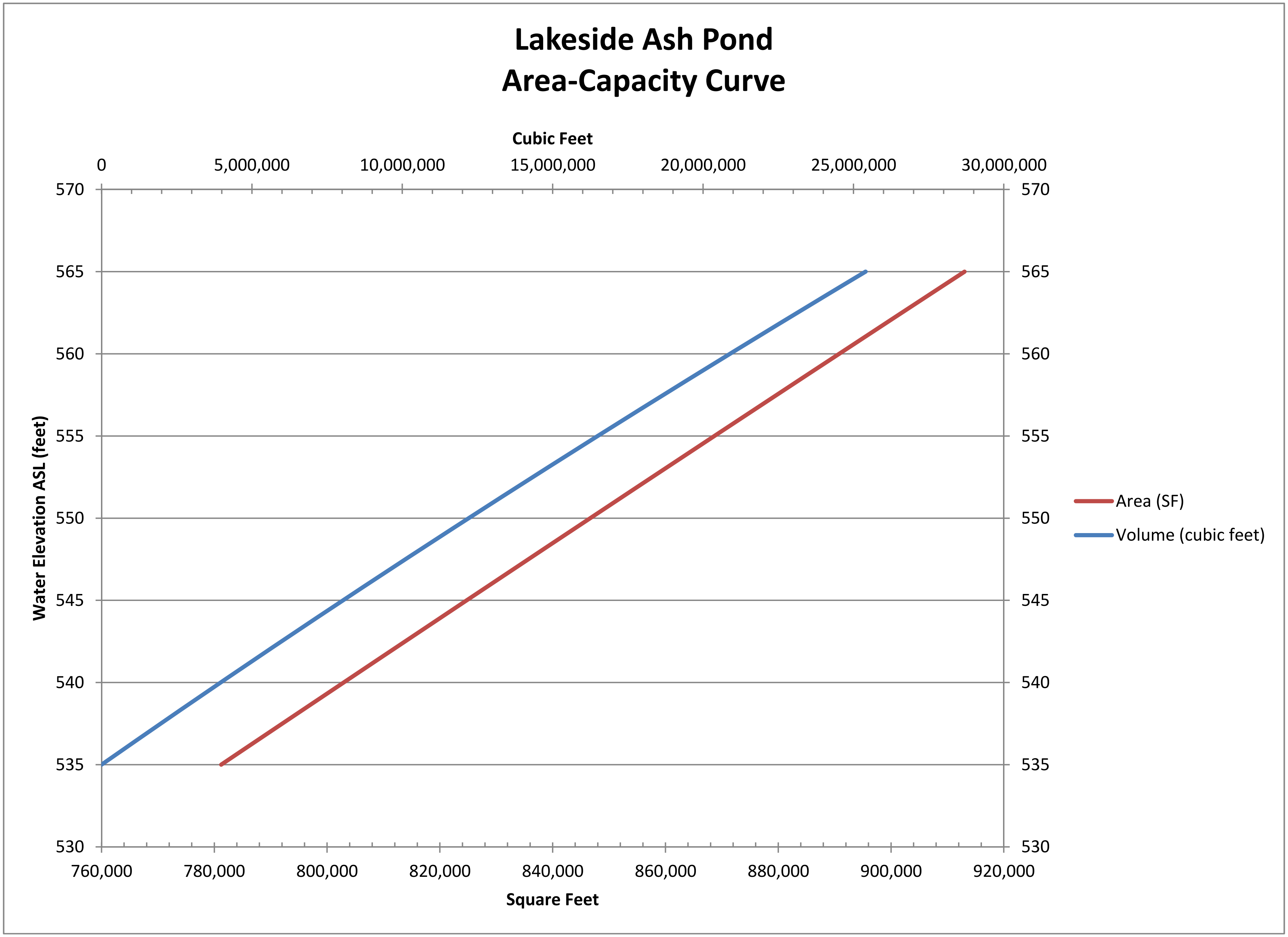
SHEET NUMBER:

FIG. 2

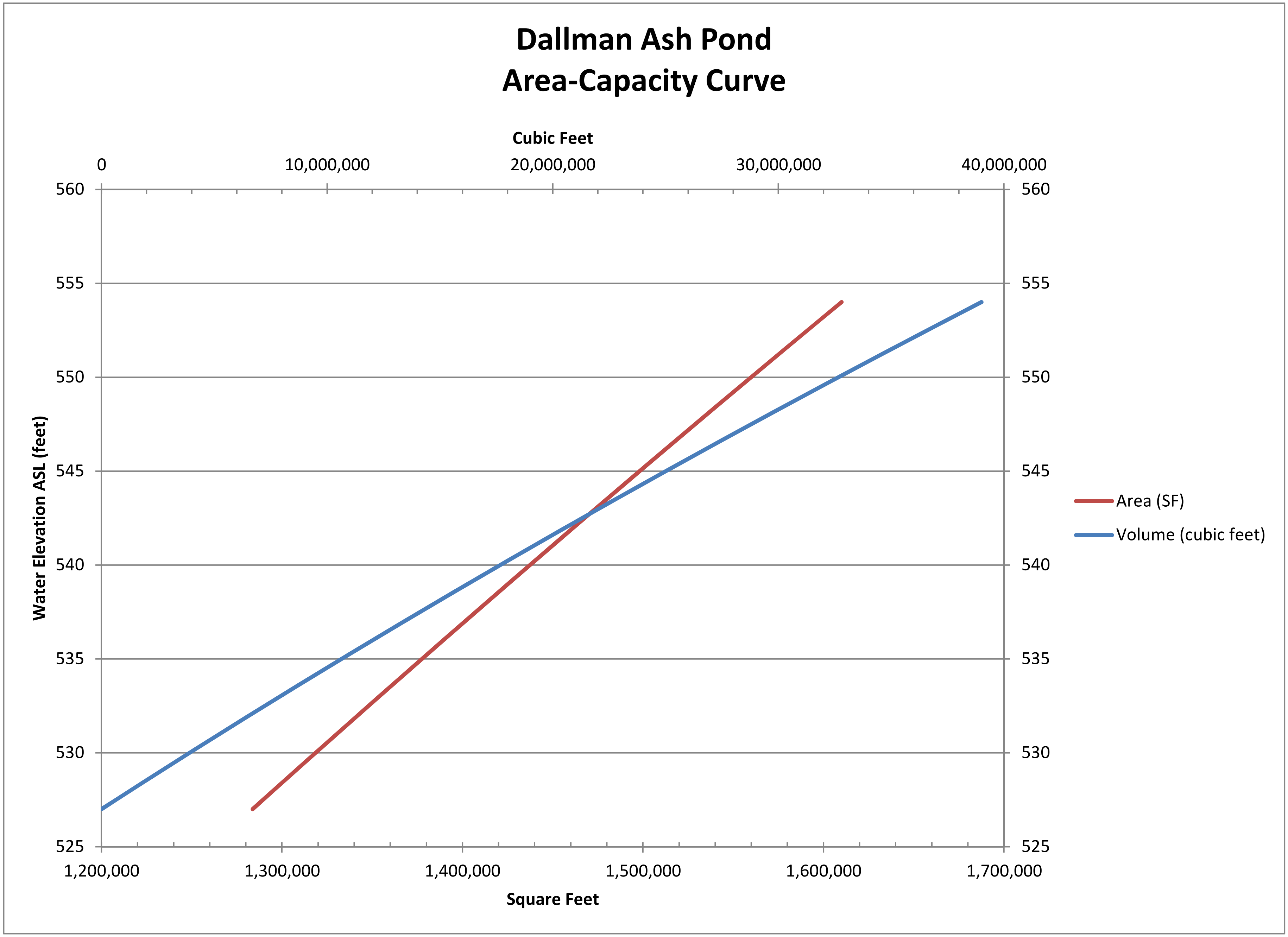
J:\S\Springfield CWLP\CWLP\dwg\SURFACE IMPOUNDMENTS.dwg Tab: FIGURE 2 Last Saved: October 6, 2016, by Ryan Curtis Plotted: Thursday, October 06, 2016 8:24:18 AM

APPENDIX B

Area-Capacity Curves



Lakeside Ash Pond
Area-Capacity Curve
Cubic Feet
0
5,000,000
10,000,000
15,000,000
20,000,000
25,000,000
30,000,000
570
565
560
555
550
545
540
535
530
Water Elevation ASL (feet)
Area (SF)
Volume (cubic feet)
760,000
780,000
800,000
820,000
840,000
860,000
880,000
900,000
920,000
Square Feet



Dallman Ash Pond
Area-Capacity Curve
Cubic Feet
0
10,000,000
20,000,000
30,000,000
40,000,000
560
555
550
545
540
535
530
525
Water Elevation ASL (feet)
1,200,000
1,300,000
1,400,000
1,500,000
1,600,000
1,700,000
Square Feet
Area (SF)
Volume (cubic feet)

ATTACHMENT 5 - ANALYTICAL REPORT FOR CCR SURFACE IMPOUNDMENTS

- DOCUMENT 1: LAKESIDE ASH POND - NON CCR - OLD LIME SLUDGE LAB RESULTS - CURRENTLY IN LAKESIDE ASH POND
- DOCUMENT 2: LAKESIDE ASH POND - NON CCR - DRINKING WATER PURIFICATION PLANT SLUDGE ENTERING LAKESIDE ASH POND
- DOCUMENT 3: LAKESIDE ASH POND - CCR - LIME SLUDGE AND FILTER PLANT SLUDGE CCR THAT GOES TO LAKESIDE ASH POND
- DOCUMENT 4: DALLMAN ASH POND - NON CCR - EVAPORATION POND WATER FROM FGDS LANDFILL
- DOCUMENT 5: DALLMAN ASH POND P – EVAPORATION POND LIQUIDS - 21051663
- DOCUMENT 6: DALLMAN ASH POND – EVAPORATION POND LIQUIDS -21050850
- DOCUMENT 7: DALLMAN ASH POND - CCR - UNIT 31 32 AND 33 BOTTOM ASH
- DOCUMENT 8: DALLMAN ASH POND - CCR - JAN 2017 COMBINED FLY ASH TRACE METALS - REPRESENTS ALL ASH GOING TO DALLMAN ASH POND
- DOCUMENT 9: DALLMAN ASH POND - CCR - JAN 2017 COMBINED FLY ASH TOTALS DALLMAN ASH POND - REPRESENTS ALL ASH GOING TO DALLMAN ASH POND
- DOCUMENT 10: DALLMAN ASH POND - CCR - FLUE GAS DESULFURIZATION SLUDGE ENTERING DALLMAN ASH POND

DOCUMENT 1: LAP - NON CCR - OLD LIME SLUDGE LAB RESULTS - CURRENTLY IN LAP

TMI Analytical Services
3501 South Sixth Street
Springfield, IL 62703

Fax:(217) 585-1838
Phone:(217) 585-1557

To: C.W.L.P.
201 E. LAKE SHORE DRIVE
SPRINGFIELD, IL 62707

ATTN: SUE CORCORAN

Site: CITY, WATER, LIGHT & POWER

Project: CWL00141

Sampled By: CORCORAN

Report Comments:

Receipt Date: 08/05/97
Report Date: 08/19/97
Sample Date: 08/05/97

Client Sample ID: DRY SLUDGE

Lab ID: MM11970
Sample Matrix: SOLID
DRY SLUDGE

Analyte	Method	MDL	Units	Result
METALS				
Arsenic, dry weight	EPA 7060	0.200	mg/kg	9.70
Cadmium, dry weight	EPA 7130	1.25	mg/kg	BELOW MDL
Chromium, dry weight	EPA 7190	2.5	mg/kg	11.5
Lead, dry weight	EPA 7420	25	mg/kg	BELOW MDL
Mercury, dry weight	EPA 7470	0.25	mg/kg	BELOW MDL
Selenium, dry weight	EPA 7740	0.200	mg/kg	BELOW MDL
Copper, dry weight	EPA 7210	1.0	mg/kg	21.6
Zinc, dry weight	EPA 7950	0.50	mg/kg	92.9
Nickel, dry weight	EPA 7520	25	mg/kg	37.9
Barium, dry weight	EPA 7080	25	mg/kg	BELOW MDL
Silver, dry weight	EPA 7760	2.5	mg/kg	4.09
Hexavalent chromium	SM 312 B	10	mg/kg	BELOW MDL
WET CHEMISTRY				
Calcium Carbonate Equivalents	ASTM		lbs/yd3	1070
Percent Solids	EPA 160.3	0.5	%	94.1
pH, solid	EPA 150.1	NONE	UNITS	8.74

Signed: for Corcoran
Authorized Signature

BELOW MDL = compound is not detected at or above the specified MDL.

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TECHNOLOGIES, INC.

8100 North Austin Avenue • Morton Grove, IL 60053-3203
847.967.6666 • 800.246.0663 • fax: 847.967.6735 • www.emt.com

Sue Corcoran
City Water, Light & Power
201 East Lake Shore Drive
Springfield, IL 62707

December 13, 2002

RE Filter Plant Sludge Mix

Lab Orders:
02120160

Dear Ms. Sue Corcoran:

Enclosed are the analytical reports for the EMT Lab Order listed. If you have any questions, please contact me at 847-967-6666.

Sincerely,

Andrew R Wemmer
Project Manager

Approved by,

Mitchell Ostrowski
Laboratory Director

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TECHNOLOGIES, INC.

8100 North Austin Avenue • Morton Grove, IL 60053-3203
847.967.6666 • 800.246.0663 • fax: 847.967.6735 • www.emt.com

CLIENT: City Water, Light & Power

Project: Filter Plant Sludge Mix

Lab Order: 02120160

Date: *13-Dec-02*

CASE NARRATIVE

Unless other wise noted, analysis conducted according to the Methods specified in 40 CFR Part 136.

Unless otherwise noted, all method blanks, laboratory spikes, and/or matrix spikes met quality assurance objectives.

Sample results relate only to the analytes of interest tested and to the sample received at the laboratory.

All results are reported on a wet weight basis, unless otherwise noted. Dry weight adjusted results are indicated by the notation "dry" in the Units column.

Accreditation by the State of Illinois is not an endorsement or a guarantee of the validity of data generated. For specific information regarding EMT's scope of accreditation , please contact your EMT project manager.

The Reporting Limit listed on the Report of Laboratory Analysis is EMT's reporting limit for the analyte reported. For most test methods this reporting limit is primarily based upon the lowest point in the calibration curve. The Reporting Limit may not reflect the regulatory limit for the given analyte.

Method References:

SW=USEPA, Test Methods for Evaluating Solid Waste, SW-846.

E=USEPA Methods for the Determination of Inorganic Substances in Environmental Samples; Methods for Chemical Analysis of Water and Wastes; Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, 40 CFR Part 136, App A; methods for the Determination of Metals in Environmental Samples; Methods for the Determination of Organic Compounds in Drinking Water.

SM= APHA, Standard Methods for the Examination of Water and Wastewater.

D=ASTM, Annual Book of Standards

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Report of Laboratory Analysis

CLIENT: City Water, Light & Power
Lab Order: 02120160
Project: Filter Plant Sludge Mix
Lab ID: 02120160-01

Client Sample ID: Lime Sludge Mix
Report Date: 12/13/2002
Collection Date: 12/5/2002
Matrix: Solid

Analyses	Result	EMT Reporting Limit	Units	Date Analyzed	Analyst
Ammonia as N		**Method: E350.2**			
Nitrogen, Ammonia (As N)	< 0.9	0.9	mg/Kg-dry	12/9/2002	IA
Corrosivity by pH		**Method: SW9045C**			
pH	9.24		pH Units	12/7/2002 8:20:22 AM	VT
Hexavalent Chromium		**Method: M3500-CR D**			
Chromium, Hexavalent	< 0.13	0.13	mg/kg	12/6/2002	LNS
Solids, Total		**Method: M2540B**			
Total Solids (Percent)	43.9	0.1	% (Percent)	12/7/2002 1:43:11 PM	VT
Total Kjeldahl Nitrogen		**Method: E351.3**			
Nitrogen, Kjeldahl, Total	456	310	mg/Kg-dry	12/11/2002	IA
Volatile Matter		**Method: D2369-86**			
Volatile Matter	54.7	0.2	% (Percent)	12/10/2002	RM2
Hardness Calculated from Ca		**Method: E200.7**			
Hardness (Ca as CaCO3)	814000.	5.	mg/K-dry	12/10/2002 1:23:26 PM	MLB
ICP Metals Solids Total		**Method: SW6010B**			
Barium	108.	0.79	mg/Kg-dry	12/10/2002 1:23:26 PM	MLB
Cadmium	< 1.38	1.38	mg/Kg-dry	12/10/2002 1:23:26 PM	MLB
Calcium	326000.	57700.	mg/Kg-dry	12/10/2002 1:23:26 PM	MLB
Chromium	14.7	3.16	mg/Kg-dry	12/10/2002 1:23:26 PM	MLB
Copper	8.84	6.64	mg/Kg-dry	12/10/2002 1:23:26 PM	MLB
Lead	< 8.31	8.31	mg/Kg-dry	12/10/2002 1:23:26 PM	MLB
Nickel	15.4	8.31	mg/Kg-dry	12/10/2002 1:23:26 PM	MLB
Phosphorous	727.	75.7	mg/Kg-dry	12/10/2002 1:23:26 PM	MLB
Potassium	140.	98.7	mg/Kg-dry	12/12/2002 11:27:39 AM	AG
Silver	< 3.16	3.16	mg/Kg-dry	12/10/2002 1:23:26 PM	MLB
Zinc	18.8	6.72	mg/Kg-dry	12/10/2002 1:23:26 PM	MLB
Mercury in Solid		**Method: SW7471A**			
Mercury	0.135	0.0436	mg/Kg-dry	12/9/2002	VM

Qualifiers:
B - Analyte detected in the associated Method Blank
E - Estimated
H - Holding Time Exceeded
C - Laboratory not accredited for this parameter
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
J - Analyte detected below quanititation limits

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Report of Laboratory Analysis

CLIENT:	City Water, Light & Power	**Client Sample ID:**	Lime Sludge Mix
Lab Order:	02120160	**Report Date:**	12/13/2002
Project:	Filter Plant Sludge Mix	**Collection Date:**	12/5/2002
Lab ID:	02120160-01	**Matrix:**	Solid

Analyses	Result	EMT Reporting Limit	Units	Date Analyzed	Analyst
Metals by GFAA Total		**Method: SW7060A**			
Arsenic	11.4	0.718	mg/Kg-dry	12/10/2002	IG
Metals by GFAA Total		**Method: SW7740**			
Selenium	2.9	1.07	mg/Kg-dry	12/10/2002	IG

Qualifiers:
- B - Analyte detected in the associated Method Blank
- E - Estimated
- H - Holding Time Exceeded
- C - Laboratory not accredited for this parameter
- S - Spike Recovery outside accepted recovery limits
- R - RPD outside accepted recovery limits
- J - Analyte detected below quanititation limits

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847-967-6666
FAX: 847-967-6735
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Chain of Custody Record

TURNAROUND TIME:
☐ RUSH
____ day turnaround
☒ ROUTINE

Due Date: __-__-__ COC #:

Company: City Water Light & Power
Address: 201 E. Lake Shore Drive
Springfield IL 62707
Phone #: (217) 757-8610 Fax #: (217) 757-8615
P.O. #:
Proj. #:
Client Contact: Sue Corcoran
Project ID / Location: Filter Plant Sludge Mix

Sample Type: 1. Waste Water 2. Drinking Water 3. Soil 4. Sludge 5. Oil 6. Groundwater 7. Groundwater (filtered) 8. Other (circled) Solid

Container Type: P - Plastic G - Glass V - VOC Vial B - Tedlar Bag O - Other

Preservative: 1. None 2. H_2SO_4 3. HNO_3 4. NaOH 5. HCl 6. MeOH 7. Zn Ace 8. Other

Sample I.D.	Sample Type	Container Size	Container Type	Container No.	Sampling By	Sampling Date	Sampling Time	pH	Temp.	Preservation Field	Preservation Lab	[illegible]	% Solids	Calcium Carbonate	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	EMT USE ONLY EMT WORKORDER # 02120160
Lime Sludge mix	8		G	2	SC	12/5/02				1	1	X	X	X	X	X	X	X	X	X	X	X	01A

report in mg/kg for metals

Relinquished By:	Date / Time	Received By:	Date / Time
Susan Curran	Date: 12-5-02 Time: 2:00pm	Fed Ex	Date: 12-5-02 Time: 2:00pm
Relinquished By:	Date: - - Time: :	Received By:	Date: - - Time: :
Relinquished By:	Date: - - Time: :	Received For Lab By: [signature]	Date: 12-6-02 Time: 10:00

EMT USE ONLY
Client Code:
EMT Project I.D.
Jar Lot No.

☐ SAMPLE RECEIVED ON ICE.
☒ TEMPERATURE (Must be recorded if sampling was greater than 6 hrs. prior to sample receipt) 4°C

EMT SAMPLE RETURN POLICY ON BACK

SPECIAL INSTRUCTIONS:

Prairie Analytical Systems, INCORPORATED

Tuesday, February 26, 2013

Ms. Sue Corcoran
City, Water, Light & Power
3100 Stevenson Drive
Springfield, IL 62707

TEL: (217) 757-8610
FAX: (217) 757-8615

RE: Lime Sludge Analysis 1-25-13 PAS WO: 13A0445

Prairie Analytical Systems, Inc. received 1 sample(s) on 1/24/2013 for the analyses presented in the following report.

All applicable quality control procedures met method specific acceptance criteria unless otherwise noted.

If you have any questions, please feel free to contact me at (217) 753-1148.

Respectfully submitted,

Michael D. Brophy
Project Manager

Certifications: NELAP/NELAC - IL #100323

Prairie Analytical Systems, Inc. **Date:** 2/26/2013

LABORATORY RESULTS

Client: City, Water, Light & Power
Project: Lime Sludge Analysis 1-25-13 **Lab Order:** 13A0445
Client Sample ID: Lime Sludge **Lab ID:** 13A0445-01
Collection Date: 1/24/13 13:00 **Matrix:** Solid

Analyses	Result	Limit	Qual	Units	DF	Date Prepared	Date Analyzed	Method	Analyst
Metals by ICP-MS									
*Barium	109	0.802		mg/Kg dry	2	1/29/13 13:24	1/31/13 12:15	SW 6020A	JTC
*Mercury	0.428	0.160		mg/Kg dry	2	1/29/13 13:24	1/31/13 12:15	SW 6020A	JTC
*Selenium	1.94	0.802		mg/Kg dry	2	1/29/13 13:24	1/31/13 12:15	SW 6020A	JTC
TCLP Metals by ICP-MS									
*Arsenic	U	0.0150		mg/L	3	1/29/13 13:45	1/30/13 23:38	SW 6020A	JTC
*Mercury	U	0.000600		mg/L	3	1/29/13 13:45	1/30/13 23:38	SW 6020A	JTC
*Selenium	0.0174	0.0150		mg/L	3	1/29/13 13:45	1/30/13 23:38	SW 6020A	JTC
*Silver	U	0.0150		mg/L	3	1/29/13 13:45	1/30/13 23:38	SW 6020A	JTC
Metals by ICP									
*Aluminum	1030	160		mg/Kg dry	20	1/29/13 13:24	1/30/13 13:41	SW 6010B	JHN
*Arsenic	3.86	0.802		mg/Kg dry	1	1/29/13 13:24	1/30/13 12:42	SW 6010B	JHN
*Cadmium	0.460	0.401		mg/Kg dry	1	1/29/13 13:24	1/30/13 12:42	SW 6010B	JHN
*Chromium	10.5	0.401		mg/Kg dry	1	1/29/13 13:24	1/30/13 12:42	SW 6010B	JHN
*Cobalt	1.66	0.401		mg/Kg dry	1	1/29/13 13:24	1/30/13 12:42	SW 6010B	JHN
*Copper	8.16	0.401		mg/Kg dry	1	1/29/13 13:24	1/30/13 12:42	SW 6010B	JHN
*Iron	11500	802		mg/Kg dry	100	1/29/13 13:24	1/30/13 13:37	SW 6010B	JHN
*Lead	0.777	0.401		mg/Kg dry	1	1/29/13 13:24	1/30/13 12:42	SW 6010B	JHN
*Manganese	391	4.01		mg/Kg dry	10	1/29/13 13:24	1/30/13 13:44	SW 6010B	JHN
*Molybdenum	0.595	0.401		mg/Kg dry	1	1/29/13 13:24	1/30/13 12:42	SW 6010B	JHN
*Nickel	7.88	0.401		mg/Kg dry	1	1/29/13 13:24	1/30/13 12:42	SW 6010B	JHN
*Potassium	204	80.2		mg/Kg dry	1	1/29/13 13:24	1/30/13 12:42	SW 6010B	JHN
*Sodium	107	40.1		mg/Kg dry	1	1/29/13 13:24	1/30/13 12:42	SW 6010B	JHN
*Vanadium	22.2	0.401		mg/Kg dry	1	1/29/13 13:24	1/30/13 12:42	SW 6010B	JHN
*Zinc	14.0	0.401		mg/Kg dry	1	1/29/13 13:24	1/30/13 12:42	SW 6010B	JHN
TCLP Metals by ICP									
*Barium	0.0697	0.00500		mg/L	1	1/29/13 13:45	1/30/13 11:57	SW 6010B	JHN
*Cadmium	U	0.00500		mg/L	1	1/29/13 13:45	1/30/13 11:57	SW 6010B	JHN
*Chromium	U	0.00500		mg/L	1	1/29/13 13:45	1/30/13 11:57	SW 6010B	JHN
*Lead	U	0.00500		mg/L	1	1/29/13 13:45	1/30/13 11:57	SW 6010B	JHN
Anions by Ion Chromatography									
Sulfate	37100	1010		mg/Kg dry	200	1/30/13 14:50	1/30/13 23:30	EPA 300.0	JHN
Conventional Chemistry Parameters									
Sulfite	U	33.8		mg/Kg dry	1	1/29/13 9:05	1/29/13 13:25	SM 4500-SO3	RSR
Total Alkalinity (as CaCO3)	537000	337		mg/Kg dry	1	1/28/13 9:04	1/28/13 13:16	SM 2320B (M	CMH
Ammonia (as N)	11.6	3.32		mg/Kg dry	1	2/4/13 8:58	2/4/13 12:04	SM 4500-NH:	CMH
Ash Content	96.0	0.100		%	1	1/30/13 14:20	1/31/13 9:17	ASTM D2974	CCD
Organic Matter	4.03	0.100		%	1	1/30/13 14:20	1/31/13 9:17	ASTM D2974	CCD
Fractional Organic Carbon	2.34	0.100		%	1	1/30/13 14:20	1/31/13 9:17	ASTM D2974	CCD
*Hexavalent Chromium	U	1.04		mg/Kg dry	1	1/29/13 10:44	1/30/13 11:00	SW 7196A	RSR
*Reactive Cyanide	U	2.01		mg/Kg dry	1	1/28/13 9:32	1/28/13 16:07	SW 9014	CMH
*Ignitability (Flash Point)	>200	50.0		°F	1	1/28/13 10:30	1/28/13 11:04	SW 1010 (M)	CCD
Total Kjeldahl Nitrogen	751	82.0		mg/Kg dry	1	1/29/13 9:13	1/30/13 11:02	EPA 351.4 (M	CMH
Oil and Grease	U	56.3		mg/Kg dry	1	1/29/13 9:48	1/29/13 15:39	EPA 1664A (I	SLS

Prairie Analytical Systems, Inc. **Date:** 2/26/2013

LABORATORY RESULTS

Client: City, Water, Light & Power
Project: Lime Sludge Analysis 1-25-13 **Lab Order:** 13A0445
Client Sample ID: Lime Sludge **Lab ID:** 13A0445-01
Collection Date: 1/24/13 13:00 **Matrix:** Solid

Analyses	Result	Limit	Qual	Units	DF	Date Prepared	Date Analyzed	Method	Analyst
Biochemical Oxygen Demand	**139**	33.8		mg/Kg dry	1	1/28/13 10:05	2/2/13 10:30	SM 5210B (M	JHN
Chemical Oxygen Demand	**22600**	10300		mg/Kg dry	25	1/29/13 9:05	1/30/13 9:03	SM 5220D	RSR
*Paint Filter	Pass			P/F	1	1/28/13 10:30	1/28/13 11:04	SW 9095A	CCD
***pH**	**8.29**	0.0100		pH Units	1	1/28/13 10:40	1/28/13 14:17	SW 9045C	CCD
*Phenolics	U	8.44		mg/Kg dry	1	1/28/13 9:00	1/28/13 14:04	SW 9065 (M)	CCD
Phosphorus	**600**	84.4	MC	mg/Kg dry	50	1/30/13 10:10	1/30/13 14:48	EPA 365.2 (M	RSR
Total Volatile Solids	**4.03**	0.100		%	1	1/30/13 14:20	1/31/13 9:17	SM 2540E (M	CCD
*Reactive Sulfide	U	15.8		mg/Kg dry	1	1/30/13 12:58	1/30/13 14:00	SW 9034	CMH
Percent Moisture	**40.8**	0.100		%	1	1/29/13 10:05	1/29/13 15:47	ASTM D2216	CCD
Percent Solids	**59.2**	0.100		%	1	1/29/13 10:05	1/29/13 15:47	ASTM D2216	CCD

Precision Petroleum Labs, Inc

Analyses	Result	Limit	Qual	Units	DF	Date Prepared	Date Analyzed	Method	Analyst
Sulfur	U	0.001		Wt%	1	2/21/13 0:00	2/21/13 0:00	D-4294	SUB
Extractable Organic Halides	U	1		mg/Kg	1	2/21/13 0:00	2/21/13 0:00	SW 9023	SUB

Prairie Analytical Systems, Inc. **Date:** 2/26/2013

LABORATORY RESULTS

Client: City, Water, Light & Power
Project: Lime Sludge Analysis 1-25-13 **Lab Order:** 13A0445

Notes and Definitions

S	Spike recovery outside acceptance limits.
R	RPD outside acceptance limits.
P1	Pass
MC	Matrix correction performed due to the presence of turbidity.
I	Matrix interference.
E	Result above quantitation range.
*	NELAC certified compound.
U	Analyte not detected (i.e. less than RL or MDL).

Chain of Custody Record

Prairie Analytical Systems, Incorporated
www.prairieanalytical.com

Central IL - 1210 Capital Airport Drive - Springfield, IL 62707-8490 - Phone (217) 753-1148 - Facsimile (217) 753-1152
Chicago IL Office - 9114 Virginia Rd., Ste 112 - Lake in the Hills, IL 60156 - Phone (847) 651-2604 - Facsimile (847) 458-9680
Central/Southern IL Office - Phone (217) 414-7762 - Facsimile (217) 223-7922

Client	CWLP
Address	201 E Lake Shore Drive
City, State, Zip Code	Springfield IL 62717
Phone / Facsimile	757-8710
Project Name / Number	Lime Sludge Analyses
Project Location	Lime Sludge Pond Staging area
P.O. # or Invoice To	CWLP
Contact Person	[illegible]

Analysis and/or Method Requested:

1. Green sheet analyses minus organics - mg/L
2. Reactive Cyanide mg/Kg dry; Reactive Sulfide
3. % Total Solids; % total volatile solids
4. % moisture; COD, BOD5, TOC
5. Total alkalinity as $CaCO_3$
6. O+G mg/L; Sulfate + Sulfite Total mg/L
7. Ammonia mg/L; Total Kjeldahl Nitrogen mg/L
8. Sulfur, Al, As, Ba, Cd, Co, Chrom hex, Cr, Cu
9. Fe, P, K, Hg, Mn, Mo, Ni, Pb, Se, Na, V, Zn

Sample Description	Sampling Date	Sampling Time	Matrix Code	Preserv Code	No. of Containers	Comp.	Grab	1	2	3	4	5	6	7	8	9	Sampler Comments
Lime Sludge	1/24/13	1100	S	0	1	X		X	X	X	V	X	V	V	V	X	
																	metals as mg/Kg dry
	sample is a composite of 10 sites																

Reporting: TACO ☐ Resid ☐ Ind/Comm; CALM ☐ A ☐ B ☐ C ☐ D ☐ E ☐ F; RISC ☐ Resid ☐ Indust

Matrix Code	A - Aqueous	DW - Drinking Water	GW - Ground Water	NA - Non-Aqueous Liquid	S - Solid	O - Oil	X - Other (Specify)
Preserv Code	0 - None	1 - HCl	2 - H2SO4	3 - HNO3	4 - NaOH	5 - 5035 Kit	X - Other (Specify)

Relinquished By	Date	Time	Received By	Date	Time	Method of Shipment
[signature]	1/24/13	2:35	[signature]	1-24-13	2:35	Hand

Special Instructions: in out of field

Turnaround Time: Standard ☑ Rush ☐
Date Required:

QC Level 1☐ 2☐ 3☐ 4☐

On wet ice? Yes No (circled: No)

Temperature (°C) 17.4

PAS COC Rev. 3

Page 1 of 1

Copies: White - Client / Yellow - PAS, Inc. / Pink - Sampler

DA Daily Analytical Laboratories
1621 W. Candletree Drive Peoria, Illinois 61614
Tel. (309) 692-5252 (800) 752-6651

City Water, Light & Power
201 E Lake Shore Drive
Springfield, IL 62707

Attn: Ms. Sue Corcoran

Work ID: Scrubber Sludge
P O # :

Date Received: 07/06/95
Date of Report: 07/24/95
Work Order: 95-07-112
Job Number:
# of Samples: 1

Test	Units	Scrubber Sludge 07/05/95 08:30
Silver, Total Dry Wt.	mg/kg	<0.21
Silver, Total	mg/kg	<0.19
Aluminum, Total Dry Wt.	mg/kg	140
Aluminum, Total	mg/kg	130
Arsenic, Total Dry Wt.	mg/kg	<1.2
Arsenic, Total	mg/kg	<1.1
Barium, Total Dry Wt.	mg/kg	0.60
Barium, Total	mg/kg	0.55
Cadmium, Total Dry Wt.	mg/kg	<0.10
Cadmium, Total	mg/kg	<0.09
Cobalt, Total Dry Wt.	mg/kg	<0.21
Cobalt, Total	mg/kg	<0.19
Chromium, Total Dry Wt.	mg/kg	0.68
Chromium, Total	mg/kg	0.62
Copper, Total Dry Wt.	mg/kg	0.44
Copper, Total	mg/kg	0.40
Iron, Total Dry Wt.	mg/kg	330
Iron, Total	mg/kg	300
Mercury, Total Dry Wt.	mg/kg	0.071
Mercury, Total	mg/kg	0.065
Potassium, Total Dry Wt.	mg/kg	68

Daily Analytical Laboratories
1621 W. Candletree Drive Peoria, Illinois 61614
Tel. (309) 692-5252 (800) 752-6651

DAILY LABS REPORT
07/24/95 14:14:13

Work Order # 95-07-112
Continued From Above

Test	Units	Scrubber Sludge 07/05/95 08:30
Potassium, Total	mg/kg	62
Manganese, Total Dry Wt.	mg/kg	18
Manganese, Total	mg/kg	16
Molybdenum, Total Dry Wt.	mg/kg	<0.42
Molybdenum, Total	mg/kg	<0.38
Sodium, Total Dry Wt.	mg/kg	9.2
Sodium, Total	mg/kg	8.4
Nickel, Total Dry Wt.	mg/kg	0.38
Nickel, Total	mg/kg	0.34
Lead, Total Dry Wt.	mg/kg	<0.42
Lead, Total	mg/kg	<0.38
Selenium, Total Dry Wt.	mg/kg	<0.84
Selenium, Total	mg/kg	<0.76
Sulfur, Total Dry Wt.	mg/kg	48000
Sulfur, Total	mg/kg	44000
Vanadium, Total Dry Wt.	mg/kg	0.42
Vanadium, Total	mg/kg	0.38
Zinc, Total Dry Wt.	mg/kg	0.56
Zinc, Total	mg/kg	0.51
Metals Digest, nonaqueous	date of prep.	07/07/95
Acidity, Total Dry Wt.	mg/kg	18000
Acidity, Total as CaCO3	mg/kg	16000
Alkalinity, Total Dry Wt.	mg/kg	10000
Alkalinity, Total as CaCO3	mg/kg	9500
Biochemical Oxygen Demand	mg/kg	<30

DA Daily Analytical Laboratories
1621 W. Candletree Drive Peoria, Illinois 61614
Tel. (309) 692-5252 (800) 752-6651

Received: 07/06/95

DAILY LABS REPORT
07/24/95 14:14:13

Work Order # 95-07-112
Continued From Above

Test	Units	Scrubber Sludge 07/05/95 08:30
Cyanide, Reactive Dry Wt.	mg/kg	<0.51
Cyanide, Reactive	mg/kg	<0.46
Cyanide, Total Dry Wt.	mg/kg	<0.52
Cyanide, Total	mg/kg	<0.47
COD, Total Dry Wt.	mg/kg	600
Chem. Oxygen Dem. Hi Range	mg/kg	550
Chromium, Hex. Dry Wt.	mg/kg	<0.5
Chromium, Hexavalent	mg/kg	<0.5
Flashpoint, Closed Cup	degrees F	>200
Grease & Oil, Dry Wt.	mg/kg	120
Grease & Oil	mg/kg	110
Nitrogen, Ammonia Dry Wt.	mg/kg	<12
Nitrogen, Ammonia as N	mg/kg	<11
Phenol, Dry Wt.	mg/kg	4.8
Phenol	mg/kg	4.4
pH Nonaqueous	units	7.5
Phosphorus, Total Dry Wt.	mg/kg	75
Phosphorus, Total as P	mg/kg	68
Radio Chemistry	C/100 ml	*
Sulfide, Reactive Dry Wt.	mg/kg	<0.51
Reactive Sulfide	mg/kg	<0.46
Sulfide, Total Dry Wt.	mg/kg	0.86
Total Sulfide	mg/kg	0.78
Sulfate, Dry Wt.	mg/kg	16000
Sulfate	mg/kg	15000

Daily Analytical Laboratories
1621 W. Candletree Drive Peoria, Illinois 61614
Tel. (309) 692-5252 (800) 752-6651

Received: 07/06/95 07/24/95 14:14:13 Continued From Above

Test	Units	Scrubber Sludge 07/05/95 08:30
Specific Conductivity	umhos/cm	21000
Total Organic Carbon	mg/kg	370
Total Solids	%w/w	91
Tot Volatile Solid Dry Wt.	%w/w	20
Volatile Acids of Filtrate	mg/l	36

* Subcontracted, report to follow.

Certified By: [signature]
David J. Cirilli
Senior Inorganic Chemist

Daily Analytical is an IEPA certified laboratory.
All analyses are performed by methodology
acceptable to USEPA and IEPA.

Prairie Analytical Systems, Inc.

Date: *24-Jul-07*

CLIENT: City, Water, Light & Power
Project: Lime Sludge

Lab Order: 0706403

Lab ID: 0706403-001
Client Sample ID: Lime Sludge

Collection Date 6/29/2007 10:10:00 AM
Matrix: SOLID

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
METALS ANALYSIS		**SW6020**		**(SW3050B)**		Analyst: **MCL**
Arsenic	16.0	0.798		mg/Kg-dry	2	7/8/2007 1:07:00 AM
Barium	84.2	0.798		mg/Kg-dry	2	7/8/2007 1:07:00 AM
Cadmium	U	0.798		mg/Kg-dry	2	7/8/2007 1:07:00 AM
Chromium	10.1	0.798		mg/Kg-dry	2	7/8/2007 1:07:00 AM
Copper	3.27	1.60		mg/Kg-dry	2	7/8/2007 1:07:00 AM
Lead	1.71	0.798		mg/Kg-dry	2	7/8/2007 1:07:00 AM
Mercury	0.306	0.160		mg/Kg-dry	2	7/8/2007 1:07:00 AM
Nickel	9.28	0.798		mg/Kg-dry	2	7/8/2007 1:07:00 AM
Phosphorus	701	16.0		mg/Kg-dry	2	7/9/2007 4:54:00 PM
Potassium	U	160		mg/Kg-dry	2	7/9/2007 4:54:00 PM
Selenium	2.13	0.798		mg/Kg-dry	2	7/8/2007 1:07:00 AM
Silver	U	0.798		mg/Kg-dry	2	7/8/2007 1:07:00 AM
Zinc	15.9	1.60		mg/Kg-dry	2	7/8/2007 1:07:00 AM
VOLATILE SOLIDS ANALYSIS		**E160.4 (M)**				Analyst: **AJD**
Total Volatile Solids	1.83	0.100		%	1	7/12/2007
ALKALINITY ANALYSIS		**M2320 B M**				Analyst: **AJD**
Alkalinity, Total (as CaCO3)	182000	8390		mg/Kg-dry	10	7/11/2007
AMMONIA ANALYSIS		**M4500-NH3 F M**				Analyst: **ARR**
Ammonia (as N)	U	14.5		mg/Kg-dry	1	7/12/2007
HEXAVALENT CHROMIUM ANALYSIS		**SW7196A**		**(SW3060A)**		Analyst: **RMN**
Chromium, Hexavalent	U	11.5		mg/Kg-dry	10	7/18/2007
PH ANALYSIS		**SW9045C**				Analyst: **ARR**
pH	8.79	0.01		pH Units	1	7/3/2007 11:11:00 AM
PERCENT MOISTURE ANALYSIS		**D2216**				Analyst: **RMN**
Percent Moisture	41.6	0.01		wt%	1	7/12/2007
PERCENT SOLIDS ANALYSIS		**D2216**				Analyst: **RMN**
Percent Solids	58.4	0.01		wt%	1	7/12/2007
TOTAL KJELDAHL NITROGEN ANALYSIS		**M4500-NORG B**				Analyst: **AJD**
Total Kjeldahl Nitrogen	408	150		mg/Kg-dry	1	7/12/2007 4:12:00 PM

Prairie Analytical Systems, Inc.

Qualifiers:

B - Analyte detected in the associated method blank.

E - Value above quantitation range.

H - Analysis performed past holding time.

HT - Sample received past holding time.

J - Analyte detected between RL and MDL.

R - RPD outside acceptance limits.

S - Spike recovery outside acceptance limits.

U - Analyte not detected (i.e. less than RL or MDL).

Prairie Analytical Systems, Inc.

Date: *07-Jan-05*

CLIENT: City, Water, Light & Power
Project: Lime Sludge Mixture
Lab Order: 0412152

Lab ID: 0412152-001
Client Sample ID: Limesludge Mixture
Collection Date: 12/27/2004 3:00:00 PM
Matrix: SOLID

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
METALS ANALYSIS		**SW6020**		**(SW3050B)**		Analyst: **MCL**
Arsenic	4.88	0.601		mg/Kg-dry	2	12/30/2004 12:19:00 PM
Barium	35.3	0.601		mg/Kg-dry	2	12/30/2004 12:19:00 PM
Cadmium	U	0.601		mg/Kg-dry	2	12/30/2004 12:19:00 PM
Chromium	15.5	0.601		mg/Kg-dry	2	12/30/2004 12:19:00 PM
Copper	7.15	1.20		mg/Kg-dry	2	12/30/2004 12:19:00 PM
Lead	4.33	0.120		mg/Kg-dry	2	12/30/2004 12:19:00 PM
Mercury	U	0.120		mg/Kg-dry	2	1/6/2005 8:30:00 PM
Nickel	13.7	0.601		mg/Kg-dry	2	1/6/2005 8:30:00 PM
Phosphorus	409	12.0		mg/Kg-dry	2	1/6/2005 8:30:00 PM
Potassium	262	120		mg/Kg-dry	2	1/6/2005 8:30:00 PM
Selenium	U	0.601		mg/Kg-dry	2	12/30/2004 12:19:00 PM
Silver	U	0.601		mg/Kg-dry	2	12/30/2004 12:19:00 PM
Zinc	28.6	1.20		mg/Kg-dry	2	12/30/2004 12:19:00 PM
VOLATILE SOLIDS ANALYSIS		**E160.4 (M)**				Analyst: **RMN**
Total Volatile Solids	0.288	0.100		%	1	1/7/2005
ALKALINITY ANALYSIS		**M2320 B M**				Analyst: **RMN**
Alkalinity, Total (as CaCO3)	640	120		mg/Kg-dry	1	1/7/2005
AMMONIA ANALYSIS		**M4500-NH3 F M**				Analyst: **RMN**
Ammonia (as N)	U	12.0		mg/Kg-dry	1	1/7/2005
HEXAVALENT CHROMIUM ANALYSIS		**SW7196A**		**(SW3060A)**		Analyst: **RMN**
Chromium, Hexavalent	U	6.35		mg/Kg-dry	10	1/7/2005
PH ANALYSIS		**SW9045C**				Analyst: **RMN**
pH	7.37	0.01		pH Units	1	1/7/2005
PERCENT MOISTURE ANALYSIS		**D2216**				Analyst: **RMN**
Percent Moisture	21.2	0.01		wt%	1	1/3/2005
PERCENT SOLIDS ANALYSIS		**D2216**				Analyst: **RMN**
Percent Solids	78.8	0.01		wt%	1	1/3/2005
TOTAL KJELDAHL NITROGEN ANALYSIS		**M4500-NORG B**				Analyst: **RMN**
Total Kjeldahl Nitrogen	99.0	60.7		mg/Kg-dry	1	1/5/2005

RECEIVED
JAN 13 2005
ENVIRONMENTAL HEALTH & SAFETY

Prairie Analytical Systems, Inc.

Qualifiers:

B - Analyte detected in the associated method blank.

E - Value above quantitation range.

H - Analysis performed past holding time.

HT - Sample received past holding time.

J - Analyte detected between RL and MDL.

R - RPD outside acceptance limits.

S - Spike recovery outside acceptance limits.

U - Analyte not detected (i.e. less than RL or MDL).

An Analytical Testing Laboratory
Prairie Analytical Systems, INCORPORATED
1210 Capital Airport Drive
Springfield, Illinois 62707
Phone: 217-753-1148
Fax: 217-753-1152
www.prairieanalytical.com

January 07, 2005

Ms. Sue Corcoran
City, Water, Light & Power
3100 Stevenson Drive
Springfield, IL 62707

RE: Lime Sludge Mixture

PAS Order No.: 0412152

Dear Ms. Sue Corcoran:

Prairie Analytical Systems, Inc. received 1 sample on 12/28/2004 12:05:00 PM for the analyses presented in the following report.

All applicable quality control procedures met method specific acceptance criteria.

This report shall not be reproduced, except in full, without the prior written consent of Prairie Analytical Systems, Inc.

If you have any questions, please feel free to call me at (217) 753-1148.

Sincerely,

Michael D. Brophy
Project Manager

Chain of Custody Record

1210 Capital Airport Drive • Springfield, IL 62707-8490 • Phone (217) 753-1148 • Facsimile (217) 753-1152 • E-mail info@prairieanalytical.com

Prairie Analytical Systems, Incorporated

Client	CWLP	Client Project	lime sludge mixture
Address	201 E. Lake Shore Drive	Project Location	FGDS Landfill
City, State Zip Code	Spfld IL 62712	Sampler(s) / Phone No.	Sue Corcoran / 757-8610
Phone / Facsimile No.	757-8610 x1108 / 757 8615	Turnaround Time	Standard [X] Rush [ ] Date Required:
Contact Person	Sue Corcoran	P.O. # or Invoice To	CWLP - Sue Corcoran

Sample Description (10 Characters Only)	Sampling Date	Sampling Time	Container [1] Size	Container [2] Type / No.	[3] M / [4] P Code	Analysis and / or Method Requested	Laboratory Comments
limesludge mixture	12/27/04	3:00	quart	G / 1	S / A	Ba, Cd, Cr, Cu, Pb, Hg, Ni, P, K, Ag, Zn	
				/	/	Arsenic, Selenium,	
				/	/	Alkalinity, Total (as CaCO3)	
				/	/	Chromium hexavalent	
				/	/	ph	
				/	/	% moisture	
				/	/	Nitrogen, Ammonia (As N)	
				/	/	Total solids	
				/	/	Nitrogen, Kjeldahl total	
				/	/	Volatile matter	
				/	/		
				/	/		

[1] Size of Container	40 mL	125 mL	250 mL	500 mL	1000 mL	O - Other (Specify)
[2] Type of Container	G - Glass (Clear)	AG - Glass (Amber)	P - HDPE	VC - Volatile Core	SC - Soil Core	O - Other (Specify)
[3] M = Matrix Code	A - Aqueous	DW - Drinking Water	NA - Non-aqueous Liquid	SE - Saline Water	S - Solids	O - Other (Specify)
[4] P = Preservative Code	A - None	B - HNO_3	C - H_2SO_4	D - NaOH	E - HCl	O - Other (Specify)

Relinquished By	Date	Time	Received By	Date	Time	Method of Shipment
Patrick A. Tucker	12-28-04	12:05	[signature]	12/28/04	12:05	HAND

Special Instructions:

Temperature (°C) 10.1

PDF 0301

Page _____ of _____

Copies: White - Client Yellow - PAS, Inc. Pink - Sampler

TMI Analytical Services

3501 South Sixth Street
Springfield, IL 62703

Fax:(217) 585-1838
Phone:(217) 585-1557

To: C.W.L.P.
201 E. LAKE SHORE DRIVE
SPRINGFIELD, IL 62707

ATTN: SUE CORCORAN

Project: CWL00141

Sampled By: S CORCORAN

Report Comments:

Receipt Date: 10/31/96
Report Date: 11/01/96
Sample Date: 10/28/96

Site: CITY, WATER, LIGHT & POWER

Client Sample ID: LIME SLUDGE MIX.
Lab ID: MM09690
Sample Matrix: SOLID

Analyte	Method	MDL	Units	Result
Manganese, total	EPA 7460	12.5	mg/kg	425
Boron/total	EPA 6010A	10	mg/kg	94.2
Molybdenum/total	EPA 6010A	10	mg/kg	BELOW MDL

Signed: ______________________
Authorized Signature

BELOW MDL = compound is not detected at or above the specified MDL.

Prairie Analytical Systems, Inc.

An Environmental and Agricultural Testing Laboratory

City, Water, Light & Power
201 East Lake Shore Drive
Springfield, IL 62707

Date Sampled: 27 September 1996
Date Received: 30 September 1996
Date Analyzed: 01-03 October 1996
Date Reported: 03 October 1996

Project: Lime Sludge/Scrubber Sludge

PAS Project Code: GEN-038

Sample Description:	Lime Sludge	Scrubber Sludge	Lime/Scrubber
Sample Number:	9609304057	9609304058	9609304059

Total Metal Analysis

Parameters	Detection Limit mg/kg	Result mg/kg	Result mg/kg	Result mg/kg	E.P.A. Method
Arsenic, Total	0.2	15.9	<0.2	2.2	7060A
Barium, Total	0.1	135	2.4	41.8	7081
Cadmium, Total	0.1	0.2	<0.1	0.1	7131A
Chromium, Total	0.1	5.2	1.1	2.3	7191
Chromium, Hexavalent	2.5	<2.5	<2.5	<2.5	7196A
Copper, Total	0.1	9.9	<0.1	4.4	7211
Lead, Total	0.1	0.2	<0.1	<0.1	7421
Manganese, Total	0.1	423	8.4	205	7461
Mercury, Total	0.01	<0.01	0.06	0.21	7471A
Nickel, Total	0.1	9.0	<0.1	4.0	6010A
Phosphorus, Total	0.1	1354	92.6	319	6010A
Selenium, Total	0.2	<0.2	<0.2	<0.2	7740
Silver, Total	0.1	<0.1	<0.1	<0.1	7761
Zinc, Total	0.1	33.9	0.9	2.9	7951

Miscellaneous Analysis

Parameters	Detection Limit mg/kg	Result mg/kg	Result mg/kg	Result mg/kg	S.M. Method
Ammonia (as N)	1.0	<1.0	<1.0	<1.0	4500-NH_3F
Organic Nitrogen	25	1410	<25	<25	4500-N_{ORG}B
Total Kjeldahl Nitrogen	25	1410	<25	<25	4500-N_{ORG}B

Stephen R. Johnson, Laboratory Director

P.O. Box 8326 • 205 Main Terminal • Capital Airport • Springfield, IL 62791-8326 • (217) 753-1148

Form PAS-RWMET3

DOCUMENT 2: LAP - NON CCR - DRINKING WATER PURIFICATION PLANT SLUDGE ENTERING LAP

Teklab, Inc. Environmental Laboratory

http://www.teklabinc.com/

March 03, 2021

Rhon Hasenyager
Hanson Professional Services, Inc.
1525 South Sixth Street
Springfield, IL 62703
TEL: (217) 747-9235
FAX: (217) 788-5241

NELAP ACCREDITED TNI LABORATORY

Illinois	100226
Kansas	E-10374
Louisiana	05002
Louisiana	05003
Oklahoma	9978

RE: CWLP - 19E0107/4000 **WorkOrder:** 21021164

Dear Rhon Hasenyager:

TEKLAB, INC received 2 samples on 2/23/2021 4:30:00 PM for the analysis presented in the following report.

Samples are analyzed on an as received basis unless otherwise requested and documented. The sample results contained in this report relate only to the requested analytes of interest as directed on the chain of custody. NELAP accredited fields of testing are indicated by the letters NELAP under the Certification column. Unless otherwise documented within this report, Teklab Inc. analyzes samples utilizing the most current methods in compliance with 40CFR. All tests are performed in the Collinsville, IL laboratory unless otherwise noted in the Case Narrative.

All quality control criteria applicable to the test methods employed for this project have been satisfactorily met and are in accordance with NELAP except where noted. The following report shall not be reproduced, except in full, without the written approval of Teklab, Inc.

If you have any questions regarding these tests results, please feel free to call.

Sincerely,

Elizabeth A. Hurley

Elizabeth A. Hurley
Project Manager
(618)344-1004 ex 33
ehurley@teklabinc.com

Report Contents

http://www.teklabinc.com/

Client: Hanson Professional Services, Inc. **Work Order:** 21021164

Client Project: CWLP - 19E0107/4000 **Report Date:** 03-Mar-21

This reporting package includes the following:

Teklab, Inc. Environmental Laboratory

Definitions

http://www.teklabinc.com/

Client: Hanson Professional Services, Inc. **Work Order:** 21021164

Client Project: CWLP - 19E0107/4000 **Report Date:** 03-Mar-21

Abbr	Definition
*	Analytes on report marked with an asterisk are not NELAP accredited
CCV	Continuing calibration verification is a check of a standard to determine the state of calibration of an instrument between recalibration.
CRQL	A Client Requested Quantitation Limit is a reporting limit that varies according to customer request. The CRQL may not be less than the MDL.
DF	Dilution factor is the dilution performed during analysis only and does not take into account any dilutions made during sample preparation. The reported result is final and includes all dilution factors.
DNI	Did not ignite
DUP	Laboratory duplicate is a replicate aliquot prepared under the same laboratory conditions and independently analyzed to obtain a measure of precision.
ICV	Initial calibration verification is a check of a standard to determine the state of calibration of an instrument before sample analysis is initiated.
IDPH	IL Dept. of Public Health
LCS	Laboratory control sample is a sample matrix, free from the analytes of interest,spiked with verified known amounts of analytes and analyzed exactly like a sample to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.
LCSD	Laboratory control sample duplicate is a replicate laboratory control sample that is prepared and analyzed in order to determine the precision of the approved test method. The acceptable recovery range is listed in the QC Package (provided upon request).
MBLK	Method blank is a sample of a matrix similar to the batch of associated sample (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences should present at concentrations that impact the analytical results for sample analyses.
MDL	"The method detection limit is defined as the minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from method blank results."
MS	Matrix spike is an aliquot of matrix fortified (spiked) with known quantities of specific analytes that is subjected to the entire analytical procedures in order to determine the effect of the matrix on an approved test method’s recovery system. The acceptable recovery range is listed in the QC Package (provided upon request).
MSD	Matrix spike duplicate means a replicate matrix spike that is prepared and analyzed in order to determine the precision of the approved test method. The acceptable recovery range is listed in the QC Package (provided upon request).
MW	Molecular weight
NC	Data is not acceptable for compliance purposes
ND	Not Detected at the Reporting Limit
NELAP	NELAP Accredited
PQL	Practical quantitation limit means the lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operation conditions.
RL	The reporting limit the lowest level that the data is displayed in the final report. The reporting limit may vary according to customer request or sample dilution. The reporting limit may not be less than the MDL.
RPD	Relative percent difference is a calculated difference between two recoveries (ie. MS/MSD). The acceptable recovery limit is listed in the QC Package (provided upon request).
SPK	The spike is a known mass of target analyte added to a blank sample or sub-sample; used to determine recovery deficiency or for other quality control purposes.
Surr	Surrogates are compounds which are similar to the analytes of interest in chemical composition and behavior in the analytical process, but which are not normally found in environmental samples.
TIC	Tentatively identified compound: Analytes tentatively identified in the sample by using a library search. Only results not in the calibration standard will be reported as tentatively identified compounds. Results for tentatively identified compounds that are not present in the calibration standard, but are assigned a specific chemical name based upon the library search, are calculated using total peak areas from reconstructed ion chromatograms and a response factor of one. The nearest Internal Standard is used for the calculation. The results of any TICs must be considered estimated, and are flagged with a "T". If the estimated result is above the calibration range it is flagged "ET"
TNTC	Too numerous to count (> 200 CFU)

Definitions

Client: Hanson Professional Services, Inc. **Work Order:** 21021164

Client Project: CWLP - 19E0107/4000 **Report Date:** 03-Mar-21

Qualifiers

- # - Unknown hydrocarbon
- B - Analyte detected in associated Method Blank
- C - RL shown is a Client Requested Quantitation Limit
- E - Value above quantitation range
- H - Holding times exceeded
- I - Associated internal standard was outside method criteria
- J - Analyte detected below quantitation limits
- M - Manual Integration used to determine area response
- ND - Not Detected at the Reporting Limit
- R - RPD outside accepted recovery limits
- S - Spike Recovery outside recovery limits
- T - TIC(Tentatively identified compound)
- X - Value exceeds Maximum Contaminant Level

Case Narrative

http://www.teklabinc.com/

Client: Hanson Professional Services, Inc. **Work Order:** 21021164

Client Project: CWLP - 19E0107/4000 **Report Date:** 03-Mar-21

Cooler Receipt Temp: 7.8 °C

Locations

Collinsville

Address	5445 Horseshoe Lake Road Collinsville, IL 62234-7425
Phone	(618) 344-1004
Fax	(618) 344-1005
Email	jhriley@teklabinc.com

Springfield

Address	3920 Pintail Dr Springfield, IL 62711-9415
Phone	(217) 698-1004
Fax	(217) 698-1005
Email	KKlostermann@teklabinc.com

Kansas City

Address	8421 Nieman Road Lenexa, KS 66214
Phone	(913) 541-1998
Fax	(913) 541-1998
Email	jhriley@teklabinc.com

Collinsville Air

Address	5445 Horseshoe Lake Road Collinsville, IL 62234-7425
Phone	(618) 344-1004
Fax	(618) 344-1005
Email	EHurley@teklabinc.com

Chicago

Address	1319 Butterfield Rd. Downers Grove, IL 60515
Phone	(630) 324-6855
Fax	
Email	arenner@teklabinc.com

Accreditations

Client: Hanson Professional Services, Inc. **Work Order:** 21021164

Client Project: CWLP - 19E0107/4000 **Report Date:** 03-Mar-21

State	Dept	Cert #	NELAP	Exp Date	Lab
Illinois	IEPA	100226	NELAP	1/31/2022	Collinsville
Kansas	KDHE	E-10374	NELAP	4/30/2021	Collinsville
Louisiana	LDEQ	05002	NELAP	6/30/2021	Collinsville
Louisiana	LDEQ	05003	NELAP	6/30/2021	Collinsville
Oklahoma	ODEQ	9978	NELAP	8/31/2021	Collinsville
Arkansas	ADEQ	88-0966		3/14/2021	Collinsville
Illinois	IDPH	17584		5/31/2021	Collinsville
Kentucky	UST	0073		1/31/2022	Collinsville
Missouri	MDNR	00930		5/31/2021	Collinsville
Missouri	MDNR	930		1/31/2022	Collinsville

Laboratory Results

Teklab, Inc. Environmental Laboratory

http://www.teklabinc.com/

Client: Hanson Professional Services, Inc. **Work Order:** 21021164

Client Project: CWLP - 19E0107/4000 **Report Date:** 03-Mar-21

Lab ID: 21021164-001 **Client Sample ID:** Clarifier Water

Matrix: AQUEOUS **Collection Date:** 02/23/2021 9:00

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
EPA 1664A								
Hexane Extractable Material	NELAP	4		**< 4**	mg/L	1	02/24/2021 13:09	R287799
EPA 600 351.2								
Total Kjeldahl Nitrogen (as N)	NELAP	1.0		**< 1.0**	mg/L	1	02/25/2021 10:24	174177
STANDARD METHODS 2320 B (TOTAL) 1997								
Alkalinity, Bicarbonate (as CaCO3)	NELAP	0		**274**	mg/L	1	02/24/2021 12:08	R287751
STANDARD METHODS 2320 B 1997								
Alkalinity, Carbonate (as CaCO3)	NELAP	0		**214**	mg/L	1	02/24/2021 12:08	R287751
STANDARD METHODS 2540 C (TOTAL) 1997								
Total Dissolved Solids	NELAP	20		**166**	mg/L	1	02/25/2021 14:28	R287851
STANDARD METHODS 2540 D 1997								
Total Suspended Solids	*	1.0		**265**	mg/L	2	02/24/2021 9:55	R287746
STANDARD METHODS 4500-NH3 G (TOTAL) 1997, 2011								
Nitrogen, Ammonia (as N)	NELAP	0.10		**0.23**	mg/L	1	02/24/2021 16:53	R287738
STANDARD METHODS 4500-NO2 B (TOTAL) 2000								
Nitrogen, Nitrite (as N)	NELAP	0.05		**< 0.05**	mg/L	1	02/23/2021 18:57	R287672
STANDARD METHODS 4500-NO3 F (TOTAL) 2000, 2011								
Nitrogen, Nitrate (as N)	NELAP	0.050		**0.258**	mg/L	1	02/24/2021 15:59	R287750
SW-846 7196A								
Chromium, Hexavalent	NELAP	0.001		**0.001**	mg/L	1	02/23/2021 18:04	R287671
SW-846 9012A (TOTAL)								
Cyanide	NELAP	0.005		**< 0.005**	mg/L	1	02/25/2021 9:35	174161
SW-846 9036 (TOTAL)								
Sulfate	NELAP	10		**45**	mg/L	1	02/25/2021 17:57	R287821
SW-846 9066 (TOTAL)								
Phenols	NELAP	0.005		**< 0.005**	mg/L	1	02/24/2021 11:06	R287726
SW-846 9214 (TOTAL)								
Fluoride	NELAP	0.10		**0.24**	mg/L	1	02/25/2021 19:10	R287857
SW-846 9251 (TOTAL)								
Chloride	NELAP	1		**26**	mg/L	1	02/25/2021 17:58	R287822
EPA 600 4.1.4, 200.7R4.4, METALS BY ICP (TOTAL)								
Arsenic	NELAP	0.0250		**< 0.0250**	mg/L	1	03/01/2021 17:17	174118
Barium	NELAP	0.0025		**0.0497**	mg/L	1	03/01/2021 17:17	174118
Boron	NELAP	0.0200		**0.0420**	mg/L	1	03/01/2021 17:17	174118
Calcium	NELAP	0.100	S	**59.9**	mg/L	1	03/03/2021 15:13	174355
Chromium	NELAP	0.0050		**< 0.0050**	mg/L	1	03/01/2021 17:17	174118
Copper	NELAP	0.0050		**< 0.0050**	mg/L	1	03/03/2021 15:13	174355
Iron	NELAP	0.0400		**1.65**	mg/L	1	03/03/2021 15:13	174355
Lead	NELAP	0.0150		**< 0.0150**	mg/L	1	03/01/2021 17:17	174118
Magnesium	NELAP	0.0500		**6.43**	mg/L	1	03/03/2021 15:13	174355
Manganese	NELAP	0.0070		**0.0244**	mg/L	1	03/03/2021 15:13	174355
Nickel	NELAP	0.0050		**< 0.0050**	mg/L	1	03/03/2021 15:13	174355
Potassium	NELAP	0.100		**3.24**	mg/L	1	03/03/2021 15:13	174355
Sodium	NELAP	0.0500		**13.7**	mg/L	1	03/03/2021 15:13	174355
Zinc	NELAP	0.0100		**< 0.0100**	mg/L	1	03/03/2021 15:13	174355

Teklab, Inc. Environmental Laboratory

Laboratory Results

http://www.teklabinc.com/

Client: Hanson Professional Services, Inc. **Work Order:** 21021164
Client Project: CWLP - 19E0107/4000 **Report Date:** 03-Mar-21
Lab ID: 21021164-001 **Client Sample ID:** Clarifier Water
Matrix: AQUEOUS **Collection Date:** 02/23/2021 9:00

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
EPA 600 4.1.4, 200.7R4.4, METALS BY ICP (TOTAL)								
Matrix spike control limits for Ca are not applicable due to high sample/spike ratio.								
EPA 600 4.1.4, 200.8 R5.4, METALS BY ICPMS (TOTAL)								
Cadmium	NELAP	0.0010		**< 0.0010**	mg/L	5	02/25/2021 23:44	174119
Selenium	NELAP	0.0010		**< 0.0010**	mg/L	5	02/25/2021 23:44	174119
Silver	NELAP	0.0010		**< 0.0010**	mg/L	5	02/25/2021 23:44	174119
MERCURY BY EPA METHOD 1631E (TOTAL)								
Mercury	NELAP	0.80		**< 0.80**	ng/L	1	02/25/2021 16:35	174152

Teklab, Inc. Environmental Laboratory

Laboratory Results

http://www.teklabinc.com/

Client: Hanson Professional Services, Inc.
Work Order: 21021164
Client Project: CWLP - 19E0107/4000
Report Date: 03-Mar-21
Lab ID: 21021164-002
Client Sample ID: Clarifier Water FB
Matrix: AQUEOUS
Collection Date: 02/23/2021 9:00

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
MERCURY BY EPA METHOD 1631E (TOTAL)								
Mercury	NELAP	0.80		**< 0.80**	ng/L	1	02/25/2021 15:53	174152

Teklab Inc. Environmental Laboratory

Receiving Check List

http://www.teklabinc.com/

Client: Hanson Professional Services, Inc. **Work Order:** 21021164

Client Project: CWLP - 19E0107/4000 **Report Date:** 03-Mar-21

Carrier: T. Cooper **Received By:** EAH

Completed by: Mary E. Kemp **On:** 23-Feb-21

Reviewed by: Elizabeth A. Hurley **On:** 23-Feb-21

Pages to follow: Chain of custody 1 Extra pages included 1

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐	Temp °C 7.8
Type of thermal preservation?	None ☐	Ice ☑	Blue Ice ☐	Dry Ice ☐
Chain of custody present?	Yes ☑	No ☐		
Chain of custody signed when relinquished and received?	Yes ☑	No ☐		
Chain of custody agrees with sample labels?	Yes ☑	No ☐		
Samples in proper container/bottle?	Yes ☑	No ☐		
Sample containers intact?	Yes ☑	No ☐		
Sufficient sample volume for indicated test?	Yes ☑	No ☐		
All samples received within holding time?	Yes ☑	No ☐		
Reported field parameters measured:	Field ☐	Lab ☐	NA ☑	
Container/Temp Blank temperature in compliance?	Yes ☑	No ☐		

When thermal preservation is required, samples are compliant with a temperature between 0.1°C - 6.0°C, or when samples are received on ice the same day as collected.

Water – at least one vial per sample has zero headspace?	Yes ☐	No ☐	No VOA vials ☑	
Water - TOX containers have zero headspace?	Yes ☐	No ☐	No TOX containers ☑	
Water - pH acceptable upon receipt?	Yes ☐	No ☑	NA ☐	
NPDES/CWA TCN interferences checked/treated in the field?	Yes ☐	No ☐	NA ☑	

Any No responses must be detailed below or on the COC.

pH strip #74446/75146. - ARH/MKemp - 2/23/2021 4:46:10 PM

Additional sodium hydroxide (75679) was needed upon arrival at the laboratory. - MKemp - 2/23/2021 4:46:31 PM

Samples were preserved with bromine chloride (75629) for low level mercury analysis upon arrival at the laboratory.

CHAIN OF CUSTODY

pg. ____ of ____ Work order # 21021164

TEKLAB, INC. 5445 Horseshoe Lake Road - Collinsville, IL 62234 - Phone: (618) 344-1004 - Fax: (618) 344-1005

Client:	Hanson Professional Services, Inc.
Address:	1525 South Sixth Street
City / State / Zip	Springfield, IL 62703
Contact:	Rhon Hasenyager
Phone:	(217) 788-2450
E-Mail:	rhasenyager@hanson-inc.com
Fax:	

Samples on: [X] ICE [ ] BLUE ICE [ ] NO ICE 7.8 °C LTG# 3

Preserved In: [X] LAB [ ] FIELD **FOR LAB USE ONLY**

Lab Notes: Added NaOH (75679) AH 2/23/21 74446/75146

Are these samples known to be involved in litigation? If yes, a surcharge will apply [ ] Yes [ ] No

Are these samples known to be hazardous? [ ] Yes [ ] No

Are there any required reporting limits to be met on the requested analysis?. If yes, please provide limits in the comment section. [ ] Yes [ ] No

Client Comments:
Metals: As Ba B Cd Ca Cr Cu Fe Pb Mg Mn Ni P K Ag Na Zn ICP/MS: Se
see attached list,

* FB per container - SAH 2/23/21

Project Name/Number: CWLP -- 19E0107/4000

Sample Collector's Name: Rhon Hasenyager

Results Requested: [X] Standard [ ] 1-2 Day (100% Surcharge) [ ] Other ____ [ ] 3 Day (50% Surcharge)

Billing Instructions:

Lab Use Only	Sample Identification	Date/Time Sampled	UNPRES	HNO3	NaOH	H2SO4	HCL	MeOH	NaHSO4	OTHER	Aqueous	Drinking Water	Soil	Sludge	Special Waste	Groundwater	Alkalinity (B/C)	Ammonia/TKN	Chloride/Sulfate	Fluoride/TDS	Hexavalent Cr	LL Mercury	Metals	Nitrate	Nitrite	Oil and Grease	Phenols	Total Cyanide	TSS, Low Range
21021164001	Clarifier Water	2/23/21 9:00	3	1	1	1	2				X						X	X	X	X	X	X	X	X	X	X	X	X	X
-002	* FB																												

Relinquished By	Date/Time	Received By	Date/Time
R. Hasenyager	2/23/21 15:09	T Cooper 2/23/2021	2/23/2021 15:09
T Cooper	2/23/21 16:30	Elizabeth [illegible]	2/23/21 1630

The individual signing this agreement on behalf of the client, acknowledges that he/she has read and understands the terms and conditions of this agreement, and that he/she has the authority to sign on behalf of the client. See www.teklabinc.com for terms and conditions.

BottleOrder: 63816

AH 2/23/2

35 IAC 302/304 Parameters

Analyte as total concentrations	Limit of Detection in mg/L, unless noted	Analyte as total concentrations	Limit of Detection in mg/L, unless noted
Alkalinity, Bicarbonate	2.	Mercury, low level (in ng/L)	0.5
Alkalinity, Carbonate	2.	Nickel	0.005
Ammonia	0.1	Nitrate	0.1
Arsenic	0.05	Nitrite	0.1
Barium	0.5	Oil & Grease	3.
Boron	0.1	Oxidation-Reduction Potential	n/a
Cadmium	0.001	pH	n/a
Calcium	0.1	Phenolics, total recoverable	0.005
Chloride	5.	Phosphorus	0.01
Chromium	0.05	Potassium	0.1
Chromium (hexavalent)	0.01	Selenium	0.005
Copper	0.005	Silver	0.003
Cyanide	0.005	Sodium	0.1
Fluoride	0.1	Sulfate	0.01
Iron	0.5	Total Dissolved Solids	1.
Lead	0.05	Total Kjeldahl Nitrogen	0.1
Magnesium	0.1	Total Suspended Solids	1.5
Manganese	0.01	Zinc	0.025

DOCUMENT 3: LAP - CCR - LIME SLUDGE AND FILTER PLANT SLUDGE CCR THAT GOES TO LAP

Lab No. 201800517-001
Date Rec'd. 2/14/2018 10:30:00 AM
Date Sampled 2/9/2018
Sampled By CLIENT

STANDARD LABORATORIES, INC.
8451 River King Drive
Freeburg, IL 62243

Report Date: 3/7/2018 3:28:35 PM

Remark: FILTER PLANT

FILTER PLANT LIME SLUDGE

TEST	Result	UNIT	METHOD	D.F.	MDL	DATE	TIME	TECH
Mercury Total	< 0.2	ug/L	SM 3112 B-2009	5	0.2	02/20/18	12:06	ELD
Boron, Total	1140	ug/L	EPA 200.7 4.4 1994	2	34	03/07/18	15:20	KGD
Iron, Total	422	mg/L	EPA 200.7 4.4 1994	5	0.035	02/23/18	12:11	KGD
Magnesium, Total	2410	mg/L	EPA 200.7 4.4 1994	10	0.2	02/23/18	15:20	KGD
Manganese, Total	11.8	mg/L	EPA 200.7 4.4 1994	1	0.004	02/23/18	12:11	KGD
Zinc, Total	0.591	mg/L	EPA 200.7 4.4 1994	1	0.004	02/23/18	12:11	KGD
Silver, Total	< 1	ug/L	EPA 200.8 5.5 1998	5	1	02/20/18	14:30	ELD
Arsenic, Total	199	ug/L	EPA 200.8 5.5 1998	5	3.5	02/20/18	14:30	ELD
Barium, Total	4550	ug/L	EPA 200.8 5.5 1998	10	4	02/20/18	14:30	ELD
Beryllium, Total	3.3	ug/L	EPA 200.8 5.5 1998	5	1	02/20/18	14:30	ELD
Cadmium, Total	11.4	ug/L	EPA 200.8 5.5 1998	5	4	02/20/18	14:30	ELD
Cobalt, Total	87.9	ug/L	EPA 200.8 5.5 1998	5	0.5	02/20/18	14:30	ELD
Chromium, Total	135	ug/L	EPA 200.8 5.5 1998	5	4	02/20/18	14:30	ELD
Copper, Total	324	ug/L	EPA 200.8 5.5 1998	5	4.5	02/20/18	14:30	ELD
Molybdenum, Total	23.1	ug/L	EPA 200.8 5.5 1998	5	2.5	02/20/18	14:30	ELD
Nickel, Total	483	ug/L	EPA 200.8 5.5 1998	10	4	02/20/18	14:30	ELD
Lead, Total	41.5	ug/L	EPA 200.8 5.5 1998	5	3.5	02/20/18	14:30	ELD
Antimony, Total	2.4	ug/L	EPA 200.8 5.5 1998	5	1	02/20/18	14:30	ELD
Selenium, Total	30.0	ug/L	EPA 200.8 5.5 1998	5	10	02/20/18	14:30	ELD
Thallium, Total	< 2	ug/L	EPA 200.8 5.5 1998	5	2	02/20/18	14:30	ELD
Vanadium, Total	835	ug/L	EPA 200.8 5.5 1998	10	20	02/20/18	14:30	ELD

Sludge from basins. coming off [illegible]

Respectfully Submitted, Kayla Dunphy

DOCUMENT 4: DAP - NON CCR - EVAPORATION POND WATER FROM FGDS LANDFILL

Single Location

Name: City Water, Light and Power

Location ID: Evaporation Pond

Number of Sampling Dates: 1

Parameter Name	Units	5/13/2021
Alkalinity, Bicarbonate, total (as CaCO3)	mg/L	282
Alkalinity, Carbonate, total (as CaCO3)	mg/L	0
Arsenic, total	mg/L	<0.025/<0.008
Barium, total	mg/L	0.03
Boron, total	mg/L	5.25
Cadmium, total	mg/L	<0.001
Calcium, total	mg/L	302
Chloride, total	mg/L	116
Chromium, Hexavalent, dissolved	mg/L	<0.001
Chromium, total	mg/L	<0.005
Copper, total	mg/L	<0.005
Cyanide, total	mg/L	<0.005
Fluoride, total	mg/L	0.34
Hexane Extractable Material	mg/L	<4
Iron, total	mg/L	0.366
pH (lab)	SU	8
Lead, total	mg/L	<0.015
Magnesium, total	mg/L	85.7
Manganese, total	mg/L	0.113
Mercury, total	ng/L	3.53
Nickel, total	mg/L	<0.005
Nitrogen, Ammonia, total	mg/L	<0.1
Nitrogen, Nitrite, total	mg/L	<0.05
Phenols	mg/L	0.006
Phosphorus, total (as P)	mg/L	0.37
Potassium, total	mg/L	5.44
Selenium, total	mg/L	0.0016
Silver, total	mg/L	<0.001
Sodium, total	mg/L	24.3
Sulfate, total	mg/L	616
Total Dissolved Solids	mg/L	1350
Total Kjeldahl Nitrogen	mg/L	1.5
Total Suspended Solids	mg/L	16
Zinc, total	mg/L	<0.01
Oxidation-Reduction Potential	mV	251
Nitrogen, Nitrate (as N)	mg/L	0.63

DOCUMENT 5: DAP - EVAPPOND-21051663

Teklab, Inc. Environmental Laboratory

http://www.teklabinc.com/

June 04, 2021

Rhon Hasenyager
Hanson Professional Services, Inc.
1525 South Sixth Street
Springfield, IL 62703
TEL: (217) 747-9235
FAX: (217) 788-5241

Illinois	100226
Kansas	E-10374
Louisiana	05002
Louisiana	05003
Oklahoma	9978

RE: CWLP - Antidegradation Samples **WorkOrder:** 21051663

Dear Rhon Hasenyager:

TEKLAB, INC received 1 sample on 5/13/2021 3:36:00 PM for the analysis presented in the following report.

Samples are analyzed on an as received basis unless otherwise requested and documented. The sample results contained in this report relate only to the requested analytes of interest as directed on the chain of custody. NELAP accredited fields of testing are indicated by the letters NELAP under the Certification column. Unless otherwise documented within this report, Teklab Inc. analyzes samples utilizing the most current methods in compliance with 40CFR. All tests are performed in the Collinsville, IL laboratory unless otherwise noted in the Case Narrative.

All quality control criteria applicable to the test methods employed for this project have been satisfactorily met and are in accordance with NELAP except where noted. The following report shall not be reproduced, except in full, without the written approval of Teklab, Inc.

If you have any questions regarding these tests results, please feel free to call.

Sincerely,

Elizabeth A. Hurley

Elizabeth A. Hurley
Project Manager
(618)344-1004 ex 33
ehurley@teklabinc.com

Teklab, Inc. Environmental Laboratory

Report Contents

http://www.teklabinc.com/

Client: Hanson Professional Services, Inc.
Work Order: 21051663
Client Project: CWLP - Antidegradation Samples
Report Date: 04-Jun-21

This reporting package includes the following:

Definitions

http://www.teklabinc.com/

Client: Hanson Professional Services, Inc. **Work Order:** 21051663

Client Project: CWLP - Antidegradation Samples **Report Date:** 04-Jun-21

Abbr	Definition
*	Analytes on report marked with an asterisk are not NELAP accredited
CCV	Continuing calibration verification is a check of a standard to determine the state of calibration of an instrument between recalibration.
CRQL	A Client Requested Quantitation Limit is a reporting limit that varies according to customer request. The CRQL may not be less than the MDL.
DF	Dilution factor is the dilution performed during analysis only and does not take into account any dilutions made during sample preparation. The reported result is final and includes all dilution factors.
DNI	Did not ignite
DUP	Laboratory duplicate is a replicate aliquot prepared under the same laboratory conditions and independently analyzed to obtain a measure of precision.
ICV	Initial calibration verification is a check of a standard to determine the state of calibration of an instrument before sample analysis is initiated.
IDPH	IL Dept. of Public Health
LCS	Laboratory control sample is a sample matrix, free from the analytes of interest,spiked with verified known amounts of analytes and analyzed exactly like a sample to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.
LCSD	Laboratory control sample duplicate is a replicate laboratory control sample that is prepared and analyzed in order to determine the precision of the approved test method. The acceptable recovery range is listed in the QC Package (provided upon request).
MBLK	Method blank is a sample of a matrix similar to the batch of associated sample (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences should present at concentrations that impact the analytical results for sample analyses.
MDL	"The method detection limit is defined as the minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from method blank results."
MS	Matrix spike is an aliquot of matrix fortified (spiked) with known quantities of specific analytes that is subjected to the entire analytical procedures in order to determine the effect of the matrix on an approved test method’s recovery system. The acceptable recovery range is listed in the QC Package (provided upon request).
MSD	Matrix spike duplicate means a replicate matrix spike that is prepared and analyzed in order to determine the precision of the approved test method. The acceptable recovery range is listed in the QC Package (provided upon request).
MW	Molecular weight
NC	Data is not acceptable for compliance purposes
ND	Not Detected at the Reporting Limit
NELAP	NELAP Accredited
PQL	Practical quantitation limit means the lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operation conditions.
RL	The reporting limit the lowest level that the data is displayed in the final report. The reporting limit may vary according to customer request or sample dilution. The reporting limit may not be less than the MDL.
RPD	Relative percent difference is a calculated difference between two recoveries (ie. MS/MSD). The acceptable recovery limit is listed in the QC Package (provided upon request).
SPK	The spike is a known mass of target analyte added to a blank sample or sub-sample; used to determine recovery deficiency or for other quality control purposes.
Surr	Surrogates are compounds which are similar to the analytes of interest in chemical composition and behavior in the analytical process, but which are not normally found in environmental samples.
TIC	Tentatively identified compound: Analytes tentatively identified in the sample by using a library search. Only results not in the calibration standard will be reported as tentatively identified compounds. Results for tentatively identified compounds that are not present in the calibration standard, but are assigned a specific chemical name based upon the library search, are calculated using total peak areas from reconstructed ion chromatograms and a response factor of one. The nearest Internal Standard is used for the calculation. The results of any TICs must be considered estimated, and are flagged with a "T". If the estimated result is above the calibration range it is flagged "ET"
TNTC	Too numerous to count (> 200 CFU)

Definitions

http://www.teklabinc.com/

Client: Hanson Professional Services, Inc. **Work Order:** 21051663

Client Project: CWLP - Antidegradation Samples **Report Date:** 04-Jun-21

Qualifiers

- # - Unknown hydrocarbon
- C - RL shown is a Client Requested Quantitation Limit
- H - Holding times exceeded
- J - Analyte detected below quantitation limits
- ND - Not Detected at the Reporting Limit
- S - Spike Recovery outside recovery limits
- X - Value exceeds Maximum Contaminant Level
- B - Analyte detected in associated Method Blank
- E - Value above quantitation range
- I - Associated internal standard was outside method criteria
- M - Manual Integration used to determine area response
- R - RPD outside accepted recovery limits
- T - TIC(Tentatively identified compound)

Case Narrative

http://www.teklabinc.com/

Client: Hanson Professional Services, Inc.
Client Project: CWLP - Antidegradation Samples
Work Order: 21051663
Report Date: 04-Jun-21

Cooler Receipt Temp: °C

Additional analyses to WO# 21050850.

Locations

Collinsville

Address	5445 Horseshoe Lake Road Collinsville, IL 62234-7425
Phone	(618) 344-1004
Fax	(618) 344-1005
Email	jhriley@teklabinc.com

Springfield

Address	3920 Pintail Dr Springfield, IL 62711-9415
Phone	(217) 698-1004
Fax	(217) 698-1005
Email	KKlostermann@teklabinc.com

Kansas City

Address	8421 Nieman Road Lenexa, KS 66214
Phone	(913) 541-1998
Fax	(913) 541-1998
Email	jhriley@teklabinc.com

Collinsville Air

Address	5445 Horseshoe Lake Road Collinsville, IL 62234-7425
Phone	(618) 344-1004
Fax	(618) 344-1005
Email	EHurley@teklabinc.com

Chicago

Address	1319 Butterfield Rd. Downers Grove, IL 60515
Phone	(630) 324-6855
Fax	
Email	arenner@teklabinc.com

Accreditations

http://www.teklabinc.com/

Client: Hanson Professional Services, Inc.
Client Project: CWLP - Antidegradation Samples

Work Order: 21051663
Report Date: 04-Jun-21

State	Dept	Cert #	NELAP	Exp Date	Lab
Illinois	IEPA	100226	NELAP	1/31/2022	Collinsville
Kansas	KDHE	E-10374	NELAP	4/30/2022	Collinsville
Louisiana	LDEQ	05002	NELAP	6/30/2022	Collinsville
Louisiana	LDEQ	05003	NELAP	6/30/2022	Collinsville
Oklahoma	ODEQ	9978	NELAP	8/31/2021	Collinsville
Arkansas	ADEQ	88-0966		3/14/2022	Collinsville
Illinois	IDPH	17584		5/31/2021	Collinsville
Kentucky	UST	0073		1/31/2022	Collinsville
Missouri	MDNR	00930		5/31/2021	Collinsville
Missouri	MDNR	930		1/31/2022	Collinsville

Teklab, Inc. Environmental Laboratory

Laboratory Results

http://www.teklabinc.com/

Client: Hanson Professional Services, Inc. **Work Order:** 21051663

Client Project: CWLP - Antidegradation Samples **Report Date:** 04-Jun-21

Lab ID: 21051663-001 **Client Sample ID:** Evaporation Pond

Matrix: AQUEOUS **Collection Date:** 05/13/2021 10:15

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
STANDARD METHOD 4500-H B 2000, 2011, LABORATORY ANALYZED								
Lab pH	NELAP	1.00		**8.00**		1	06/01/2021 15:08	R291715
STANDARD METHODS 2580B								
Oxidation-Reduction Potential	*	0.100		**251**	mV	1	05/28/2021 15:05	R291776

Sample was analyzed at 19C with saturated Ag/AgCl electrode.

TEKLAB, INC
5445 Horseshoe Lake Road
Collinsville, IL 62234-7425
TEL: (618) 344-1004
FAX: (618) 344-1005

CHAIN-OF-CUSTODY RECORD

WorkOrder: 21051663

Client:
Hanson Professional Services, Inc.
1525 South Sixth Street
Springfield, IL 62703

TEL: (217) 788-2450
FAX: (217) 788-5241
Project: CWLP - Antidegradation Sa

27-May-21

Sample ID	ClientSampID	Matrix	Date Collected	Bottle	Requested Tests: M2580B	M4500-H B					
21051663-001	Evaporation Pond	Aqueous	5/13/2021 10:15:00 AM		A	A					

Comments: Excel_PrState EDD
Per Rhon Hasenyager, additional analyses requested for WO# 21050850. MLDII 5/27/21

	Date/Time		Date/Time
Relinquished by:		**Received by:** Elizabeth O'Hanley	5/27/21
Relinquished by:		**Received by:**	
Relinquished by:		**Received by:**	

NOTE: Samples are discarded 60 days after results are reported unless other arrangements are made. Hazardous samples will be returned to client or disposed of at client expense.

Bottle Type: L-Liter V-Voa S-Soil Jar O-Orbo T-Tedlar B-Brass P-Plastic OT-Other

DOCUMENT 6: DAP - EVAPPOND-21050850

Teklab, Inc. Environmental Laboratory

http://www.teklabinc.com/

Illinois	100226
Kansas	E-10374
Louisiana	05002
Louisiana	05003
Oklahoma	9978

May 27, 2021

Rhon Hasenyager
Hanson Professional Services, Inc.
1525 South Sixth Street
Springfield, IL 62703
TEL: (217) 747-9235
FAX: (217) 788-5241

RE: CWLP - Antidegradation Samples **WorkOrder:** 21050850

Dear Rhon Hasenyager:

TEKLAB, INC received 2 samples on 5/13/2021 3:36:00 PM for the analysis presented in the following report.

Samples are analyzed on an as received basis unless otherwise requested and documented. The sample results contained in this report relate only to the requested analytes of interest as directed on the chain of custody. NELAP accredited fields of testing are indicated by the letters NELAP under the Certification column. Unless otherwise documented within this report, Teklab Inc. analyzes samples utilizing the most current methods in compliance with 40CFR. All tests are performed in the Collinsville, IL laboratory unless otherwise noted in the Case Narrative.

All quality control criteria applicable to the test methods employed for this project have been satisfactorily met and are in accordance with NELAP except where noted. The following report shall not be reproduced, except in full, without the written approval of Teklab, Inc.

If you have any questions regarding these tests results, please feel free to call.

Sincerely,

Marvin L. Darling
Project Manager
(618)344-1004 ex 41
mdarling@teklabinc.com

Teklab, Inc. Environmental Laboratory

Report Contents

http://www.teklabinc.com/

Client: Hanson Professional Services, Inc. **Work Order:** 21050850

Client Project: CWLP - Antidegradation Samples **Report Date:** 27-May-21

This reporting package includes the following:

Teklab, Inc. Environmental Laboratory

Definitions

http://www.teklabinc.com/

Client: Hanson Professional Services, Inc. **Work Order:** 21050850

Client Project: CWLP - Antidegradation Samples **Report Date:** 27-May-21

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Definitions

http://www.teklabinc.com/

Client: Hanson Professional Services, Inc.
Work Order: 21050850
Client Project: CWLP - Antidegradation Samples
Report Date: 27-May-21

Qualifiers

- # - Unknown hydrocarbon
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- R - RPD outside accepted recovery limits
- T - TIC(Tentatively identified compound)

Teklab, Inc. Environmental Laboratory

Case Narrative

http://www.teklabinc.com/

Client: Hanson Professional Services, Inc.

Client Project: CWLP - Antidegradation Samples

Work Order: 21050850

Report Date: 27-May-21

Cooler Receipt Temp: 4.2 °C

Locations

Collinsville

Address	5445 Horseshoe Lake Road Collinsville, IL 62234-7425
Phone	(618) 344-1004
Fax	(618) 344-1005
Email	jhriley@teklabinc.com

Springfield

Address	3920 Pintail Dr Springfield, IL 62711-9415
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Fax	(618) 344-1005
Email	EHurley@teklabinc.com

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Phone	(630) 324-6855
Fax	
Email	arenner@teklabinc.com

Accreditations

Client: Hanson Professional Services, Inc.
Client Project: CWLP - Antidegradation Samples
Work Order: 21050850
Report Date: 27-May-21

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Louisiana	LDEQ	05003	NELAP	6/30/2021	Collinsville
Oklahoma	ODEQ	9978	NELAP	8/31/2021	Collinsville
Arkansas	ADEQ	88-0966		3/14/2022	Collinsville
Illinois	IDPH	17584		5/31/2021	Collinsville
Kentucky	UST	0073		1/31/2022	Collinsville
Missouri	MDNR	00930		5/31/2021	Collinsville
Missouri	MDNR	930		1/31/2022	Collinsville

Laboratory Results

Teklab, Inc. Environmental Laboratory

http://www.teklabinc.com/

Client: Hanson Professional Services, Inc.
Work Order: 21050850
Client Project: CWLP - Antidegradation Samples
Report Date: 27-May-21
Lab ID: 21050850-001
Client Sample ID: Evaporation Pond
Matrix: AQUEOUS
Collection Date: 05/13/2021 10:15

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
EPA 1664A								
Hexane Extractable Material	NELAP	4		**< 4**	mg/L	1	05/19/2021 17:31	R291282
EPA 600 351.2								
Total Kjeldahl Nitrogen (as N)	NELAP	1.0		**1.5**	mg/L	1	05/19/2021 13:23	177080
EPA 600 365.4 (TOTAL)								
Phosphorus, Total (as P)	NELAP	0.100		**0.370**	mg/L	1	05/19/2021 13:21	177082
STANDARD METHODS 2320 B (TOTAL) 1997, 2011								
Alkalinity, Bicarbonate (as CaCO3)	NELAP	0		**282**	mg/L	1	05/14/2021 17:15	R291100
STANDARD METHODS 2320 B 1997, 2011								
Alkalinity, Carbonate (as CaCO3)	NELAP	0		**0**	mg/L	1	05/14/2021 17:15	R291100
STANDARD METHODS 2540 C (TOTAL) 1997, 2011								
Total Dissolved Solids	NELAP	20		**1350**	mg/L	1	05/19/2021 15:12	R291299
STANDARD METHODS 2540 D 1997, 2011								
Total Suspended Solids	NELAP	6		**16**	mg/L	1	05/19/2021 10:19	R291259
STANDARD METHODS 4500-NH3 G (TOTAL) 1997, 2011								
Nitrogen, Ammonia (as N)	NELAP	0.10		**< 0.10**	mg/L	1	05/17/2021 20:37	R291161
STANDARD METHODS 4500-NO2 B (TOTAL) 2000, 2011								
Nitrogen, Nitrite (as N)	NELAP	0.05		**< 0.05**	mg/L	1	05/13/2021 20:05	R290975
STANDARD METHODS 4500-NO3 F (TOTAL) 2000, 2011								
Nitrogen, Nitrate (as N)	NELAP	0.100		**0.630**	mg/L	2	05/14/2021 10:50	R291127
SW-846 7196A								
Chromium, Hexavalent	NELAP	0.001		**< 0.001**	mg/L	1	05/13/2021 21:20	R291000
SW-846 9012A (TOTAL)								
Cyanide	NELAP	0.005		**< 0.005**	mg/L	1	05/21/2021 11:35	177169
Sample was checked for Chlorine and Sulfide interferences in the lab and was negative for Sulfide and positive for Chlorine.								
SW-846 9036 (TOTAL)								
Sulfate	NELAP	200		**616**	mg/L	20	05/20/2021 15:35	R291329
SW-846 9066 (TOTAL)								
Phenols	NELAP	0.005		**0.006**	mg/L	1	05/17/2021 15:29	R291143
SW-846 9214 (TOTAL)								
Fluoride	NELAP	0.10		**0.34**	mg/L	1	05/18/2021 20:54	R291254
SW-846 9251 (TOTAL)								
Chloride	NELAP	10		**116**	mg/L	10	05/17/2021 20:50	R291124
EPA 600 4.1.4, 200.7R4.4, METALS BY ICP (TOTAL)								
Arsenic	NELAP	0.0250		**< 0.0250**	mg/L	1	05/19/2021 21:04	176997
Barium	NELAP	0.0025		**0.0300**	mg/L	1	05/19/2021 21:04	176997
Boron	NELAP	0.0200		**5.25**	mg/L	1	05/19/2021 21:04	176997
Calcium	NELAP	0.100		**302**	mg/L	1	05/19/2021 21:04	176997
Chromium	NELAP	0.0050		**< 0.0050**	mg/L	1	05/19/2021 21:04	176997
Copper	NELAP	0.0050		**< 0.0050**	mg/L	1	05/19/2021 21:04	176997
Iron	NELAP	0.0400		**0.366**	mg/L	1	05/19/2021 21:04	176997
Lead	NELAP	0.0150		**< 0.0150**	mg/L	1	05/19/2021 21:04	176997
Magnesium	NELAP	0.0500		**85.7**	mg/L	1	05/19/2021 21:04	176997
Manganese	NELAP	0.0070		**0.113**	mg/L	1	05/19/2021 21:04	176997
Nickel	NELAP	0.0050		**< 0.0050**	mg/L	1	05/19/2021 21:04	176997

Teklab, Inc. Environmental Laboratory

Laboratory Results

http://www.teklabinc.com/

Client: Hanson Professional Services, Inc.
Work Order: 21050850
Client Project: CWLP - Antidegradation Samples
Report Date: 27-May-21
Lab ID: 21050850-001
Client Sample ID: Evaporation Pond
Matrix: AQUEOUS
Collection Date: 05/13/2021 10:15

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
EPA 600 4.1.4, 200.7R4.4, METALS BY ICP (TOTAL)								
Potassium	NELAP	0.100		**5.44**	mg/L	1	05/19/2021 21:04	176997
Sodium	NELAP	0.0500	B	**24.3**	mg/L	1	05/19/2021 21:04	176997
Zinc	NELAP	0.0100		**< 0.0100**	mg/L	1	05/19/2021 21:04	176997
Sample result for Na exceeds 10 times the method blank contamination. Data is reportable per the TNI Standard.								
EPA 600 4.1.4, 200.8 R5.4, METALS BY ICPMS (TOTAL)								
Cadmium	NELAP	0.0010		**< 0.0010**	mg/L	5	05/19/2021 23:05	176996
Selenium	NELAP	0.0010		**0.0016**	mg/L	5	05/19/2021 23:05	176996
Silver	NELAP	0.0010		**< 0.0010**	mg/L	5	05/19/2021 23:05	176996
LCS recovered outside upper control limits for Cd, & Ag. Sample results are below the reporting limit. Data is reportable per the TNI Standard.								
CCV recovered outside the upper control limits for Cd & Ag. Sample results are below the reporting limit. Data is reportable per the TNI standard.								
MERCURY BY EPA METHOD 1631E (TOTAL)								
Mercury	NELAP	0.80		**3.53**	ng/L	1	05/14/2021 18:53	176939

Teklab, Inc. Environmental Laboratory

Laboratory Results

http://www.teklabinc.com/

Client: Hanson Professional Services, Inc. **Work Order:** 21050850

Client Project: CWLP - Antidegradation Samples **Report Date:** 27-May-21

Lab ID: 21050850-002 **Client Sample ID:** Evap. Pond Blank

Matrix: AQUEOUS **Collection Date:** 05/13/2021 10:15

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
MERCURY BY EPA METHOD 1631E (TOTAL)								
Mercury	NELAP	0.80		**< 0.80**	ng/L	1	05/14/2021 19:04	176939

Teklab Inc. Environmental Laboratory

Receiving Check List

http://www.teklabinc.com/

Client: Hanson Professional Services, Inc.

Work Order: 21050850

Client Project: CWLP - Antidegradation Samples

Report Date: 27-May-21

Carrier: Employee

Received By: JHR

Completed by: Mary E. Kemp
On: 13-May-21
Mary E. Kemp

Reviewed by: Marvin L. Darling II
On: 13-May-21
Marvin L. Darling

Pages to follow: Chain of custody [1] Extra pages included [0]

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐	Temp °C 4.2
Type of thermal preservation?	None ☐	Ice ☑	Blue Ice ☐	Dry Ice ☐
Chain of custody present?	Yes ☑	No ☐		
Chain of custody signed when relinquished and received?	Yes ☑	No ☐		
Chain of custody agrees with sample labels?	Yes ☑	No ☐		
Samples in proper container/bottle?	Yes ☑	No ☐		
Sample containers intact?	Yes ☑	No ☐		
Sufficient sample volume for indicated test?	Yes ☑	No ☐		
All samples received within holding time?	Yes ☑	No ☐		
Reported field parameters measured:	Field ☐	Lab ☐	NA ☑	
Container/Temp Blank temperature in compliance?	Yes ☑	No ☐		

When thermal preservation is required, samples are compliant with a temperature between 0.1°C - 6.0°C, or when samples are received on ice the same day as collected.

Water – at least one vial per sample has zero headspace?	Yes ☐	No ☐	No VOA vials ☑	
Water - TOX containers have zero headspace?	Yes ☐	No ☐	No TOX containers ☑	
Water - pH acceptable upon receipt?	Yes ☐	No ☑	NA ☐	
NPDES/CWA TCN interferences checked/treated in the field?	Yes ☐	No ☐	NA ☑	

Any No responses must be detailed below or on the COC.

pH strip #75145/75146. - EH/MKemp - 5/13/2021 4:30:32 PM

Additional sodium hydroxide (76347) was needed upon arrival at the laboratory. - EH/MKemp - 5/13/2021 4:30:45 PM

Samples were preserved with bromine chloride (76381) for low level mercury analysis upon arrival at the laboratory. - MKemp - 5/13/2021 4:31:24 PM

CHAIN OF CUSTODY

pg. ____ of ____ Work order # 21050850

TEKLAB, INC. 5445 Horseshoe Lake Road - Collinsville, IL 62234 - Phone: (618) 344-1004 - Fax: (618) 344-1005

Client: Hanson Professional Services, Inc.
Address: 1525 South Sixth Street
City / State / Zip Springfield, IL 62703
Contact: Rhon Hasenyager **Phone:** (217) 788-2450
E-Mail: rhasenyager@hanson-inc.com **Fax:**

Samples on: ☒ ICE ☐ BLUE ICE ☐ NO ICE 4.2 °C LTG# 3
Preserved in: ☒ LAB ☐ FIELD EH 5/13/21 **FOR LAB USE ONLY**
Lab Notes added ~~H2SO4~~ NaOH (718347) to Evap. Pond 75145 / 75146 EH 5/13/21

Client Comments:
Metals: As Ba B Ca Cr Cu Fe Pb Mg Mn Ni K Na Zn ICP/MS: Cd Se Ag

Are these samples known to be involved in litigation? If yes, a surcharge will apply ☐ Yes ☐ No
Are these samples known to be hazardous? ☐ Yes ☐ No
Are there any required reporting limits to be met on the requested analysis?. If yes, please provide limits in the comment section. ☐ Yes ☐ No

Project Name/Number: CWLP - Antidegradation Samples
Sample Collector's Name: Rhon Hasenyager

Results Requested: ☐ Standard ☐ 1-2 Day (100% Surcharge) ☐ Other ____ ☐ 3 Day (50% Surcharge)

Billing Instructions

Lab Use Only	Sample Identification	Date/Time Sampled	UNPRES	HNO3	NaOH	H2SO4	HCL	MeOH	NaHSO4	OTHER	Aqueous	Drinking Water	Soil	Sludge	Special Waste	Groundwater	Alkalinity (B/C)	Ammonia	Chloride/Sulfate	Cyanide (T)	Fluoride/Nitrite	Hex. Chromium	Mercury 1631	Metals	Nitrate	Oil and Grease	Phenol	TDS/TSS	TKN/Phos		
21050850-001	~~Outfall~~ Evaporation Pond	13 May 21 @ 10:15									X						x	x	x	x	x	x	x	x	x	x	x	x	x		
↓ 002	~~Field Blank~~ Evap. Pond Blank	13 May 21 @ 10:15																					x								

(# and Type of Containers: UNPRES, HNO3, NaOH, H2SO4, HCL, MeOH, NaHSO4, OTHER; MATRIX: Aqueous through Groundwater; INDICATE ANALYSIS REQUESTED: Alkalinity (B/C) through TKN/Phos)

Relinquished By	Date/Time	Received By	Date/Time
[signature]	13 May 21 @ 14:08	[signature]	5/13/21 2:08
[signature]	5/13/21 3:36	[signature]	5/13/21 3:36

The individual signing this agreement on behalf of the client, acknowledges that he/she has read and understands the terms and conditions of this agreement, and that he/she has the authority to sign on behalf of the client. See www.teklabinc.com for terms and conditions.

BottleOrder: 65570

EH 5/13/21

DOCUMENT 7: DAP - CCR - UNIT 31 32 AND 33 BOTTOM ASH

Lab No. : 201800252-001
Date Rec'd. : 1/22/2018
Date Sampled : 1/17/2018
Sampled By : CLIENT

STANDARD LABORATORIES, INC.
8451 River King Drive
Freeburg, IL 62243

ANAB ACCREDITED TESTING LABORATORY

Certificate # L2179.02-1 Testing

CITY WATER, LIGHT AND POWER
MUNICIPAL CENTER, EAST
800 EAST MONROE ST., 4TH FLOOR
SPRINGFIELD, IL 62757
ATTN: BRANDEN POWELL

Report Date: 2/1/2018 12:36:52 PM

Sample ID : 201800252-001
P.O. #: SCM100 CAB 00000557637

Remark: CWLP SPRINGFIELD - UNIT 31 - BOTTOM ASH

	TEST	DRY BASIS CONCENTRATION	UNITS	METHOD	DATE	TECH
	Antimony	0.47	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Arsenic	1.5	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Barium	466	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Beryllium	11.1	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
*	Boron	308	µg/g	ICPMS	1/30/2018	JMW
	Cadmium	0.14	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Chlorine	11	µg/g	ASTM D6721	1/31/2018	CJH
	Chromium	716	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Cobalt	20.7	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Copper	33	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Fluorine	< 10	µg/g	ASTM D5987 - IC	1/25/2018	RLR
	Lead	2.6	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
*	Magnesium	3990	µg/g	ASTM D6357 - ICP-AES	1/29/2018	JMW
	Manganese	621	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Mercury	< 0.010	µg/g	ASTM D6722	1/25/2018	CJH
	Molybdenum	82.1	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Nickel	390	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Selenium	< 0.1	µg/g	ASTM D4606	1/30/2018	JMW
	Silver	0.04	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Thallium	0.12	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Vanadium	164	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Zinc	78	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW

Respectfully Submitted, Jeremy Weiss

* Not an Accredited Test

STANDARD LABORATORIES, INC.
8451 River King Drive
Freeburg, IL 62243

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

Certificate # L2179.02-1 Testing

Lab No :	201800252-002
Date Rec'd :	1/22/2018
Date Sampled	1/17/2018 to 1/17/2018
Sampled By:	CLIENT

CITY WATER, LIGHT AND POWER
MUNICIPAL CENTER, EAST
800 EAST MONROE ST., 4TH FLOOR
SPRINGFIELD, IL 62757
ATTN: BRANDEN POWELL

Date : 2/12/2018 9:16:33 AM
P.O.# : SCM100 CAB 00000557637

Remark: CWLP SPRINGFIELD - UNIT 32 - BOTTOM ASH

Weight %

PROXIMATE ANALYSIS		As-Received	Dry Basis
% Moisture	D3302	25.29	******
% Ash	D3174	74.78	100.1
% Volatile	D3175	0.04	0.06
% Fixed Carbon	D3172	< 0.01	< 0.01
BTU	D5865	212	284
MAF BTU	D3180	< 1	
% Total Sulfur	D4239	0.18	0.24
SULFUR FORMS			
% Pyritic	D2492MOD	0.04	0.06
% Sulfate	D2492MOD	0.13	0.18
% Organic	D2492MOD	< 0.01	< 0.01
% Total Sulfur	D4239	0.18	0.24
WATER SOLUBLE			
% Na2O	D8010	0.007	0.009
% K2O	D8010	0.004	0.005
* % Chlorine	ASME1974	******	******
Alkalies as Na2O	ASME1974	1.89	2.53

FUSION TEMP. OF ASH D1857 °F	Reducing	Oxidizing
I.D.	1928	2279
H=W	1940	2381
H=1/2W	1950	2486
FLUID	2335	2520

GRINDABILITY INDEX D409 ****** @ ****** % Moist.

FREE SWELLING INDEX D720 ******

* Apparent Specific Gravity of Coal ModIC7113 ******

% Equilibrium Moisture D1412 ******

* % Loss on Ignition @ 950C D7348 ******

ULTIMATE ANALYSIS		As-Received	Dry Basis
% Moisture	D3302	25.29	******
% Carbon	D5373	0.83	1.11
% Hydrogen	D5373	0.21	0.28
% Nitrogen	D5373	< 0.01	< 0.01
% Chlorine	D6721	< 0.01	< 0.01
% Sulfur	D4239	0.18	0.24
% Ash	D3174	74.78	100.1
% Oxygen (Diff.)	D3176	< 0.01	< 0.01

(Chlorine D6721 Dry Basis ug/g 12)

MINERAL ANALYSIS D6349		% Ignited Basis
Phos. Pentoxide, P2O5		0.07
Silica, SiO2		52.35
Ferric Oxide, Fe2O3		21.54
Alumina, Al2O3		13.32
Titania, TiO2		0.72
Lime, CaO		5.80
Magnesia, MgO		0.64
Sulfur Trioxide, SO3		0.31
Potassium Oxide, K2O		1.42
Sodium Oxide, Na2O		1.59
Barium Oxide, BaO		0.04
Strontium Oxide, SrO		0.02
Manganese Dioxide, MnO2		0.10
Undetermined		2.08
Type of Ash	ASME1974	Bituminous
Silica Value	ASME1974	65.17
T250 Deg F	BW	2338
Base/Acid Ratio	ASME1974	0.47
lb Ash/mm BTU		3524.30
lb SO2/mm BTU		< 0.01

*Using 20000 as SO2 calculation factor

Fouling Index	ASME1974	0.75
Slagging Index	ASME1974	< 0.01

(Mercury D6722 Dry Basis ug/g < 0.010)

Respectfully Submitted, Steven Arndt

* Not an Accredited Test

Lab No. : 201800252-002
Date Rec'd. : 1/22/2018
Date Sampled : 1/17/2018
Sampled By : CLIENT

STANDARD LABORATORIES, INC.
8451 River King Drive
Freeburg, IL 62243

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

Certificate # L2179.02-1 Testing

CITY WATER, LIGHT AND POWER
MUNICIPAL CENTER, EAST
800 EAST MONROE ST., 4TH FLOOR
SPRINGFIELD, IL 62757
ATTN: BRANDEN POWELL

Report Date: 2/1/2018 12:36:52 PM

Sample ID : 201800252-002

P.O. #: SCM100 CAB 00000557637

Remark: CWLP SPRINGFIELD - UNIT 32 - BOTTOM ASH

	TEST	DRY BASIS CONCENTRATION	UNITS	METHOD	DATE	TECH
	Antimony	1.47	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Arsenic	3.3	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Barium	401	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Beryllium	14.0	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
*	Boron	558	µg/g	ICPMS	1/30/2018	JMW
	Cadmium	0.70	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Chlorine	12	µg/g	ASTM D6721	1/31/2018	CJH
	Chromium	689	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Cobalt	22.4	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Copper	43	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Fluorine	< 10	µg/g	ASTM D5987 - IC	1/25/2018	RLR
	Lead	9.5	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
*	Magnesium	3900	µg/g	ASTM D6357 - ICP-AES	1/29/2018	JMW
	Manganese	600	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Mercury	< 0.010	µg/g	ASTM D6722	1/25/2018	CJH
	Molybdenum	78.2	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Nickel	369	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Selenium	< 0.1	µg/g	ASTM D4606	1/30/2018	JMW
	Silver	0.05	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Thallium	0.18	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Vanadium	185	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Zinc	246	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW

Respectfully Submitted, Jeremy Weiss

* Not an Accredited Test

Lab No : 201800252-003
Date Rec'd : 1/22/2018
Date Sampled 1/17/2018 to 1/17/2018
Sampled By: CLIENT

STANDARD LABORATORIES, INC.
8451 River King Drive
Freeburg, IL 62243

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY
Certificate # L2179.02-1 Testing

CITY WATER, LIGHT AND POWER
MUNICIPAL CENTER, EAST
800 EAST MONROE ST., 4TH FLOOR
SPRINGFIELD, IL 62757
ATTN: BRANDEN POWELL

Date : 2/12/2018 9:16:33 AM
P.O.# : SCM100 CAB 00000557637

Remark: CWLP SPRINGFIELD - UNIT 33 - BOTTOM ASH

PROXIMATE ANALYSIS		As-Received	Dry Basis
% Moisture	D3302	21.43	******
% Ash	D3174	78.58	100.0
% Volatile	D3175	0.31	0.39
% Fixed Carbon	D3172	< 0.01	< 0.01
BTU	D5865	222	282
MAF BTU	D3180	< 1	
% Total Sulfur	D4239	0.13	0.17

SULFUR FORMS			
% Pyritic	D2492MOD	0.07	0.09
% Sulfate	D2492MOD	0.06	0.08
% Organic	D2492MOD	< 0.01	< 0.01
% Total Sulfur	D4239	0.13	0.17

WATER SOLUBLE			
% Na2O	D8010	0.006	0.007
% K2O	D8010	0.004	0.005
* % Chlorine	ASME1974	******	******
Alkalies as Na2O	ASME1974	1.52	1.93

FUSION TEMP. OF ASH D1857 °F	Reducing	Oxidizing
I.D.	1915	2291
H=W	1948	2378
H=1/2W	1990	2484
FLUID	2370	2516

GRINDABILITY INDEX D409 ****** @ ****** % Moist.

FREE SWELLING INDEX D720 ******

* Apparent Specific Gravity of Coal ModIC7113 ******

% Equilibrium Moisture D1412 ******

* % Loss on Ignition @ 950C D7348 ******

Weight %

ULTIMATE ANALYSIS		As-Received	Dry Basis
% Moisture	D3302	21.43	******
% Carbon	D5373	0.49	0.63
% Hydrogen	D5373	0.19	0.25
% Nitrogen	D5373	< 0.01	< 0.01
% Chlorine	D6721	< 0.01	< 0.01
% Sulfur	D4239	0.13	0.17
% Ash	D3174	78.58	100.0
% Oxygen (Diff.)	D3176	< 0.01	< 0.01

(Chlorine D6721 Dry Basis ug/g 15)

MINERAL ANALYSIS D6349		% Ignited Basis
Phos. Pentoxide, P2O5		0.09
Silica, SiO2		47.87
Ferric Oxide, Fe2O3		28.68
Alumina, Al2O3		12.12
Titania, TiO2		0.68
Lime, CaO		5.80
Magnesia, MgO		0.61
Sulfur Trioxide, SO3		0.23
Potassium Oxide, K2O		1.27
Sodium Oxide, Na2O		1.09
Barium Oxide, BaO		0.05
Strontium Oxide, SrO		0.02
Manganese Dioxide, MnO2		0.09
Undetermined		1.40
Type of Ash	ASME1974	Bituminous
Silica Value	ASME1974	57.70
T250 Deg F	BW	2240
Base/Acid Ratio	ASME1974	0.62
lb Ash/mm BTU		3546.45
lb SO2/mm BTU		< 0.01

*Using 20000 as SO2 calculation factor

Fouling Index	ASME1974	0.68
Slagging Index	ASME1974	< 0.01

(Mercury D6722 Dry Basis ug/g < 0.010)

Respectfully Submitted, Steven Arndt

* Not an Accredited Test

Lab No. : 201800252-003

Date Rec'd. : 1/22/2018

Date Sampled : 1/17/2018

Sampled By : CLIENT

STANDARD LABORATORIES, INC.
8451 River King Drive
Freeburg, IL 62243

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

Certificate # L2179.02-1 Testing

CITY WATER, LIGHT AND POWER
MUNICIPAL CENTER, EAST
800 EAST MONROE ST., 4TH FLOOR
SPRINGFIELD, IL 62757
ATTN: BRANDEN POWELL

Report Date: 2/1/2018 12:36:52 PM

Sample ID : 201800252-003

P.O. #: SCM100 CAB 00000557637

Remark: CWLP SPRINGFIELD - UNIT 33 - BOTTOM ASH

	TEST	DRY BASIS CONCENTRATION	UNITS	METHOD	DATE	TECH
	Antimony	1.50	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Arsenic	3.2	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Barium	432	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Beryllium	12.3	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
*	Boron	684	µg/g	ICPMS	1/30/2018	JMW
	Cadmium	1.17	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Chlorine	15	µg/g	ASTM D6721	1/31/2018	CJH
	Chromium	505	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Cobalt	22.9	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Copper	46	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Fluorine	< 10	µg/g	ASTM D5987 - IC	1/25/2018	RLR
	Lead	12.6	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
*	Magnesium	3780	µg/g	ASTM D6357 - ICP-AES	1/29/2018	JMW
	Manganese	579	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Mercury	< 0.010	µg/g	ASTM D6722	1/25/2018	CJH
	Molybdenum	60.7	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Nickel	294	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Selenium	< 0.1	µg/g	ASTM D4606	1/30/2018	JMW
	Silver	0.09	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Thallium	0.28	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Vanadium	171	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW
	Zinc	248	µg/g	ASTM D6357 - ICP-MS	1/29/2018	JMW

Respectfully Submitted, Jeremy Weiss

* Not an Accredited Test

DOCUMENT 8: DAP - CCR - JAN 2017 COMBINED FLY ASH TRACE METALS - REPRESENT ALL ASH GOING TO DAP

Lab No. :	201700339-001
Date Rec'd. :	2/1/2017
Date Sampled :	1/30/2017
Sampled By :	CLIENT

STANDARD LABORATORIES, INC.
8451 River King Drive
Freeburg, IL 62243

LABORATORY ACCREDITATION BUREAU
ACCREDITED ISO/IEC 17025
Certificate # L2179.02-1 Testing

CITY WATER, LIGHT AND POWER
MUNICIPAL CENTER, EAST
800 EAST MONROE ST., 4TH FLOOR
SPRINGFIELD, IL 62757
ATTN: BRANDEN POWELL

Report Date: 2/10/2017 3:47:53 PM

Sample ID : 201700339-001
P.O. #: SCM100 557233

Remark: CWLP SPRINGFIELD - COMBINE FLY ASH: D31,32,33

	TEST	DRY BASIS CONCENTRATION	UNITS	METHOD	DATE	TECH
	Antimony	17.1	µg/g	ASTM D6357 - ICP-MS	2/7/2017	JMW
	Arsenic	74.7	µg/g	ASTM D6357 - ICP-MS	2/7/2017	JMW
	Barium	402	µg/g	ASTM D6357 - ICP-MS	2/7/2017	JMW
	Beryllium	20.2	µg/g	ASTM D6357 - ICP-MS	2/7/2017	JMW
*	Boron	1950	µg/g	ICPMS	2/7/2017	JMW
	Cadmium	24.3	µg/g	ASTM D6357 - ICP-MS	2/7/2017	JMW
	Chlorine	332	µg/g	ASTM D6721	2/6/2017	CJH
	Chromium	687	µg/g	ASTM D6357 - ICP-MS	2/7/2017	JMW
	Cobalt	25.1	µg/g	ASTM D6357 - ICP-MS	2/7/2017	JMW
	Copper	103	µg/g	ASTM D6357 - ICP-MS	2/7/2017	JMW
	Fluorine	363	µg/g	ASTM D5987 - IC	2/6/2017	RLR
	Lead	85.5	µg/g	ASTM D6357 - ICP-MS	2/7/2017	JMW
*	Magnesium	3910	µg/g	ASTM D6357 - ICP-AES	2/7/2017	JMW
	Manganese	522	µg/g	ASTM D6357 - ICP-MS	2/7/2017	JMW
	Mercury	0.335	µg/g	ASTM D6722	2/2/2017	CJH
	Molybdenum	157	µg/g	ASTM D6357 - ICP-MS	2/7/2017	JMW
	Nickel	334	µg/g	ASTM D6357 - ICP-MS	2/7/2017	JMW
	Selenium	140	µg/g	ASTM D4606	2/6/2017	JMW
	Silver	0.69	µg/g	ASTM D6357 - ICP-MS	2/7/2017	JMW
	Thallium	17.9	µg/g	ASTM D6357 - ICP-MS	2/7/2017	JMW
	Vanadium	326	µg/g	ASTM D6357 - ICP-MS	2/7/2017	JMW
	Zinc	1140	µg/g	ASTM D6357 - ICP-MS	2/7/2017	JMW

Respectfully Submitted, Jeremy Weiss

* Not an Accredited Test

DOCUMENT 9: DAP - CCR - JAN 2017 COMBINED FLY ASH TOTALS DALLMAN ASH POND - REPRESENT ALL ASH GOING TO DAP

Lab No :	201700339-001
Date Rec'd :	2/1/2017
Date Sampled	1/30/2017 to 1/30/2017
Sampled By:	CLIENT

STANDARD LABORATORIES, INC.
8451 River King Drive
Freeburg, IL 62243

LABORATORY ACCREDITATION BUREAU
ACCREDITED ISO/IEC 17025
Certificate # L2179.02-1 Testing

CITY WATER, LIGHT AND POWER
MUNICIPAL CENTER, EAST
800 EAST MONROE ST., 4TH FLOOR
SPRINGFIELD, IL 62757
ATTN: BRANDEN POWELL

Date : 2/15/2017 6:11:06 AM
P.O.# : SCM100 557233

Remark: CWLP SPRINGFIELD - COMBINE FLY ASH: D31,32,33

PROXIMATE ANALYSIS		As-Received	Dry Basis
% Moisture	D3302	0.83	******
% Ash	D3174	86.74	87.47
% Volatile	D3175	15.44	15.57
% Fixed Carbon	D3172	< 0.01	< 0.01
BTU	D5865	< 1	< 1
MAF BTU	D3180		< 1
% Total Sulfur	D4239	5.47	5.52
SULFUR FORMS			
% Pyritic	D2492MOD	0.09	0.09
% Sulfate	D2492MOD	5.55	5.60
% Organic	D2492MOD	< 0.01	< 0.01
% Total Sulfur	D4239	5.47	5.52
WATER SOLUBLE			
% Na2O	ASME1974	0.891	0.898
% K2O	ASME1974	0.270	0.272
* % Chlorine	ASME1974	******	******
Alkalies as Na2O	ASME1974	3.27	3.30

FUSION TEMP. OF ASH D1857 °F	Reducing	Oxidizing
I.D.	1963	2249
H=W	1983	2319
H=1/2W	1994	2362
FLUID	2193	2596

GRINDABILITY INDEX D409 ****** @ ****** % Moist.

FREE SWELLING INDEX D720 ******

* Apparent Specific Gravity of Coal ModIC7113 ******

% Equilibrium Moisture D1412 ******

* % Loss on Ignition @ 950C D7348 ******

Weight %

ULTIMATE ANALYSIS		As-Received	Dry Basis
% Moisture	D3302	0.83	******
% Carbon	D5373	0.69	0.70
% Hydrogen	D5373	0.75	0.75
% Nitrogen	D5373	0.99	1.00
% Chlorine	D6721	0.03	0.03
% Sulfur	D4239	5.47	5.52
% Ash	D3174	86.74	87.47
% Oxygen (Diff.)	D3176	4.50	4.53

(Chlorine D6721 Dry Basis ug/g 332)

MINERAL ANALYSIS D6349		% Ignited Basis
Phos. Pentoxide, P2O5		0.13
Silica, SiO2		47.75
Ferric Oxide, Fe2O3		21.07
Alumina, Al2O3		13.76
Titania, TiO2		1.04
Lime, CaO		5.39
Magnesia, MgO		0.75
Sulfur Trioxide, SO3		5.54
Potassium Oxide, K2O		2.18
Sodium Oxide, Na2O		2.34
Barium Oxide, BaO		0.05
Strontium Oxide, SrO		0.04
Manganese Dioxide, MnO2		0.09
Undetermined		-0.13
Type of Ash	ASME1974	Bituminous
Silica Value	ASME1974	63.70
T250 Deg F	BW	2302
Base/Acid Ratio	ASME1974	0.51
lb Ash/mm BTU		< 0.01
lb SO2/mm BTU		< 0.01

*Using 20000 as SO2 calculation factor

Fouling Index	ASME1974	1.19
Slagging Index	ASME1974	2.82

(Mercury D6722 Dry Basis ug/g 0.335)

Respectfully Submitted, Steven Arndt

* Not an Accredited Test

DOCUMENT 10: DAP - CCR - FLUE GAS DESULFURIZATION SLUDGE ENTERING DAP

Client: Hanson Professional Services, Inc. **Work Order:** 20111337

Client Project: CWLP analysis **Report Date:** 01-Dec-2020

Lab ID: 20111337-003 **Client Sample ID:** FGD SD

Matrix: AQUEOUS **Collection Date:** 11/20/2020 11:50

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
EPA 1664A								
Hexane Extractable Material	NELAP	6		**< 6**	mg/L	1	11/25/2020 7:25	R284609
EPA 600 351.2								
Total Kjeldahl Nitrogen (as N)	NELAP	25		**200**	mg/L	1	11/24/2020 8:57	171484
EPA 600 365.4 (TOTAL)								
Phosphorus, Total (as P)	NELAP	2.50		**74.6**	mg/L	1	11/24/2020 8:56	171486
EPA 600 420.4 R1.0 (TOTAL)								
Phenols	NELAP	0.010		**< 0.010**	mg/L	2	11/30/2020 10:53	R284625
Elevated reporting limit due to sample composition.								
STANDARD METHOD 4500-H B 2000, LABORATORY ANALYZED								
Lab pH	NELAP	1.00		**7.56**		1	11/23/2020 15:42	R284492
STANDARD METHODS 2320 B (TOTAL) 1997								
Alkalinity, Bicarbonate (as CaCO3)	NELAP	0		**1750**	mg/L	1	11/25/2020 11:32	R284575
STANDARD METHODS 2320 B 1997								
Alkalinity, Carbonate (as CaCO3)	NELAP	0		**0**	mg/L	1	11/25/2020 11:32	R284575
STANDARD METHODS 2540 C (TOTAL) 1997								
Total Dissolved Solids	NELAP	400		**26100**	mg/L	20	11/23/2020 16:52	R284524
STANDARD METHODS 2540 D 1997								
Total Suspended Solids	NELAP	545		**71100**	mg/L	90.91	11/23/2020 13:29	R284469
STANDARD METHODS 4500-CL E (TOTAL) 1997								
Chloride	NELAP	2000		**5300**	mg/L	500	11/23/2020 19:56	R284496
STANDARD METHODS 4500-NH3 G (TOTAL) 1997								
Nitrogen, Ammonia (as N)	NELAP	0.50		**3.99**	mg/L	5	11/24/2020 15:39	R284521
STANDARD METHODS 4500-NO2 B (TOTAL) 2000								
Nitrogen, Nitrite (as N)	NELAP	0.05		**< 0.05**	mg/L	1	11/20/2020 20:52	R284404
STANDARD METHODS 4500-NO3 F (DISSOLVED) 2000								
Nitrogen, Nitrate-Nitrite (as N)	NELAP	0.100		**< 0.100**	mg/L	1	11/24/2020 13:49	R284515
SW-846 7196A								
Chromium, Hexavalent	NELAP	0.005	S	**< 0.005**	mg/L	5	11/20/2020 18:58	R284371
Matrix spike did not recover within control limits due to matrix interference.								
Elevated reporting limit due to matrix interference.								
SW-846 9012A (TOTAL)								
Cyanide	NELAP	0.100		**0.412**	mg/L	20	11/24/2020 15:54	171466
SW-846 9036 (TOTAL)								
Sulfate	NELAP	500		**1130**	mg/L	50	11/23/2020 19:51	R284495
SW-846 9214 (TOTAL)								
Fluoride	NELAP	0.10		**3.22**	mg/L	1	11/24/2020 12:56	R284532
EPA 600 4.1.4, 200.7R4.4, METALS BY ICP (TOTAL)								
Arsenic	NELAP	0.125		**1.10**	mg/L	5	11/25/2020 17:27	171423
Barium	NELAP	0.0125		**1.57**	mg/L	5	11/25/2020 17:27	171423
Boron	NELAP	1.00		**202**	mg/L	50	11/30/2020 23:38	171423
Calcium	NELAP	0.500	B	**6600**	mg/L	5	11/25/2020 17:27	171423
Chromium	NELAP	0.0250		**3.99**	mg/L	5	11/25/2020 17:27	171423
Copper	NELAP	0.0250		**3.52**	mg/L	5	11/25/2020 17:27	171423
Iron	NELAP	0.200		**1490**	mg/L	5	11/25/2020 17:27	171423
Lead	NELAP	0.0750		**1.32**	mg/L	5	11/25/2020 17:27	171423

Client: Hanson Professional Services, Inc. **Work Order:** 20111337

Client Project: CWLP analysis **Report Date:** 01-Dec-2020

Lab ID: 20111337-003 **Client Sample ID:** FGD SD

Matrix: AQUEOUS **Collection Date:** 11/20/2020 11:50

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
EPA 600 4.1.4, 200.7R4.4, METALS BY ICP (TOTAL)								
Magnesium	NELAP	0.250		**780**	mg/L	5	11/25/2020 17:27	171423
Manganese	NELAP	0.0350		**51.6**	mg/L	5	11/25/2020 17:27	171423
Nickel	NELAP	0.0250		**6.46**	mg/L	5	11/25/2020 17:27	171423
Potassium	NELAP	2.00		**153**	mg/L	20	11/25/2020 17:23	171423
Sodium	NELAP	0.250	B	**303**	mg/L	5	11/25/2020 17:27	171423
Zinc	NELAP	0.0500		**2.26**	mg/L	5	11/25/2020 17:27	171423
Sample results for Ca and Na exceed 10 times the method blank contamination. Data is reportable per the TNI Standard.								
EPA 600 4.1.4, 200.8 R5.4, METALS BY ICPMS (TOTAL)								
Cadmium	NELAP	0.0010		**0.176**	mg/L	5	11/25/2020 14:52	171424
Selenium	NELAP	0.0010		**4.84**	mg/L	5	11/25/2020 14:52	171424
Silver	NELAP	0.0010		**0.0030**	mg/L	5	11/25/2020 14:52	171424
MERCURY BY EPA METHOD 1631E (TOTAL)								
Mercury	NELAP	400		**30800**	ng/L	500	11/24/2020 13:29	171455

ATTACHMENT 6 – EVALUATION OF LOCATION STANDARDS

CITY WATER, LIGHT AND POWER
CCR SURFACE IMPOUNDMENT LOCATION RESTRICTIONS

The following information provides an evaluation of the CCR locations standards with respect to closure or retrofitting the CCR surface impoundments.

The locations restrictions consist of:

1. Placement Above the Uppermost Aquifer (§257.60)
2. Wetlands (§257.61)
3. Fault Areas (§257.62)
4. Seismic Impact Zones (§257.63)
5. Unstable Areas (§257.64)

Documentation showing compliance with the location standards must be placed in the operational record by October 17, 2018. If compliance cannot be certified, closure requirements of §257.101(b)(1) will apply. Each restriction is discussed separately below. The Lakeside and Dallman ash ponds are both considered CCR impoundments.

Placement Above the Uppermost Aquifer

The impoundments must be constructed with a base that is located no less than 5 feet above the upper limit of the uppermost aquifer, or must demonstrate that there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to fluctuations in the groundwater elevations. If the demonstration cannot be made by the aforementioned date, the facility must cease accepting the CCR and begin closure activities pursuant to §257.101(b)(1).

Definitions of relevant terms in the paragraph above include (from §257.53):

> "*Aquifer* means a geologic formation, group of formations, or portion of a formation capable of yielding usable quantities of groundwater to wells or springs."

> "*Uppermost Aquifer* means the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility's property boundary. Upper limit is measured at a point nearest to the natural ground surface to which the aquifer rises during the wet season."

It is debatable whether the deposits beneath the ash ponds are capable of yielding "usable" quantities of groundwater as the term is vague. Therefore, since the term "aquifer" is part of "uppermost aquifer," it can also be debatable if the unconsolidated deposits overlying the bedrock but beneath the ash ponds constitute an uppermost aquifer.

There are fine-grained sediments (silty clay/clayey silt) present beneath the ponds that do have confining hydraulic properties. However, there are also sand/sandy deposits that are water-bearing with potentiometric surfaces within 5 feet of the bottom of the ponds.

Documents from Hanson Engineers (1987) indicate the base of the Lakeside ash pond is approximately 535 feet above mean sea level (msl). Design drawings from Burns & McDonnell (1976) show the base of the Dallman ash pond to be approximately 533 feet above msl, with some variability. The potentiometric surfaces along the perimeter of the impoundments are largely above those elevations with the exception of the wells adjacent to (north and west) the Dallman ash pond. However, because the water level in the pond is approximately 548 feet above msl, an outward hydraulic gradient is present which fully saturates the soils beneath the impoundment. There is a direct hydraulic connection with the water table.

The term “uppermost aquifer” is contained in the RCRA Subtitle D regulations that were used when creating the CCR regulations. Additionally, the “uppermost aquifer” was incorporated into the 35 Illinois Administrative Code (IAC) Part 814, Subpart C regulations, which apply to the FGDS onsite landfill. The uppermost aquifer at the landfill site does include the water-bearing deposits beneath the landfill, which also extend beneath and adjacent to the ash ponds.

Based on the potentiometric surfaces and the bottom elevations of the Dallman and Lakeside ash ponds, it is likely the ponds would be found not to meet the location standard of §257.60. Therefore, either retrofit or closure must be implemented pursuant to §257.101(b)(1).

Wetlands

The applicable units must not be located in wetlands. The existing and potential applicable units are listed on the wetland inventory map as a wetland. Clarification with the U.S. Fish and Wildlife Service and the U.S. Army Corps of Engineers (USACE) should adequately address any issues. It is Andrews’ experience that no USACE permit will be necessary for any of the operational ponds (CCR or process) and that the wetlands can be disturbed or removed.

Fault Areas

The applicable surface impoundments must not be located within 200 feet of the outermost damage zone of a fault that has had displacement in Holocene time unless the owner or operator demonstrates that an alternative setback distance of less than 200 feet will prevent damage to the structural integrity of the CCR unit.

The fault areas for the FGDS landfill were identified as part of the initial Significant Modification Application (Log No. 1995-243-LFM). The study area incorporates that of the surface impoundments. There are no fault areas in the vicinity of the surface impoundments.

Seismic Impact Zones

The applicable units must not be located in seismic impact zones unless the owner or operator demonstrates that all structural components including liners, leachate collection and removal systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site.

The seismic impact zones were evaluated as part of the initial Significant Modification Application (Log No. 1995-243-LFM) to Unit 2 of the FGDS landfill, including evaluation of the slope and mass stability. The study area includes the location of the impoundments. The ponds are not located within a seismic impact zone that would pose a threat to the structural integrity of the impoundments.

Unstable Areas

The applicable units must not be located in an unstable area unless it can be demonstrated that recognized and generally accepted good engineering practices have been incorporated into the design of the CCR units to ensure that the integrity of the structural components of the CCR unit will not be disrupted.

Unstable area means a location that is susceptible to natural or human-induced events or forces capable of impairing the integrity of some or all of the structural components responsible for preventing releases from the CCR unit. The preamble implies these issues will specifically relate to foundation conditions resulting in mass movement of soils, or karst terrains where bedrock is involved.

The hazard potential classification assessment with oversight from the Illinois Department of Natural Resources, and structural integrity assessments, did not indicate any unstable areas in the immediate surface impoundment area. Geotechnical analyses were conducted for both the Lakeside and Dallman ponds, and for the FGDS landfill as part of the permitting process. As provided in the differing reports, the soil characteristics were adequate to support the structures designed for the Lakeside and Dallman ash ponds.

COMPLIANCE

Of the five location requirements, four appear to comply with the specific rules. However, unlined ponds are placed directly above and within 5 feet of the high water table for the uppermost aquifer. Either it must be demonstrated that there will not be intermittent, reoccurring or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer, or cessation of disposal and closure must begin.

Hydraulic separation can be shown by retrofitting the ponds. A composite liner consisting of a two-foot (minimum) low hydraulic conductivity (< 1.0×10^{-7} cm/sec) clayey material overlain by a minimum 30 mil geomembrane (or equivalent) will be adequate to demonstrate hydraulic separation. Part or all of the impoundments can be retrofitted to meet the location requirement.

City Water, Light & Power
Ash Impoundments
Springfield, Sangamon County, Illinois

Fault Areas Report for Coal Combustion Residuals Surface Impoundments

October 2021

Prepared for:
City Water, Light & Power
3100 Stevenson Drive
Springfield, Illinois 62703

ANDREWS ENGINEERING

3300 Ginger Creek Drive, Springfield, IL 62711 | 217.787.2334

ILLINOIS | MISSOURI | INDIANA

TABLE OF CONTENTS

APPENDICES

1. INTRODUCTION

City Water, Light and Power (CWLP) ash ponds are coal combustion residuals (CCR) surface impoundments, which include both the Lakeside and Dallman ash ponds. Andrews Engineering, Inc. (AEI) has completed a review of available information for compliance with the requirements under 35 IAC Part 845.320.

845.320(a) Existing and new CCR surface impoundments, and all lateral expansions of CCR surface impoundments, must not be located within 60 meters (200 feet) of the outermost damage zone of a fault that has had displacement in Holocene time unless the owner or operator demonstrates that an alternative setback distance of less than 60 meters (200 feet) will prevent damage to the structural integrity of the CCR surface impoundment.
…

Andrews Engineering, Inc. (AEI) performed the review of available information, which included the following source:

- U.S. Quaternary Faults Interactive Faults Map, USGS Geologic Hazards Science Center, U.S. Geological Survey (October 2021).

2. FAULT AREA LOCATIONS

The interactive faults map provided by the US Geological Survey (USGS) Geologic Hazards Science Center displays the most up-to-date information for quaternary faults in the United States.

A site plan showing the location of the CWLP CCR surface impoundments is included in Appendix A. A copy of a map generated by the US Quaternary Faults is included in Appendix B. According to this map, the Lakeside and Dallman ash ponds are more than 200 feet from the boundary of the nearest known fault area.

3. STATEMENT

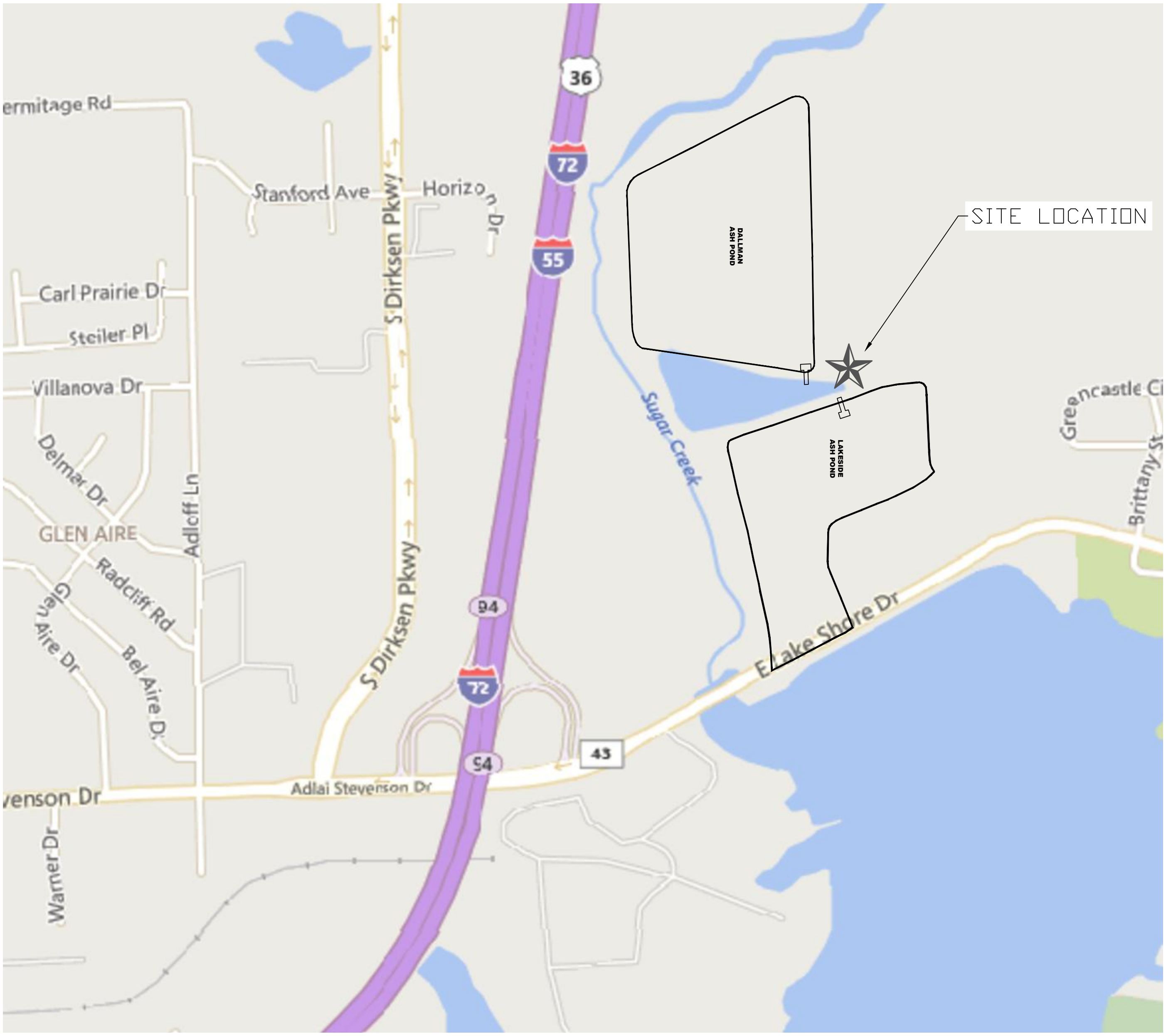
The Lakeside and Dallman ash ponds are existing CWLP CCR surface impoundments. It has been demonstrated as discussed above that the ash ponds are located more than 200 feet from the boundary of the nearest known fault area, and therefore meet the requirements of subsection (a) of 35 IAC Part 845.320.

Paul M. Van Metre, P.E. 10-20-21
Date

STATE OF ILLINOIS
PAUL VAN METRE
062-064175
REGISTERED PROFESSIONAL ENGINEER

APPENDIX A

CWLP CCR Surface Impoundments Site Plan
(Aerial Photograph)



N

0 500 1000 2000

SCALE: IN FEET

NOTE:
BASE IMAGE DERIVED FROM BING

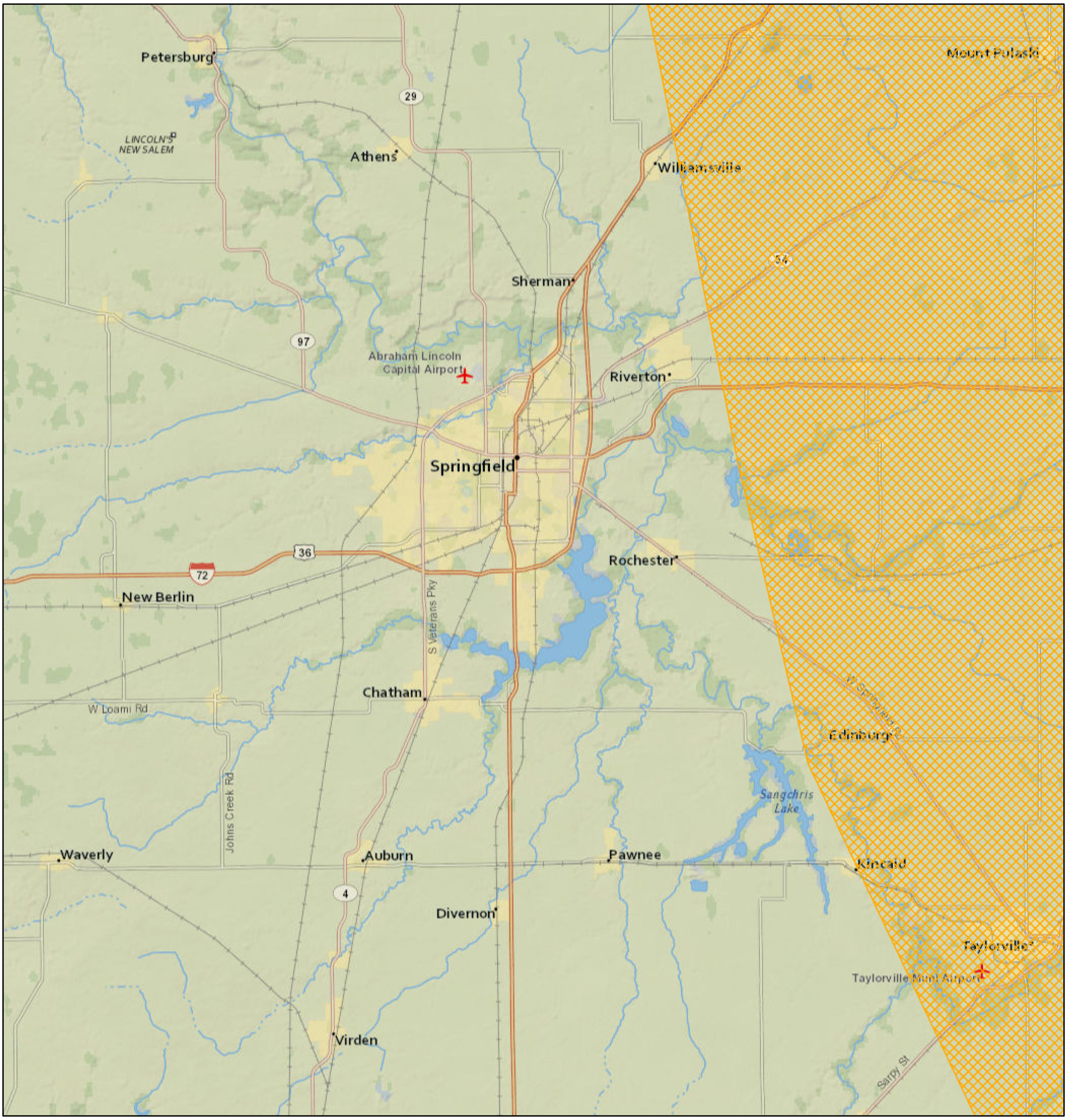
SITE LOCATION

ANDREWS ENGINEERING, INC. 3300 Ginger Creek Drive, Springfield, IL 62711-7233 Tel (217) 787-2334 Fax (217) 787-9495 Pontiac, IL • Naperville, IL • Indianapolis, IN • Warrenton, MO Professional Design Engineering and Land Surveying Firm #184-001541	SITE LOCATION MAP	DATE: OCTOBER 2016
	PLANS PREPARED FOR CWLP SPRINGFIELD, SANGAMON COUNTY, ILLINOIS	PROJECT ID: 150077/0011
APPROVED BY: PMV DESIGNED BY: PMV DRAWN BY: RMC		SHEET NUMBER: FIG. 1

APPENDIX B

U.S. Quaternary Faults Interactive Faults Map

U.S. Geological Survey Quaternary Faults



10/8/2021, 2:05:32 PM

1:288,895

0 2.5 5 10 mi

0 4 8 16 km

Fault Areas

- Class B
- historic
- late Quaternary
- latest Quaternary
- middle and late Quaternary

National Database

- Historic (< 150 years), well constrained location
- Historic (< 150 years), moderately constrained location
- Historic (< 150 years), inferred location
- Latest Quaternary (<15,000 years), well constrained location
- Latest Quaternary (<15,000 years), moderately constrained location
- Latest Quaternary (<15,000 years), inferred location
- Late Quaternary (< 130,000 years), well constrained location

National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

City Water, Light & Power
Ash Impoundments
Springfield, Sangamon County, Illinois

Wetland Assessment Report for Coal Combustion Residuals Surface Impoundments

October 2021

Prepared for:
City Water, Light & Power
3100 Stevenson Drive
Springfield, Illinois 62703

ANDREWS ENGINEERING

3300 Ginger Creek Drive, Springfield, IL 62711 | 217.787.2334

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APPENDICES

1. INTRODUCTION

City Water, Light and Power (CWLP) ash ponds are coal combustion residuals (CCR) surface impoundments, which include both the Lakeside and Dallman ash ponds. Andrews Engineering, Inc. (AEI) has completed a review of available information for compliance with the requirements under 35 IAC Part 845.310.

845.310(a) Existing and new CCR surface impoundments, and all lateral expansions of CCR surface impoundments, must not be located in wetlands unless the owner or operator demonstrates the following:
...

Andrews Engineering, Inc. (AEI) performed the review of available information, which included the following source:

- Wetlands Mapper, The National Wetlands Inventory, US Fish and Wildlife Service (October 2021).

2. WETLANDS LOCATION

The Wetlands Mapper tool provided by the US Fish and Wildlife Service (FWS) integrates National Wetland Inventory (NWI) data with additional natural resource information to provide users with a map-like view of America's wetland resources. It should be noted that the maps within the Wetlands Mapper tool are prepared from the analysis of high altitude imagery.

A site plan showing the location of the CWLP CCR surface impoundments is included in Appendix A. A copy of a map generated by the Wetlands Mapper is included in Appendix B. According to this map, the Lakeside and Dallman ash ponds have been identified as a Freshwater Emergent Wetland / Freshwater Pond and a Lake, respectively. This is likely a result of the imagery analysis of the ash ponds as they exist.

The nearest wetlands shown in the Wetlands Map that are not one of the CCR surface impoundments is the Riverine habitat (classified as a R2UBH) that is Sugar Creek as well as an adjacent Freshwater Forested/Shrub Wetland (classified as PFO1A).

3. STATEMENT

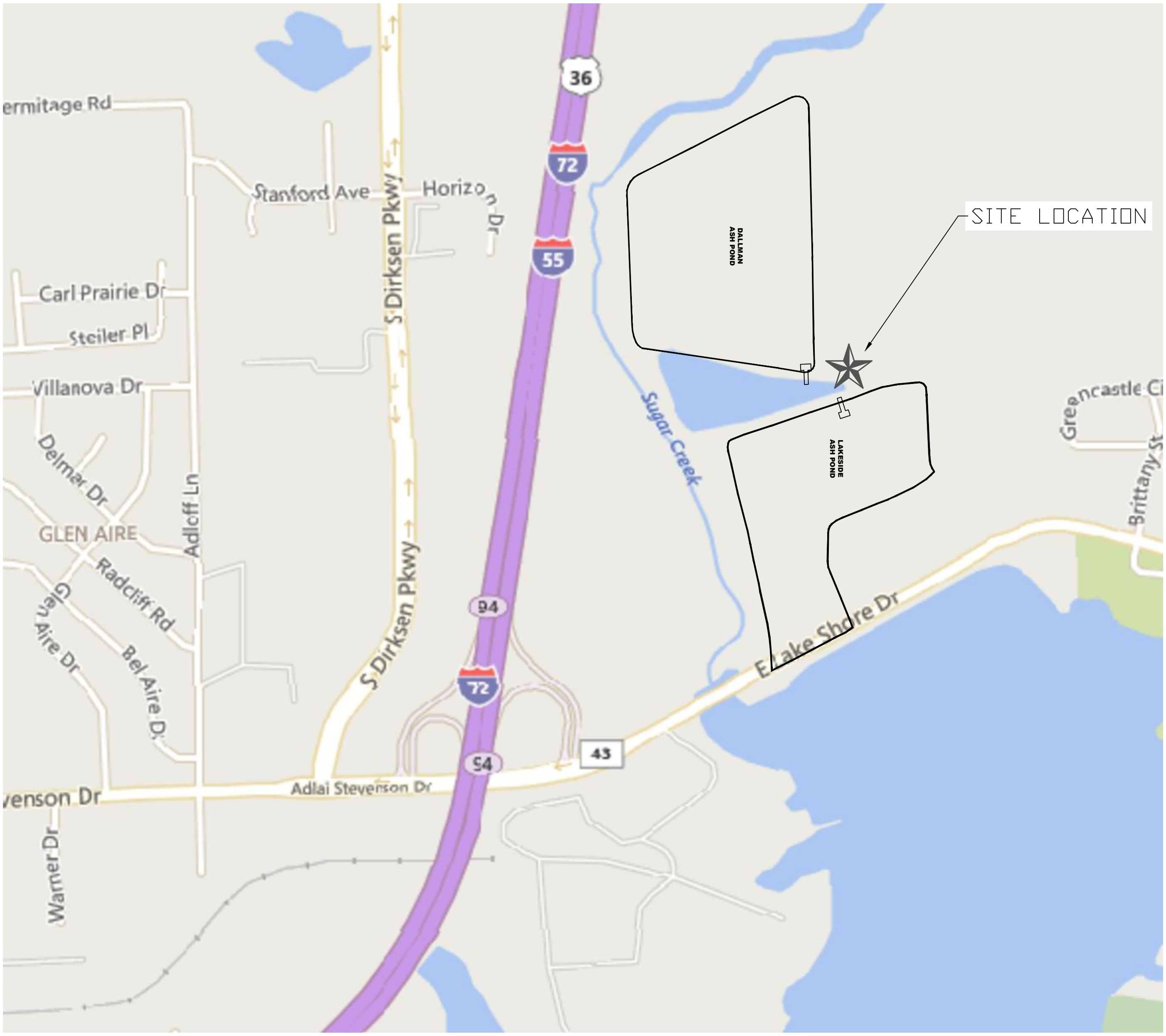
The Lakeside and Dallman ash ponds are existing CWLP CCR surface impoundments. It has been demonstrated as discussed above that the ash ponds are not located in wetlands, and therefore meet the requirements of subsection (a) of 35 IAC Part 845.310.

Paul M. Van Metre, P.E.	10-20-21 Date

STATE OF ILLINOIS
PAUL VAN METRE
062-064175
REGISTERED
PROFESSIONAL ENGINEER

APPENDIX A

CWLP CCR Surface Impoundments Site Plan
(Aerial Photograph)



SITE LOCATION

N

0 500 1000 2000

SCALE: IN FEET

NOTE:
BASE IMAGE DERIVED FROM BING

ANDREWS ENGINEERING, INC.
3300 Ginger Creek Drive, Springfield, IL 62711-7233
Tel (217) 787-2334 Fax (217) 787-9495
Pontiac, IL • Naperville, IL • Indianapolis, IN • Warrenton, MO
Professional Design Engineering and Land Surveying Firm #184-001541

SITE LOCATION MAP	DATE: OCTOBER 2016
	PROJECT ID: 150077/0011
PLANS PREPARED FOR CWLP SPRINGFIELD, SANGAMON COUNTY, ILLINOIS	SHEET NUMBER: FIG. 1

APPROVED BY: PMV | DESIGNED BY: PMV | DRAWN BY: RMC

NO.	DATE	REVISIONS DESCRIPTION	BY

ANDREWS ENGINEERING, INC.
3300 GINGER CREEK DRIVE
SPRINGFIELD, ILLINOIS 62711-7233
PH (217) 787-2334 FAX (217) 787-9495
PONTIAC, IL • LOMBARD, IL • INDIANAPOLIS, IN • WARRENTON, MO
PROFESSIONAL DESIGN ENGINEERING AND LAND SURVEYING FIRM #184001541

APPROVED BY: PMV DESIGNED BY: PMV DRAWN BY: MPN

CWLP COAL COMBUSTION RESIDUALS SURFACE IMPOUNDMENTS

PLANS PREPARED FOR
CITY, WATER, LIGHT & POWER
SPRINGFIELD, SANGAMON COUNTY, ILLINOIS

DATE: OCTOBER 2016

PROJECT ID: 150077/0011

SHEET NUMBER:

FIG. 2

J:\S\Springfield CWLP\CWLP\dwg\SURFACE IMPOUNDMENTS.dwg Tab: FIGURE 2 (2) Last Saved: October 6, 2016, by Ryan Curtis Plotted: Thursday, October 06, 2016 8:24:42 AM

APPENDIX B

FWS National Wetlands Inventory Wetlands Map

U.S. Fish and Wildlife Service
National Wetlands Inventory

CWLP wetlands

October 4, 2021

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

ATTACHMENT 7 – PERMANENT MARKER DOCUMENTATION

Attachment 4.1(a): Evidence that the permanent markers required by 35 Ill. Adm. Code 845.130 have been installed.

	CWLP Lakeside Ash Pond ID W1671200052-01 City of Springfield
	CWLP Dallman Ash Pond ID W1671200052-02 City of Springfield

ATTACHMENT 8 - SURFACE IMPOUNDMENTS CLOSURE PLAN

City Water, Light & Power
Ash Impoundments
Springfield, Sangamon County, Illinois

Closure Plan for Coal Combustion Residuals Surface Impoundments

October 2021

Prepared for:
City Water, Light & Power
3100 Stevenson Drive
Springfield, Illinois 62703

ANDREWS ENGINEERING

3300 Ginger Creek Drive, Springfield, IL 62711 | 217.787.2334

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APPENDICES

1. INTRODUCTION

City Water, Light and Power (CWLP) ash ponds are coal combustion residuals (CCR) surface impoundments, which include both the Lakeside and Dallman ash ponds. The locations of these CCR units are shown in Appendix A of this Plan. This closure plan was prepared according to the requirements under 35 IAC Part 845.720.

The closure for Lakeside Ash Pond and the Dallman Ash Pond will be accomplished by leaving CCR in place. The closure of both ponds will contain the following elements:

- Drainage/dewatering of ash ponds
- Stabilization of CCR
- Structural fill, if necessary
- Final cover system

Details of these items are discussed in the following sections. This plan may be revised at any time as allowed under 35 IAC Part 845.720 (b)(3). Amendments to this plan will be required if and when any significant changes occur to the operation of the CCR units that would substantially affect this plan, or unanticipated events necessitate a revision of this plan. This plan must be amended at least 60 days prior to a planned change in operation of the facility or CCR unit, or no later than 60 days after an unanticipated event requires the need to revise this closure plan.

2. CLOSURE PLAN

2.1 Drainage/Dewatering

Free liquids will be removed from the ash ponds by utilizing existing pumping structures that will remove the liquids to an existing clarification pond, located to the south of the Dallman Ash Pond. Water will eventually be discharged by permitted NPDES Outfall 004. The dewatering will be monitored for effectiveness and other methods employed to complete the process if determined to be necessary. Vegetation existing inside the pond will be removed during this process.

2.2 CCR Material Stabilization

After fee liquids and vegetation are removed from the ash ponds, CCR materials within the inactive Fly Ash Pond will be stabilized by grading and compacting to minimize the probability of future impoundment of water or sediment due to settlement. Grading and compacting the CCR materials will also provide slope stability to prevent sloughing or movement of the final cover system. Grading design plans and compaction specifications for CCR material stabilization will be developed during the final engineering design, but will likely include a minimum slope of one to two percent to promote surface drainage. Structural fill may be added above the CCR material to provide sufficient slope for the final cover system.

2.3 Final Cover System

The preliminary design of the final cover system for the Ash Ponds will meet the requirements of 35 IAC Part 845.750. In order to meet these requirements, the final cover design will contain the following elements:

2.3.1 Low Permeability Layer

A low permeability compacted soil layer with a maximum permeability of $1x10^{-7}$ cm/sec will be placed. This low permeability layer will be at least three feet thick and will minimize the infiltration of liquids through the CCR units. Material to be used for the compacted low permeability soil layer will be Unified Soil Classification System types ML, CL, or CH. The source of cover material will be from onsite stockpiles and nearby borrow areas.

The compacted soil layer is to be placed in lifts not to exceed eight inches (8-inches loose). The low permeability layer will be compacted with a sheepsfoot roller or a self-propelled soil compactor. Each layer will be worked sufficiently to breakdown oversized clods, obtain a uniform moisture content and ensure uniform density as needed. The soil material will be placed at a moisture content above optimum and recompacted to at least 95-percent Standard Proctor density (ASTM D698) to achieve a hydraulic conductivity of $1.0x10^{-7}$ cm/sec.

Three-inch diameter Shelby tube samples shall be taken from the compacted soil layer and subsequent tests shall be completed in accordance with the Flexible Walled Permeameter (ASTM D5084) to verify the permeability of the compacted low permeable soils. Nuclear density tests and Field Moisture Tests (ASTM D6938) will be completed to confirm appropriate moisture and compaction of the soil material. All voids generated as a result of the Shelby tube sampling will be backfilled with hydrated bentonite to maintain competency of the compacted soil layer. Proctor samples will be taken in accordance with the proposed Construction Quality Assurance Plan (Section 2.3).

Roots, cobbles, debris, organic, and other deleterious material will be removed from the soil material prior to compaction. Cover thickness documentation will be conducted separately for the compacted soil layer and the final protective layers, by boring locations selected utilizing a 100-foot grid (for the earthen low permeability layer component only) or by topographic surveying prior to and after placement of final cover system components. Areas disturbed by borings will be filled with a mixture of bentonite and cover spoil.

Material to be used for the compacted low permeability soil layer will be Unified Soil Classification System types ML, CL, or CH. The source of cover material will be from onsite stockpiles and borrow areas. Adequate records are available from past testing to demonstrate that this material can achieve a maximum permeability of 1.0×10^{-7} cm/sec when compacted.

Testing of the earthen component of the low permeability layer will be done to fulfill these frequencies on a minimum basis:

Testing Parameter	Test Method	Min. Testing Frequency
Nuclear Density (Including Moisture Content)	ASTM D6938	5 test/Acre Lift
Atterberg Limits	ASTM D4318	1 test/10,000 yd^3
Grain Size Distribution	ASTM D422	1 test/10,000 yd^3
Standard Proctor Density	ASTM D698	1 test/10,000 yd^3
Laboratory Permeability	ASTM D5084	1 test/10,000 yd^3

2.3.2 Erosion Layer

An erosion layer containing a minimum of 6 inches of soil capable of sustaining plant growth will overlie the low permeable layer. The soil used for the erosion layer should not be compacted and should be the best onsite readily available soil for supporting vegetation. Shallow-rooted grasses and legumes should be used to establish a vegetative growth for erosion control. The mixture of grasses and legumes selected must be amenable to the soil quality and thickness, slopes, moisture, and climatological conditions that exist without the need for continued maintenance.

Lime, fertilizer, and any other appropriate soil amendments, may be incorporated into the erosion layer at application rates determined from composite soil tests of the area to be seeded. Mulch consisting of straw, yard waste compost, jute, and/or wood excelsior may be used as necessary to hold the seed in place and conserve moisture. A professional knowledgeable in vegetation establishment will be consulted for determining the specific seed mixtures to be sown, suitable soil amendments, and application rates based upon specific seasonal conditions at the time of placement.

2.3.3 Final Grading Design

A final grading design will be implemented that accommodates the anticipated amount of settling and/or subsidence of the CCR materials, as well as any structural fill placed in the CCR units. The thickness of CCR materials remaining in the Ash Ponds will be estimated. Published parameters for similar CCR materials or laboratory results of analysis performed on CCR samples taken from the Ash Ponds will be used to determine the appropriate slopes required to maintain sufficient drainage in order to minimize infiltration of liquids through the CCR units.

3. CCR INVENTORY ESTIMATES

The maximum inventory of CCR ever on site for the active life of the Lakeside Ash Pond is estimated to be equivalent to the current inventory of CCR in that unit. According to CWLP personnel, the Lakeside Ash Pond currently has an approximate impounded CCR volume of 1,080,000 cubic yards. Therefore, premature closure or closure near the end of regulatory life of the facility will be essentially the same. There is no need to provide a separate premature closure plan.

The storage capacity for the Dallman Ash Pond is 1,100,000 cubic yards. The Dallman Ash Pond currently has an approximate impounded CCR volume of 978,000 cubic yards, approximately 28,000 cubic yards of which is piled up above the normal water elevation that is being dried out for beneficial reuse. The maximum inventory of CCR ever on site for the active life would not exceed the 1,100,000 cubic yard storage capacity.

4. FINAL COVER AREA

It is assumed that the entire area of the ash ponds represents the largest area that will require a final cover system, as described in Section 2.3 of this report. Under these assumptions, the Lakeside Ash Pond will require a final cover system of approximately 27.6 acres, and the Dallman Ash Pond will require a final cover system of approximately 34.5 acres.

5. CLOSURE SCHEDULE

Closure of each Ash Pond will occur when the CCR unit is considered inactive, as determined by CWLP. The closure process will commence no later than 30 days after the date on which the CCR unit receives the known final receipt of CCR, or removes the final volume of CCR from the CCR unit for the purpose of beneficial use. If the final receipt of CCR is not known, then the closure process must still commence if the CCR unit has not received CCR material, or has not had CCR material removed from it for a duration of two years, unless it can be demonstrated that the idle unit will resume to receive or remove CCR materials in the foreseeable future.

The general sequence and timing of closure activities identified below will be applied to the closure of each Ash Pond as follows:

Season 1 – Initiation of the closure process
- Final engineering design
- Dewatering of CCR materials
- Remove existing vegetation
- Initial grading and compaction of CCR materials

Season 2 – Beginning one year after initiation of closure process
- Complete grading of CCR materials
- Add and grade structural fill, if necessary
- Construction of final cover system

Season 3 – Beginning two years after initiation of closure process
- Complete construction of final cover system, if necessary

6. NOTICES AND REPORTS

6.1 Closure Notices

In accordance with 35 IAC Parts 845.730(d), and 845.760(f), the following closure documentation will be completed and placed in the CWLP's CCR operating record and on the CWLP website:

- Notification of Intent to Close (Due on the date of the initiation of closure)
- Notification of Completion of Closure (30 days after completion of closure activities)
    - Will include a certified Construction Acceptance Report

6.2 Construction Acceptance Report

Both the Operator and a Professional Engineer (Engineer) must certify that closure is in accordance with the closure plan. Therefore, the Engineer should be retained at the outset of the closure process so that all aspects of the closure can be overseen. The Engineer will need to spend sufficient time on site to ensure adequate cover quality and thickness as well as proper completion of the other tasks. Furthermore, the Engineer will conduct testing to meet the requirements of the final cover design. The Engineer's services will include the preparation of plan sheets showing the final conditions at the closed site.

6.3 Deed Notations

Following the closure of all units, the owner or operator will record a notation on the deed to the landfill property, or some other instrument that is normally examined during title search. Within 30 days of the deed notation, a notification that the notation has been recorded and a copy will be placed in the operating record, and posted on the CWLP's website. The notation on the deed will in perpetuity notify any potential purchaser of the property that the land has been used as a CCR unit and its use is restricted under 35 IAC Part 845.760(h).

7. STATEMENT

This Closure Plan for Coal Combustion Residuals Surface Impoundments was completed for CWLP by Andrews Engineering, Inc. in accordance with the requirements under 40 CFR Part 720.

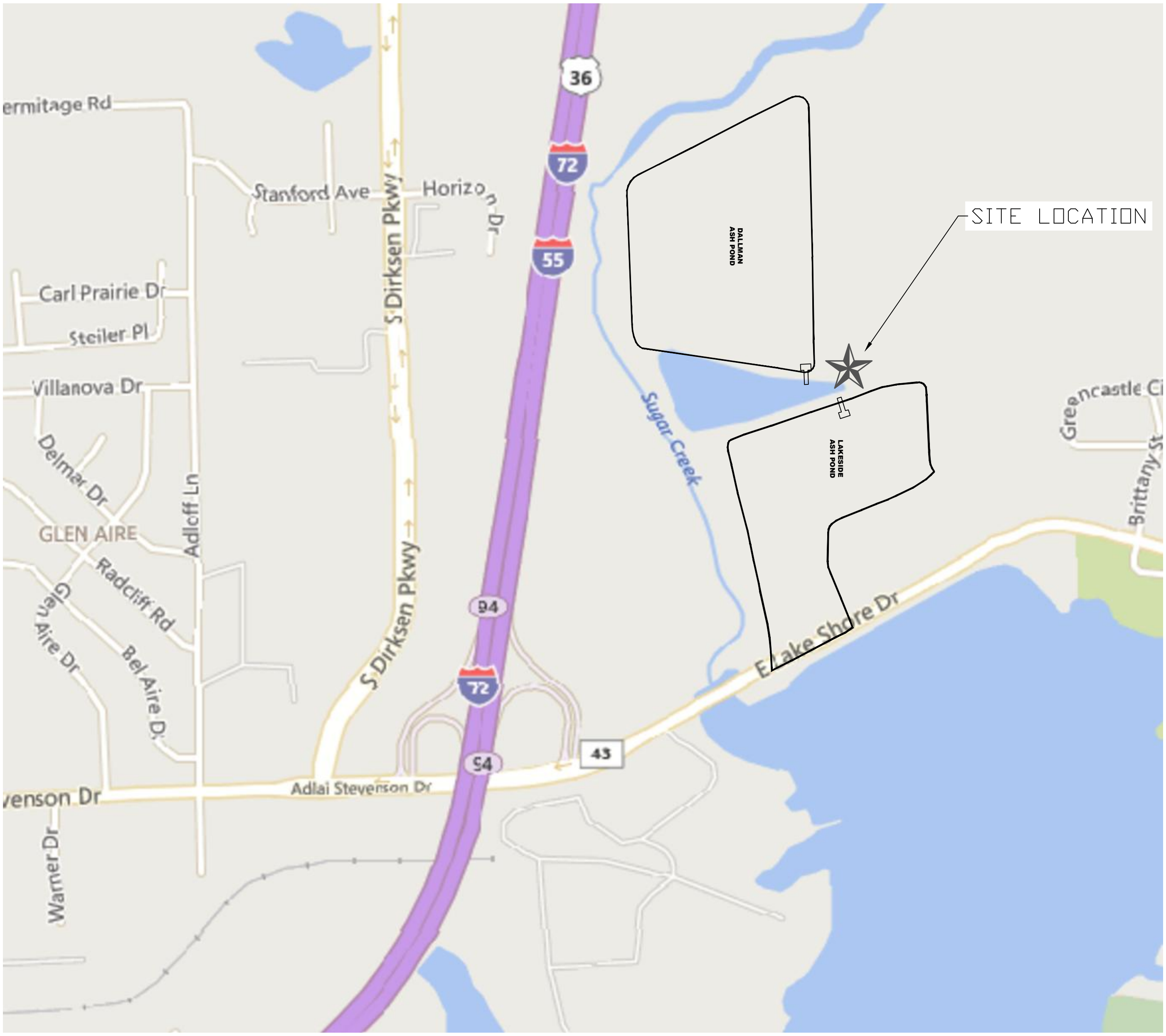
Paul M. Van Metre, P.E.

10-20-21

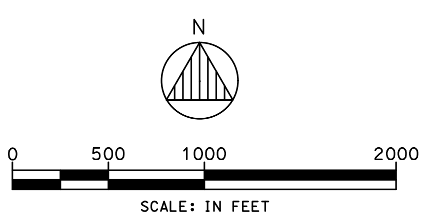
Date

APPENDIX A

Site Map



SITE LOCATION



NOTE:
BASE IMAGE DERIVED FROM BING

ANDREWS ENGINEERING, INC.
3300 Ginger Creek Drive, Springfield, IL 62711-7233
Tel (217) 787-2334 Fax (217) 787-9495
Pontiac, IL • Naperville, IL • Indianapolis, IN • Warrenton, MO
Professional Design Engineering and Land Surveying Firm #184-001541

APPROVED BY: PMV	DESIGNED BY: PMV	DRAWN BY: RMC

SITE LOCATION MAP

PLANS PREPARED FOR

CWLP

SPRINGFIELD, SANGAMON COUNTY, ILLINOIS

DATE: OCTOBER 2016

PROJECT ID: 150077/0011

SHEET NUMBER:

FIG. 1

NO.	DATE	REVISIONS DESCRIPTION	BY

ANDREWS ENGINEERING, INC.
3300 GINGER CREEK DRIVE
SPRINGFIELD, ILLINOIS 62711-7233
PH (217) 787-2334 FAX (217) 787-9495
PONTIAC, IL • LOMBARD, IL • INDIANAPOLIS, IN • WARRENTON, MO
PROFESSIONAL DESIGN ENGINEERING AND LAND SURVEYING FIRM #184-001541

APPROVED BY: PMV DESIGNED BY: PMV DRAWN BY: MPN

CWLP COAL COMBUSTION RESIDUALS SURFACE IMPOUNDMENTS

PLANS PREPARED FOR
CITY, WATER, LIGHT & POWER
SPRINGFIELD, SANGAMON COUNTY, ILLINOIS

DATE: OCTOBER 2016
PROJECT ID: 150077/0011
SHEET NUMBER:

FIG. 2

ATTACHMENT 9 – EMERGENCY ACTION PLAN AND ACCOMPANYING CERTIFICATION

Emergency Action Plan

Prepared for:

City Water, Light and Power

3100 Stevenson Drive

Springfield, Illinois 62703

Prepared by:

Hanson Professional Services, Inc

1525 South Sixth Street

Springfield, Illinois 62703

Emergency Action Plan

Ash Ponds: Lakeside Dallman

Sangamon County, Illinois

~~March 2016~~

~~Revision 1: July 2021~~

Revision 2: October 2021

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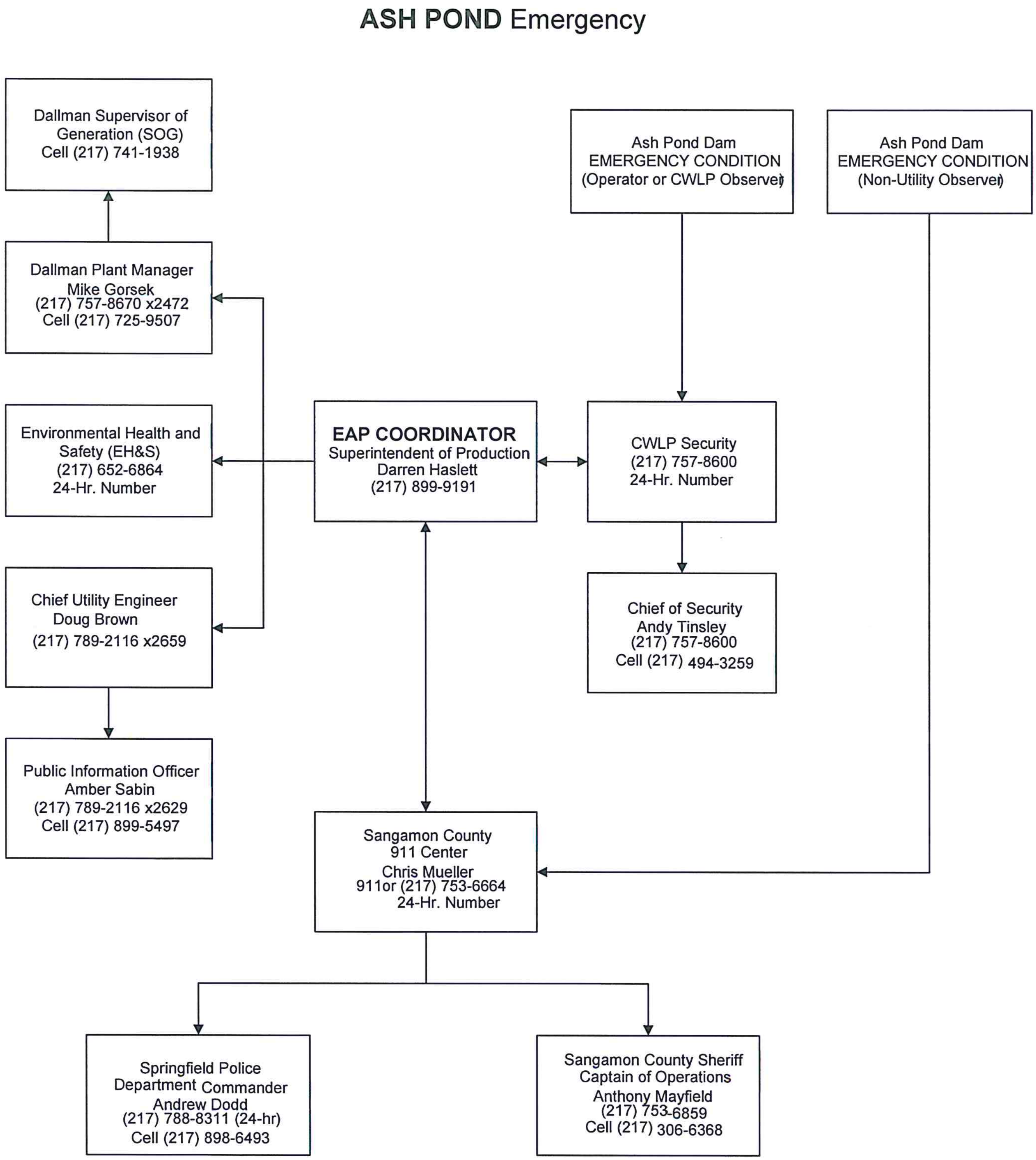
Tables

Figures

Appendices

1. Notification Flowchart



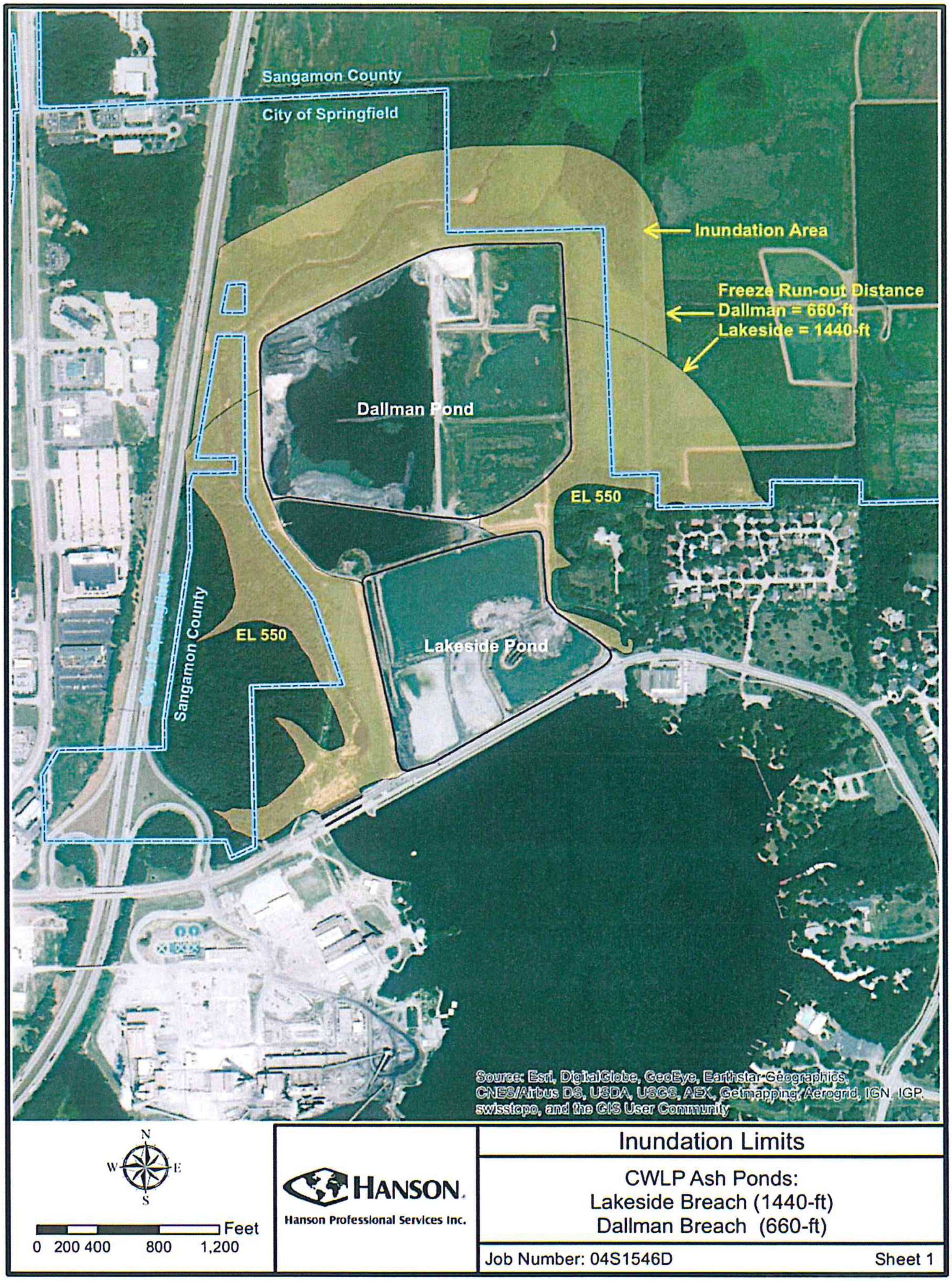


Figure 1-1: Inundation Area Map

2. Purpose

The purpose of this Emergency Action Plan (EAP) is three-fold:

A. to define the procedures which will be used to identify unusual conditions which may endanger the Ash Pond Dams and specify the actions to be taken to mitigate any such dangerous condition;

B. to define specific responsibilities and procedures which will be followed to notify all appropriate CWLP personnel and emergency management officials of possible, impending, or actual failure of the dam; and

C. to reduce property damage in the event of failure of the Ash Pond Dams.

This Emergency Action Plan was developed by Hanson Professional Services Inc. and adopted by CWLP. The Plan is not in any way intended to reflect on the structural integrity of the dam.

3. Dam Description and Location

There are no structures identified within the inundation limits. Based on the anticipated inundation area shown in Figure 1-1, an ash pond dam failure is not a direct hazard to public safety. There are no residential structures, no frequently traveled roads and no people commonly in the area outside of CWLP personnel.

3.1 Details and Location

A location map for the Ash Disposal Pond Dams is provided in Figure 1-1. The ash disposal site includes three impounding structures: (1) Lakeside Pond Dam; (2) Dallman Pond Dam; and (3) a clarification pond dam. A failure of the clarification pond dam is not anticipated to result in loss of life or any significant economic damage. Therefore, problems with, or failure of, the clarification pond dam are not addressed in this document.

The CWLP ash pond dams are located in the East 1/2 of Section 12, Township 15 North, Range 5 West of the Third Principal Meridian in Sangamon County, Illinois. More specifically, the dams are located immediately north of Lake Springfield's Spaulding Dam in Springfield, Illinois. The latitude of the site is 39.7639°N, and longitude is 89.5983°W.

3.2 Determination of Inundation Area

When saturated ash liquefies (due to shaking or excessive stress) it will flow much like a liquid until the surface of the ash is flat enough to resist flow or "freeze". It is estimated that the travel time required for an ash breach wave to reach a sufficiently flat slope to "freeze" is less than 3 minutes. During this time, the ash flow could be expected to travel up to 1/4 mile. The breach inundation map provided in Figure 1-1 depicts the 1/4 mile limit around the dam. The shown example assumes a worst case scenario, i.e., failure after ash has been stacked to its ultimate height. In addition to the run-out, or "freeze" limits, the inundation limits also account for topography noting that the breach will not extend to a depth greater than half of the original dam height. There are no structures identified within the inundation limits.

3.3 Potential Hazards

While it is anticipated that there is not a direct public safety hazard, it is recognized that an ash pond dam failure would result in an environmental hazard. To mitigate this hazard, CWLP has incorporated measures for control, monitoring, clean-up and restoration in order to minimize the potential impacts.

4. Classification of Emergency Conditions

4.1 Failure Has Occurred or Is Imminent –CONDITION A

Obviously, if failure of the dam has occurred or is imminent, the situation shall be treated with utmost urgency and the Sangamon County 911 Center shall be **IMMEDIATELY** notified to **EXECUTE THE NOTIFICATION FLOWCHART** for protection of the dam breach area. Failure shall be deemed imminent for any of the following conditions:

A. water flowing over the crest of any portion of the perimeter embankment;

B. a breach in any portion of the perimeter embankment; or

C. sudden and severe sliding or cracking of any portion of the perimeter embankment.

4.2 Potential Failure Situation Is Developing – CONDITION B

This is a situation where a failure of the dam may eventually occur, but actions may be taken to moderate or alleviate failure. This matter is extremely serious and must be treated with urgency. The Sangamon County 911 Center shall be immediately notified of the situation so they may **BE PREPARED** to EXECUTE THE NOTIFICATION FLOWCHART if the condition worsens. A failure situation shall be deemed to be developing for any of the following conditions:

A. unaccounted for seepage or any increase in the rate of flow of any existing seep;

B. muddy or chalky water discharge from any portion of the perimeter embankment or from concrete joints, cracks, or openings; or

C. "boils" forming in any portion of the perimeter embankment or downstream areas.

5. Emergency Detection, Evaluation and Response

The following problems are indicators of a potential or actual emergency. This section presents information for detecting, evaluating and responding to problems to aid the dam operator in a first response. In all cases, suspected problems should be reported to the Superintendent of Production and Chief of Security. Additional assistance as necessary should be obtained from a qualified engineer as soon as possible. In all cases where failure of the dam is deemed to be developing or is imminent, extreme caution and concern for emergency responders shall be exercised in the performance of the prescribed protective actions.

5.1 Cracks *– See Appendix C – Page 17*
5.2 Seepage *– See Appendix C – Page 17*
5.3 Piping *– See Appendix C – Page 18*
5.4 Boils *– See Appendix C – Page 18*
5.5 Slides *– See Appendix C – Page 18*
5.6 Failure of the Principal Spillway *– See Appendix C – Page 19*
5.7 Overtopping *– See Appendix C – Page 19*

5.8 Erosion

Fly ash and bottom ash are highly erosive materials. Accordingly, all ash berms shall be routinely inspected, particularly after rainfall events of any significance. If at any time erosion rills develop to a depth of two feet or greater the affected area(s) shall be immediately repaired to restore appropriate lines and grades.

5.9 Dewatering Plan

If a problem develops with any portion of the earthen embankment which necessitates lowering of the water/slurry level, the following actions shall be taken:

A. all slurry discharge to the ash ponds shall be immediately ceased;

B. all stop logs in the transfer channels shall be immediately removed; and

C. depending on the effectiveness of the above measures to address the problem, pumping shall be immediately employed to assist in the dewatering effort.

6. Specific Responsibilities under the Plan

6.1 Dam Owner Responsibilities

CWLP is the owner of the Ash Pond Dams and the responsible parties listed in this EAP are employees of CWLP.

The development and maintenance of this EAP is critical to minimizing the damages in the event that a problem occurs at the dam. A failure of the dam is a dangerous scenario that could result in loss of life to anyone in the area in a matter of minutes. Therefore, for this EAP to be effective, the persons responsible for notification, in Section 6.2 below, must be confident that they have the authority and ability to make a quick and decisive decision to execute this EAP in the event that a problem becomes evident at the dam.

Specific decisions, communications and actions that are required of each participant in this plan are detailed in Section 6.2 below. Communications between all participants (CWLP employees and local authorities) must be clear and direct. For example, all communications should include the following information:

- ❑ Caller's name and title
- ❑ Exchange of telephone numbers
- ❑ Time and date that problem was identified
- ❑ Details of the problem
- ❑ Classification of Emergency Condition (A-impending failure or B-potential failure)
- ❑ Mutual confirmation of actions to be taken
- ❑ Time frame for contacting that person with an update
- ❑ Clear indication of whether this is a TEST or an ACTUAL EMERGENCY

When possible, a log of all communications should be kept during the emergency so that response procedures can be reviewed at a later time for improvement of the EAP.

6.2 CWLP Responsibilities for Notification

A) Superintendent of Production

The Superintendent of Production will serve as the **EAP Coordinator** for an emergency condition at the ash pond dams. The EAP coordinator will be responsible for all EAP-related activities, including preparing revisions to the EAP. Following termination of any emergency, the EAP coordinator will complete a follow-up evaluation with all responders during the emergency. The results of the evaluation and any recommended procedural changes to the Emergency Action Plan will be documented in a written report.

The Superintendent of Production will be the first position in the emergency notification chain. If the Superintendent of Production determines that Emergency Condition A exists (as detailed in Sections 4 and 5), he will immediately:

a. call the Sangamon County 911 Center and initiate the notification process, as provided in the Notification Flowchart and reiterated as follows, **(see 6.4 for Anticipated Impacts)**

b. notify CWLP Security,

c. notify the Dallman Plant Manager,

d. notify Environmental Health and Safety (EH&S) and,

e. notify the General Manager of Public Utilities.

The Superintendent of Production will make a clear emphasis on which Emergency Condition exists and the appropriate response, including the location of any breach or potential breach for the identification of security.

The Superintendent of Production will also be responsible for on-site monitoring of the situation at the dam and keeping all authorities informed of developing conditions at the dam from the time that an emergency starts until the emergency has been terminated. He will be responsible for declaring that the emergency at the dam is terminated.

B) Chief of Security

CWLP Security will notify the EAP Coordinator (Superintendent of Production) of the situation and will control access to the plant and site.

C) Dallman Plant Manager

The Dallman Plant Manager will contact the Dallman Power Station Control Room and provide appropriate direction regarding changes to operations to prevent additional slurry discharge to the ash ponds. He will clearly emphasize which Emergency Condition exists and the appropriate response, including the location of any breach or potential breach.

D) Environmental Health and Safety Officer

The Environmental Health and Safety Officer will oversee actions to control the material to the extents of the initial inundation. Downstream control will be established to prevent material from migrating away from the site. Coordination with the Spaulding Dam Operator will be conducted to minimize lake discharges when warranted and practical. Monitoring will be established to evaluate impacts. Clean-up will be conducted to restore the impacted area to pre-failure conditions.
Coordination will be maintained with the appropriate environmental regulatory agencies.

E) General Manager of Public Utilities

The General Manager of Public Utilities will contact the Public Information Officer with clear emphasis on which Emergency Condition exists and the appropriate response, including the location of any breach or potential breach.

He will assist in dissemination of a press release that the emergency at the dam is terminated.

F) Public Information Officer

The Public Information Officer will coordinate press releases with the media.

6.3 Non-CWLP Personnel Responsibilities

A) Sangamon County 911 Center

The Sangamon County 911 Center will contact the Springfield Police Department and Sangamon County Sheriff's Office and advise them of the emergency status.

B) Springfield Police

As appropriate, the Springfield Police Department will:

a. provide warnings and notifications to affected downstream, and adjacent residential, properties.

b. provide a safety buffer of the potentially affected downstream properties.

c. coordinate the closure and/or traffic direction of affected roads, as needed.

C) Sangamon County Sheriff

As appropriate, the Sangamon County Sheriff's Office will:

a. provide warnings and notifications to affected downstream, and adjacent residential, properties.

b. provide a safety buffer of the potentially affected downstream properties.

c. coordinate the closure and/or traffic direction of affected roads, as needed.

6.4 Anticipated Impacts

- The ash pond dam failure is ***not*** anticipated to be a public safety hazard. Material from the CWLP ash ponds will not extend far from the dam embankments (see Figure 1-1).
- There are no residential structures, roadways or people commonly within the inundation limits other than CWLP personnel.
- The ash pond dam failure is anticipated to be an environmental hazard with potential economic losses.
- Impacts may be minimized by implementing downstream control measures, monitoring and enacting immediate repairs, clean-up and restoration.
- Refer to Figure 1-1 (Ash Page 2) for an inundation map of the anticipated hazard area.

7. Preparedness

7.1 Normal Conditions Surveillance

CWLP shall follow the Lakeside Ash Pond Dam and Dallman Ash Pond Dam Maintenance Plan. A preventative maintenance schedule has been established through the CWLP work order system, which documents all major activities that occur at the ash ponds, including periodic inspections per 17 Ill. ADM. Code Part 3702 Construction and Maintenance of Dams.

7.2 Unusual and Potentially Dangerous Conditions Surveillance

The ash pond dams are designed to accommodate the design flood of 0.5 Probable Maximum Flood event at Lakeside and 0.3 Probable Maximum Flood event at Dallman with the standard discharge of water outside the system. However, immediately following any unusually high rainfall or windstorm, or any seismic event, the shift supervisor or a designated representative shall make visual inspections of the embankments and appurtenances. The EAP Dam Inspection Checklist (Appendix A) shall be completed for all unusual or potentially dangerous conditions inspections and copies shall be provided as soon as possible to the Superintendent of Production for review. If any problems are detected or suspected, a qualified engineer shall perform an inspection and provide an evaluation and recommended action. If any potential failure situation is developing (CONDITION B as detailed in Section 4.2), the Sangamon County 911 Center shall be immediately notified of the situation to be prepared to act if the condition worsens.

7.3 Response During Periods of Darkness

The power plant has generators and portable lights available as well as spotting lights for response during periods of darkness.

7.4 Access to the Site

The dam is accessible from the roads depicted in Figure 1-1: Inundation Area Map.

7.5 Response During Weekends and Holidays

The Dallman Power Station is manned 24 hours a day, seven days a week. There will always be a shift supervisor on site at the plant. The contact number for the Sangamon County 911 Center is also 24 hour contact number.

7.6 Response During Periods of Adverse Weather

Sangamon County provides maintenance of the local county roads. The power station has two pickup trucks with blades and also has snow removal capability. The shift supervisor should be contacted with regard to usage of this equipment.

7.7 *Alternative Systems of Communication*

The numbers listed on the notification flowchart contain land line numbers and cell numbers for the CWLP personnel. CWLP personnel also carry radios that can be used to communicate between CWLP personnel on site.

7.8 *Annual Exercise with Local Emergency Responders*

Employees of CWLP are active members of the Sangamon Valley LEPC and participate in regular meetings and exercises with the LEPC and local first responders. On an annual basis, CWLP will facilitate a review of this EAP during a regularly scheduled meeting of the Sangamon Valley LEPC or as a face-to-face table top exercise in conjunction with the annual meetings conducted with the LEPC and local first responders by CWLP's Water Division for their Lake Springfield Emergency Action Plan – Spaulding Dam and Saddle Dam. Documentation of the meeting minutes and sign in sheet will be maintained as part of this plan.

7.9 *Emergency Equipment and Materials Locations*

The following equipment and materials are available on site at CWLP:

CWLP Equipment – Track Excavators, Endloaders, Cherry Picker, Emergency Lighting, Trucking
CWLP Materials – Aggregate, Riprap, Clay, Sand
Bill Antonacci 217-361-4948 (24 hours)
CWLP Coalhouse 217-757-8670, x-2433 (7AM-11PM)

Equipment and Materials can also be obtained following locations:

Company	Contact	Supplying	Contact Number
Darren Burris, Inc.	Charles Eades	Equipment, Trucking	217-306-6247 (c); 217-528-7741 (o)
United Contractors Midwest	Jeff Clausen	Equipment, Trucking	217-494-9905 (c); 217-546-6192 (o)
Buckhart Sand & Gravel	Barney Flatt	Gravel, Sand, Riprap	217-652-1752 (c); 217-498-7248 (o)
Callender Quarry	Bruce Callender	Gravel, Sand, Riprap	217-285-5487 (c); 217-285-2161 (o)
Rain For Rent	Dave Partney	Diesel Pumps 22k gpm	618-781-0842 (c); 618-931-0901 (o)
Linden and Company	Jerry Boyles	Submer Pumps 50k gpm	309-696-7026 (c); 309-691-4811 (o)
Great Western Bag Co	Barry Roche	Sand Bags	314-686-5198 (c); 314-421-0498 (o)
Sunbelt Rentals	Adam Reeter	Emergency Lighting	217-725-5594 (c); 217-528-1065 (o)

7.10 *Professional Certification*

This Revision 2 of the Emergency Action Plan for the Lakeside and Dallman Ash Ponds meets the requirements of 35 Illinois Administrative Code Part 845.

William E. Antonacci 10/19/21

William E. Antonacci, P.E. Date

WILLIAM E. ANTONACCI
062-057915
LICENSED
PROFESSIONAL
ENGINEER
STATE OF ILLINOIS

Ash Appendix

Appendix Ash-A

Emergency Action Plan

Ash Pond Dam Inspection Checklist

EAP Dam Inspection Checklist

(To Be Used Only for Unusual or Potentially Dangerous Conditions Inspections)

Dam Name (circle one): Lakeside Ash Pond Dam or Dallman Ash Pond Dam .

Date: ______________________ Time: ____________________

Name of Inspector: ____

Reservoir Elevation: ______________ feet

ITEM	NO	YES	IF YES
Flow over top of dam			**Emergency Notification - Condition A**
Structural failure of spillway			
- no discharge of water from the reservoir			Initiate Dewatering Plan and schedule immediate engineer inspection.
- unexpected discharge of water from the dam			Initiate Dewatering Plan and schedule immediate engineer inspection. If failure seems imminent, **Emergency Notification – Condition A**
Cracks			
- cracking of surface soils and soil is dry			No action to be taken.
- longitudinal crack (indicates slide may be forming)			Monitor. Schedule engineer inspection.
- transverse crack does not extend completely across dam crest			Monitor.
- transverse crack extends completely across dam crest, water level is *more than 3 feet* below base of crack			Initiate Dewatering Plan and schedule immediate engineer inspection.
- transverse crack extends completely across dam crest, water level is *less than 3 feet* below base of crack			**Emergency Notification - Condition B** Initiate Dewatering Plan and schedule immediate engineer inspection. Plug upstream side and construct granular blanket on downstream side.
- transverse crack extends completely across dam crest and water is flowing through crack			**Emergency Notification - Condition A** Initiate Dewatering Plan and schedule immediate engineer inspection. Plug upstream side and construct granular blanket on downstream side.
Seepage			
- wet or soggy area on downstream face			Monitor.
- clear water and constant rate of flow			Monitor. Measure flow and note clarity of water.

EAP Dam Inspection Checklist

(To Be Used Only for Unusual or Potentially Dangerous Conditions Inspections)

- clear water and increasing rate of flow			Schedule immediate engineer inspection. Monitor constantly. Measure flow periodically and note clarity.
Piping			
- active flow of cloudy to muddy water			**Emergency Notification – Condition B** Initiate Dewatering Plan and schedule immediate engineer inspection. Construct granular blanket over discharge point.
- active flow of cloudy to muddy water with a whirlpool in the reservoir			**Emergency Notification - Condition A** Initiate Dewatering Plan and schedule immediate engineer inspection. Construct granular blanket over discharge point. Plug the entrance to the pipe in the reservoir using whatever is available.
Boils			
- clear water and constant rate of flow			Monitor. Measure flow and note clarity of water.
- clear water and increasing rate of flow			Schedule immediate engineer inspection. Monitor constantly. Measure flow and note clarity of water.
- active flow of cloudy to muddy water			**Emergency Notification – Condition B** Initiate Dewatering Plan and schedule immediate engineer inspection. Construct granular blanket over discharge point.
- active flow of cloudy to muddy water with a whirlpool in the reservoir			**Emergency Notification - Condition A** Initiate Dewatering Plan and schedule immediate engineer inspection. Construct granular blanket over discharge point. Plug the entrance to the pipe in the reservoir using whatever is available.
Slide on the upstream or downstream face			
- does not pass through crest			Schedule immediate engineer inspection.
- passes through crest and lowered crest is *more than 3 feet* above reservoir water level			**Emergency Notification – Condition B** Schedule immediate engineer inspection.
- passes through crest and lowered crest is *less than 3 feet* above reservoir water level			**Emergency Notification - Condition A** Initiate Dewatering Plan and schedule immediate engineer inspection. Armor crest & attempt to restore freeboard.
Burrow Holes			Consult O&M Plan – repair as soon as practicable

Comments:

____

____

____

____

Ash Appendix

Appendix Ash-B

Emergency Action Plan Approval Record and Revision L

Emergency Action Plan Approval Record

IMPOUNDMENTS:
CWLP Lakeside Ash Pond Dam and CWLP Dallman Ash Pond Dam

PREPARED FOR:
City Water Light & Power
Dallman Power Station
3100 Stevenson Drive
Springfield, Illinois 62703

PREPARED BY:
Hanson Professional Services Inc.
1525 South Sixth Street
Springfield, Illinois 62703-2886

APPROVED BY:

CWLP SUPERVISOR OF FUELS AND BYPRODUCTS

Name: JEFF HILLEBRENNER Signature: [signature] Date: 11/17/15

SANGAMON COUNTY 911 CENTER

Name: Mark Boughton Signature: [signature] Date: 3-22-16

SPRINGFIELD POLICE DEPARTMENT

Name: D/c Dennis L. Arnold Signature: [signature] Date: 03/01/2015

SANGAMON COUNTY SHERIFF'S OFFICE

Name: Capt. Cheryllynn Williams Signature: [signature] Date: 11/25/15

THE SIGNATORY PARTIES HEREBY INDICATE THEIR APPROVAL OF THE PLAN AND AGREE TO THEIR RESPONSIBILITIES FOR ITS EXECUTION.

Emergency Action Plan Revision Log

Revision	Date	Pages Updated
Revision 1	July 2021	All Pages
Revision 2	October 2021	Pg 9, Added 7.10

Ash Appendix

Appendix Ash-C
Common Problems and Emergency Level Identification

Common Problems

The following problems are indicators of a potential or actual emergency. This section presents information for detecting, evaluating and responding to problems to aid the dam operator in a first response. In all cases, suspected problems should be reported to the Superintendent of Water Purification. Additional assistance as necessary should be obtained from a qualified engineer as soon as possible. Note: additional discussion of these conditions is provided in Appendix D. In all cases where failure of the dam is deemed to be developing or is imminent, extreme caution and concern for emergency responders shall be exercised in the performance of the prescribed protective actions.

A. Cracks

Some cracking of the embankment's surface soils may occur when they become dry, and some cracking is to be expected during prolonged periods of little or no rain. No action is required for this situation except to monitor the condition to ensure the detection of possible more serious problems as described below.

1. *A longitudinal (along the length of the dam) crack can indicate the beginning of a slide or an uneven settlement of the embankment and, therefore, must be regularly monitored. If appreciable growth in any dimension is noted, then a qualified engineer should be contacted for assistance in evaluating the crack and recommending repairs.*
2. *If a transverse crack extends completely across the dam, but the base of the crack is more than 5 feet above the reservoir level, then a qualified engineer should be contacted for immediate assistance in evaluating the crack and recommending action.*
3. *A transverse crack that extends completely across the dam and has a base elevation less than 5 feet above the reservoir level is categorized as **EMERGENCY CONDITION B** (see Section IV-B). If no damage is suspected to the spillway, the dewatering plan shall be strongly considered and a qualified engineer should be retained immediately for an inspection, an evaluation and any recommended action. If it is raining, or if precipitation is forecast, then the crack should be plugged without delay and a granular blanket (see Appendix D) should be applied to the downstream end of the crack.*
4. *A transverse crack that extends completely across the dam and has water flowing through the crack is categorized as **EMERGENCY CONDITION A** (see Section IV-B). If no damage to the spillway is suspected, then the dewatering plan shall be immediately implemented, and a qualified engineer should be retained immediately for an inspection, an evaluation and any recommended action. The crack should be plugged without delay and a granular blanket (see Appendix D) should be applied to the downstream end of the crack.*

B. Seepage

Seepage areas on the downstream embankment slope, or in any other area downstream of the embankment, may exhibit little or no surface water or very minor seeps. This condition may be caused by infiltration of rain water and is typically not serious. No action is required for this situation, except to note the location and monitor the condition to ensure the detection of possibly more serious problems as described below.

1. *If a wet area develops moderate seeps of clear or relatively clear water, but the rate of flow is not increasing, the flow should be measured periodically and observed for any changes in water clarity. No immediate action is required, except to note and record the flow rate and clarity for future comparison. The seepage area should especially be observed for any changes when stages in the reservoir exceed that of normal pool.*
2. *If a wet area develops moderate seeps of clear or relatively clear water, and the rate of flow is increasing, the flow must be measured periodically, and any changes in water clarity must be noted and recorded. The downstream area should be inspected for any new seeps, and a qualified engineer should be contacted for an immediate inspection. The condition should be observed and monitored constantly for any further changes in flow rate or clarity, unless directed otherwise by the engineer.*

C. Piping

Piping is moderate to active flow of cloudy to muddy water and indicates the removal of material from the foundation or the embankment. If the flow rate is increasing, then this condition could lead to failure of the dam. This situation is serious and is categorized as **EMERGENCY CONDITION B** (see Section IV-B). A qualified engineer shall be retained immediately for an inspection, an evaluation and any recommended action, but no delay shall be taken in employing the following protective measures.

1. *The dewatering plan shall be strongly considered. If the piping is occurring in a seepage area on the downstream side of the dam, a granular blanket shall be immediately installed over the area. The granular blanket consists of filter cloth (if available) and a 3 to 5 ft thick blanket of material graded from coarse sand and pea gravel at the bottom to 3-inch stone at the top (see Appendix D). Larger stones should be placed on the top of the filter as needed to provide added weight to keep the blanket in place. Plugging or stopping the flow of water from this location should not be attempted. Rather, the intent of the granular blanket is to try to reduce the movement of earthen material, while allowing the water to flow through it.*
2. *The reservoir area along the upstream face of the dam shall be immediately inspected. If an uncontrolled upstream swirl or whirlpool is noted, this indicates that water is entering the abutments or embankment, and failure of the dam may be imminent. This situation is extremely urgent and is categorized as* ***EMERGENCY CONDITION A*** *(see Section IV-B).*
3. *It should be confirmed that the dewatering plan has been effectively implemented and that the granular blanket, as described above, has been constructed. Additional thickness may be added as determined by the engineer. In addition, plugging of the upstream entrance of the flow through the embankment may be attempted using large rock or anything else that is available (rolls of fencing, bed springs, cars, large hay bales, etc.). If the large material placed in the hole appears to have reduced the flow, then further sealing of the entrance with progressively smaller material should be attempted.*

D. Boils

Boils are deposits of soil particles in the form of a cone around a point of discharging water. Boils can vary from a few inches to several feet in diameter and may occur 2 to 3 ft apart or in isolated locations in the floodplain downstream of the dam. Boils may show the same types of flow as noted above for piping. Evaluation of and response to the problem is the same as noted under the Seepage and Piping discussions above for the various flow conditions, i.e., clear and constant, clear and increasing, and cloudy or muddy and increasing. An additional method to try to control the movement of material from a boil is the construction of a boil ring (or ring dike). An example is shown in Appendix D. In placing the ring, it must be remembered that the work is not being done to stop the flow of water, but rather to stop the movement of material. When the ring reaches an elevation where the water that is discharging from the ring is flowing clear, the work should stop and the flows monitored for changes.

E. Slides

A slide is the movement of a portion of the embankment, either the upstream or downstream slope, toward the toe of the dam. The following are three possible slide conditions, listed in order of severity.

1. *The slide does not pass through the crest. A qualified engineer should be consulted before any repairs are initiated to determine the cause of the slide and to recommend any modifications to prevent future slides. The downstream side of the dam should be watched for the emergence of any water, either through the slide or, if the slide is on the upstream slope, opposite the slide. If discharging water is noted, then the area of the slide should be treated as a seepage location and monitored.*
2. *The slide passes through the crest, and the reservoir elevation is more than 5 ft below the lowered crest. The same actions as above shall be taken, but this situation is serious and is categorized as* ***EMERGENCY CONDITION B*** *(see Section IV-B).*
3. *The slide passes through the crest, and the reservoir elevation is less than 5 feet below the lowered crest. This condition is critical, and failure of the dam should be considered imminent. This situation is extremely urgent and is categorized as* ***EMERGENCY CONDITION A*** *(see Section IV-B). A qualified engineer shall be retained immediately for an inspection, an evaluation and any recommended action, but no delay shall be*

taken in employing the following protective measures. The dewatering plan shall be immediately implemented. The crest of the damaged portion of the embankment shall be armored, and attempts should be made to restore the lost freeboard. If seepage is also occurring, then the appropriate actions as noted above should be taken.

F. Failure of the Principal Spillway

A structural failure of the principal spillway or gates could result from unforeseen circumstances such as earthquake, differential settlement, fatigue or sabotage. In such an event, an assessment of the situation shall be made and the appropriate response tailored to the severity of the situation. The following are two examples of appropriate responses:

1. *Failure of any portion of the principal spillway or gates, during which there is no discharge through the spillway, and which does not result in the release of water from the reservoir or deformation of the embankment. A qualified engineer should be contacted for an immediate inspection, an evaluation and any recommended action. The reservoir level should be lowered sufficiently to prevent discharges through the damaged spillway.*
2. *Failure of any portion of the principal spillway that results in an uncontrolled release of water from the reservoir and/or deformation of the embankment. The response to this condition will depend on the assessment of the situation. The reservoir should immediately be drawn down if possible, and if the discharge through the spillway will not cause further damage to the structure. However, if imminent failure of the spillway or dam embankment is anticipated, the situation should be categorized as* ***EMERGENCY CONDITION A*** *(see Section IV-B).*

G. Overtopping

Water flowing over the crest of the embankment (overtopping) can be caused by excessive precipitation, obstruction or damage to the principal spillway or gates, or a sudden and severe slide of the embankment. This situation is extremely urgent and is categorized as **EMERGENCY CONDITION A** (see Section IV-B). If the cause is due to deformation of the embankment or a slide, the dewatering plan shall be immediately implemented and a qualified engineer shall be retained immediately for an inspection, evaluation and any recommended action.

See the following page for guidance in determining the proper emergency level for various situations.

Guidance for Determining the Emergency Level

Event	Situation	Emergency Level*
Embankment overtopping	Reservoir level is at the top of outlet pipe	3
	Reservoir level is above outlet pipe	2
	Water from the reservoir is near the top of the dam	1
Seepage	New seepage areas in or near the dam	3
	New seepage areas with cloudy discharge or increasing flow rate	2
	Seepage with discharge greater than 10 gallons per minute	1
Sinkholes	Observation of new sinkhole in reservoir area or on embankment	2
	Rapidly enlarging sinkhole	1
Embankment cracking	New cracks in the embankment greater than ¼-inch wide without seepage	3
	Cracks in the embankment with seepage	2
Embankment movement	Visual movement/slippage of the embankment slope	3
	Sudden or rapidly proceeding slides of the embankment slopes	1
Instruments	Field verified instrumentation readings beyond predetermined values	3
Earthquake	Measurable earthquake felt or reported on or within 50 miles of the dam	3
	Earthquake resulting in visible damage to the dam or appurtenances	2
	Earthquake resulting in uncontrolled release of water from the dam	1
Security threat	Verified bomb threat that, if carried out, could result in damage to the dam	2
	Detonated bomb that has resulted in damage to the dam or appurtenances	1
Sabotage/ vandalism	Damage to dam or appurtenances with no impacts to the functioning of the dam	3
	Modification to the dam or appurtenances that could adversely impact the functioning of the dam	3
	Damage to dam or appurtenances that has resulted in seepage flow	2
	Damage to dam or appurtenances that has resulted in uncontrolled water release	1

* Condition A/Emergency Level 1: **Imminent failure** - urgent
* Condition B/Emergency Level 2: **Rapidly developing situation** – potential dam failure
* Condition C/Emergency Level 3: **Non-failure** emergency, unusual event, slowly developing

ATTACHMENT 10 – FUGITIVE DUST CONTROL PLAN AND ACCOMPANYING CERTIFICATION

Fugitive Dust Control Plan

For the

Dallman and Lakeside Coal Combustion Residuals Surface Impoundments and Landfill

For

City Water, Light and Power (CWLP)

Springfield, Illinois

Prepared by:

Environmental, Health & Safety, CWLP

October 2021

Introduction

Pursuant to the requirements of IAC Title 35 Part 845.500 this written operating program describes the measures being implemented to control fugitive dust emissions from the roadways and coal combustion residuals (CCR) piles at the Dallman and Lakeside CCR surface impoundments and CCR landfill.

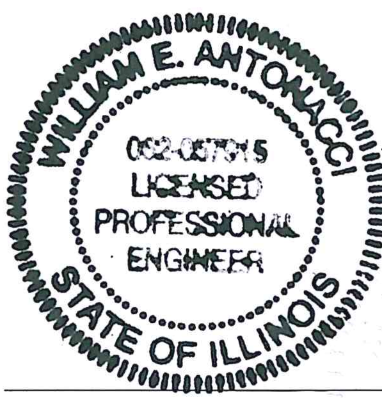
The facility consists of the following;

- Dallman CCR Surface Impoundment
- Lakeside CCR Surface Impoundment
- CCR Landfill
- Corresponding Roadways

Qualified Professional Engineer Certification

This plan meets all the requirements of IAC Title 35 Part 845.500

William E. Antonacci, P.E.	Technical Specialist III
Name	Title
City, Water, Light & Power	10/18/21
Company	Date



Signature

Professional Engineer Certification

The facility will operate in accordance with the written procedures in this program outlined in the following descriptions.

Fugitive Dust Management Practices

Roadways and CCR piles are a potential source of fugitive dust emissions; the following control measures will be implemented at the facility to control CCR fugitive dust.

Control Measures

a) The paved roadway entrance to the facility shall be watered and/or swept as often as practicable to remove mud, dirt or similar debris.
b) Fugitive dust emission reduction, roadway conditions, and employee safety concerns will limit vehicle speed to 10 mph on all roadways inside the facility.
c) CCR storage piles maintain surface moisture sufficient to reduce wind-blown erosion and fugitive dust. Gypsum and ash have a moisture content of 10-20%.
d) Material handlers operating inside the facility will exercise caution and care in CCR pile manipulation and loading procedures in order to minimize fugitive dust emissions.
e) During high wind events, material handlers will reduce or halt operations.
f) All haul trucks carrying wet CCR material from the Dallman generating station into the facility are not required to be covered due to the natural surface moisture content of the material. However, if the CCR material is handled dry in the future, then all haul trucks will be covered to reduce fugitive dust.
g) In order to reduce roadway fugitive dust from the facility, a six foot concrete barrier wall has been constructed on the southeast side of the facility as a preventative measure.
h) In addition to the constructed wall mentioned above, the natural growth of vegetation within and surrounding the facility serves as a further control against roadway fugitive dust.

Emissions Monitoring

CWLP shall conduct fugitive dust inspections with personnel who are certified by the Illinois Environmental Protection Agency (IEPA) in the evaluation of visible emissions to ensure the adequacy of existing emission controls at the facility. Opacity measurements shall be taken on the paved entrance road using Method 22 or Method 9 on a monthly basis. Measurements will be repeated within 10 days in the event of major changes involving the facility that would act to increase opacity. Opacity measurements shall be taken on the CCR piles using Method 22 or Method 9 on an as needed basis since material already has a surface moisture content between 10-20%. If current control measures on the roadway or CCR piles are at any time deemed inadequate, they will be reanalyzed for effectiveness and additional controls will be considered. If additional controls are deemed necessary, this fugitive dust plan will be updated.

Recordkeeping, Reporting and Notifications

a) The CCR fugitive dust control plan will be submitted in the operating record in accordance with IAC Title 35 Part 845.800(d)(7) and notifications will be executed in accordance with IAC Title 35 Part 845.810(g), which states that CWLP will notify IEPA that the CCR fugitive dust control plan is available on CWLP's CCR Rule Compliance Data and Information website

b) The quarterly CCR fugitive dust complaint report will be completed in accordance with IAC Title 35 part 845.500(b)(2)(A) and submitted in accordance with IAC Title 35 part 845.500(b)(2)(B).

c) The annual CCR fugitive dust control report will be completed in accordance with IAC Title 35 part 845.500(c) and reported in accordance with IAC Title 35 part 845.550(a)(1). This report will include the following:

   a. Description of actions taken to control CCR fugitive dust

   b. Four previous quarterly fugitive dust complaint reports

d) The CCR fugitive dust control plan and annual CCR fugitive dust control report will be available on CWLP's CCR Rule Compliance Data and Information website in accordance with IAC Title 35 part 845.810(a)

e) All records will be retained in accordance with IAC Title 35 part 845.800 (b)

ATTACHMENT 11 – HYDROGEOLOGY REPORT AND GROUNDWATER MONITORING PROGRAM

City Water, Light & Power

Coal Combustion Residuals Surface Impoundments

Springfield, Sangamon County, Illinois

Hydrogeologic Report, Groundwater Monitoring Program and Statistical Procedures

October 2021

Prepared for:
City Water, Light & Power
3100 Stevenson Drive
Springfield, Illinois 62703

ANDREWS ENGINEERING

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ILLINOIS | MISSOURI | INDIANA

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1. INTRODUCTION

City Water, Light and Power (CWLP) owns and operates two (2) existing coal combustion residual (CCR) surface impoundments subject to the Illinois EPA's rules (35 Ill. Adm. Code 845) for CCR surface impoundments.

The two (2) CCR surface impoundments are regulated by Illinois EPA CCR rule 35 Ill. Adm. Code 845 Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments. As indicated above, the hydrogeologic site characterization, groundwater monitoring and statistical procedures requirements of Illinois EPA CCR rules 35 Ill. Adm. Code 845.Subpart F apply to both impoundments. This Hydrogeologic Report and Groundwater Monitoring Program were prepared to meet the hydrogeologic site characterization, groundwater monitoring and statistical procedures requirements of the Illinois EPA CCR surface impoundment rules 35 Ill. Adm. Code 845.Subpart F.

1.1 Site Description

The CWLP CCR surface impoundments are located north and east of the former Lakeside Power Generating Station and Dallman Power Generating Station in the Eastern ½ of Section 12, Township 15 North, Range 5 West, in Springfield, Illinois (see Figure 1). These CCR surface impoundments are identified as the Lakeside Ash Pond and the Dallman Ash Pond (see Figure 2).

The former Lakeside Power Generating Station and Dallman Power Generating Station are situated on the northwestern bank of Lake Springfield in Springfield, Illinois. The Lakeside Ash Pond is immediately south of Spaulding Dam at the northern end of Lake Springfield. The Dallman Ash Pond is immediately northwest of the Lakeside Ash Pond.

1.2 Site History

The Sugar Creek historically meandered across the site, generally from the west to east with an overall flow direction to the north (see Figure 3). During the construction of the ash ponds, the creek was abandoned and relocated to the west of the site. The old creek bed was filled with different types of soil, ranging from cohesive soils characterized as silty clays, to granular fill characterized as poorly graded silty to clayey sands.

The Lakeside Ash Pond is primarily a diked embankment with some incising along the east perimeter. The Lakeside Ash Pond consists of four separate ponds (i.e., three lime softening ponds and a settling pond) totaling approximately 35 acres. CCR ash was first placed in the Lakeside Ash Pond area in the middle 1930's. The Lakeside Ash Pond is its present configuration was placed into service prior to 1958 and ceased receiving ash in 2009.

The Lakeside Ash Pond was originally used as a settling pond for fly ash and bottom ash sluiced with raw lake water. Presently, lime-softening ponds located on the southern portion of the Lakeside Ash Pond receive water softening lime residuals from the CWLP Drinking Water Purification Plant, Flue Gas Desulfurization Waste Water Treatment Plant (FGD WWTP) clarifier blowdown sludge, and wash-down water from miscellaneous floor drains. The FGD WWTP sludge contains CCR. The other flows are non-CCR.

The most recent change made to the Lakeside Ash Pond was a vertical expansion completed in 1988. The vertical expansion consists of berms built on top of and inside of the existing embankments in such a way that the toe of the outer slope of the expansion berms matches up with the top of the inner slope of the existing embankments. The vertical expansion berms are approximately ten feet in height.

The Dallman Ash Pond is a partially incised and diked embankment placed into service in approximately 1976. The Dallman Ash Pond is one contiguous 34.5 acre pond. The Dallman Ash Pond is used as a settling pond for fly ash and bottom ash, which are sluiced with raw lake water from Dallman Power Station Units 31, 32 and 33. In addition, industrial wastewater treatment plant clarifier blowdown, landfill leachate and evaporation pond water is pumped into the Dallman Ash Pond. The evaporation water is non-CCR storm water from the FGD Landfill area that collects in the eastern portion of the undeveloped area. The generating facility (GF) WWTP sludge, landfill leachate and evaporation water are non-CCR. All materials being sent to the Dallman Ash Pond are liquid or wet processed solids. No expansion of the Dallman Ash Pond has occurred since its construction.

Settled water from both the Lakeside Ash Pond and Dallman Ash Pond flow into opposite sides of a Clarification Pond for final polishing before being discharged to Sugar Creek at a permitted NPDES outfall.

2. SITE GEOLOGY

The geologic conditions have been investigated through both literature and site-specific geologic investigations including multiple subsurface investigations, including those prior to the impoundment development, along the perimeter of the impoundments and including the hydrogeologic investigation at the permitted Subtitle D CCR landfill located north of the Lakeside Ash Pond and east of the Dallman Ash Pond. These investigations were as follows:

- Professional Service Industries (PSI), June 1989. This investigation consisted of five soil borings within the east section of the south cell (Cell 1).

- Andrews Environmental Engineering, Inc., February 1990. This investigation was performed for Cell 2 and consisted of 13 soil borings. The drilling and testing were completed by PSI.

- Andrews Environmental Engineering, Inc. , March 1990. This investigation was performed to install six wells at the Facility. The drilling and testing were completed by PSI.

- Patrick Engineering, Inc. (PEI), July 1992. This investigation was performed to further characterize the hydrogeology of the landfill setting. Approximately 44 soil borings and piezometers were installed by PEI.

- Stabilize, Inc. (SI), December 2008. This investigation installed three new monitoring wells as part of an assessment program for the landfill. The drilling, soil testing, and well construction were performed by Reynolds Well Drilling.

- City Water, Light and Power (CWLP), April 2010. This investigation was performed to install four piezometers on the west side of the CCR surface impoundments along Sugar Creek. The drilling and testing were completed by PSI.

- Stabilize, Inc. (SI), May 2011. This investigation installed four new monitoring wells to further the characterization of the CCR surface impoundments. The drilling, soil testing, and well construction were performed by PSI.

- Andrews Engineering, Inc., January 2012. This investigation was performed to replace CCR surface impoundment wells and install an additional background well. The drilling and well installation were completed by TerraDrill.

- Andrews Engineering, Inc., July 2017. This project included drilling peripheral to the Dallman Ash Pond.

- Andrews Engineering, Inc., September and October 2018. This project included borings peripheral to the Dallman Ash Pond.

- Andrews Engineering, Inc., May and July 2019. This project included advancement of borings drilling peripheral to the Dallman Ash Pond.

- Andrews Engineering, Inc., February 2021. This project included the installation of 4 assessment wells located west of Sugar Creek.

The geologic characterization was prepared in context of the April 15, 2021 Illinois EPA CCR rule 35 Ill. Adm. Code 845.Subpart F requirements. Emphasis is placed on characterizing the uppermost aquifer and the underlying confining aquitard. The uppermost aquifer is the required unit for groundwater quality monitoring under the Illinois EPA CCR rules.

The occurrence of the deposits discussed below are variable due to the meandering nature of Sugar Creek prior to the development of Lake Springfield and Spaulding Dam. The meandering creek has resulted in sequential erosion and deposition (scour and fill) throughout much of the creek drainage system, both laterally and vertically.

The geologic boring logs and well construction reports upon which the site-specific hydrogeologic conditions are based are provided in Appendix A. Geologic cross-sections are provided in Appendix B. The site specific geologic conditions are in general agreement with the geologic literature for the region. Given that the CCR ash impoundments are located within the former Sugar Creek drainage basin, many of the quaternary deposits present in the uplands are absent. The surficial deposits within the limits of the CCR surface impoundments appear to be comprised of alluvium overlying glacio-fluvial deposits (i.e., till and outwash sands and gravels). The quaternary deposits rest directly on top of Pennsylvanian aged bedrock primarily comprised of shale.

2.1 Surficial Deposits

The shallow stratigraphy and lithology at the CCR surface impoundments include approximately 20 to 50 feet of Pleistocene sediments, dependent upon location. In descending order these materials are identified as fill material, upper cohesive deposit, shallow sand, lower cohesive deposit, basal sand and creek fill.

The overall tendency is for the finer-grained materials (clays, silty clays and silts) to overlie the coarser-grained materials (sands and gravels). This coarsening downward is present throughout much of the site. At the majority of the borehole locations, the coarser materials rest directly on top of the weathered bedrock surface. It is this coarser material, the basal sand, which is characterized as the uppermost aquifer.

Fill Material

Fill material encountered at the facility is either used as structural fill adjacent to the CCR surface impoundments or as berm construction material. Where encountered as structural fill, it as much as 25 feet thick and is described as a brown to dark brown and grey to dark grey silty clay, clayey silt, silt or sand, typically with trace to some organic material (i.e., rootlets and fragments of wood).

Within the abandoned creek area, the underlying upper cohesive deposit and shallow sand are absent and the fill material may rest directly on top of creek fill.

Upper Cohesive Deposit

The upper cohesive deposit is an alluvial deposit described as brown to gray silty clay with trace fine sand, and is stiff with a medium plasticity and containing trace organics towards the bottom. Where encountered, the upper cohesive deposit ranges from 2.5 to 16 feet thick and overlies the shallow sand. Within the abandoned creek area, the upper cohesive deposit and underlying shallow sand are absent.

The upper cohesive deposit has a relatively low hydraulic conductivity in the vertical direction as determined by laboratory triaxial hydraulic conductivity tests from borings taken from the landfill investigation. The hydraulic conductivity values determined from the laboratory tests ranged from 1.6×10^{-5} cm/sec to 5.2×10^{-7} cm/sec. However, the upper cohesive deposit is an alluvial deposit and it is expected that the horizontal coefficient of hydraulic conductivity will be greater than the vertical coefficient. Based on test results for the lower cohesive deposit, it is anticipated that the horizontal hydraulic conductivity for the upper cohesive deposit is in the range of 10^{-6} to 10^{-5} cm/sec.

Shallow Sand

The shallow sand underlies the upper cohesive deposit and overlies the lower cohesive deposit. Where encountered, the unit is described as a brown to gray silty to clayey fine sand. It contains small lenses of silty clay and clayey silt. This unit is not contiguous over the entire site. Its thickness ranges from 1 to 3 feet over most of the investigated area and where encountered likely represents the pre-construction ground surface.

Laboratory tests performed on representative samples collected from the shallow sand unit during this and previous investigations indicate the shallow sand contains 0% gravel, 50% to 52% sand, and 48% to 50% silt/clay. Two landfill piezometers were screened in the shallow sand unit to obtain potentiometric surface information and conduct field hydraulic conductivity tests. The hydraulic conductivity of this unit based on the slug test results ranges from 3.6×10^{-3} to 2.9×10^{-2} cm/sec.

Lower Cohesive Deposit

The lower cohesive deposit consists of brown, gray, and brownish gray silty clays, clayey silts, and clays, having very soft to stiff consistency. The lower cohesive deposit ranges in thickness from 0 to 22 feet with an average thickness of about 15 feet. The deposit was not encountered in isolated areas along the abandoned creek, possibly due to excessive erosion of creek bottom in these areas.

The lower cohesive deposit is generally overlain by the shallow sand and underlain by the basal sand. However, within the abandoned creek area, the lower cohesive deposit was encountered directly below the creek fill. In some areas the basal sand is not present and the lower cohesive deposit directly overlies the bedrock.

The soils in the lower cohesive deposit can be similar in color and texture to the soils in the upper cohesive deposit. The distinction between the two deposits was based on the presence or changes in soil consistency (as measured with a calibrated hand held penetrometer) and a marked difference in moisture content. The lower cohesive deposit is not exposed at the ground surface in the investigated area.

The lower cohesive deposit consists of 0% gravel, 8% to 48% sand, and 52% to 95% silt/clay; and has a relatively low hydraulic conductivity. The vertical hydraulic conductivity ranges from 1.3 x 10^{-8} to 1.8 x 10^{-6} cm/sec (triaxial permeameter). The horizontal hydraulic conductivity ranges from 4.6 x 10^{-5} to 7.6 x 10^{-5} cm/sec (field slug tests).

Basal Sand

In most locations, the basal sand is the lower-most surficial deposit. The basal sand is a gray colored, poorly graded, silty to clayey fine sand to well graded sand with minor amounts of fine gravel. This unit was encountered in a medium dense to dense condition. The top elevation of the basal sand varies from 491 to 513 feet mean sea level (MSL) and the thickness ranges from about 0 to 12.3 feet. The unit was not encountered consistently, likely due to excessive erosion of the creek bottom.

The basal sand generally overlies the bedrock surface and underlies the lower cohesive deposit. There are some pockets of very hard, fine grained silty clay to clay overlying bedrock in a few areas. The basal sand is present above these pockets of clayey deposits, thought to be weathered bedrock.

The basal sand generally consists of 0% to 34% gravel, 50% to 91% sand, and 6% to 44% silt/clay; and exhibits a mean field hydraulic conductivity of 1.73 x 10^{-2} cm/sec. The basal sand was saturated in all locations where it was encountered.

Creek Fill Material

The·borings made along the abandoned creek locations indicate that the creek fill materials consist of variable soils ranging from silty clays to silty sands. Cohesive soils characterized as silty clays to organic silty clay were typically encountered. In some areas, the cohesive fill materials extended down to the top of bedrock. The granular fill materials are typically poorly graded silty to clayey sands and contain organics or wood fragments. In some areas, the granular fill materials also extended down to the top of bedrock.

The cohesive fill material contains 0% gravel, 2% to 48% sand, and 52% to 98% silt/clay. The vertical hydraulic conductivity ranges from 7.6 x 10^{-8} cm/sec to.2.1x10^{-5} cm/sec. The granular fill materials contain 0 to 2% gravel, 55% to 65% sand and 33% to 45% silt/clay. Based on one laboratory hydraulic conductivity test performed on a Shelby tube sample obtained from berm fill, the hydraulic conductivity of the granular fill material is 3.3 x 10^{-8} cm/sec.

The creek fill materials identified during the previous landfill investigations have a significant effect on the site hydrogeologic conditions. The upper and lower cohesive deposits are considered to act as aquitards (where present) which restrict vertical flow into the water bearing units. For all practical purposes, the bedrock is considered to be an aquiclude.

Fill materials encountered in the landfill borings range from silty clays and organic silty clays to silty sands and clayey sands. These water level measurements indicate that groundwater movement within the creek fill materials is complicated because of the highly variable hydraulic characteristics of the fill materials and their random placement.

Four landfill piezometers are screened into the fill materials. Of these, one piezometer was installed into cohesive fill material and the other piezometers were installed in granular fill materials. Hydraulic conductivity of the granular fill materials is based on one field test resulting in a value of 6.1×10^{-2} cm/sec. The hydraulic conductivity of the cohesive fill material ranged from 7.1×10^{-5} cm/sec to 1.1×10^{-4} cm/sec. These values represent the hydraulic conductivity in the horizontal direction.

Laboratory hydraulic conductivity test performed on landfill cohesive fill materials ranged from 2.1×10^{-3} cm/sec to 3.3×10^{-8} cm/sec. The higher hydraulic conductivity values are believed to be typical of soils which contain organic matter (e.g. wood fragments). The hydraulic conductivity values based on laboratory tests are generally considered to be representative of the coefficient of hydraulic conductivity in the vertical direction because of the sample configuration during testing. However, because of the randomness of the fill, it is more likely that the hydraulic conductivity is within the range of 10^{-5} to 10^{-4} cm/sec.

2.2 Uppermost Bedrock

The bedrock at the project site consists of Pennsylvanian shales which are gray in color. The bedrock surface elevation varies from approximately 492 feet MSL near the center of the existing landfill, to approximately 554 feet MSL located on a bedrock outcrop near the landfill area (southeast corner of Cell 1). In general, the bedrock surface slopes from the east and west towards the center of the landfill area.

Rock Quality Designation (RQD) measurements were performed on all core samples taken from the landfill area. RQDs measured from core samples collected during this investigation ranges from 80% to 100%. The RQD values indicate that the bedrock is not highly fractured. Two in situ hydraulic conductivity tests were performed to determine the hydraulic conductivity of the upper portions of the bedrock. Test results indicate hydraulic conductivity values of 1.8×10^{-7} cm/sec and 1.3×10^{-6} cm/sec. This shows that the bedrock encountered at the project site is relatively impermeable. There is good correlation between the lithology of the rocks tested and the hydraulic conductivity values obtained. The upper bedrock beneath the impoundments is expected to exhibit the same characteristics as encountered at the landfill.

3. SITE HYDROGEOLOGY

The uppermost aquifer and underlying confining unit control groundwater movement and the potential for CCR impacted groundwater migration. This narrative provides a description of the regional and site-specific hydrogeologic conditions.

3.1 Uppermost Aquifer

The uppermost aquifer is characterized as the basal sand overlying the shale bedrock. In some locations the creek fill materials, ranging from silty clays and organic silty clays to silty sands and clayey sands, were found to be in direct hydraulic communication with the basal sand that directly overlies the bedrock surface. Due to the highly variable hydraulic characteristics and random placement of the creek fill materials, further characterization is difficult.

As indicated above, the hydraulic conductivity of the basal sand ranges from 5.6×10^{-4} to 3.6×10^{-2} cm/sec. The groundwater in the basal sand appears to be under confined, semi-confined, or unconfined conditions dependent upon location. The upper limit of the uppermost aquifer is dependent upon the seasonally fluctuating groundwater table. The potentiometric surface of the basal sand varies from 565 feet MSL at upgradient locations, south of the Lakeside Ash Pond, to 525 feet MSL at downgradient locations near Sugar Creek, north of the Dallman Ash Pond. As a result, the saturated thickness is variably dependent upon the location and the seasonal variation in the groundwater table.

Groundwater movement within the uppermost aquifer is controlled by recharge along topographic highs and discharge along the original stream valley. The pre-surface impoundment flow direction in the uppermost aquifer was dominantly horizontal from the adjacent banks toward the natural convergence along Sugar Creek, which formerly drained the site. This was overall from south to north with local deviations. This dominant flow pattern persists under present day conditions but with localized variation introduced by the hydrologic discontinuity created upon construction of the CCR surface impoundments.

The CCR surface impoundment wells were used to derive potentiometric surface maps for the most recent four consecutive events. This was completed to capture climatic, including seasonal and temporal fluctuations in groundwater flow. As shown, overall groundwater movement is from south to north (see Appendix C). The east perimeter of the Lakeside Ash Pond is largely upgradient, and the west side is largely sidegradient where groundwater movement is parallel to the perimeter. Excavated areas within the FGDS Landfill area act as a groundwater sink along the east side of the Dallman Ash Pond. Groundwater generally moves northward from the Dallman Ash Pond, but also moves easterly towards the FGDS Landfill and westerly towards Sugar Creek.

3.2 Lower Confining Unit

The uppermost bedrock at the project site is primarily Pennsylvanian age shale with isolated thin coal layers. The Pennsylvanian shale functions as a lower confining unit due to its low permeability and effective porosity. The lower confining unit represents a natural hydrogeologic barrier (i.e., aquitard) to the vertical movement of groundwater.

In situ hydraulic conductivity test (slug tests) indicate that the hydraulic conductivity for the upper portions of the bedrock range from 1.8×10^{-7} to 1.3×10^{-6} cm/sec. There appears to be good correlation between the rock lithology and the measured values of hydraulic conductivity. The bedrock over most of the site will act as an aquiclude and prevent the downward movement of groundwater.

3.3 Surface Water

The nearest surface water bodies are Lake Springfield, located upgradient to the CCR surface impoundments and Sugar Creek located adjacent to the western and northern perimeter of the CCR surface impoundments (see Figure 2).

- Lake Springfield

- Sugar Creek

3.3.1 Surface Water Intakes

There are two surface water intakes located near the CCR surface impoundments facility (see Appendix D). These intakes are identified as:

- Intake No. 52140 - Lake Springfield 1 Intake 2
- Intake No. 52141 - South Fork Horse Creek Intake

Both of these intakes are located along Lake Springfield and supply water to the Springfield public water supply (IL1671200). These intakes are upgradient of the CCR surface impoundments and completely disassociated with the impoundments.

3.4 Community Water Supply Wells

A potable water well survey was completed in the vicinity of the Dallman and Lakeside Ash Ponds. The survey was conducted using the Illinois EPA's web-based Geographic Information System (GIS) database1 in the Source Water Assessment Program (SWAP) for potable water wells downgradient of the CCR impoundments.

The Illinois EPA's SWAP GIS database system identifies community water supply wells and other potable wells (private, semi-private and non-community water supply wells) include data from the following sources:

- Illinois EPA, Division of Public Water Supplies;
- Illinois State Geological Survey (ISGS);
- Illinois State Water Survey; and
- Illinois Department of Public Health.

Based on groundwater elevation data from numerous monitoring wells and piezometers located between and adjacent to the CWLP CCR impoundments, groundwater movement in the vicinity of the CCR impoundments is generally from the south-southwest to the north-northeast, approximately paralleling the Sugar Creek basin. The search extended to the first water well encountered hydraulically downgradient of the impoundments, located near Illinois Route 29 at a distance of approximately 3,400 feet. The results of the IEPA SWAP query is provided in Appendix D.
There is no reason to believe that potable wells exist within 2,500-feet of the CCR impoundments that were not identified as part of this potable water well survey.

3.5 Designated Nature Preserves

The nearest designated nature preserve (DNP), as approved by the Illinois EPA Groundwater Section of the Bureau of Water pursuant to 35 Ill. Adm. Code 620.230 are the Thomas W and Elizabeth Moews Dore Seep, located approximately 100 miles north-northeast and Stemler Cave located approximately 100 miles south-southwest of the subject facility. Moews Dore Seep is

[1] (http://illinois-epa.maps.arcgis.com/apps/webappviewer/index.html?id=4d37a05f5ba441f1b30dab54ccb81fc8)

situated in Putnam county (Section 34, T32N R2W 3PM), Hennepin Township, along the Illinois River bluffs about 1 mile west of State Route 26 and is a 26-acre seep and seep-related wetland community. It is within the Hennepin and Hopper Lakes Project area and it is the largest identified seep area in the Illinois River Section of the Upper Mississippi River and Illinois River Bottomlands. Stemler Cave in St. Clair county (Sections 12, 13 and 14, T1S R10W 3PM), Sugar Loaf Township, on the karst highlands approximately 2 miles east of Columbia, Illinois.

3.6 Underground Mines

Pursuant to 35 Ill. Adm. Code 845.620(b)(14) the initial permit application must include a map displaying any known underground mines beneath a CCR surface impoundment. Using the ISGS ILMINES GIS coverage (https://prairie-research.maps.arcgis.com/apps/webappviewer) a map displaying the extent of underground mines within the limits of the CCR surface impoundments has been prepared. Included as Appendix E, the map shows the presence of an underground coal mine beneath the location of the Dallman Ash Pond. There are no underground mines located beneath the Lakeside Ash Pond.

It is noted from historical mine location maps that the Dallman Ash Pond was partially undermined using the room and pillar panel method, during the period from 1901 to 1938 by various coal companies operating in the region. Brewerton Coal Company operated the mine during the final year. The main shaft was located in what is now a commercial/residential area at the north end of Fox Bridge Road, off of Adlai Stevenson Drive (Section 11, T15N R5W 3PM, 650 FSL, 440 FWL). The Springfield (No.5) Coal was mined from a 5 to 6 foot thick seam at a depth of 235 feet. (Bargh et al, 1993).

There is no evidence (i.e., subsidence, altered groundwater flow patterns, bedrock fracturing) that the presence of these underground mines have structurally compromise the Dallman Ash Pond or the Lakeside Ash Pond.

4. GROUNDWATER MONITORING

Groundwater monitoring at the CWLP CCR surface impoundments has been prepared to address the groundwater monitoring system, the groundwater sampling and analysis, groundwater monitoring program, the assessment of corrective measures, corrective action plan and implementation of the corrective action plan.

4.1 Groundwater Monitoring System

In accordance with 35 Ill. Adm. Code 845.630 the groundwater monitoring system consists of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the uppermost aquifer that: (1) accurately represent the quality of background groundwater that has not been affected by leakage from a CCR surface impoundment, and (2) accurately represent the quality of groundwater passing the impoundment boundary of the CCR surface impoundment to monitor potential contaminant pathways in the uppermost aquifer.

Pursuant to 35 Ill. Adm. Code 845.630(b) the number, spacing, and depths of the groundwater monitoring wells have been determined based upon site-specific technical information to meet the rule's performance standard, including the subsurface conditions observed at the site. This includes a characterization of the uppermost aquifer and the confining bedrock layer immediately below the uppermost aquifer.

The monitoring well locations take into consideration the natural (pre-surface impoundment) and current convergence of groundwater flow paths. The wells are located as close as feasible to the downgradient CCR surface impoundments based on topography, surface impoundment construction, and operations. The existing monitor well network (number of wells, locations, and screen interval) was installed pursuant to recommendations of the Illinois EPA Bureau of Water.

The groundwater monitoring system consists of eleven monitor wells screening the silt, sand, and gravel at the bedrock interface. The direction of groundwater movement, as described above, is to the west-northwest; therefore, the northern and western boundaries of the impoundments will be downgradient, and the southern and eastern boundaries will be upgradient.

Pursuant to 35 Ill. Adm. Code 845.630(c) the groundwater monitoring system includes a sufficient number of monitoring wells to meet the performance standards specified in 35 Ill. Adm. Code 845.630(a) based upon the site-specific information specified in 35 Ill. Adm. Code 845.630(b). The well locations are depicted in Figure 4. Table 1 provides a summary of well construction and the approximate screened intervals. Appendix A contains the well construction reports.

Two (2) groundwater monitoring wells are representative of background (ambient) groundwater quality conditions of the uppermost aquifer. These wells are identified as AP-4 and AP-5. Background concentrations are chemical concentrations or parameter values that represent naturally-occurring groundwater that has not been impacted by the surface impoundment or other facility activities.

Monitoring well AP-4 is located in an upgradient position, southwest of the CCR surface impoundments and along the eastern bank of Sugar Creek, immediately north of Lake Springfield dam. The well is screened at the surface of the Pennsylvanian shale and basal sand. This well is not upgradient of the subject CCR surface impoundments in a hydrologic sense but it is located on available CWLP property where it provides representative background groundwater quality, as allowed under 35 Ill. Adm. Code 845.630(a).

Monitoring well AP-5 is located in an upgradient position, southeast of the CCR surface impoundments and in a topographically slightly higher position. The well screen elevation is screened at the top of Pennsylvanian shale and basal sand at this location. This well monitors the upgradient groundwater quality of the uppermost aquifer at this location.

Nine (9) groundwater wells allow monitoring of the downgradient groundwater quality conditions in the uppermost aquifer. These wells are identified as AP-1R, AP-2A, AP-3, AP-6, AP-7, AP-8, AP-10, AP-14 and RW-3. The locations and depths of these wells accurately represent the quality of groundwater passing the impoundment boundaries of the CCR units and reasonably make possible the detection of geochemical changes in the uppermost aquifer. These groundwater monitoring wells are all screened across the interface of the overburden (basal sand) and weathered bedrock. Monitoring wells AP-1, AP-2, AP-3, AP-6, AP-7, AP-8, AP-10, AP-14 and AW-3 are located along the toe of the CCR surface impoundments and adjacent to Sugar Creek.

Pursuant to 35 Ill. Adm. Code 845.630(e) the monitoring wells are constructed in a manner that maintains the integrity of the monitoring well and borehole. All wells were installed pursuant to the Illinois Department of Public Health Water Well Construction Code (77 IAC 920) for monitoring well construction standards (see Appendix F). Any replacement and/or new groundwater monitoring wells will be constructed to meet 77 IAC 920. All monitoring well installations were documented in the respective reports. Boring logs and well construction reports are provided in

Appendix A. All drilling and groundwater monitoring well construction was completed under the direct supervision of an Illinois Licensed Professional Geologist.

4.2 Groundwater Sampling and Analysis Program

The groundwater monitoring program includes consistent sampling and analysis procedures to provide accurate representation of groundwater quality (35 Ill. Adm. Code 845.640(a)). The activities include sample collection, preservation and shipment, analytical procedures, chain of custody, and quality assurance and quality control.

Groundwater is sampled for the constituents listed in 35 Ill. Adm. Code 600(a)(1), total calcium and turbidity (see Table 2). For groundwater monitoring, these constituents include:

- Antimony
- Arsenic
- Barium
- Beryllium
- Boron
- Cadmium
- Chloride
- Chromium
- Cobalt
- Fluoride
- Lead
- Lithium
- Mercury
- Molybdenum
- pH
- Selenium
- Sulfate
- Thallium
- Total Dissolved Solids
- Radium 226 and 228 combined
- Calcium
- Turbidity

In accordance with 35 Ill. Adm. Code 845.640(i) all constituents are analyzed as total recoverable, where samples are not field filtered. All groundwater samples collected pursuant to 35 Ill. Adm. Code 845.Subpart F shall be analyzed by a certified laboratory using Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846 (35 Ill. Adm. Code 845.640(j)).

Pursuant to 35 Ill. Adm. Code 845.640(c), groundwater levels will be measured in each groundwater monitoring well immediately prior to purging, and each time groundwater is sampled. Other wells may be retained as water level measurement points. Levels will be measured to the nearest 0.01 feet (1/100 hundredth) and used to determine rate and direction of groundwater movement each time groundwater is sampled. In addition, a water table map/potentiometric surface map for the uppermost aquifer will be generated using the measured water levels obtained from each sampling event. The contours on these maps will allow for a quantitative assessment of flow rate and direction. Measurements of well depths will also be obtained during each sampling event to verify that the wells are physically intact and not filling with sediment, except where such measurements are not possible due to the presence of dedicated sampling equipment in the well.

Pursuant to 35 Ill. Adm. Code 845.640(d) the background groundwater quality has been established for each of the constituents listed in 35 Ill. Adm. Code 845.600 by using the upgradient and background wells described under 35 Ill. Adm. Code 845.630(a)(1), as applicable for groundwater monitoring requirements (35 Ill. Adm. Code 845.650). The upgradient and background wells include AP-4 and AP-5.

Background concentrations for AP-4 and AP-5 were developed from samples collected for eight consecutive quarters, allowing the statistical method employed to account for seasonal/temporal variability. The chemical constituents include only those parameters listed at 35 Ill. Adm. Code 845.600(a)(1).

The background concentrations are statistically analyzed to establish site-specific upper confidence limits for each chemical or parameter. The statistical methodology utilized for derivation of the background concentrations is provided in Appendix G. Background concentrations and groundwater analytical results are summarized in Appendix H.

Results from the background wells (AP-4 and AP-5) will be continually evaluated. If the groundwater quality significantly changes, it will become necessary to revise the background concentrations. In such an event, the statistical method contained in Appendix G will be utilized for such revision. Details for any revision will be placed in the facility record.

The number of samples collected under groundwater monitoring, if necessary (for both downgradient and background wells), will be consistent with the statistical procedures selected under 35 Ill. Adm. Code 845.640(f) and the performance standard under 35 Ill. Adm. Code 845.640(g). The sampling procedures for background wells AP-4 and AP-5 and downgradient groundwater monitoring wells AP-1, AP-2, AP-3, AP-6, AP-7, AP-8, AP-10, AP-14 and AW-3 are consistent with that specified under 35 Ill. Adm. Code 845.650.

Pursuant to 35 Ill. Adm. Code 845.640(f), the selected statistical method to be used during in evaluating groundwater monitoring data for each constituent is the Prediction Interval Procedure under 35 Ill. Adm. Code 845.640(f)(1)(C). For this procedure, an interval for each constituent is established from the distribution of the background data and then the level of each constituent in each compliance well (i.e., well/constituent) is compared to the upper prediction limit to assess if a statistically significant increase (SSI) over background has occurred.

The selected method to evaluate concentrations obtained as part of the groundwater monitoring program is appropriate to determine the occurrence of statistically significant changes in the groundwater quality data and complies with the performance standards under 35 Ill. Adm. Code 845.640(g), including:

(1) 35 Ill. Adm. Code 845.640(g)(1) addressing the distribution of constituents where normal distributions will use parametric methods and non-normal distributions will use non-parametric methods.

(2) 35 Ill. Adm. Code 845.640(g)(4) addressing the effectiveness of this approach by considering the number of samples in the background database, the data distribution, and the range of concentrations values for each constituent of concern.

(3) 35 Ill. Adm. Code 845.640(g)(5) establishing the practical quantitation limit as the lowest concentration level that can be reliably achieved during routine laboratory operating conditions.

(4) 35 Ill. Adm. Code 845.640(g)(6) allowing for the correction of seasonal and spatial variability as well as temporal correlation in the data.

4.3 Groundwater Monitoring Program

In accordance with 35 Ill. Adm. Code 845.650, the Groundwater Monitoring Program (GMP) includes, at a minimum, groundwater monitoring for all constituents listed in 35 Ill. Adm. Code 845.600(a)(1), calcium and turbidity.

Eight (8) independent samples were collected from each background and downgradient well and analyzed for the constituents listed in 35 Ill. Adm. Code 845.600(a)(1) and calcium. Samples are continuing to be collected to develop a background for turbidity. The initial eight (8) independent sampling events were completed on a semi-annual basis over the second quarter 2015 through first quarter 2017. This schedule allowed the capture of seasonal variability in quality and groundwater flow conditions. Details for derivation of the background concentrations are provided in Appendix G. Background concentrations and groundwater analytical results are summarized in Appendix H.

Monitoring frequency for the CCR constituents under 35 Ill. Adm. Code 845.650(b)(1)(A) will proceed on a quarterly interval during the active life of the CCR unit and the post closure period, except as allowed by 35 Ill. Adm. Code 845.650(b)(4).

The number of samples collected and analyzed are consistent with the sampling and statistical procedures required by 35 Ill. Adm. Code 845.640(e) and account for any unique characteristics of the site (35 Ill. Adm. Code 845.650(c)). Sampling for will occur on a quarterly basis, except as allowed by 35 Ill. Adm. Code 845.650(b)(4).

Pursuant to 35 Ill. Adm. Code 845.650(d), if it is determined pursuant to 35 Ill. Adm. Code 845.640(h) that there is a statistically significant increase (SSI) over the groundwater protection standard for one or more of the constituents listed in 35 Ill. Adm. Code 845.600, the Illinois EPA shall be notified which constituent exceeded the groundwater protection standard and place the notification in the facility’s operating record as required by 35 Ill. Adm. Code 845.800(d)(16). Also, the owner must either 1) within 60 days of the SSI, complete an alternative source demonstration (35 Ill. Adm. Code 845.650(e)); or 2) within 90 days of the SSI initiate an assessment of corrective measures as required by 35 Ill. Adm. Code 845.660 following the completion of the nature and extent characterization (35 Ill. Adm. Code 845.650(d)(1)) and notification requirements (35 Ill. Adm. Code 845.650(d)(2)).

Pursuant to 35 Ill. Adm. Code 845.650(e) an Alternate Source Demonstration (ASD) may be used to demonstrate that a source other than the CCR unit(s) caused the SSI, or that the SSI was the result of error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. The ASD must be submitted to the Illinois EPA within 60 days of detecting the SSI and within 24 hours of submittal be placed on the CWLP’s CCR website. If the Illinois EPA concurs with the ASD, groundwater monitoring shall resume as required by 35 Ill. Adm. Code 845.650. The ASD must be included in the annual groundwater monitoring and corrective action report required by 35 Ill. Adm. Code 845.610(e). If the Illinois EPA does not concur with the ASD, the assessment of corrective measures must be initiated under 35 Ill. Adm. Code 845.660. If the Illinois EPA does not concur with the ASD, the facility may petition the Illinois Environmental Pollution Control Board (the Board) for review of the Illinois EPA’s non-concurrence under 35 Ill. Adm. Code 105.

Pursuant to 35 Ill. Adm. Code 845.650(d), if it has been determined that the SSI is due to a release from the CCR surface impoundment(s) the facility must initiate an assessment of corrective measure (ACM) (35 Ill. Adm. Code 845.660) within 90 days after the detected exceedance of the GWPS. The remedy ultimately selected by the ACM must be based on a characterization of the nature and extent of the release sufficient to clean up all releases from the CCR surface impoundment pursuant to 35 Ill. Adm. Code 845.660.

The characterization must be submitted to the Illinois EPA and be placed in the facility's operating record as required by 35 Ill. Adm. Code 845.800(d)(16). Characterization of the release includes the following minimum measures:

A) Install additional monitoring wells necessary to define the contaminant plume(s);

B) Collect data on the nature and estimated quantity of material released including specific information on the constituents listed in 35 Ill. Adm. Code 845.600 and the levels at which they are present in the material released;

C) Install at least one additional monitoring well at the facility boundary in the direction of contaminant migration and sample this well in accordance with 35 Ill. Adm. Code 845.650(a) and (b); and

D) Sample all wells in accordance with 35 Ill. Adm. Code 845.650(a) and (b) to characterize the nature and extent of the release.

As part of the ACM, the facility shall notify all persons who own the land or reside on the land that directly overlies any part of the plume of contamination if contaminants have migrated off-site as indicated by sampling of wells in accordance with 35 Ill. Adm. Code 845(d)(1). Notifications made pursuant to 35 Ill. Adm. Code 845.650(d)(2) shall be submitted to the Illinois EPA and placed into the facility's operating record as required by 845.800(d)(16).

4.4 Assessment of Corrective Measures

Within 90 days of determining that an SSI has occurred for any constituent listed in 35 Ill. Adm. Code 845.600, or immediately upon detection of a release, the facility must initiate an ACM to prevent further releases, to remediate releases, and to restore the affected area. The ACM must be completed within 90 days unless a time extension of not more than 60 days is needed to complete the ACM, as demonstrated by the facility. The facility will include any such demonstration in the annual groundwater monitoring and corrective action report required under 35 Ill. Adm. Code 845.610(e). The CCR unit will continue to monitor groundwater in accordance with the groundwater monitoring program (35 Ill. Adm. Code 845.650) during the ACM.

The ACM will evaluate the effectiveness of potential corrective measures in meeting the requirements and objectives of the remedy as described under 35 Ill. Adm. Code 845.670, including performance, reliability, ease of implementation, impacts, exposure, time required, permitting, etc. (35 Ill. Adm. Code 845.660(c)).

The completed assessment of corrective measures will be placed in the operating record; discussed at a public meeting at least 30 days prior to the selection of a remedy under 35 Ill. Adm. Code 845.240; and recordkeeping, notification, and internet requirements will be met.

Pursuant to 35 Ill. Adm. Code 845.660(e) when the facility is completing closure and corrective action simultaneously, the facility may combine the ACM required by 35 Ill. Adm. Code 845.660 and the closure alternatives analysis required by 35 Ill. Adm. Code 845.710 into one assessment of alternatives.

4.5 Corrective Action Plan

Within one year after completing the ACM as specified in 35 Ill. Adm. Code 845.660, and after completion of the public meeting in 35 Ill. Adm. Code 845.660(d), the facility shall submit in a construction permit application, a corrective action plan (CAP) that identifies the selected remedy. The CAP shall be:

- based on the results of the ACM conducted under 35 Ill. Adm. Code 845.660;
- identify a selected remedy that meets the standards listed in 35 Ill. Adm. Code 845.670(d);
- contain the corrective action alternatives analysis specified in 35 Ill. Adm. Code 845.670(e); and
- contain a proposed schedule for implementation, including an analysis of the factors in 35 Ill. Adm. Code 845.670(f).

Pursuant to 35 Ill. Adm. Code 845.670(d), the selected remedy must be protective of human health and environment, attain the GWPS, control the source(s) of release so as to reduce or eliminate, to the extent feasible, further releases on constituents listed in 35 Ill. Adm. Code 845.600, remove from the environment as much of the contaminated material as feasible, and comply with standards for management of wastes under 35 Ill. Adm. Code 845.680(d).

Pursuant to 35 Ill. Adm. Code 845.670(e) the corrective action alternatives analysis shall consider the long and short term effectiveness and protectiveness of each potential remedy along with the degree of certainty that the remedy will prove successful based on the factors under 35 Ill. Adm. Code 845.670(e)(1)(A) through (H), the effectiveness of the remedy in controlling the source to reduce further releases based on consideration of each of the factors (35 Ill. Adm. Code 845.670(e)(2), the ease or difficulty of implementing each potential remedy (35 Ill. Adm. Code 845.670(e)(3), and the degree to which the community concerns are addressed by each potential remedy (35 Ill. Adm. Code 845.670(e)(4)).

Pursuant to 35 Ill. Adm. Code 845.670(f), the schedule for implementing and completing remedial activities must require the completion of remedial activities within a reasonable time, taking into consideration the factors in 35 Ill. Adm. Code 845.670(f)(1) through (6).

4.6 Implementation of the Corrective Action Plan

Pursuant to 35 Ill. Adm. Code 845.680(a), within 90 days of selecting the remedy, the facility will initiate remedial activities. Based on the schedule provided under 35 Ill. Adm. Code 845.670(f) for implementation of corrective action, the facility must establish and implement a corrective action groundwater monitoring program that meets the requirements of the monitoring program under 35 Ill. Adm. Code 845.650, implement the corrective action remedy selected under 35 Ill. Adm. Code 845.670, and address any interim measures that might be needed to reduce the contaminants leaching from the CCR unit. If at any time the facility determines that compliance with the requirements of 35 Ill. Adm. Code 845.670(d) is not being achieved through the remedy selected, other methods or techniques that could feasibly achieve compliance should be evaluated and implemented 35 Ill. Adm. Code 845.680(b).

Pursuant to 35 Ill. Adm. Code 845.680(c), the remedy will be considered complete when compliance with the GWPS has been achieved at all points within the plume of contamination that lies beyond the waste boundary, the concentrations of constituents listed in 35 Ill. Adm. Code

845.600 have not exceeded the GWPS for a period of three consecutive years, and all action required to complete the remedy have been satisfied. The effectiveness of the remedial actions will be evaluated based on the confidence intervals constructed for applicable well/constituent pairs as compared to a specified clean-up standard which is the GWPS. When the entire interval is determined to be below the GWPS for three consecutive years, that well/constituent pair will be declared to be in compliance, and inorganic well/constituent pairs will be moved back into routine groundwater monitoring and appropriate limit-based statistics will resume.

All CCR units that are managed under a remedy required under 35 Ill Adm. Code 845.670 will be managed in a manner that complies with applicable requirements (35 Ill. Adm. Code 845.680(d)).

Pursuant to 35 Ill. Adm. Code 845.680(e), upon completion of the corrective action plan the facility will prepare a corrective action completion report and a certification from a qualified professional engineer that the corrective action plan has been completed in accordance with 35 Ill. Adm. Code 845.680(c). The corrective action completion report shall include the information under 35 Ill. Adm. Code 845.680(e)(1)(A) through (F) and shall be placed into the facility's operating record as required by 35 Ill. Adm. Code 845.800(d)(18).

5. REFERENCES CITED

U.S. Environmental Protection Agency (EPA). March 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance. Office of Resource Conservation and Recovery Program Implementation and Information Division, U.S. Environmental Protection Agency, Washington, DC. 888 p.

TABLES

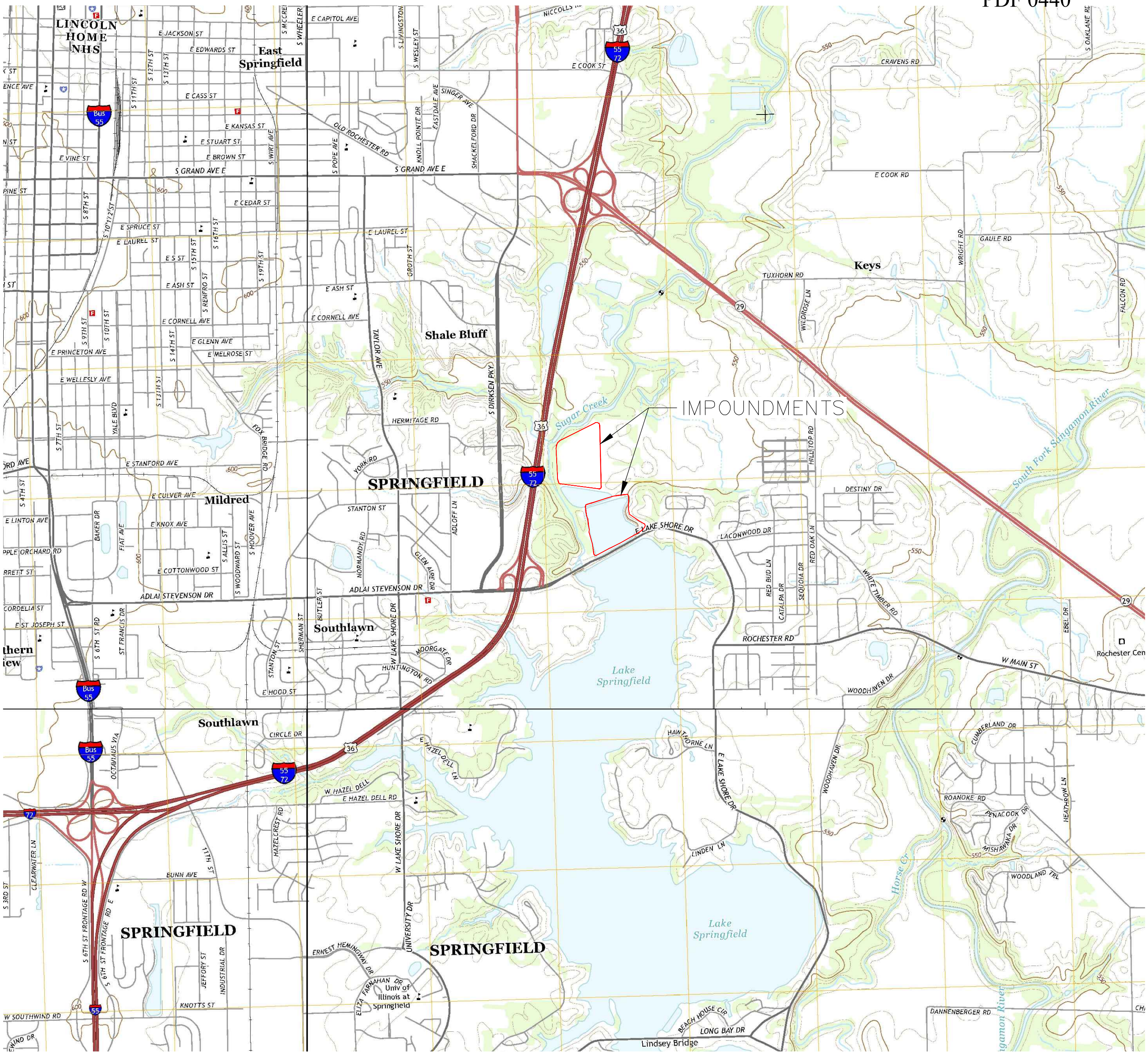
TABLE 1
PROPOSED MONITORING NETWORK
Power Plant Ash Impoundment
CWLP

Well ID	Monitoring Position	Material Screened	Ground Surface Elevation (ft MSL)	Top of Casing Elevation (ft MSL)	Approximate Screen Interval (ft MSL)		
AP-1R	Downgradient	Bedrock/unconsolidated interface	533.1	535.6	511.5	-	502.1
AP-2A	Downgradient	Bedrock/unconsolidated interface	533.6	536.1	525.2	-	515.1
AP-3	Downgradient	Bedrock/unconsolidated interface	533.7	535.6	523.7	-	513.7
AP-4	Upgradient	Bedrock/unconsolidated interface	553.9	554.6	503.9	-	493.9
AP-5	Upgradient	Bedrock/unconsolidated interface	581.6	583.9	563.8	-	553.9
AP-6	Downgradient	Bedrock/unconsolidated interface	534.8	537.8	508.4	-	498.6
AP-7	Downgradient	Bedrock/unconsolidated interface	536.1	539	506.8	-	497.1
AP-8	Downgradient	Bedrock/unconsolidated interface	537.2	540.3	508.6	-	498
AP-10	Downgradient	Bedrock/unconsolidated interface	534.4	537.5	509.7	-	499.9
AP-14	Downgradient	Bedrock/unconsolidated interface	536.8	539.6	519.5	-	509.8
RW-3	Downgradient	Bedrock/unconsolidated interface	536.8	539.3	505.5	-	495.9

TABLE 2
PROPOSED ROUTINE MONITORING PARAMETERS
Power Plant Ash Impoundment
CWLP

Parameter	Units	Parameter Type
Bottom of well elevation	ft MSL	Field
Depth to water	feet	Field
Depth to water from measuring point	feet	Field
Elevation of groundwater surface	ft MSL	Field
pH, Field	units	Field
Spec. Conductance, Field	µmhos/cm @25C	Field
Temperature	°F	Field
Turbidity	NTU	Field
Antimony	mg/L	Inorganic
Arsenic, Total	mg/L	Inorganic
Barium, Total	mg/L	Inorganic
Beryllium, Total	mg/L	Inorganic
Boron, Total	mg/L	Inorganic
Cadmium, Total	mg/L	Inorganic
Calcium, Total	mg/L	Inorganic
Chloride, Total	mg/L	Inorganic
Chromium, Total	mg/L	Inorganic
Cobalt, Total	mg/L	Inorganic
Fluoride, Total	mg/L	Inorganic
Lead, Total	mg/L	Inorganic
Lithium	mg/L	Inorganic
Mercury, Total	mg/L	Inorganic
Molybdenum, Total	mg/L	Inorganic
Radium-226	pci/L	Inorganic
Radium-228	pci/L	Inorganic
Selenium	mg/L	Inorganic
Sulfate, Total	mg/L	Inorganic
Thallium	mg/L	Inorganic
Total Dissolved Solids	mg/L	Inorganic

FIGURES



N

0 200 4000 8000

SCALE: IN FEET

NOTE:

BACKGROUND IMAGE COURTESY OF UNITED STATES GEOLOGICAL SURVEY.

ANDREWS ENGINEERING
3300 GINGER CREEK DRIVE
SPRINGFIELD, ILLINOIS 62711-7233
PH (217) 787-2334 WWW.ANDREWS-ENG.COM
PONTIAC, IL • LOMBARD, IL • INDIANAPOLIS, IN • WARRENTON, MO

SITE LOCATION

PLANS PREPARED FOR

CITY, WATER, LIGHT & POWER

SPRINGFIELD, SANGAMON COUNTY, ILLINOIS

DATE: JULY 2021

PROJECT ID: 200387/0026

SHEET NUMBER: FIGURE 1

APPROVED BY: BJH | DESIGNED BY: BJH | DRAWN BY: MPN

LEGEND

CCR SURFACE IMPOUNDMENT

NOTE

IMAGE SOURCE: GOOGLE EARTH PRO, IMAGE DATE JUNE 7, 2016.

N

0 150 300 600

SCALE: IN FEET

NO.	DATE	REVISION DESCRIPTION	BY

ANDREWS ENGINEERING
3300 GINGER CREEK DRIVE
SPRINGFIELD, ILLINOIS 62711-7233
PH (217) 787-2334 WWW.ANDREWS-ENG.COM
PONTIAC, IL • LOMBARD, IL • INDIANAPOLIS, IN • WARRENTON, MO

APPROVED BY: DG DESIGNED BY: DG DRAWN BY: MPN

SITE DETAILS

PLANS PREPARED FOR
CITY, WATER, LIGHT AND POWER
SPRINGFIELD, SANGAMON COUNTY, ILLINOIS

DATE: JULY 2021

PROJECT ID: 200387/0026

SHEET NUMBER:

FIG. 2

Tab: Layout1 Last Saved: July 28, 2021, by Mike Nguyen Plotted: Wednesday, July 28, 2021 9:34:45 AM
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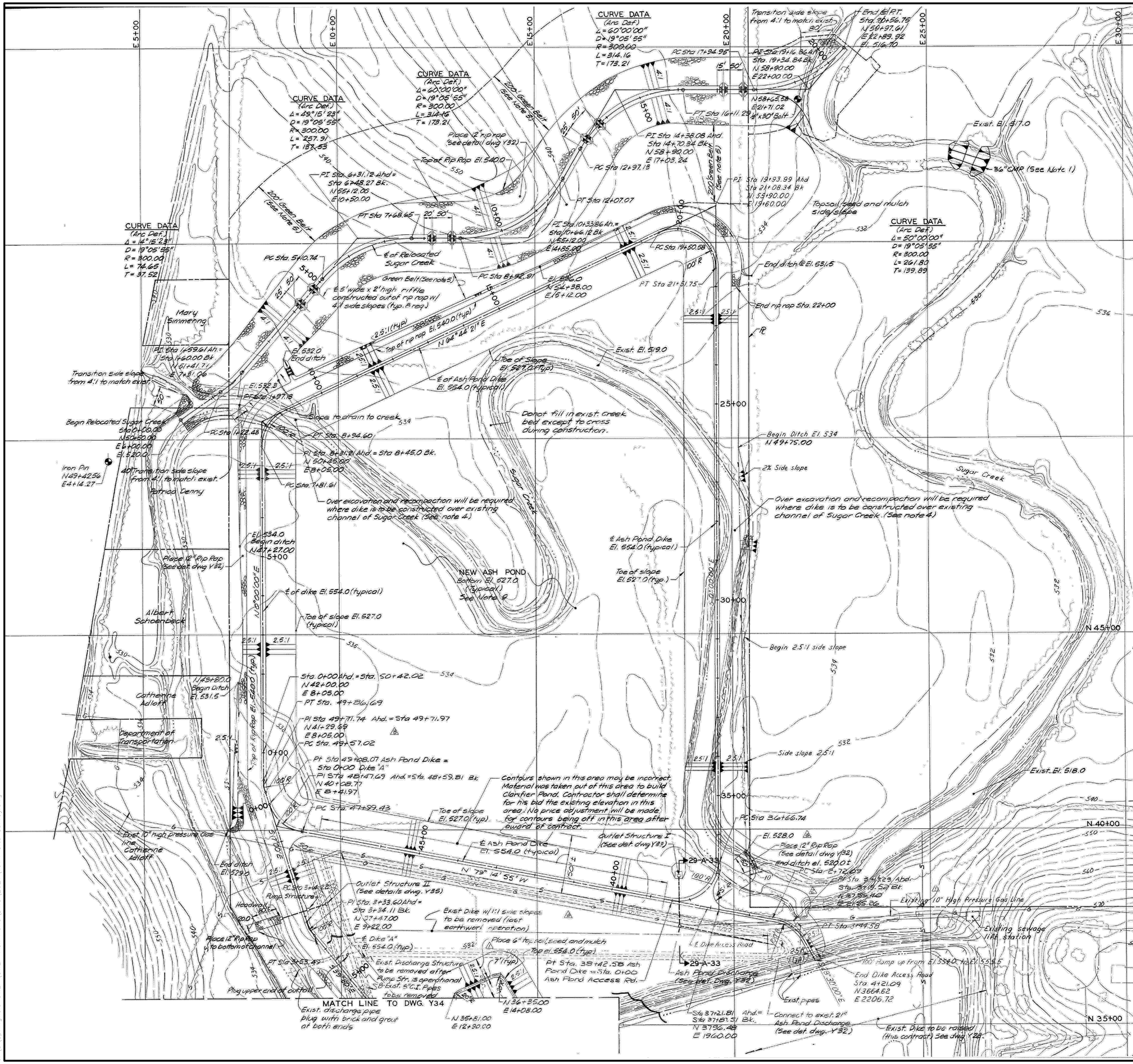

Notes:

1. Two 36" Corregated Metal Pipe, 16 gauge, Bituminous coated, 2½" x ⅔" corrugations, with 2 end sections required.
2. Excavate for Relocated Sugar Creek from Sta. 2+00 to Sta 19+00 leaving excavation isolated from Sugar Creek waters untill excavation and Rip Rap is completed between the above mentioned stations.
3. Area is suseptable to flooding
4. Over excavate at least 4.0 feet under dike below exist. channel banks and bottom. (See cross sections) Fill with cohesive material and compact to at least 90%
5. Form a greenbelt on both sides of Relocated Sugar Creek. Areas within Greenbelt which are cleared or disturbed during construction shall be topsoiled & seeded. Plant trees on 25' ctr. On ground above el. 540.0 10 trees shall be Hard Maple the rest shall be Sycamore. On ground that is below El. 540.0 10 trees shall be Pin Oak the rest shall be Sycamore. Do not plant trees on ash pond dike
6. Clearing Limits as shown outside of Purchacers property lines. Within Purchacers proprerty clear as necessary for const. Keep clearing limits as close to work as possible
7. Waste area is north of Green Belt. Grade waste area to drain and to present a neat appearance. Seed and mulch Waste Area.

△1

9. Borrow material for the Ash Pond Dikes shall come from center of pond and Relocated Sugar Creek. If in the opinion of the engineer material taken from the pond area is too wet to dry in a reasonable length of time the contractor will be permitted to borrow from the area directly north of Relocated Sugar Creek as long as the borrow area is topsoiled, seeded, and mulched, and graded to drain as directed by engineer.

NO.	DATE	BY	REVISION
△1	12-7-76	TKP	(M,7) Added 6" topsoil to dike. (L,13) Removed Bench Mark and note 8.
	12-10-76	LNB	ISSUED
△2	4-27-77	MGH	Changed Dike Access Rd. and exist. dike alignments. Removed 300' pipe. Moved exist. pipe
	4-27-77	LNB	ISSUED
△3	5-26-77	DEJ	Revised dike alignment along So. side of Ash Pond.
	5-31-77	LNB	ISSUED
△4	2-1-79	DLM	CONFORMING TO CONSTRUCTION RECORDS

NO.	DATE	REVISION DESCRIPTION	BY

CONTRACT NO. 3333
ASH POND

V.Y. DALLMAN POWER STATION - UNIT 33

SPRINGFIELD, ILLINOIS

GRADING PLAN

Burns & McDonnell
Engineers - Architects - Consultants
KANSAS CITY, MISSOURI

DATE	AUG. 13, 1976	DRAWING NO. / REV.	Y29 — 4
DESIGNED	LNB		
DETAILED	TRP	PROJECT	73-008-1
CHECKED	[signature]	SHEET OF SHEETS	

0 120 240 480
SCALE: IN FEET

ANDREWS ENGINEERING
3300 GINGER CREEK DRIVE
SPRINGFIELD, ILLINOIS 62711-7233
PH (217) 787-2334 WWW.ANDREWS-ENG.COM
PONTIAC, IL • LOMBARD, IL • INDIANAPOLIS, IN • WARRENTON, MO

APPROVED BY: BJH
DESIGNED BY: MTH
DRAWN BY: MPN

1976 SITE SURVEY

PLANS PREPARED FOR
CITY, WATER, LIGHT, AND POWER
SPRINGFIELD, SANGAMON COUNTY, ILLINOIS

DATE: AUGUST 2021

PROJECT ID: 200325/0003

SHEET NUMBER:

FIG. 3

PDF 0443

NO.	DATE	REVISION DESCRIPTION	BY

ANDREWS ENGINEERING
3300 GINGER CREEK DRIVE
SPRINGFIELD, ILLINOIS 62711-7233
PH (217) 787-2334 WWW.ANDREWS-ENG.COM
PONTIAC, IL • LOMBARD, IL • INDIANAPOLIS, IN • WARRENTON, MO

APPROVED BY: DG DESIGNED BY: DG DRAWN BY: MPN

GROUNDWATER MONITORING NETWORK

PLANS PREPARED FOR
CITY, WATER, LIGHT AND POWER
SPRINGFIELD, SANGAMON COUNTY, ILLINOIS

DATE: JULY 2021
PROJECT ID: 200387/0026
SHEET NUMBER:
FIG. 4

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APPENDIX A

BORING LOGS AND WELL CONSTRUCTION REPORTS

RAPPS

ENGINEERING and APPLIED SCIENCE

BORING LOG

821 SOUTH DURKIN – SPRINGFIELD IL 62704 – (217)787–2118

Site Name: FGDS Development Landfill Boring No: AW–3

Drilling Firm: Reynolds Drilling Corp. Drilling Method: HSA Surface Elev: 537.75

Logged By: KJM Checked By: KJM Date Started: 12/30/08 Completed: 12/31/08

DEPTH	Material Description (Classification System ____)	Sampling: Tube No.	Sampling: Type	Sampling: % Rec.	Tests: OVM (ppm)	Tests: Qu t/sf PEN	Tests: Moist	Comments	Well	DEPTH
0	Dark brown clayey silt; Moist; Firm; Organic debris & plant roots		5' CONTINUOUS SAMPLER							0
	Gray to brown mottled silty clay; Moist; Firm; Trace sand; Laminated; Fe oxidation stains	1		100						
5		2		100						5
10		3		95				Wet seam @ 11.5'		10
15	Gray sandy clay; Moist; Firm; Finely laminated	4		95				Water on rods		15
20	Dark gray sandy silt; Moist; Soft to firm; Some clay	5		80						20
25		6		30				No recovery 26.5'–30'		25
30										30

Water Level ____ after ____ hrs.

Sheet 1 of 2

RAPPS

BORING LOG

ENGINEERING and APPLIED SCIENCE
821 SOUTH DURKIN – SPRINGFIELD IL 62704 – (217)787-2118

Site Name: FGDS Development Landfill Boring No: AW-3
Drilling Firm: Reynolds Drilling Corp. Drilling Method: HSA Surface Elev: 537.75
Logged By: KJM Checked By: KJM Date Started: 12/30/08 Completed: 12/31/08

DEPTH	Material Description (Classification System ____)	Sampling: Tube No.	Sampling: Type	Sampling: % Rec.	Tests: OVM (ppm)	Tests: Qu t/sf PEN	Tests: Moist	Comments
30	Dark gray silt; Trace sand	7	5' CONTINUOUS SAMPLER	100				
35	Sandy							
	Gray fine to medium silty sand; Wet; Gravelly @ base	8		100				
40	Gray shale							Broken shale in bit No recovery past 40'
	End of Boring @ 41.83'	9		0				Refusal
45								
50								
55								
60								

Water Level____after____hrs.

Illinois Environmental Protection Agency **Well Completion Report**

Site Number: 1678250020 County: Sangamon

Well #: AW-3

Site Name: FGDS Development Landfill

State Plane Coordinate: X ____ Y ____ (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Borehole #: AW-3

Surveyed by: David Mihelsic IL Registration #: 3762

Drilling Contractor: Reynolds Drilling Corp. Driller: Andrew Rachford

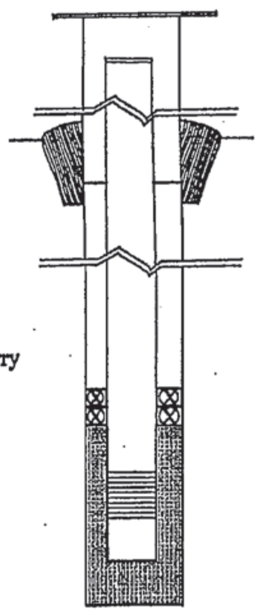
Consulting Firm: Rapps Engineering & Applied Science Geologist: Ken Miller

Drilling Method: HSA Drilling Fluid (Type): NA

Logged By: Ken Miller Date Started: 12/30/08 Date Finished: 12/31/08

Report Form Completed By: Ken Miller Date: 5/18/09

ANNULAR SPACE DETAILS



	Elevations (MSL)*	Depths (BGS)	(.01ft.)
	____	____	Top of Protective Casing
	540.33	-2.58	Top of Riser Pipe
Type of Surface Seal: Cement	537.75	0	Ground Surface
Type of Annular Sealant: Bentonite Chips	534.75	3.00	Top of Annular Sealant
Installation Method: Poured	____	____	Static Water Level (After Completion)
Setting Time: >24 hrs			
Type of Bentonite Seal -- Granular, (Pellet), Slurry (Choose One)	511.32	26.43	Top of Seal
Installation Method: Poured	508.32	29.43	Top of Sand Pack
Setting Time: 16 hrs	506.32	31.43	Top of Screen
Type of Sand Pack: Quartz Sand	496.32	41.43	Bottom of Screen
Grain Size: 50 (Sieve Size)	495.92	41.83	Bottom of Well
Installation Method: Poured	495.92	41.83	Bottom of Borehole

* Referenced to a National Geodetic Datum

Type of Backfill Material: ____ (if applicable)

Installation Method: ____

WELL CONSTRUCTION MATERIAL

(Choose one type of material for each area)

Protective Casing	SS304, SS316, PTFE, PVC, or (Other)
Riser Pipe Above W.T.	SS304, SS316, PTFE, (PVC) or Other
Riser Pipe Below W.T.	SS304, SS316, PTFE, (PVC) or Other
Screen	SS304, SS316, PTFE, (PVC) or Other

CASING MEASURMENTS

Diameter of Borehole (inches)	8.25
ID of Riser Pipe (inches)	2
Protective Casing Length (feet)	5
Riser Pipe Length (feet)	34.01
Bottom of Screen to End Cap (feet)	0.4
Screen Length (1st slot to last slot) (feet)	10
Total Length of Casing (feet)	44.41
Screen Slot Size **	0.010

**Hand-Slotted Well Screens are Unacceptable

Professional Service Industries, Inc.
480 North Street
Springfield, Illinois 62704
Telephone: 217/544-6663
Fax: 217/544-6143

LOG OF BORING AP-1

Sheet 1 of 1

PSI Job No.: 0020522
Project: Piezometer Installation
Location: CWLP Ash Pond
East Lake Shore Drive
Springfield, Illinois

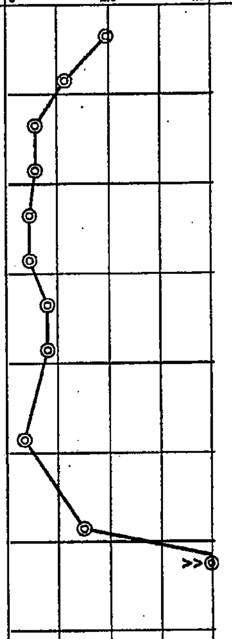
Drilling Method: Hollow Stem Auger
Sampling Method: Split Spoon
Hammer Type: CME Automatic; ETR = 86%
Boring Location: See attached boring location plan.

WATER LEVELS	
While Drilling	9 feet
Upon Completion	N/A
Delay	N/A

Station: N/A
Offset: N/A

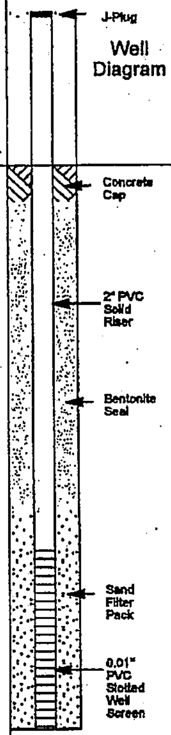
Elevation (feet)	Depth, (feet)	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %
	0–3.5	Split-Spoon	1	18	Dark brown silty CLAY, very stiff, slightly moist	CL	7-8-9 N_{60}=24	
	3.5–6	Split-Spoon	2	18	Dark brown clayey SILT, stiff, slightly moist	ML	5-5-5 N_{60}=14	
		Split-Spoon	3	18	Gray clayey SILT, trace brown, firm, moist	ML	2-2-3 N_{60}=7	
		Split-Spoon	4	18			2-2-3 N_{60}=7	
		Split-Spoon	5	18			1-2-2 N_{60}=6	
		Split-Spoon	6	18	Gray silty CLAY, few brown sand, firm, saturated	CL	1-2-2 N_{60}=6	
		Split-Spoon	7	18	Gray sandy CLAY, stiff, saturated	CLS	4-3-4 N_{60}=10	
		Split-Spoon	8	18	Blue-gray clayey SILT, soft to very stiff, moist to saturated	ML	3-3-4 N_{60}=10	
		Split-Spoon	9	18			1-2-1 N_{60}=4	
		Split-Spoon	10	18	Gray SAND with SILT, medium dense/very stiff, saturated	SW-SM	6-7-6 N_{60}=19	
		Split-Spoon	11	6	Gray SHALE, hard, slightly moist	CL	50/6"	
					Boring terminated ay -31.5'			

STANDARD PENETRATION TEST DATA
N in blows/ft ◎
× Moisture PL LL
0 25 50
STRENGTH, tsf
▲ Qu ✳ Qp
0 2.0 4.0



Additional Remarks

Well Diagram



Completion Depth: 35.0 ft
Date Boring Started: 4/21/10
Date Boring Completed: 4/21/10
Logged By: Rob Preuss
Drilling Contractor: PSI, Inc.

Sample Types:
Auger Cutting
Split-Spoon
Rock Core
Shelby Tube
Hand Auger
Texas Cone

Latitude:
Longitude:
Drill Rig: ATV D50
Remarks: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633. Moistures determined by visual methods

The stratification lines represent approximate boundaries. The transition may be gradual.

Professional Service Industries, Inc.
480 North Street
Springfield, Illinois 62704
Telephone: 217/544-6663
Fax: 217/544-6143

LOG OF BORING AP-2

Sheet 1 of 1

PSI Job No.:	0020522	Drilling Method:	Hollow Stem Auger
Project:	Piezometer Installation	Sampling Method:	Split Spoon
Location:	CWLP Ash Pond, East Lake Shore Drive, Springfield, Illinois	Hammer Type:	CME Automatic; ETR = 86%
		Boring Location:	See attached boring location plan.

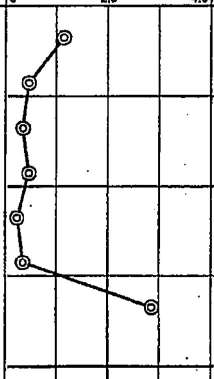
WATER LEVELS

While Drilling	9 feet
Upon Completion	N/A
Delay	N/A

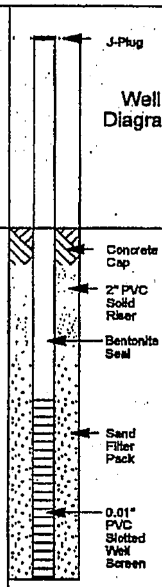
Station: N/A
Offset: N/A

Elevation (feet)	Depth, (feet)	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0	Split-Spoon	1	10	Dark brown silty CLAY, some sand, stiff, slightly moist (FILL)	CL	4-4-6 N_{60}=14		
	5	Split-Spoon	2	8	Dark brown silty CLAY, soft to firm, moist	CL	2-2-2 N_{60}=6		
		Split-Spoon	3	6	Gray silty CLAY, soft to firm, moist	CL	1-1-2 N_{60}=4		
	10	Split-Spoon	4	18	Gray clayey SILT, soft to firm, saturated	ML	2-2-2 N_{60}=6		
		Split-Spoon	5	18			2-1-1 N_{60}=3		
	15	Split-Spoon	6	18			2-1-2 N_{60}=4		
		Split-Spoon	7	18	Light gray SAND, dense, saturated	SP	4-9-16 N_{60}=36		
	20	Split-Spoon	8	14	Gray SHALE, hard, slightly moist	CL	19-24-50/2"		
					Boring terminate at -20'				

STANDARD PENETRATION TEST DATA
N in blows/ft ◎
× Moisture ◪ PL ✚ LL
0 25 50
STRENGTH, tsf
▲ Qu ✳ Qp
0 2.0 4.0



Well Diagram



Completion Depth:	20.0 ft	Latitude:	
Date Boring Started:	4/21/10	Longitude:	
Date Boring Completed:	4/21/10	Drill Rig:	ATV D50
Logged By:	Rob Preuss		
Drilling Contractor:	PSI, Inc.		

Sample Types: Auger Cutting, Split-Spoon, Rock Core, Shelby Tube, Hand Auger, Texas Cone

Remarks: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633. Moistures determined by visual methods.

The stratification lines represent approximate boundaries. The transition may be gradual.

Professional Service Industries, Inc.
480 North Street
Springfield, Illinois 62704
Telephone: 217/544-6663
Fax: 217/544-6143

LOG OF BORING AP-3

Sheet 1 of 1

PSI Job No.: 0020522
Project: Piezometer Installation
Location: CWLP Ash Pond
East Lake Shore Drive
Springfield, Illinois

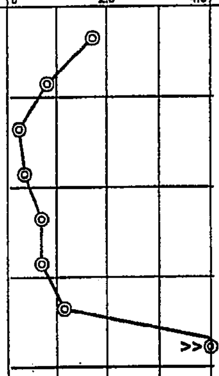
Drilling Method: Hollow Stem Auger
Sampling Method: Split Spoon
Hammer Type: CME Automatic; ETR = 86%
Boring Location: See attached boring location plan.

WATER LEVELS	
While Drilling	None feet
Upon Completion	N/A
Delay	N/A

Station: N/A
Offset: N/A

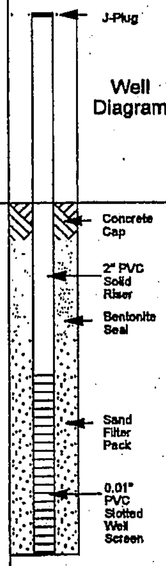
Elevation (feet)	Depth, (feet)	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %
	0	Split-Spoon	1	18	Dark brown silty CLAY, very stiff, slightly moist	CL	6-7-8 N_{60}=21	
		Split-Spoon	2	18	Gray/brown clayey SILT, soft to stiff, moist to saturated	ML	3-3-4 N_{60}=10	
	5	Split-Spoon	3	18			1-1-1 N_{60}=3	
		Split-Spoon	4	18	Gray clayey SILT, soft to very stiff, saturated	ML	2-1-2 N_{60}=4	
	10	Split-Spoon	5	18			2-2-4 N_{60}=9	
		Split-Spoon	6	16			2-2-4 N_{60}=9	
	15	Split-Spoon	7	18			4-4-6 N_{60}=14	
		Split-Spoon	8	10	Gray SHALE, hard, slightly moist	CL	32-50/3"	
	20				Boring terminated at -19.5			

STANDARD PENETRATION TEST DATA
N in blows/ft
× Moisture PL LL
0 25 50
STRENGTH, tsf
▲ Qu ✱ Qp
0 2.0 4.0



Additional Remarks

Well Diagram



Completion Depth:	20.0 ft
Date Boring Started:	4/21/10
Date Boring Completed:	4/21/10
Logged By:	Rob Preuss
Drilling Contractor:	PSI, Inc.

Sample Types:
Auger Cutting
Split-Spoon
Rock Core
Shelby Tube
Hand Auger
Texas Cone

Latitude:
Longitude:
Drill Rig: ATV D50
Remarks: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633. Moistures determined by visual methods

The stratification lines represent approximate boundaries. The transition may be gradual.

Professional Service Industries, Inc.
480 North Street
Springfield, Illinois 62704
Telephone: 217/544-6663
Fax: 217/544-6143

LOG OF BORING AP-4

Sheet 1 of 1

PSI Job No.: 0020522
Project: Piezometer Installation
Location: CWLP Ash Pond, East Lake Shore Drive, Springfield, Illinois

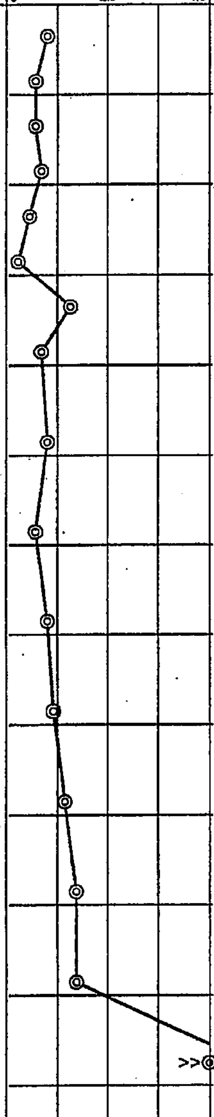
Drilling Method: Hollow Stem Auger
Sampling Method: Split Spoon
Hammer Type: CME Automatic; ETR = 86%
Boring Location: See attached boring location plan.

WATER LEVELS
- While Drilling: 11 feet
- Upon Completion: N/A
- Delay: N/A

Station: N/A
Offset: N/A

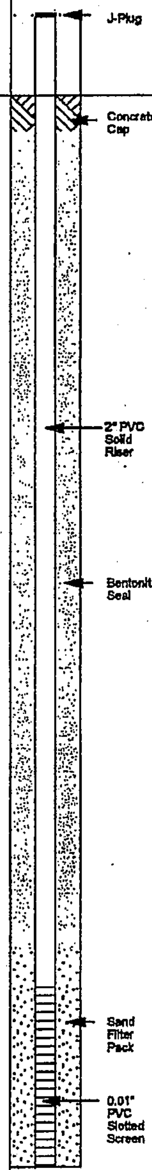
Depth (feet)	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)
0	Split-Spoon	1	17	Brown silty CLAY, some brown sand, firm to stiff, slightly moist (FILL)	CL	4-4-3, N_{60}=10
	Split-Spoon	2	18	Brown silty CLAY, trace roots, firm to stiff, moist (FILL)	CL	4-3-2, N_{60}=7
5	Split-Spoon	3	10	Brown SILT, trace gray, firm to stiff, moist (FILL)	ML	6-3-2, N_{60}=7
	Split-Spoon	4	12	5" Brown SAND transitioning to Black FLY ASH at 9.4', stiff to very stiff, slightly moist (FILL)	SAND/FLY ASH	2-2-4, N_{60}=9
10	Split-Spoon	5	18			2-2-2, N_{60}=6
15	Split-Spoon	6	16			2-1-1, N_{60}=3
	Split-Spoon	7	16			6-6-5, N_{60}=16
	Split-Spoon	8	18	Black FLY ASH, some fine sub-round gravel, stiff to very stiff, moist to saturated (FILL)	FLY ASH	3-3-3, N_{60}=9
20				Gray/green (organic?) CLAY, stiff, trace fine sand, moist to saturated	CL	
25	Split-Spoon	9	1			3-3-4, N_{60}=10
30	Split-Spoon	10	18	Brown/gray silty CLAY, fiorm to stiff, saturated	CL	2-2-3, N_{60}=7
35	Split-Spoon	11	18	Gray SILT, stiff to very stiff, saturated	ML	3-3-4, N_{60}=10
40	Split-Spoon	12	18			4-4-4, N_{60}=11
45	Split-Spoon	13	18			4-4-6, N_{60}=14
50	Split-Spoon	14	18	Gray fine to coarse SAND, medium dense, saturated	SW	4-5-7, N_{60}=17
55	Split-Spoon	15	18			5-5-7, N_{60}=17
	Split-Spoon	16	1	Gray SHALE, hard, moist	CL	50/1"
60				Boring terminated at -60'		

STANDARD PENETRATION TEST DATA — N in blows/ft; Moisture; PL; LL; STRENGTH, tsf: Qu, Qp



Additional Remarks

Well Diagram



Completion Depth: 60.0 ft
Date Boring Started: 4/20/10
Date Boring Completed: 4/20/10
Logged By: Rob Preuss
Drilling Contractor: PSI, Inc.

Sample Types: Auger Cutting, Split-Spoon, Rock Core, Shelby Tube, Hand Auger, Texas Cone

Latitude:
Longitude:
Drill Rig: ATV D50
Remarks: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633. Moistures determined by visual methods.

The stratification lines represent approximate boundaries. The transition may be gradual.

Andrews Engineering, Inc.
3300 Ginger Creek Drive, Springfield, IL 62711 (217) 787-2334

PDF 0452

Field Boring Log

Site Information:
Name: City Water, Light, & Power
Location: Springfield, IL
County: Sangamon
Site No.:
AEEI No.: 2011-127

Location:
Coord. System: Site Grid
Northing: 5132.40
Easting: 831.70

Weather:
Cloudy; 38° F; West 10-15 MPH

Boring Information:
Boring No.: AP-1R
Well No.: AP-1R
Surf. Elev.: 533.10

Depth Information:
Total: 32.50
Auger: 32.50
Core:

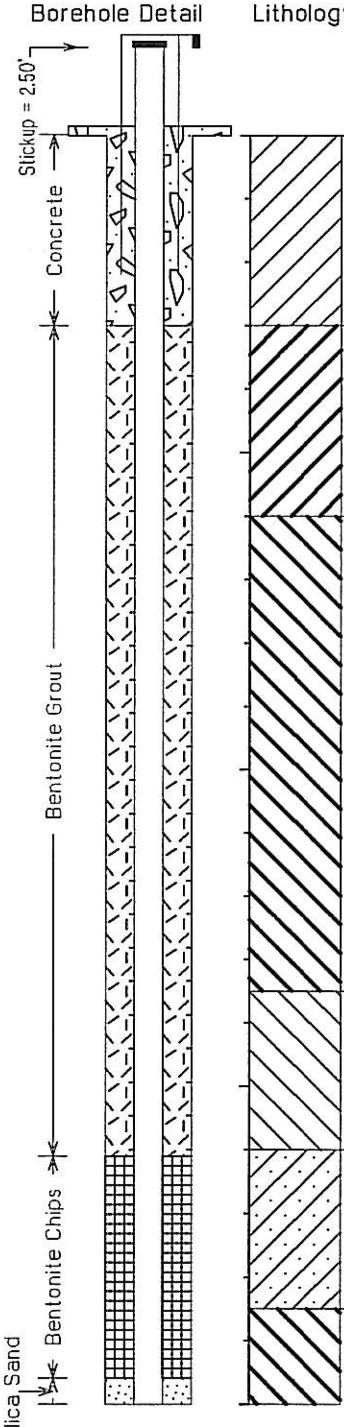
Dates:
Start: 1/30/2012
Finish: 1/30/2012

Drilling Contractor:
Name: Terra Drill, Inc.
City: Dupo, IL
Equipment: CME 550 with 4¼" I.D. HSA and 5' CB

Personnel:
Geologist: M. Hewitt
Driller: J. Brown
Helper (s): J. Horn

Sample Type: Continuous Barrel; Split Spoon; Shelby Tube; Core; Blind Drill

Run No.	Sample Type	Sample No.	Recov.	Blow Count	q_p [q_s] (in tsf)	% Moisture
1			NA			
2			NA			
3			NA			
4			NA			
5	Continuous Barrel					



Description/*Comments*	USC
Dark brown silty CLAY; very stiff; slightly moist	CL
Dark brown clayey SILT; stiff; slightly moist	ML
Gray clayey SILT; trace brown; firm; moist	ML
Gray silty CLAY; few brown sand; firm; saturated	CL
Gray sandy CLAY; stiff; saturated	SC
Blue-gray clayey SILT; soft to very stiff; moist to saturated	ML

Depth (ft.): 5, 10, 15, 20
Elev. (MSL): 530, 525, 520, 515

NOTES: AP-1R blind-drilled to 19.0 ft bgs
Geology from 0-19.0 ft bgs based on AP-1 log

Andrews Engineering, Inc.
3300 Ginger Creek Drive, Springfield, IL 62711 (217) 787-2334

Field Boring Log

Site Information:
Name: City Water, Light, & Power
Location: Springfield, IL
County: Sangamon
Site No.:
AEEI No.: 2011-127

Location:
Coord. System: Site Grid
Northing: 5132.40
Easting: 831.70

Boring Information:
Boring No.: AP-1R
Well No.: AP-1R
Surf. Elev.: 533.10

Weather:
Cloudy; 38° F; West 10-15 MPH

Depth Information:
Total: 32.50
Auger: 32.50
Core:

Drilling Contractor:
Name: Terra Drill, Inc.
City: Dupo, IL
Equipment: CME 550 with 4¼" I.D. HSA and 5' CB

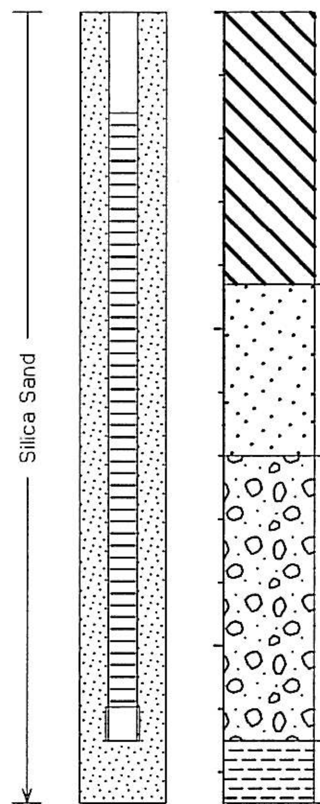
Personnel:
Geologist: M. Hewitt
Driller: J. Brown
Helper (s): J. Horn

Dates:
Start: 1/30/2012
Finish: 1/30/2012

Sample Type: - Continuous Barrel - Split Spoon - Shelby Tube - Core - Blind Drill

Depth (ft.)	Run No.	Sample Type	Sample No.	Sample Recov.	Blow Count	q_p [q_s] (in tsf)	% Moisture
	5	Continuous Barrel		100%			
25	6	Continuous Barrel		100%			
30	7	Continuous Barrel		100%			
35							
40							

Borehole Detail / Lithology



Description/*Comments*	USC	Elev. (MSL)
(Cont'd) Blue-gray clayey SILT; soft to very stiff; moist to saturated	ML	510
Gray SAND with silt; medium dense; saturated	SM	
Dark gray SAND and GRAVEL; loose; saturated	SW	505
Dark gray SHALE; weathered; dense; moist	CL	
End of Boring = 32.5 '		500
		495

NOTES: AP-1R blind-drilled to 19.0 ft bgs
Geology from 0-19.0 ft bgs based on AP-1 log

Illinois Environmental Protection Agency — Well Completion Report

Site #: ______ County: Sangamon Well #: AP-1R

Site Name: City Water, Light, & Power Borehole #: AP-1R

Coordinates: X 831.70 Y 5132.40 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed by: ______ IL Registration #: ______

Drilling Contractor: Terra Drill, Inc. Consulting Firm: Andrews Engineering, Inc.

Driller: J. Brown Geologist: M. Hewitt

Drilling Method: 4¼" HSA w/ 5' Continuous Barrel Logged by: M. Hewitt

Drilling Fluids (type): ______ Report Form Completed by: J. Rhoades

Date Well Started: 1/30/2012 Date Well Finished: 1/30/2012 Date Form Completed: 2/27/2012

ANNULAR SPACE DETAILS

Type of surface seal: Concrete

Type of annular sealant: Bentonite Grout

Installation method: Tremie

Setting time: 2 Hours

Type of bentonite seal: Bentonite Chips

Installation method: Free drop

Setting time: 2 Hours

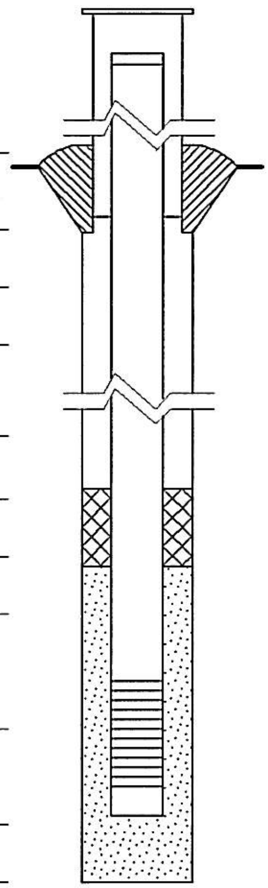
Type of sand pack: Unimin Sand

Grain size: 10/20 (sieve size)

Installation method: Free drop

Type of backfill material: ______ (if applicable)

Installation method: ______



ELEVATION (MSL)*	DEPTH (BGS)*	(0.01 ft)
535.60	-2.50	Top of Protective Casing
.00	533.10	Top of Riser Pipe
533.10	.00	Ground Surface
530.10	3.00	Top of Annular Sealant
n/a	n/a	Static Water Level Measured on (after completion)
517.00	16.10	Top of Seal
513.51	19.59	Top of Sandpack
-21.59	554.69	Top of Screen
-30.97	564.07	Bottom of Screen
-31.50	564.60	Bottom of Well
500.60	32.50	Bottom of Borehole

* Referenced to a National Geodetic Vertical Datum
* positive (+) values below GS, negitive (-) values above GS

CASING MEASUREMENTS

Diameter of Borehole (in)	8.0
ID of Riser Pipe (in)	2.0
Protective Casing Length (ft)	5.0
Riser Pipe Length (ft)	21.59
Bottom of Screen to End Cap (ft)	.53
Screen Length [1st slot to last slot] (ft)	9.38
Total Length of Casing (ft)	31.50
Screen Slot Size*	0.01"

*Hand-slotted well screens are unacceptable.

WELL CONSTRUCTION MATERIALS

Protective Casing	SS304, SS316, PTFE, PVC or *Other:Steel*
Riser Pipe Above W.T.	SS304, SS316, PTFE, *PVC*, or Other:
Riser Pipe Below W.T.	SS304, SS316, PTFE, *PVC*, or Other:
Screen	SS304, SS316, PTFE, *PVC*, or Other:

(AE950315)

PDF 0455

Andrews Engineering, Inc.

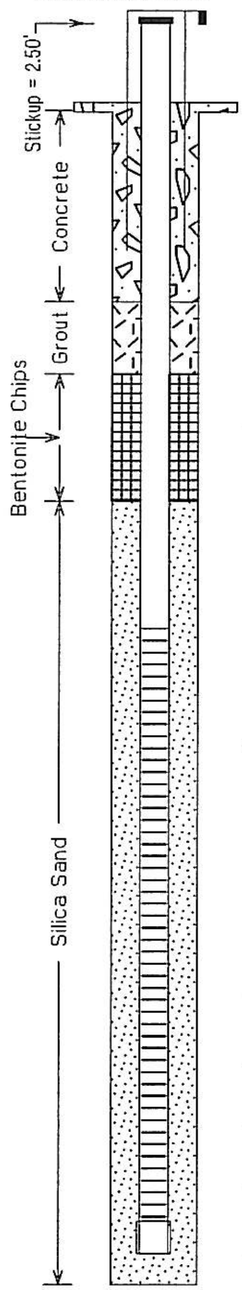
3300 Ginger Creek Drive, Springfield, IL 62711 (217) 787-2334

Field Boring Log

Site Information:	Location:	Boring Information:
Name: City Water, Light, & Power	Coord. System: Site Grid	Boring No.: AP-2R
Location: Springfield, IL	Northing: 4184.70	Well No.: AP-2R
County: Sangamon	Easting: 725.50	Surf. Elev.: 533.10
Site No.:	**Weather:**	Depth Information:
AEEI No.: 2011-127	Cloudy; 38° F; West 10-15 MPH	Total: 18.50
Drilling Contractor:	**Personnel:**	Auger: 18.50
Name: Terra Drill, Inc.	Geologist: M. Hewitt	Core:
City: Dupo, IL	Driller: J. Brown	Dates:
Equipment: CME 550 with 4¼" I.D. HSA and 5' CB	Helper (s): J. Horn	Start: 1/31/2012
		Finish: 1/31/2012

Sample Type: Continuous Barrel – Split Spoon – Shelby Tube – Core – Blind Drill

Depth (ft.)	Run No.	Sample Type	Sample No.	Recov.	Blow Count	q_p [q_s] (in tsf)	% Moisture
0–5	1	Blind Drill		NA			
5–10	2	Blind Drill		NA			
10–15	3	Continuous Barrel		70%			
15–18.5	4	Continuous Barrel		100%			



Lithology	Description/*Comments*	USC
	Dark brown silty CLAY; some sand; stiff; slightly moist	CL
	Dark brown silty CLAY; soft to firm; moist	CL
	Gray silty CLAY; soft to firm; moist	CL
	Gray clayey SILT; very soft; moist to wet	ML
	Light gray SAND; dense; saturated	SP
	Gray SHALE; hard; slightly moist	CL

End of Boring = 18.5 '

Depth (ft.): 5, 10, 15, 20

Elev. (MSL): 530, 525, 520, 515

NOTES: AP-2R blind-drilled to 10.0 ft bgs
Geology from 0-10.0 ft bgs based on AP-1 log

Illinois Environmental Protection Agency — Well Completion Report

Site #: ______ County: Sangamon Well #: AP-2R

Site Name: City Water, Light, & Power Borehole #: AP-2R

Coordinates: X 725.50 Y 4184.70 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed by: ______ IL Registration #: ______

Drilling Contractor: Terra Drill, Inc. Consulting Firm: Andrews Engineering, Inc.

Driller: J. Brown Geologist: M. Hewitt

Drilling Method: 4¼" HSA w/ 5' Continuous Barrel Logged by: M. Hewitt

Drilling Fluids (type): ______ Report Form Completed by: J. Rhoades

Date Well Started: 1/31/2012 Date Well Finished: 1/31/2012 Date Form Completed: 2/27/2012

ANNULAR SPACE DETAILS

Type of surface seal: Concrete

Type of annular sealant: Bentonite Grout

Installation method: Tremie

Setting time: 2 Hours

Type of bentonite seal: Bentonite Chips

Installation method: Free drop

Setting time: 2 Hours

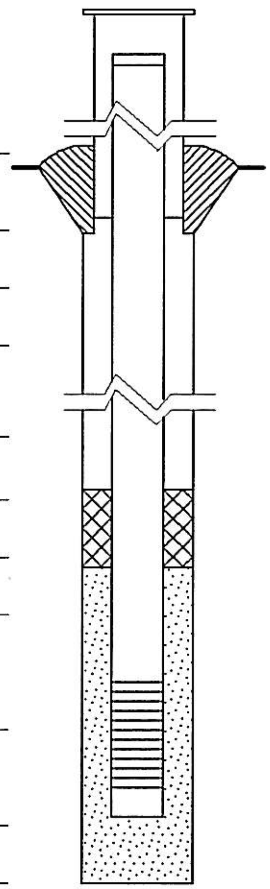
Type of sand pack: Unimin Sand

Grain size: 10/20 (sieve size)

Installation method: Free drop

Type of backfill material: ______ (if applicable)

Installation method: ______



ELEVATION (MSL)*	DEPTH (BGS)*	(0.01 ft)
535.60	-2.50	Top of Protective Casing
.00	533.10	Top of Riser Pipe
533.10	.00	Ground Surface
530.10	3.00	Top of Annular Sealant
n/a	n/a	Static Water Level Measured on (after completion)
528.96	4.14	Top of Seal
526.96	6.14	Top of Sandpack
-8.14	541.24	Top of Screen
-17.47	550.57	Bottom of Screen
-18.00	551.10	Bottom of Well
514.60	18.50	Bottom of Borehole

* Referenced to a National Geodetic Vertical Datum
* positive (+) values below GS, negitive (-) values above GS

CASING MEASUREMENTS

Diameter of Borehole (in)	8.0
ID of Riser Pipe (in)	2.0
Protective Casing Length (ft)	5.0
Riser Pipe Length (ft)	8.14
Bottom of Screen to End Cap (ft)	.53
Screen Length (1st slot to last slot) (ft)	9.33
Total Length of Casing (ft)	18.00
Screen Slot Size*	0.01"

*Hand-slotted well screens are unacceptable.

WELL CONSTRUCTION MATERIALS

Protective Casing	SS304, SS316, PTFE, PVC or *Other:Steel*
Riser Pipe Above W.T.	SS304, SS316, PTFE, *PVC*, or Other:
Riser Pipe Below W.T.	SS304, SS316, PTFE, *PVC*, or Other:
Screen	SS304, SS316, PTFE, *PVC*, or Other:

(AE950315)

Andrews Engineering, Inc.
3300 Ginger Creek Drive
Springfield, IL 62711

FIELD BORING LOG

Site Information:
Name: Springfield City Water, Light, and Power
Location: Springfield, IL
County: Sangamon
Site No.:
AEI No.: 160192

Location:
Coord. System: Site Grid
Northing: 4185.2
Easting: 735.9

Weather: Sunny, 40F

Boring Information:
Boring No: AP-2A
Well No: AP-2A
Surf Elev.: 533.6

Depth Information:
Total: 19.0
Auger: 19.0
Core:

Dates:
Start: 2/16/16
Finish: 2/16/16

Drilling Contractor:
Contractor Name: Bulldog Drilling
City: Dupo, IL
Equipment: AMS Powerprobe w/ 4.25" HSA and 5' MC

Personnel:
Geologist: C. Myrvold
Driller: J. Edwards
Helper(s): Z. Strickland

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Run No.	Sample Type	Sample Recov.	Blow Count	qu/su (tsf)	Lithology	Description/Comments	Elev. (MSL)
0							Ground Surface	533.6
0–9.0	1	Blind Drill					Blind drilled to 9.0 feet. For detailed geology refer to the original log for AP-2R	
9.0–13.0	2	CB	3.2/4				Gray CLAYEY SILT; moist to wet; moderately loose	
13.0–17.0	3	CB	4.0/4					
17.0–19.0	4	CB	2.0/2				Light gray SAND; fine to medium grained; saturated; some gravel	
							Gray SHALE; weathered; hard; slightly moist	
19							End of Boring = 19 Feet	

Depth scale (ft): 0, 5, 10, 15, 20
Elevation scale (MSL): 530.0, 525.0, 520.0, 515.0

Notes:

Illinois Environmental Protection Agency — Well Completion Report

Site #: ______ County: Sangamon Well #: AP-2A

Site Name: Springfield City Water, Light, and Power Borehole #: ______

Coordinates: X 735.9 Y 4185.2 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed by: Springfield City Water, Light, and Power IL Registration #: ______

Drilling Contractor: Bulldog Drilling, Inc. Consulting Firm: Andrews Engineering, Inc.

Driller: J. Edwards Geologist: C. Myrvold

Drilling Method: AMS Powerprobe w/ 4.25" HSA and 5' MC Logged by: C. Myrvold

Drilling Fluids (type): na Report Form Completed by: C. Myrvold

Date Well Started: 2/16/2016 Date Well Finished: 2/16/2016 Date Form Completed: 3/06/2016

ANNULAR SPACE DETAILS

Type of surface seal: Concrete

Type of annular sealant: N/A

Installation method: ______

Setting time: ______

Type of bentonite seal: Bentonite chips

Installation method: Free drop

Setting time: 24+ hours

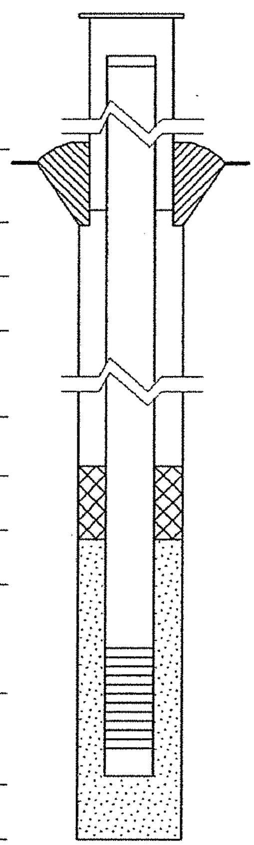
Type of sand pack: Silica sand

Grain size: 20/40 (sieve size)

Installation method: Free drop

Type of backfill material: N/A (if applicable)

Installation method: ______



ELEVATION (MSL)*	DEPTH (BGS)* (0.01 ft)	
536.50	-2.90	Top of Protective Casing
536.10	-2.50	Top of Riser Pipe
533.60	0.00	Ground Surface
	N/A	Top of Annular Sealant
		Static Water Level Measured on (after completion)
530.60	3.00	Top of Seal
527.19	6.41	Top of Sandpack
525.19	8.41	Top of Screen
515.54	18.06	Bottom of Screen
515.10	18.50	Bottom of Well
514.60	19.00	Bottom of Borehole

* Referenced to a National Geodetic Vertical Datum
* positive (+) values below GS, negitive (-) values above GS

Notes:

CASING MEASUREMENTS

Diameter of Borehole (in)	8.25
ID of Riser Pipe (in)	2
Protective Casing Length (ft)	5.0
Riser Pipe Length (ft)	10.91
Bottom of Screen to End Cap (ft)	0.44
Screen Length [1st slot to last slot] (ft)	9.65
Total Length of Casing (ft)	21.00
Screen Slot Size*	#10 (0.01)

*Hand-slotted well screens are unacceptable.

WELL CONSTRUCTION MATERIALS

Protective Casing	Anodized Aluminum
Riser Pipe Above W.T.	PVC
Riser Pipe Below W.T.	PVC
Screen	PVC

Andrews Engineering, Inc.

3300 Ginger Creek Drive, Springfield, IL 62711 (217) 787-2334

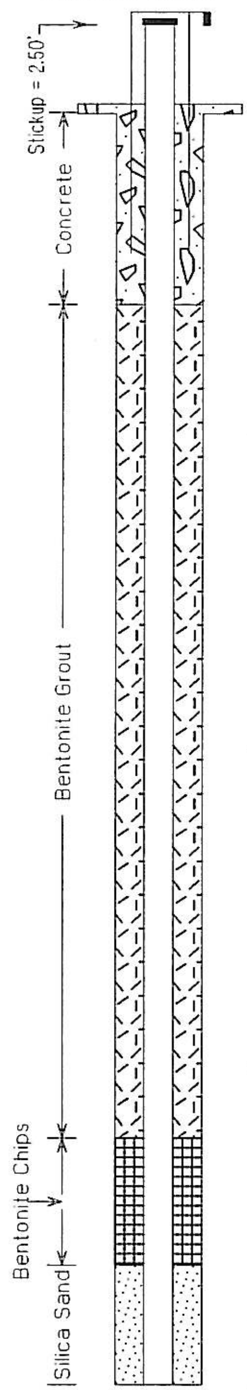
Field Boring Log

PDF 0459

Site Information:	Location:	Boring Information:
Name: City Water, Light, & Power	Coord. System: Site Grid	Boring No.: AP-5
Location: Springfield, IL	Northing: 3164.10	Well No.: AP-5
County: Sangamon	Easting: 3203.10	Surf. Elev.:
Site No.:	**Weather:**	Depth Information:
AEEI No.: 2011-127	Cloudy; 38° F; West 10-15 MPH	Total: 49.0
Drilling Contractor:	**Personnel:**	Auger: 49.0
Name: Terra Drill, Inc.	Geologist: M. Hewitt	Core:
City: Dupo, IL	Driller: J. Brown	Dates:
Equipment: CME 550 with 4¼" I.D. HSA 5' CB and 2' SS	Helper (s): J. Horn	Start: 2/1/2012
		Finish: 2/1/2012

Sample Type: Continuous Barrel – Split Spoon – Shelby Tube – Core – Blind Drill

Depth (ft.)	Run No.	Sample Type	No.	Recov.	Blow Count	q_p [q_s] (in tsf)	% Moisture
0–4	1	Continuous Barrel		100%			
4–9	2	Continuous Barrel		76%			
9–14	3	Continuous Barrel		100%			
14–19	4	Continuous Barrel		100%			
19–20	5	Split Spoon		100%			



Depth (ft.)	Description/*Comments*	USC	Elev. (MSL)
0–5.1	Dark yellowish brown silty CLAY; very firm; moist; some dark brown mottling; trace organics	CL	0
5.1–10.4	Olive brown clayey SILT; moderately soft; moist; some dark yellowish brown mottling	ML	-5
	grades dark yellowish brown; clay content increasing		
10.4–17.2	Olive brown silty CLAY; very firm; moist; trace coarse sand; few iron concretions; some dark yellowish brown mottling	CL	-10
	some gravel		-15
17.2–19.9	Dark yellowish brown sandy CLAY; some gravel; very soft; moist to wet	SC	
19.9–	Dark yellowish brown clayey SILT with sand and gravel; firm; moist	ML-SM	-20

NOTES:

Andrews Engineering, Inc.
3300 Ginger Creek Drive, Springfield, IL 62711 (217) 787-2334

Field Boring Log

PDF0460

Site Information:	Location:	Boring Information:
Name: City Water, Light, & Power	Coord. System: Site Grid	Boring No.: AP-5
Location: Springfield, IL	Northing: 3164.10	Well No.: AP-5
County: Sangamon	Easting: 3203.10	Surf. Elev.:
Site No.:	**Weather:**	Depth Information:
AEEI No.: 2011-127	Cloudy; 38° F; West 10-15 MPH	Total: 49.0
Drilling Contractor:	**Personnel:**	Auger: 49.0
Name: Terra Drill, Inc.	Geologist: M. Hewitt	Core: -
City: Dupo, IL	Driller: J. Brown	Dates:
Equipment: CME 550 with 4¼" I.D. HSA	Helper (s): J. Horn	Start: 2/1/2012
5' CB and 2' SS		Finish: 2/1/2012

Sample Type: - Continuous Barrel; - Split Spoon; - Shelby Tube; - Core; - Blind Drill

Depth (ft.)	Run No.	Sample Type	No.	Recov.	Blow Count	q_p [q_s] (in tsf)	% Moisture
20	5	Split Spoon					
	6	Split Spoon		100%			
25	7	Continuous Barrel		100%			
30	8	Continuous Barrel		100%			
	9	Split Spoon		90%			
35	10	Continuous Barrel		100%			
40	11	Continuous Barrel					

Borehole Detail: Silica Sand (to approx. 30.5 ft); Bentonite Chips (below)

Description/*Comments*	USC
(Cont'd) Dark yellowish brown clayey SILT with sand and gravel; firm; moist	ML-SM
Dark yellowish brown SAND; coarse-grained; loose; wet	SP
Yellowish gray clayey SILT with sand; trace gravel; very hard; moist	ML
Gray silty SAND with clay; some gravel; soft; wet	SM
Gray clayey SILT; some gravel; very hard; moist some shale and coal fragments	ML
Light gray silty SAND; some gravel; trace chert; rounded; moderately firm; moist	SM

Elev. (MSL): -20, -25, -30, -35, -40

NOTES:

Andrews Engineering, Inc.
3300 Ginger Creek Drive, Springfield, IL 62711 (217) 787-2334

Field Boring Log

PDF 0461

Site Information:	Location:	Boring Information:
Name: City Water, Light, & Power	Coord. System: Site Grid	Boring No.: AP-5
Location: Springfield, IL	Northing: 3164.10	Well No.: AP-5
County: Sangamon	Easting: 3203.10	Surf. Elev.:
Site No.:	Weather: Cloudy; 38° F; West 10-15 MPH	Depth Information: Total: 49.0; Auger: 49.0; Core:
AEEI No.: 2011-127		

Drilling Contractor:	Personnel:	Dates:
Name: Terra Drill, Inc.	Geologist: M. Hewitt	Start: 2/1/2012
City: Dupo, IL	Driller: J. Brown	Finish: 2/1/2012
Equipment: CME 550 with 4¼" I.D. HSA 5' CB and 2' SS	Helper (s): J. Horn	

Sample Type: Continuous Barrel; Split Spoon; Shelby Tube; Core; Blind Drill

Depth (ft.)	Run No.	Sample Type	Sample No.	Sample Recov.	Blow Count	q_p [q_s] (in tsf)	% Moisture	Borehole Detail	Description/*Comments*	USC	Elev. (MSL)
40	11	Continuous Barrel						Bentonite Chips	Dark gray silty CLAY; some gravel; some shale fragments; trace coal fragments; very firm; moist	SM / CL	-40
45	12	Continuous Barrel		100%				Bentonite Chips	Gray SHALE; hard; moist	CL	-45
	13	Continuous Barrel		55%				Bentonite Chips			

End of Boring = 49.0 '

Depth scale: 50, 55, 60 — Elev.: -50, -55, -60

NOTES:

PDF 0462

Illinois Environmental Protection Agency — Well Completion Report

Site #: ______ County: Sangamon Well #: AP-5

Site Name: City Water, Light, & Power Borehole #: AP-5

Coordinates: X 3203.10 Y 3164.10 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed by: ______ IL Registration #: ______

Drilling Contractor: Terra Drill, Inc. Consulting Firm: Andrews Engineering, Inc.

Driller: J. Brown Geologist: M. Hewitt

Drilling Method: 4¼" HSA w/ 5' CB & 2' SS Logged by: M. Hewitt

Drilling Fluids (type): ______ Report Form Completed by: J. Rhoades

Date Well Started: 2/1/2012 Date Well Finished: 2/1/2012 Date Form Completed: 2/27/2012

ANNULAR SPACE DETAILS

Type of surface seal: Concrete

Type of annular sealant: Bentonite Grout

Installation method: Tremie

Setting time: 2 Hours

Type of bentonite seal: Bentonite Chips

Installation method: Free drop

Setting time: 2 Hours

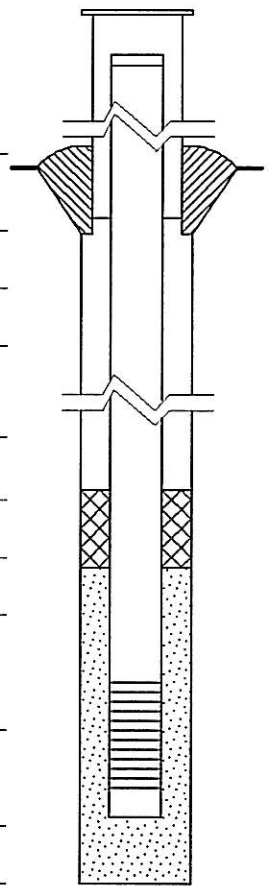
Type of sand pack: Unimin Sand

Grain size: 10/20 (sieve size)

Installation method: Free drop

Type of backfill material: Bentonite Chips (if applicable)

Installation method: Free drop



ELEVATION (MSL)*	DEPTH (BGS)*	(0.01 ft)
584.30	-2.70	Top of Protective Casing
583.90	-2.30	Top of Riser Pipe
581.60	.00	Ground Surface
578.60	3.00	Top of Annular Sealant
n/a	n/a	Static Water Level Measured on (after completion)
565.48	16.12	Top of Seal
563.48	18.12	Top of Sandpack
563.78	17.82	Top of Screen
554.44	27.16	Bottom of Screen
553.90	27.70	Bottom of Well
551.10	30.50	Bottom of Borehole

* Referenced to a National Geodetic Vertical Datum
* positive (+) values below GS, negitive (-) values above GS

NOTES:

- Borehole AP-5 sampled to 49.0 feet below ground surface (BGS) and backfilled with bentonite chips to 30.5 feet BGS

CASING MEASUREMENTS

Diameter of Borehole (in)	8.0
ID of Riser Pipe (in)	2.0
Protective Casing Length (ft)	5.0
Riser Pipe Length (ft)	20.12
Bottom of Screen to End Cap (ft)	.54
Screen Length [1st slot to last slot] (ft)	9.34
Total Length of Casing (ft)	30.00
Screen Slot Size*	0.01"

*Hand-slotted well screens are unacceptable.

WELL CONSTRUCTION MATERIALS

Protective Casing	SS304, SS316, PTFE, PVC or *Other:Steel*
Riser Pipe Above W.T.	SS304, SS316, PTFE, *PVC*, or Other:
Riser Pipe Below W.T.	SS304, SS316, PTFE, *PVC*, or Other:
Screen	SS304, SS316, PTFE, *PVC*, or Other:

(AE950315)

Andrews Engineering, Inc.
3300 Ginger Creek Drive
Springfield, IL 62711

FIELD BORING LOG

Site Information:
Name: Springfield City Water, Light, and Power
Location: Springfield, IL
County: Sangamon
Site No.:
AEI No.: 160192

Location:
Coord. System: Site Grid
Northing: 4185.2
Easting: 735.9

Weather: Sunny, 40F

Boring Information:
Boring No: AP-2A
Well No: AP-2A
Surf Elev.: 533.6

Depth Information:
Total: 19.0
Auger: 19.0
Core:

Dates:
Start: 2/16/16
Finish: 2/16/16

Drilling Contractor:
Contractor Name: Bulldog Drilling
City: Dupo, IL
Equipment: AMS Powerprobe w/ 4.25" HSA and 5' MC

Personnel:
Geologist: C. Myrvold
Driller: J. Edwards
Helper(s): Z. Strickland

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Run No.	Sample Type	Sample Recov.	Blow Count	qu/su (tsf)	Lithology	Description/Comments	Elev. (MSL)
0							Ground Surface	533.6
0–9	1						Blind drilled to 9.0 feet. For detailed geology refer to the original log for AP-2R	
9	2		3.2/4				Gray CLAYEY SILT; moist to wet; moderately loose	
	3		4.0/4					
	4		2.0/2				Light gray SAND; fine to medium grained; saturated; some gravel	
							Gray SHALE; weathered; hard; slightly moist	
19							End of Boring = 19 Feet	

Depth scale: 0, 5, 10, 15, 20. Elevation scale: 530.0, 525.0, 520.0, 515.0.

Notes:

Illinois Environmental Protection Agency — Well Completion Report

Site #: ______ County: Sangamon Well #: AP-2A

Site Name: Springfield City Water, Light, and Power Borehole #: ______

Coordinates: X 735.9 Y 4185.2 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed by: Springfield City Water, Light, and Power IL Registration #: ______

Drilling Contractor: Bulldog Drilling, Inc. Consulting Firm: Andrews Engineering, Inc.

Driller: J. Edwards Geologist: C. Myrvold

Drilling Method: AMS Powerprobe w/ 4.25" HSA and 5' MC Logged by: C. Myrvold

Drilling Fluids (type): na Report Form Completed by: C. Myrvold

Date Well Started: 2/16/2016 Date Well Finished: 2/16/2016 Date Form Completed: 3/06/2016

ANNULAR SPACE DETAILS

Type of surface seal: Concrete

Type of annular sealant: N/A

Installation method: ______

Setting time: ______

Type of bentonite seal: Bentonite chips

Installation method: Free drop

Setting time: 24+ hours

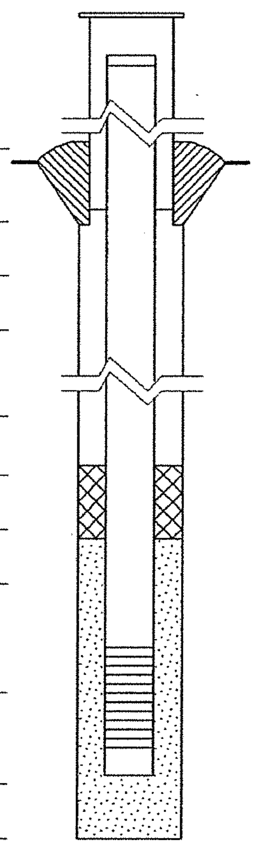
Type of sand pack: Silica sand

Grain size: 20/40 (sieve size)

Installation method: Free drop

Type of backfill material: N/A (if applicable)

Installation method: ______



ELEVATION (MSL)*	DEPTH (BGS)*	(0.01 ft)
536.50	-2.90	Top of Protective Casing
536.10	-2.50	Top of Riser Pipe
533.60	0.00	Ground Surface
	N/A	Top of Annular Sealant
		Static Water Level Measured on (after completion)
530.60	3.00	Top of Seal
527.19	6.41	Top of Sandpack
525.19	8.41	Top of Screen
515.54	18.06	Bottom of Screen
515.10	18.50	Bottom of Well
514.60	19.00	Bottom of Borehole

* Referenced to a National Geodetic Vertical Datum
* positive (+) values below GS, negitive (-) values above GS

Notes:

CASING MEASUREMENTS

Diameter of Borehole (in)	8.25
ID of Riser Pipe (in)	2
Protective Casing Length (ft)	5.0
Riser Pipe Length (ft)	10.91
Bottom of Screen to End Cap (ft)	0.44
Screen Length [1st slot to last slot] (ft)	9.65
Total Length of Casing (ft)	21.00
Screen Slot Size*	#10 (0.01)

* Hand-slotted well screens are unacceptable.

WELL CONSTRUCTION MATERIALS

Protective Casing	Anodized Aluminum
Riser Pipe Above W.T.	PVC
Riser Pipe Below W.T.	PVC
Screen	PVC

Andrews Engineering, Inc.
3300 Ginger Creek Drive
Springfield, IL 62711

FIELD BORING LOG

Site Information:	**Location:**	**Boring Information:**
Name: CWLP Ash Pond	Coord. System:	Boring No: TW3E
Location: Springfield, Illinois	Northing: 0	Well No: TW3E
County: Sangamon	Easting: 0	Surf Elev.: 0
Site No.:	Weather: sunny, 73 deg	**Depth Information:**
AEI No.:		Total: 40.5'
Drilling Contractor:	**Personnel:**	Auger: 40.5'
Contractor Name: Bulldog Drilling	Geologist: D. Ghosh	Core: -
City: Dupo	Driller: J. Gates	**Dates:**
Equipment: 4.25" HSA, CME 55, 5' Continuous Macrocore	Helper(s): C. Clines	Start: 06/27/2017
		Finish: 06/27/2017

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Run No.	Sample Type	Sample Recov.	Blow Count	qu/su (tsf)	Lithology	Description/Comments	Elev. (MSL)
							Ground Surface	0.0
0	1	CB	4.5/5				**CLAYEY SILT** dark brown, iron oxidation staining, moist, firm to hard, moderate cementation, with root structure	
5	2	CB	5.0/5				**SILT** brown to gray, iron oxidation, moist, 2" wet seam at 12', firm, moderate cementation, blocky, some clay	-5.0
10	3	CB	5.0/5					-10.0
							SILT gray, firm to hard, trace fine grained sand sandy 14.5-15'	
15	4	CB	4.5/5					-15.0
							SILTY CLAY dark gray, moist to wet, soft to firm, strong cementation, laminated, some wood fragments	
20								-20.0

Notes:

Andrews Engineering, Inc.
3300 Ginger Creek Drive
Springfield, IL 62711

FIELD BORING LOG

Boring Information: TW3E Boring No: TW3E Well No: TW3E

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Run No.	Sample Type	Sample Recov.	Blow Count	qu/su (tsf)	Lithology	Description/Comments	Elev. (MSL)
	5	CB	5.0/5				cont: dark gray, moist to wet, soft to firm, strong cementation, laminated, some wood fragments	
								-25
26	6	CB	3.0/5				**SILTY CLAY** dark gray, till, moist to wet, soft to firm, moderate cementation, trace fine grained sand and gravel	
								-30
31	7	CB	4.5/5					
							SANDY SILT fine grained sand	-35
36	8	CB	4.0/5.5				**SILTY SAND** gray, fine to medeium grained, wet	
							medium to coarse grained, trace fine grained, angular	
							SHALE	-40
41							End of Boring = 40.5 Feet	

Notes:

Illinois Environmental Protection Agency — Well Completion Report

PDF 0467

Site Number: ______ County: Sangamon

Site Name: City Water, Light & Power (CWLP) Ash Ponds

Well #: TW3E

State Plane Coordinate: X ____ Y ____ (or) Latitude: ___ ° ___ ' ___ " Longitude: ___ ° ___ ' ___ "

Borehole #: TW3E

Surveyed by: ______

IL Registration #: ______

Drilling Contractor: Bulldog Drilling, Inc.

Driller: J. Gates

Consulting Firm: Andrews Engineering, Inc.

Geologist: D. Ghosh

Drilling Method: CME 55 w/ 4.25" HSA

Drilling Fluid (Type): none

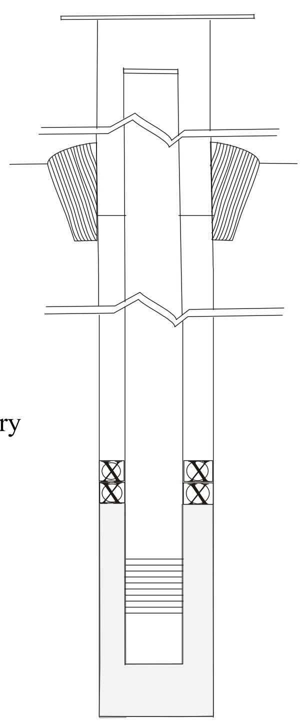
Logged By: D. Ghosh

Date Started: 6/27/17 Date Finished: 6/27/17

Report Form Completed By: M. Hewitt

Date: 9/18/17

ANNULAR SPACE DETAILS



Type of Surface Seal: Bentonite Grout

Type of Annular Sealant: Bentonite Grout

Installation Method: Tremi

Setting Time: 24 hours

Type of Bentonite Seal - - Granular, Pe✗et, Slurry (Choose One)

Installation Method: Free drop

Setting Time: N/A

Type of Sand Pack: Silica Sand

Grain Size: 10/20 (Sieve Size)

Installation Method: Free Drop

Type of Backfill Material: None (if applicable)

Installation Method: N/A

	Elevations (MSL)*	Depths (BGS) (.01ft.)
Top of Protective Casing		
Top of Riser Pipe		-2.17
Ground Surface		0
Top of Annular Sealant		0
Static Water Level (After Completion)		9.14
Top of Seal		28.0
Top of Sand Pack		28.2
Top of Screen		30.22
Bottom of Screen		39.82
Bottom of Well		40.5
Bottom of Borehole		40.5

* Referenced to a National Geodetic Datum

CASING MEASURMENTS

Diameter of Borehole (inches)	8.25
ID of Riser Pipe (inches)	2.049
Protective Casing Length (feet)	
Riser Pipe Length (feet)	32.39
Bottom of Screen to End Cap (feet)	0.68
Screen Length (1st slot to last slot) (feet)	9.6
Total Length of Casing (feet)	42.67
Screen Slot Size **	0.01

**Hand-Slotted Well Screens are Unacceptable

WELL CONSTRUCTION MATERIAL

(Choose one type of material for each area)

Protective Casing	SS304, SS316, PTFE, PVC, or Other
Riser Pipe Above W.T.	SS304, SS316, PTFE, PV✗C, or Other
Riser Pipe Below W.T.	SS304, SS316, PTFE, PV✗C, or Other
Screen	SS304, SS316, PTFE, PV✗C, or Other

Andrews Engineering, Inc.
3300 Ginger Creek Drive
Springfield, IL 62711

FIELD BORING LOG

Site Information:
Name: CWLP Ash Pond
Location: Springfield, Illinois
County: Sangamon
Site No.:
AEI No.:

Location:
Coord. System: Site Coordinates
Northing: 5613.3
Easting: 1737.4

Weather: rain, 55 deg; sunny, 73 deg

Boring Information:
Boring No: TW3N
Well No: RW-3
Surf Elev.: 536.8

Depth Information:
Total: 41.6'
Auger: 41.6'
Core: -

Dates:
Start: 06/26/2017
Finish: 06/27/2017

Drilling Contractor:
Contractor Name: Bulldog Drilling
City: Dupo
Equipment: 4.25" HSA, CME 55, 5' Continuous Macrocore

Personnel:
Geologist: D. Ghosh
Driller: J. Gates
Helper(s): C. Clines

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Run No.	Sample Type	Sample Recov.	Blow Count	qu/su (tsf)	Lithology	Description/Comments	Elev. (MSL)
							Ground Surface	536.8
0	1	CB	3.5/5				**SILTY CLAY** dark brown, pervasive iron oxidation staining, dry (moist below 3'), firm to hard, moderate cementation, with root structure	535.0
							SILTY CLAY light tan, moist, moderate cementation, blocky	
5	2	CB	5.0/5				**SILT** brown to gray, mottling, iron oxidation staining, moist, firm, moderate cementation	530.0
10	3	CB	4.5/5				**SAND** sand lens, with silt, wet, trace clay	525.0
							SANDY SILT brown to gray, laminated, some wood fragments, trace coarse sand, coal and roots	
15	4	CB	5.0/5				**SILTY CLAY** gray, wet to moist, very soft, strong cementation, laminated, some wood fragments, trace fine sand	520.0
20		CB					**SILTY CLAY** dark gray, wet, very soft, strong cementation, homogeneous	

Notes:

Andrews Engineering, Inc.
3300 Ginger Creek Drive
Springfield, IL 62711

FIELD BORING LOG

Boring Information: RW-3 Boring No: TW3N Well No: RW-3

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Run No.	Sample Type	Sample Recov.	Blow Count	qu/su (tsf)	Lithology	Description/Comments	Elev. (MSL)
							cont: dark gray, wet, very soft, strong cementation, homogeneous	515
	5	CB	3.0/5					
26								510
	6	CB	4.0/5				**SILTY CLAY** dark gray, till, moist, firm to hard, trace coarse and fine gravel, trace coal	
31								505
	7	CB	4.5/5					
							SANDY SILT	
36							**SILTY SAND** gray, fine to medium graineed, wet, trace angular gravel	500
	8	CB	5.0/5					
							SHALE weathered	
41	9							
							End of Boring = 41.6 Feet	495

Notes:

Illinois Environmental Protection Agency — Well Completion Report

PDF 0470

Site Number: ______ County: Sangamon

Site Name: City Water, Light & Power (CWLP) Ash Ponds

Well #: TW3N

State Plane Coordinate: X ____ Y ____ (or) Latitude: ____ o ____ ' ____ " Longitude: ____ o ____ ' ____ "

Borehole #: TW3N

Surveyed by: ______

IL Registration #: ______

Drilling Contractor: Bulldog Drilling, Inc.

Driller: J. Gates

Consulting Firm: Andrews Engineering, Inc.

Geologist: D. Ghosh

Drilling Method: CME 55 w/ 4.25" HSA

Drilling Fluid (Type): none

Logged By: D. Ghosh

Date Started: 6/26/17 Date Finished: 6/27/17

Report Form Completed By: M. Hewitt

Date: 9/18/17

ANNULAR SPACE DETAILS

Type of Surface Seal: Bentonite Grout

Type of Annular Sealant: Bentonite Grout

Installation Method: Tremi

Setting Time: 24 hours

Type of Bentonite Seal - - Granular, Pellet (X), Slurry (Choose One)

Installation Method: Free drop

Setting Time: N/A

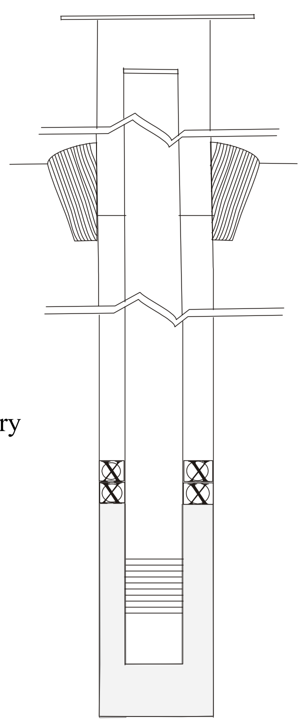
Type of Sand Pack: Silica Sand

Grain Size: 10/20 (Sieve Size)

Installation Method: Free Drop

Type of Backfill Material: None (if applicable)

Installation Method: N/A



Elevations (MSL)*	Depths (BGS) (.01ft.)	
		Top of Protective Casing
	-2.5	Top of Riser Pipe
	0	Ground Surface
	0	Top of Annular Sealant
	8.71	Static Water Level (After Completion)
	27	Top of Seal
	29.6	Top of Sand Pack
	31.34	Top of Screen
	40.92	Bottom of Screen
	41.6	Bottom of Well
	41.6	Bottom of Borehole

* Referenced to a National Geodetic Datum

WELL CONSTRUCTION MATERIAL

(Choose one type of material for each area)

Protective Casing	SS304, SS316, PTFE, PVC, or Other
Riser Pipe Above W.T.	SS304, SS316, PTFE, PVC (X), or Other
Riser Pipe Below W.T.	SS304, SS316, PTFE, PVC (X), or Other
Screen	SS304, SS316, PTFE, PVC (X), or Other

CASING MEASURMENTS

Diameter of Borehole (inches)	8.25
ID of Riser Pipe (inches)	2.049
Protective Casing Length (feet)	
Riser Pipe Length (feet)	33.84
Bottom of Screen to End Cap (feet)	0.68
Screen Length (1st slot to last slot) (feet)	9.58
Total Length of Casing (feet)	44.1
Screen Slot Size **	0.01

**Hand-Slotted Well Screens are Unacceptable

Andrews Engineering, Inc.
3300 Ginger Creek Drive
Springfield, IL 62711

FIELD BORING LOG

Site Information:	Location:	Boring Information:
Name: CWLP Ash Pond Location: Springfield, Illinois County: Sangamon Site No.: AEI No.:	Coord. System: Northing: 0 Easting: 0 Weather: rain, 55 deg	Boring No: TW3W Well No: TW3W Surf Elev.: 0
Drilling Contractor: Contractor Name: Bulldog Drilling City: Dupo Equipment: 4.25" HSA, CME 55, 5' Continuous Macrocore	**Personnel:** Geologist: D. Ghosh Driller: J. Gates Helper(s): C. Clines	**Depth Information:** Total: 23.8' Auger: 23.8' Core: - **Dates:** Start: 06/26/2017 Finish: 06/26/2017

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Run No.	Sample Type	Sample Recov.	Blow Count	qu/su (tsf)	Lithology	Description/Comments	Elev. (MSL)
							Ground Surface	0.0
0–5	1	CB	4.5/5				**SILTY CLAY** dark brown, dry, firm to hard, moderate cementation, root structure in upper 2 feet high clay content, moist, soft to firm, blocky iron oxidation spots	
5–10	2	CB	4.5/5				**SILT** brown to gray, iron oxidation pervasive, moist, soft to firm, moderate cementation, some clay very soft	-5.0
10–15	3	CB	4.0/5				**SILTY SAND** brown, fine to medium grained sand, wet, poor cementation, moderately sorted, trace clay **CLAYEY SAND** brown to dark gray, with gravel, coarse grained towards bottom, wet, strong cementation, poorly sorted	-10.0
15–20	4	CB	4.5/5				**SILTY CLAY** dark gray, with coal fragments, moist, very soft, strong cementation, homogeneous appearance, coal content high at 19-19.5'	-15.0
20–23.8	5	CB	2.8/3.8				**SILTY CLAY** blue gray, till, wet, soft, moderate cementation, homogeneous appearance, trace coarse sand and gravel light tan, silty from 22-22.5' **SANDY SHALE**	-20.0
							End of Boring = 23.8 Feet	

Notes: Borehole refusal at 23.8'.

Illinois Environmental Protection Agency — Well Completion Report

Site Number: ______ County: Sangamon

Site Name: City Water, Light & Power (CWLP) Ash Ponds

Well #: TW3W

State Plane Coordinate: X _____ Y _____ (or) Latitude: ___ ° ___ ' ___ " Longitude: ___ ° ___ ' ___ "

Borehole #: TW3W

Surveyed by: ______

IL Registration #: ______

Drilling Contractor: Bulldog Drilling, Inc.

Driller: J. Gates

Consulting Firm: Andrews Engineering, Inc.

Geologist: D. Ghosh

Drilling Method: CME 55 w/ 4.25" HSA

Drilling Fluid (Type): none

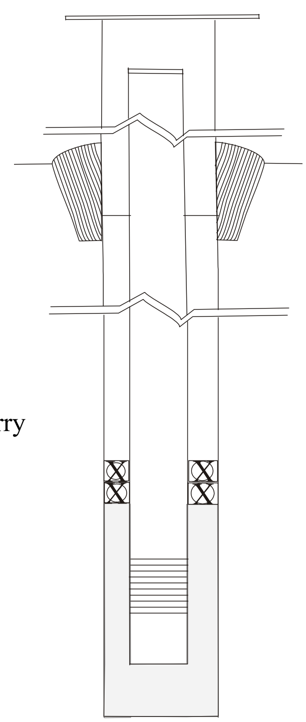
Logged By: D. Ghosh

Date Started: 6/26/17 Date Finished: 6/26/17

Report Form Completed By: M. Hewitt

Date: 9/18/17

ANNULAR SPACE DETAILS



Elevations (MSL)*	Depths (BGS) (.01ft.)	
		Top of Protective Casing
	-2.58	Top of Riser Pipe
	0	Ground Surface
	0	Top of Annular Sealant
	9.32	Static Water Level (After Completion)
	9.6	Top of Seal
	11.85	Top of Sand Pack
	13.54	Top of Screen
	23.12	Bottom of Screen
	23.8	Bottom of Well
	23.8	Bottom of Borehole

* Referenced to a National Geodetic Datum

Type of Surface Seal: Bentonite Grout

Type of Annular Sealant: Bentonite Grout

Installation Method: Tremi

Setting Time: 24 hours

Type of Bentonite Seal - - Granular, Pellet [X], Slurry (Choose One)

Installation Method: Free drop

Setting Time: N/A

Type of Sand Pack: Silica Sand

Grain Size: 10/20 (Sieve Size)

Installation Method: Free Drop

Type of Backfill Material: None (if applicable)

Installation Method: N/A

WELL CONSTRUCTION MATERIAL

(Choose one type of material for each area)

Protective Casing	SS304, SS316, PTFE, PVC, or Other
Riser Pipe Above W.T.	SS304, SS316, PTFE, PVC [X], or Other
Riser Pipe Below W.T.	SS304, SS316, PTFE, PVC [X], or Other
Screen	SS304, SS316, PTFE, PVC [X], or Other

CASING MEASURMENTS

Diameter of Borehole (inches)	8.25
ID of Riser Pipe (inches)	2.049
Protective Casing Length (feet)	
Riser Pipe Length (feet)	16.12
Bottom of Screen to End Cap (feet)	0.68
Screen Length (1st slot to last slot) (feet)	9.58
Total Length of Casing (feet)	26.38
Screen Slot Size **	0.01

**Hand-Slotted Well Screens are Unacceptable

Andrews Engineering, Inc.
3300 Ginger Creek Drive
Springfield, IL 62711

FIELD BORING LOG

Site Information:	Location:	Boring Information:
Name: CWLP Location: Springfield, IL County: Sangamon Site No.: AEEI No.: 180247	Coord. System: Northing: 0 Easting: 0 Weather: 65, overcast	Boring No: GP1 Well No: GP1 Surf Elev.: 0
Drilling Contractor: Contractor Name: Bulldog Drilling City: Dupo, IL Equipment: CME 55cc 4.25" HSA w/ 5' MC and 2' SS	**Personnel:** Geologist: B. Kenning Driller: C. Clines Helper(s): D. Smith	**Depth Information:** Total: 40.0' Auger: 40.0' Core: N/A **Dates:** Start: 6/14/2019 Finish: 6/14/2019

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Sample Run No.	Type	Recov.	Blow Count	Lithology	Description/Comments	Elev. (MSL)
						Ground Surface	0.0
0		CB				Brown clayey TOPSOIL.	
						Light brown to gray silty CLAY, moist, stiff.	
	1	CB	4.2				
5							-5.0
	2	CB	2.2				
10							-10.0
	3	CB	4.6				
15							-15.0
						Gray clayey SILT, moist to wet, moderately stiff.	
	4	CB	4.3				
20							-20.0
	5	CB	4.2			Brown/gray silty CLAY, moist, moderately stiff, contains coal fragments.	
						Gray clayey SILT, moist to wet, moderately stiff.	
25							-25.0

Notes:

Andrews Engineering, Inc.
3300 Ginger Creek Drive
Springfield, IL 62711

FIELD BORING LOG

Boring Information: GP1 Boring No: GP1 Well No: GP1

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Run No.	Type	Recov.	Blow Count	Lithology	Description/Comments	Elev. (MSL)
	6	CB	3.7				
30							-30
	7	CB	3.7			Gray SAND, fine-grained, wet, loose.	
35							-35
	8	CB	4.1			Gray SAND, fine to medium-grained, wet, loose, trace gravel.	
						Gray SAND, medium to coarse-grained, wet, loose, trace gravel.	
40						Gray SHALE, weathered, moist, soft.	-40
						End of Boring = 40 Feet	
45							-45
50							-50

Notes:

Illinois Environmental Protection Agency — Well Completion Report

Site #: ______ County: Sangamon Well #: GP1

Site Name: Springfield CWLP Ash Pond Borehole #: GP1

Coordinates: X ______ Y ______ (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed by: Andrews Engineering, Inc. IL Registration #: ______

Drilling Contractor: Bulldog drilling Consulting Firm: Andrews Engineering, Inc.

Driller: C. Clines Geologist: B. Kenning

Drilling Method: CME 55cc 4.25 in HSA w/ 5'MC and 2' SS Logged by: B. Kenning

Drilling Fluids (type): N/A Report Form Completed by: B. Kenning

Date Well Started: 6/14/19 Date Well Finished: 6/14/19 Date Form Completed: 7/19/2019

ANNULAR SPACE DETAILS

Type of surface seal: ______

Type of annular sealant: Bentonite Grout

Installation method: Tremie

Setting time: > 24 hours

Type of bentonite seal: Bentonite Chips

Installation method: Free Drop

Setting time: > 24 hours

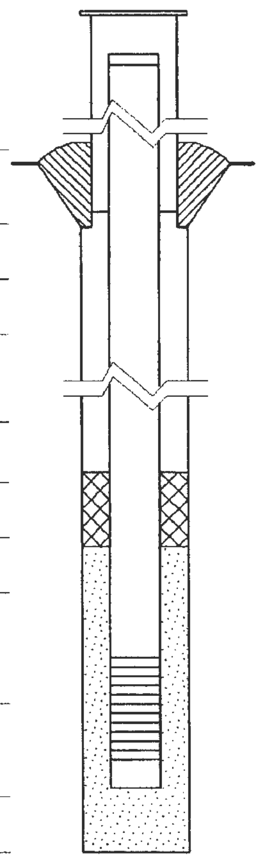
Type of sand pack: Silica Sand Pre-Pack

Grain size: 10/20 (sieve size)

Installation method: Free Drop

Type of backfill material: N/A (if applicable)

Installation method: ______



	ELEVATION (MSL)*	DEPTH (BGS)* (0.01 ft)
Top of Protective Casing		
Top of Riser Pipe		- 2.82'
Ground Surface		0.00'
Top of Annular Sealant		3.00'
Static Water Level Measured on (after completion)		
Top of Seal		25.34'
Top of Sandpack		27.34'
Top of Screen		29.34'
Bottom of Screen		39.04'
Bottom of Well		39.50'
Bottom of Borehole		40.00'

* Referenced to a National Geodetic Vertical Datum
* positive (+) values below GS, negitive (-) values above GS

CASING MEASUREMENTS

Diameter of Borehole (in)	8.25
ID of Riser Pipe (in)	#2
Protective Casing Length (ft)	N/A
Riser Pipe Length (ft)	31.91
Bottom of Screen to End Cap (ft)	0.46
Screen Length (1st slot to last slot) (ft)	9.70
Total Length of Casing (ft)	N/A
Screen Slot Size*	#10 (0.01)

*Hand-slotted well screens are unacceptable.

WELL CONSTRUCTION MATERIALS

Protective Casing	N/A
Riser Pipe Above W.T.	PVC
Riser Pipe Below W.T.	PVC
Screen	PVC

Andrews Engineering, Inc.
3300 Ginger Creek Drive
Springfield, IL 62711

FIELD BORING LOG

Site Information:	**Location:**	**Boring Information:**
Name: CWLP	Coord. System:	Boring No: GP2
Location: Springfield, IL	Northing: 0	Well No: GP2
County: Sangamon	Easting: 0	Surf Elev.: 0
Site No.:	Weather: 60, partly cloudy, light breeze	**Depth Information:**
AEEI No.: 180247		Total: 40.0'
Drilling Contractor:	**Personnel:**	Auger: 40.0'
Contractor Name: Bulldog Drilling	Geologist: B. Kenning	Core: N/A
City: Dupo, IL	Driller: C. Clines	**Dates:**
Equipment: CME 55cc 4.25" HSA w/ 5' MC and 2' SS	Helper(s): D. Smith	Start: 6/14/2019
		Finish: 6/14/2019

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Sample: Run No.	Sample: Type	Sample: Recov.	Blow Count	Lithology	Description/Comments	Elev. (MSL)
						Ground Surface	0.0
0		CB				Brown clayey TOPSOIL.	
1		CB				Brown silty CLAY, moist, stiff.	
0–5	1	CB	3.0				
5							-5.0
5–10	2	CB	3.5				
10							-10.0
11						Brown/gray clayey SILT, moist, stiff.	
10–15	3	CB	3.0				
15							-15.0
15–20	4	CB	3.8				
20							-20.0
20–25	5	CB	2.7				
25							-25.0

Notes: No signs of freewater

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FIELD BORING LOG

Boring Information: GP2 Boring No: GP2 Well No: GP2

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Run No.	Type	Recov.	Blow Count	Lithology	Description/Comments	Elev. (MSL)
	6	CB	4.1			Gray clayey SAND, fine-grained, moist, moderately stiff.	
30							-30
	7	CB	4.1			Gray clayey SILT, moist, stiff, coal fragments at 30.4'.	
35							-35
	8	CB	3.4			Gray SHALE, weathered, slightly moist, soft.	
40						End of Boring = 40 Feet	-40
45							-45
50							-50

Notes: No signs of freewater

Illinois Environmental Protection Agency — Well Completion Report

Site #: ______ County: Sangamon Well #: GP2

Site Name: Springfield CWLP Ash Pond Borehole #: GP2

Coordinates: X ______ Y ______ (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed by: Andrews Engineering, Inc. IL Registration #: ______

Drilling Contractor: Bulldog drilling Consulting Firm: Andrews Engineering, Inc.

Driller: C. Clines Geologist: B. Kenning

Drilling Method: CME 55cc 4.25 in HSA w/ 5'MC Logged by: B. Kenning

Drilling Fluids (type): N/A Report Form Completed by: B. Kenning

Date Well Started: 6/14/19 Date Well Finished: 6/14/19 Date Form Completed: 7/19/2019

ANNULAR SPACE DETAILS

Type of surface seal: ______

Type of annular sealant: Bentonite Grout

Installation method: Tremie

Setting time: > 24 hours

Type of bentonite seal: Bentonite Chips

Installation method: Free Drop

Setting time: > 24 hours

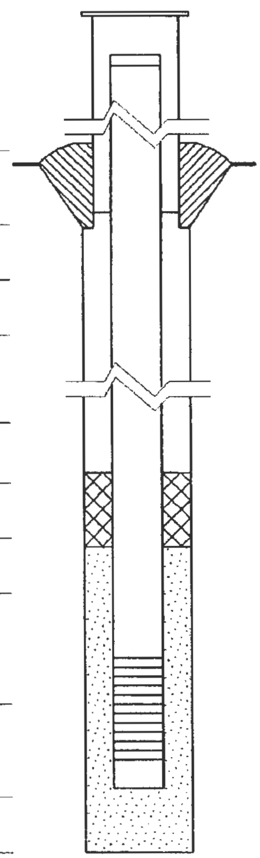
Type of sand pack: Silica Sand Pre-Pack

Grain size: 10/20 (sieve size)

Installation method: Free Drop

Type of backfill material: N/A (if applicable)

Installation method: ______



	ELEVATION (MSL)*	DEPTH (BGS)* (0.01 ft)
Top of Protective Casing		
Top of Riser Pipe		- 2.88'
Ground Surface		0.00'
Top of Annular Sealant		3.00'
Static Water Level Measured on (after completion)		
Top of Seal		25.34'
Top of Sandpack		27.34'
Top of Screen		29.34'
Bottom of Screen		39.04'
Bottom of Well		39.50'
Bottom of Borehole		40.00'

* Referenced to a National Geodetic Vertical Datum
* positive (+) values below GS, negitive (-) values above GS

CASING MEASUREMENTS

Diameter of Borehole (in)	8.25
ID of Riser Pipe (in)	#2
Protective Casing Length (ft)	N/A
Riser Pipe Length (ft)	31.78
Bottom of Screen to End Cap (ft)	0.46
Screen Length (1st slot to last slot) (ft)	9.70
Total Length of Casing (ft)	N/A
Screen Slot Size[‡]	#10 (0.01)

[‡]Hand-slotted well screens are unacceptable.

WELL CONSTRUCTION MATERIALS

Protective Casing	N/A
Riser Pipe Above W.T.	PVC
Riser Pipe Below W.T.	PVC
Screen	PVC

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FIELD BORING LOG

Site Information:
Name: CWLP
Location: Springfield
County: Sangamon
Site No.:
AEEI No.: 180247

Location:
Coord. System:
Northing: 0
Easting: 0

Weather: 65, partly cloudy

Boring Information:
Boring No: GP3
Well No: GP3
Surf Elev.: 0

Depth Information:
Total: 25'
Auger: 25'
Core: N/A

Dates:
Start: 6/13/2019
Finish: 6/13/2019

Drilling Contractor:
Contractor Name: Bulldog Drilling
City: Dupo, IL
Equipment: CME 55cc 4.25 in HSA w/ 5' MC and 2' SS

Personnel:
Geologist: B. Kenning
Driller: C. Clines
Helper(s): D. Smith

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Run No.	Type	Recov.	Blow Count	Lithology	Description/Comments	Elev. (MSL)
						Ground Surface	0.0
0						Brown silty to clayey TOPSOIL, moist, stiff.	
	1	CB	4.7			Brown silty CLAY to clayey SILT, moist, stiff.	
5	2	SS	1.6	2 4 4 6			-5.0
	3	SS	1.6	4 9 12 12		Light brown clayey SILT, slightly moist, stiff.	
10	4	SS	1.8	6 11 11 12			-10.0
	5	CB	3.0			Brown clayey SAND, fine-grained, slightly moist, moderately stiff.	
15	6	CB	4.0			Brown silty CLAY, moist, stiff, contains coal fragments.	-15.0
						Brown clayey SAND, fine-grained, moist, moderately loose.	
20							-20.0

Notes: Macrocore refusal at 23'; Split spoon refusal at 24'; blind drilled to EOB depth of 25'

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PDF 0480

FIELD BORING LOG

Boring Information: GP3 Boring No: GP3 Well No: GP3

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Sample Run No.	Sample Type	Sample Recov.	Blow Count	Lithology	Description/Comments	Elev. (MSL)
	7	CB	2.2			Gray SHALE, weathered, slightly moist, soft.	
	8	SS	0.7	41 50 3"			
25	9	Blind Drill	0.0			End of Boring = 25 Feet	-25
30							-30
35							-35
40							-40

Notes: Macrocore refusal at 23'; Split spoon refusal at 24'; blind drilled to EOB depth of 25'

Illinois Environmental Protection Agency — Well Completion Report

Site #: ______ County: Sangamon Well #: GP3

Site Name: Springfield CWLP Ash Pond Borehole #: GP3

Coordinates: X ______ Y ______ (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed by: Andrews Engineering, Inc. IL Registration #: ______

Drilling Contractor: Bulldog drilling Consulting Firm: Andrews Engineering, Inc.

Driller: C. Clines Geologist: B. Kenning

Drilling Method: CME 55cc 4.25 in HSA w/ 5'MC Logged by: B. Kenning

Drilling Fluids (type): N/A Report Form Completed by: B. Kenning

Date Well Started: 6/13/19 Date Well Finished: 6/13/19 Date Form Completed: 7/19/2019

ANNULAR SPACE DETAILS

Type of surface seal: ______

Type of annular sealant: Bentonite Chips

Installation method: Free Drop

Setting time: > 24 hours

Type of bentonite seal: Bentonite Chips

Installation method: Free Drop

Setting time: > 24 hours

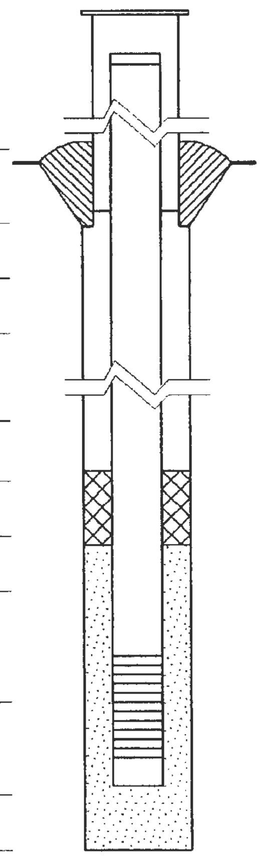
Type of sand pack: Silica Sand Pre-Pack

Grain size: 10/20 (sieve size)

Installation method: Free Drop

Type of backfill material: N/A (if applicable)

Installation method: ______



	ELEVATION (MSL)*	DEPTH (BGS)* (0.01 ft)
Top of Protective Casing		
Top of Riser Pipe		- 1.14'
Ground Surface		0.00'
Top of Annular Sealant		3.00'
Static Water Level Measured on (after completion)		
Top of Seal		3.00'
Top of Sandpack		17.07'
Top of Screen		19.07'
Bottom of Screen		23.75'
Bottom of Well		24.30'
Bottom of Borehole		24.80'

* Referenced to a National Geodetic Vertical Datum
* positive (+) values below GS, negitive (-) values above GS

CASING MEASUREMENTS

Diameter of Borehole (in)	8.25
ID of Riser Pipe (in)	#2
Protective Casing Length (ft)	N/A
Riser Pipe Length (ft)	20.33
Bottom of Screen to End Cap (ft)	0.55
Screen Length (1st slot to last slot) (ft)	4.68
Total Length of Casing (ft)	N/A
Screen Slot Size*	#10 (0.01)

*Hand-slotted well screens are unacceptable.

WELL CONSTRUCTION MATERIALS

Protective Casing	N/A
Riser Pipe Above W.T.	PVC
Riser Pipe Below W.T.	PVC
Screen	PVC

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FIELD BORING LOG

Site Information:	Location:	Boring Information:
Name: Springfield City Water Light and Power	Coord. System:	Boring No: GP4
Location: Springfield, IL	Northing: 0	Well No: GP4
County: Sangamon	Easting: 0	Surf Elev.: 0
Site No.:	Weather: 80's F, Sunny	**Depth Information:**
AEI No.: 180247		Total: 38.0
Drilling Contractor:	**Personnel:**	Auger: 38.0
Contractor Name: Bulldog Drilling, Inc.	Geologist: C. Myrvold	Core: N/A
City: Dupo, IL	Driller: J. Edwards	**Dates:**
Equipment: AMS PowerProbe 9500 w/ 5' MC	Helper(s): S. Guy	Start: 5/17/19
		Finish: 5/17/19

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Run No.	Sample Type	Sample Recov.	Blow Count	qu/su (tsf)	Lithology	Description/Comments	Elev. (MSL)
							Ground Surface	0.0
0		CB					Gray clayey SILT, moist, loose.	
	1	CB	4.3/5				Brown/gray silty CLAY, moist, stiff.	
5								-5.0
	2	CB	3.7/4				Gray clayey SILT, moist, moderately loose.	
							Brown silty SAND, fine to medium-grained, moist, moderately tight.	
10								-10.0
	3	CB	4.0/4				Gray to dark gray silty CLAY, moist, stiff; trace to some sand.	
15	4	CB	1.3/4					-15.0
	5	CB	4.0/4					
20								-20.0

Notes:

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FIELD BORING LOG

Boring Information: GP4 Boring No: GP4 Well No: GP4

Legend: - Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Run No.	Sample Type	Sample Recov.	Blow Count	qu/su (tsf)	Lithology	Description/Comments	Elev. (MSL)
		CB					(cont.) Gray to dark gray silty CLAY, moist, stiff; trace to some sand.	
	6	CB	3.1/4					
25								-25.0
	7	CB	4.0/4					
30								-30.0
	8	CB	3.4/4					
35	9	CB	4.0/4					-35.0
		Blind Drill						
							End of Boring = 38 Feet	
40								-40.0

Notes:

Illinois Environmental Protection Agency — Well Completion Report

Site #: ______ County: Sangamon Well #: GP4

Site Name: Springfield CWLP Ash Pond Borehole #: GP4

Coordinates: X ______ Y ______ (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed by: Andrews Engineering, Inc. IL Registration #: ______

Drilling Contractor: Bulldog drilling Consulting Firm: Andrews Engineering, Inc.

Driller: J. Edwards Geologist: C. Myrvold

Drilling Method: CME 55cc 4.25 in HSA w/ 5'MC Logged by: C.Myrvold

Drilling Fluids (type): N/A Report Form Completed by: B. Kenning

Date Well Started: 5/17/19 Date Well Finished: 5/17/19 Date Form Completed: 7/19/2019

ANNULAR SPACE DETAILS

Type of surface seal: ______

Type of annular sealant: Bentonite Grout

Installation method: Tremie

Setting time: > 24 hours

Type of bentonite seal: Bentonite Chips

Installation method: Free Drop

Setting time: > 24 hours

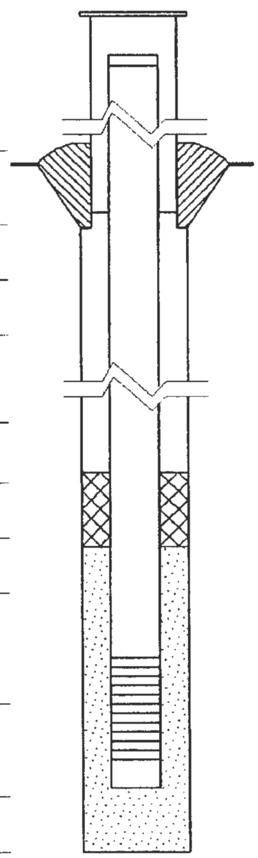
Type of sand pack: Silica Sand Pre-Pack

Grain size: 10/20 (sieve size)

Installation method: Free Drop

Type of backfill material: N/A (if applicable)

Installation method: ______



	ELEVATION (MSL)*	DEPTH (BGS)* (0.01 ft)
Top of Protective Casing		
Top of Riser Pipe		- 3.00'
Ground Surface		0.00'
Top of Annular Sealant		3.00'
Static Water Level Measured on (after completion)		
Top of Seal		23.43'
Top of Sandpack		25.43'
Top of Screen		27.43'
Bottom of Screen		37.20'
Bottom of Well		37.50'
Bottom of Borehole		38.00'

* Referenced to a National Geodetic Vertical Datum
* positive (+) values below GS, negitive (-) values above GS

CASING MEASUREMENTS

Diameter of Borehole (in)	8.25
ID of Riser Pipe (in)	#2
Protective Casing Length (ft)	N/A
Riser Pipe Length (ft)	30.18
Bottom of Screen to End Cap (ft)	0.30
Screen Length [1st slot to last slot] (ft)	9.77
Total Length of Casing (ft)	N/A
Screen Slot Size*	#10 (0.01)

*Hand-slotted well screens are unacceptable.

WELL CONSTRUCTION MATERIALS

Protective Casing	N/A
Riser Pipe Above W.T.	PVC
Riser Pipe Below W.T.	PVC
Screen	PVC

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FIELD BORING LOG

Site Information:
Name: CWLP
Location: Springfield, IL
County: Sangamon
Site No.:
AEEI No.: 180247

Location:
Coord. System:
Northing: 0
Easting: 0

Weather:

Boring Information:
Boring No: GP5
Well No: GP5
Surf Elev.: 0

Depth Information:
Total: 15.5'
Auger: 15.5'
Core: N/A

Dates:
Start: 6/11/2019
Finish: 6/11/2019

Drilling Contractor:
Contractor Name: Bulldog Drilling
City: Dupo, IL
Equipment: CME 55cc w/ 4.25" HSA and 5' MC

Personnel:
Geologist: C. Myrvold
Driller: C. Clines
Helper(s): D. Smith

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Run No.	Type	Recov.	Blow Count	Lithology	Description/Comments	Elev. (MSL)
						Ground Surface	0.0
0	1	CB	0.5		Silty clay	Brown silty CLAY, moist, stiff.	
5	2	CB	4.5		Silty clay	Brown to gray silty CLAY, moderately stiff, shows of iron oxidation.	-5.0
10	3	CB	2		Coal	Black COAL, slightly moist, soft.	-10.0
	4	CB	3		Shale	Gray SHALE, weathered, dry, soft.	
15	5	CB	0.5				-15.0
						End of Boring = 15.5 Feet	
20							-20.0

Notes: Refusal at 15.5'; No well installation

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FIELD BORING LOG

Site Information:
Name: Springfield City Water Light and Power
Location: Springfield, IL
County: Sangamon
Site No.:
AEI No.: 180247

Location:
Coord. System:
Northing: 0
Easting: 0

Weather: 80's F, Sunny

Boring Information:
Boring No: GP6
Well No: GP6
Surf Elev.: 0

Depth Information:
Total: 37.0
Auger: 37.0
Core: N/A

Dates:
Start: 5/17/19
Finish: 5/17/19

Drilling Contractor:
Contractor Name: Bulldog Drilling, Inc.
City: Dupo, IL
Equipment: AMS PowerProbe 9500 w/ 5' MC

Personnel:
Geologist: C. Myrvold
Driller: J. Edwards
Helper(s): S. Guy

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Run No.	Sample Type	Sample Recov.	Blow Count	qu/su (tsf)	Lithology	Description/Comments	Elev. (MSL)
							Ground Surface	0.0
0	1	CB	4.1/5				Dark brown clayey silt TOPSOIL, moist, moderately loose.	
							Brown/gray silty CLAY to clayey SILT, moist, stiff.	
5	2	CB	4.0/4					-5.0
10	3	CB	4.0/4					-10.0
							Brown silty SAND, fine-grained, saturated, loose.	
							Dark gray clayey SAND, fine-grained, wet to saturated, moderately loose, some silt.	
							Dark gray clayey SILT, moist, moderately stiff to stiff, some sand.	
15	4	CB	1.3/4					-15.0
	5	CB	3.0/4					
20								-20.0

Notes: refusal at 37'

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FIELD BORING LOG

Boring Information: GP6 Boring No: GP6 Well No: GP6

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Run No.	Sample Type	Sample Recov.	Blow Count	qu/su (tsf)	Lithology	Description/Comments	Elev. (MSL)
		CB					(cont.) Dark gray clayey SILT, moist, moderately stiff to stiff, some sand.	
	6	CB	4.0/4				Dark gray silty CLAY, moist, moderately stiff, some sand.	
25								-25.0
	7	CB	4.0/4					
30								-30.0
	8	CB	2.7/4					
35	9	CB	4.0/4					-35.0
							Dark brownish gray clayey SAND, fine-grained, moist to wet, moderately loose.	
							End of Boring = 37 Feet	
40								-40.0

Notes: refusal at 37'

Illinois Environmental Protection Agency — Well Completion Report

Site #: ______ County: Sangamon Well #: GP6

Site Name: Springfield CWLP Ash Pond Borehole #: GP6

Coordinates: X ______ Y ______ (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed by: Andrews Engineering, Inc. IL Registration #: ______

Drilling Contractor: Bulldog drilling Consulting Firm: Andrews Engineering, Inc.

Driller: J. Edwards Geologist: C. Myrvold

Drilling Method: CME 55cc 4.25 in HSA w/ 5'MC Logged by: C.Myrvold

Drilling Fluids (type): N/A Report Form Completed by: B. Kenning

Date Well Started: 5/17/19 Date Well Finished: 5/17/19 Date Form Completed: 7/19/2019

ANNULAR SPACE DETAILS

Type of surface seal: ______

Type of annular sealant: Bentonite Grout

Installation method: Tremie

Setting time: > 24 hours

Type of bentonite seal: Bentonite Chips

Installation method: Free Drop

Setting time: > 24 hours

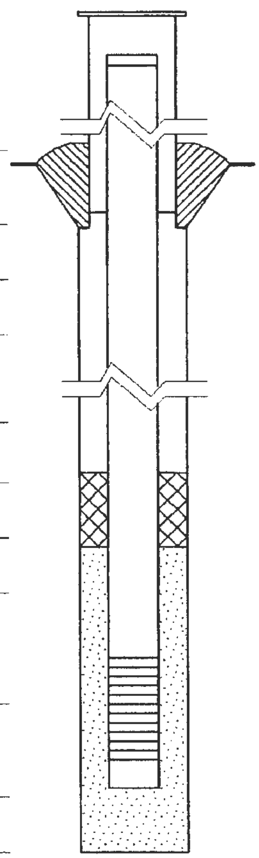
Type of sand pack: Silica Sand Pre-Pack

Grain size: 10/20 (sieve size)

Installation method: Free Drop

Type of backfill material: N/A (if applicable)

Installation method: ______



	ELEVATION (MSL)*	DEPTH (BGS)* (0.01 ft)
Top of Protective Casing		
Top of Riser Pipe		- 3.00'
Ground Surface		0.00'
Top of Annular Sealant		3.00'
Static Water Level Measured on (after completion)		
Top of Seal		22.43'
Top of Sandpack		24.43'
Top of Screen		26.43'
Bottom of Screen		36.20'
Bottom of Well		36.50'
Bottom of Borehole		37.00'

* Referenced to a National Geodetic Vertical Datum
* positive (+) values below GS, negitive (-) values above GS

CASING MEASUREMENTS

Diameter of Borehole (in)	8.25
ID of Riser Pipe (in)	#2
Protective Casing Length (ft)	N/A
Riser Pipe Length (ft)	29.18
Bottom of Screen to End Cap (ft)	0.30
Screen Length (1st slot to last slot) (ft)	9.77
Total Length of Casing (ft)	N/A
Screen Slot Size*	#10 (0.01)

*Hand-slotted well screens are unacceptable.

WELL CONSTRUCTION MATERIALS

Protective Casing	N/A
Riser Pipe Above W.T.	PVC
Riser Pipe Below W.T.	PVC
Screen	PVC

Andrews Engineering, Inc.
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Springfield, IL 62711

FIELD BORING LOG

Site Information:	**Location:**	**Boring Information:**
Name: Springfield City Water Light and Power	Coord. System:	Boring No: GP7
Location: Springfield, IL	Northing: 0	Well No: GP7
County: Sangamon	Easting: 0	Surf Elev.: 0
Site No.:	Weather: 80's F, Sunny	**Depth Information:**
AEI No.: 180247		Total: 36.5
Drilling Contractor:	**Personnel:**	Auger: 36.5
Contractor Name: Bulldog Drilling, Inc.	Geologist: C. Myrvold	Core: N/A
City: Dupo, IL	Driller: J. Edwards	**Dates:**
Equipment: AMS PowerProbe 9500 w/ 5' MC	Helper(s): S. Guy	Start: 5/16/19
		Finish: 5/16/19

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Run No.	Sample Type	Sample Recov.	Blow Count	qu/su (tsf)	Lithology	Description/Comments	Elev. (MSL)
							Ground Surface	0.0
0		CB					Dark brown clayey silt TOPSOIL, moist, moderately loose.	
							Brown/gray silty CLAY to clayey SILT, moist, stiff, trace sand.	
	1	CB	4.1/5					
5								-5.0
	2	CB	4.0/4					
10								-10.0
	3	CB	4.0/4					
							Gray silty CLAY, moist, stiff.	
15	4	CB	2.7/4					-15.0
							17.0 - 18.0: Soft, saturated.	
							18.0 - 25.0: moderately loose to moderately stiff.	
	5	CB	4.0/4					
20								-20.0

Notes: Refusal at 36.50'

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Springfield, IL 62711

FIELD BORING LOG

Boring Information: GP7 Boring No: GP7 Well No: GP7

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Run No.	Sample Type	Sample Recov.	Blow Count	qu/su (tsf)	Lithology	Description/Comments	Elev. (MSL)
		CB					(cont.) Gray silty CLAY, moist, stiff.	
	6	CB	4.0/4				23.0 - 25.0: gray to brown/gray.	
25		CB					Dark gray silty CLAY, moist, moderately stiff; some sand.	-25.0
	7	CB	3.1/4					
		CB					Dark gray silty SAND, fine-grained, wet, loose, some clay.	
30	8	CB	3.7/4					-30.0
35	9	CB	3.5/ 3.5					-35.0
							Gray to dark gray SHALE, weathered, soft, dry.	
							End of Boring = 36.5 Feet	
40								-40.0

Notes: Refusal at 36.50'

Illinois Environmental Protection Agency — Well Completion Report

Site #: ____ County: Sangamon Well #: GP7

Site Name: Springfield CWLP Ash Pond Borehole #: GP7

Coordinates: X ____ Y ____ (or) Latitude: ____° ____' ____" Longitude: ____° ____' ____"

Surveyed by: Andrews Engineering, Inc. IL Registration #: ____

Drilling Contractor: Bulldog drilling Consulting Firm: Andrews Engineering, Inc.

Driller: J. Edwards Geologist: C. Myrvold

Drilling Method: CME 55cc 4.25 in HSA w/ 5'MC Logged by: C.Myrvold

Drilling Fluids (type): N/A Report Form Completed by: B. Kenning

Date Well Started: 5/16/2019 Date Well Finished: 5/16/2019 Date Form Completed: 7/19/2019

ANNULAR SPACE DETAILS

Type of surface seal: ____

Type of annular sealant: Bentonite Grout

Installation method: Tremie

Setting time: > 24 hours

Type of bentonite seal: Bentonite Chips

Installation method: Free Drop

Setting time: > 24 hours

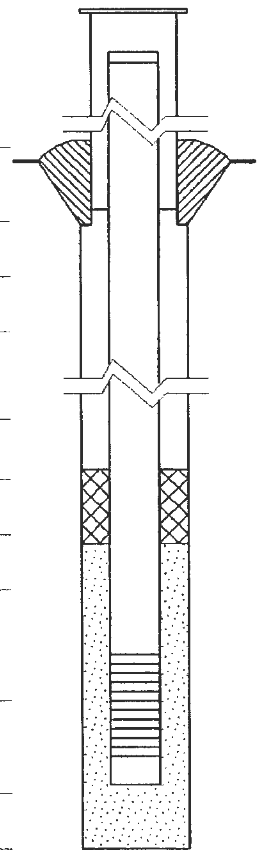
Type of sand pack: Silica Sand Pre-Pack

Grain size: 10/20 (sieve size)

Installation method: Free Drop

Type of backfill material: N/A (if applicable)

Installation method: ____



	ELEVATION (MSL)*	DEPTH (BGS)* (0.01 ft)
Top of Protective Casing		
Top of Riser Pipe		- 3.08'
Ground Surface		0.00'
Top of Annular Sealant		3.00'
Static Water Level Measured on (after completion)		
Top of Seal		21.93'
Top of Sandpack		23.93'
Top of Screen		25.93'
Bottom of Screen		35.70'
Bottom of Well		36.00'
Bottom of Borehole		36.50'

* Referenced to a National Geodetic Vertical Datum
* positive (+) values below GS, negitive (-) values above GS

CASING MEASUREMENTS

Diameter of Borehole (in)	8.25
ID of Riser Pipe (in)	#2
Protective Casing Length (ft)	N/A
Riser Pipe Length (ft)	28.76
Bottom of Screen to End Cap (ft)	0.30
Screen Length (1st slot to last slot) (ft)	9.77
Total Length of Casing (ft)	N/A
Screen Slot Size*	#10 (0.01)

*Hand-slotted well screens are unacceptable.

WELL CONSTRUCTION MATERIALS

Protective Casing	N/A
Riser Pipe Above W.T.	PVC
Riser Pipe Below W.T.	PVC
Screen	PVC

Andrews Engineering, Inc.
3300 Ginger Creek Drive
Springfield, IL 62711

FIELD BORING LOG

Site Information:
Name: Springfield City Water Light and Power
Location: Springfield, IL
County: Sangamon
Site No.:
AEI No.: 180247

Location:
Coord. System:
Northing: 0
Easting: 0

Weather: 80's F, Sunny

Boring Information:
Boring No: GP8
Well No: GP8
Surf Elev.: 0

Depth Information:
Total: 42.0
Auger: 42.0
Core: N/A

Dates:
Start: 5/15/19
Finish: 5/16/19

Drilling Contractor:
Contractor Name: Bulldog Drilling, Inc.
City: Dupo, IL
Equipment: AMS PowerProbe 9500 w/ 5' MC

Personnel:
Geologist: C. Myrvold
Driller: J. Edwards
Helper(s): S. Guy

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Run No.	Sample Type	Sample Recov.	Blow Count	qu/su (tsf)	Lithology	Description/Comments	Elev. (MSL)
							Ground Surface	0.0
0							Dark brown clayey SILT, moist to wet, loose.	
							Brown silty CLAY, moist, stiff, trace sand, black mottling.	
	1	CB	2.7/4					
5								-5.0
	2	CB	3.3/4					
10	3	CB	4.0/4					-10.0
	4	CB	4.0/4				Gray silty CLAY, moist, moderately stiff.	
15								-15.0
	5	CB	4.0/4					
20								-20.0

Notes: Refusal at 42.00'

Andrews Engineering, Inc.
3300 Ginger Creek Drive
Springfield, IL 62711

FIELD BORING LOG

Boring Information: GP8 Boring No: GP8 Well No: GP8

Legend: - Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Run No.	Sample Type	Sample Recov.	Blow Count	qu/su (tsf)	Lithology	Description/Comments	Elev. (MSL)
		CB					(cont.) Gray silty CLAY, moist, moderately stiff.	
	6	CB	2.2/4					
25								-25.0
	7	CB	4.0/4					
30	8	CB	4.0/4					-30.0
	9	CB	4.0/4					
35							Dark gray clayey SAND, fine-grained, moist, moderately stiff.	-35.0
	10	CB	4.0/4					
40								-40.0

Notes: Refusal at 42.00'

Andrews Engineering, Inc.
3300 Ginger Creek Drive
Springfield, IL 62711

FIELD BORING LOG

Boring Information: GP8 Boring No: GP8 Well No: GP8

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Run No.	Sample Type	Sample Recov.	Blow Count	qu/su (tsf)	Lithology	Description/Comments	Elev. (MSL)
	11	CB	2.0/2				Gray to dark gray weathered SHALE, soft, slightly moist.	
							End of Boring = 42 Feet	
45								-45.0
50								-50.0
55								-55.0
60								-60.0

Notes: Refusal at 42.00'

Illinois Environmental Protection Agency — Well Completion Report

Site #: ______ County: Sangamon Well #: GP8

Site Name: Springfield CWLP Ash Pond Borehole #: GP8

Coordinates: X ______ Y ______ (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed by: Andrews Engineering, Inc. IL Registration #: ______

Drilling Contractor: Bulldog drilling Consulting Firm: Andrews Engineering, Inc.

Driller: J. Edwards Geologist: C. Myrvold

Drilling Method: CME 55cc 4.25 in HSA w/ 5'MC Logged by: C.Myrvold

Drilling Fluids (type): N/A Report Form Completed by: B. Kenning

Date Well Started: 5/15/19 Date Well Finished: 5/16/19 Date Form Completed: 7/19/2019

ANNULAR SPACE DETAILS

Type of surface seal: ______

Type of annular sealant: Bentonite Grout

Installation method: Tremie

Setting time: > 24 hours

Type of bentonite seal: Bentonite Chips

Installation method: Free Drop

Setting time: > 24 hours

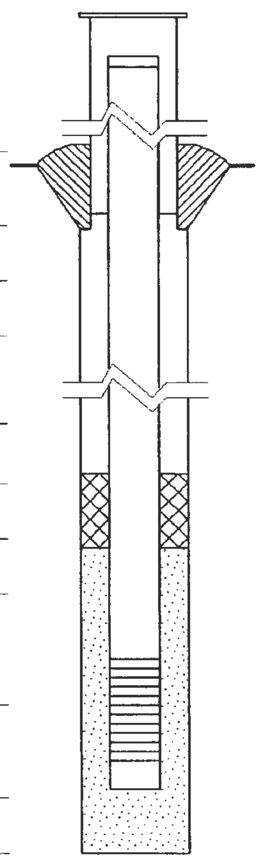
Type of sand pack: Silica Sand Pre-Pack

Grain size: 10/20 (sieve size)

Installation method: Free Drop

Type of backfill material: N/A (if applicable)

Installation method: ______



ELEVATION (MSL)*	DEPTH (BGS)•	(0.01 ft)
		Top of Protective Casing
	- 3.00'	Top of Riser Pipe
	0.00'	Ground Surface
	3.00'	Top of Annular Sealant
		Static Water Level Measured on (after completion)
	27.43'	Top of Seal
	29.43'	Top of Sandpack
	31.43'	Top of Screen
	41.20'	Bottom of Screen
	41.50'	Bottom of Well
	42.00'	Bottom of Borehole

* Referenced to a National Geodetic Vertical Datum
• positive (+) values below GS, negitive (-) values above GS

CASING MEASUREMENTS

Diameter of Borehole (in)	8.50
ID of Riser Pipe (in)	#2
Protective Casing Length (ft)	N/A
Riser Pipe Length (ft)	34.18
Bottom of Screen to End Cap (ft)	0.30
Screen Length [1st slot to last slot] (ft)	9.77
Total Length of Casing (ft)	N/A
Screen Slot Size‡	#10 (0.01)

‡ Hand-slotted well screens are unacceptable.

WELL CONSTRUCTION MATERIALS

Protective Casing	N/A
Riser Pipe Above W.T.	PVC
Riser Pipe Below W.T.	PVC
Screen	PVC

ANDREWS ENGINEERING
3300 Ginger Creek Drive - 217.787.2334
Springfield, IL 62711

FIELD BORING LOG

Site Information:
Name: CWLP
Location: Springfield, IL.
County: Sangamon
Site No.:
AEI No.: 200387

Location:
Coord. System:
Northing: 3401.7
Easting: 1265.0

Weather: 52F Sunny

Boring Information:
Boring No: W-9
Well No: AP-8
Surf Elev.: 7.00

Depth Information:
Total: 39.6
Auger: 4.25" HSA
Core: 5ft. Continuous Sampler

Dates:
Start: 2/25/2021
Finish: 2/25/2021

Drilling Contractor:
Contractor Name: Total Drilling Services/Skinner ltd.
City: Hindsboro, IL.
Equipment: CME 850

Personnel:
Geologist: C.M. Latham
Driller: Todd Skinner
Helper(s): A. Bruce

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Run No.	Sample Type	Sample Recov.	Blow Count	qu/su (tsf)	Lithology	Description/Comments	Elev. (MSL)
							Ground Surface	0.0
0	1	CB	4/5				**SILTY TOPSOIL** Dark brown, organic roots, moist, low-moderate firm.	
							SILTY CLAY Dark brown, firm, moist. Mottling with light brown and grey silty clay. Oxidation. 3'-5'.	
5	2	CB	5/5				**CLAYEY SILT** Grey, oxidation mottling, moist, soft. Increased oxidation at 8'	-5.0
							SAND SEAM Fine-grained, well sorted, subrounded, saturated, soft.	
10	3	CB	5/5				**CLAYEY SILT** Grey, oxidation, moist, soft.	-10.0
							SILTY CLAY Light grey, moist, soft	
15	4	CB	5/5					-15.0
20								-20.0

Notes:

ANDREWS ENGINEERING
3300 Ginger Creek Drive - 217.787.2334
Springfield, IL 62711

FIELD BORING LOG

Boring Information: W-9 Boring No: W-9 Well No: AP-8

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Run No.	Sample Type	Sample Recov.	Blow Count	qu/su (tsf)	Lithology	Description/Comments	Elev. (MSL)
	5	CB	5/5				**CLAYEY SILT** Brown, moist, soft-firm. Organic roots at 20'. Mottling with grey clay at 23.5'	
							SILTY CLAY Grey, moist, soft.	
25	6	CB	5/5				**SILTY CLAY** Dark grey, firm, moist. Mottled dark grey clay with blue clay at 26.5'	-25.0
							CLAY Dark grey, firm, moist. Mottled dark grey clay with blue clay at 26.5'	
30	7	CB	5/5				**SILTY CLAY** Blue, with trace organic coal fragments, moist, soft, moderate plasticity.	-30.0
							CLAYEY SILT WITH SAND Moist, poorly sorted, trace coal.	
35	8	CB	3.5/5					-35.0
							SAND Loose sands, saturated, poorly sorted.	
	9	SS		60 40			**SHALE** Blue, moist, weathered, with lamination.	
40							End of Boring = 39.6 Feet	-40.0

Notes:

Illinois Environmental Protection Agency — Well Completion Report

Site #: ______ County: Sangamon Well #: AP-8

Site Name: Springfield CWLP Ash Pond Borehole #: W-9

Coordinates: X 1265.0 Y 3401.7 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed by: Andrews Engineering, Inc. IL Registration #: ______

Drilling Contractor: Total Drilling Services/Skinner LTD. Consulting Firm: Andrews Engineering, Inc.

Driller: Todd Skinner Geologist: C. M. Latham

Drilling Method: CME 850 4.25 in HSA w/ 5'MC and 2' SS Logged by: C.M.Latham

Drilling Fluids (type): N/A Report Form Completed by: C.M. Latham

Date Well Started: 2/25/2021 Date Well Finished: 2/25/2021 Date Form Completed: 3/2/2021

ANNULAR SPACE DETAILS

Type of surface seal: Concrete

Type of annular sealant: Bentonite Chips

Installation method: Free Drop

Setting time: > 24

Type of bentonite seal: Bentonite Chips

Installation method: Free Drop

Setting time: > 24 hours

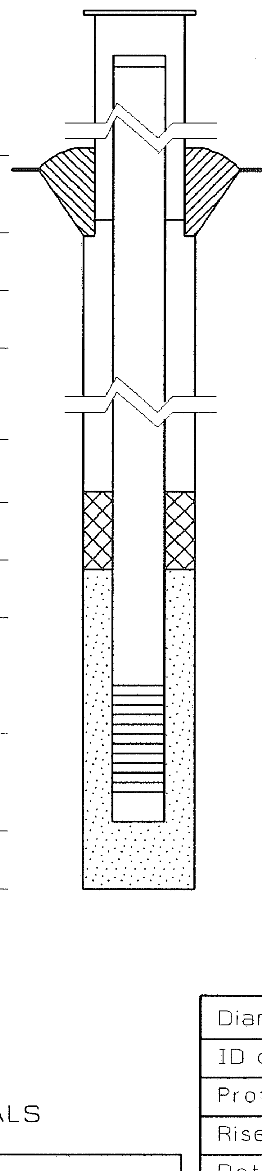
Type of sand pack: Silica Sand Pre-Pack

Grain size: 20/40 (sieve size)

Installation method: Free Drop

Type of backfill material: N/A (if applicable)

Installation method: ______



ELEVATION (MSL)*	DEPTH (BGS)*	(0.01 ft)
540.30	-3.10	Top of Protective Casing
540.30	-3.10	Top of Riser Pipe
537.20	0.00	Ground Surface
534.20	3.00	Top of Annular Sealant
530.20	7.00	Static Water Level Measured on (after completion)
	3.00	Top of Seal
510.60	26.60	Top of Sandpack
508.60	28.60	Top of Screen
498.02	39.18	Bottom of Screen
497.60	39.60	Bottom of Well
497.60	39.60	Bottom of Borehole

* Referenced to a National Geodetic Vertical Datum
* positive (+) values below GS, negitive (-) values above GS

CASING MEASUREMENTS

Diameter of Borehole (in)	8.25
ID of Riser Pipe (in)	
Protective Casing Length (ft)	N/A
Riser Pipe Length (ft)	29.48'
Bottom of Screen to End Cap (ft)	0.42
Screen Length (1st slot to last slot) (ft)	9.70
Total Length of Casing (ft)	N/A
Screen Slot Size*	#10 (0.01)

*Hand-slotted well screens are unacceptable.

WELL CONSTRUCTION MATERIALS

Protective Casing	N/A
Riser Pipe Above W.T.	PVC
Riser Pipe Below W.T.	PVC
Screen	PVC

ANDREWS ENGINEERING
3300 Ginger Creek Drive - 217.787.2334
Springfield, IL 62711

FIELD BORING LOG

Site Information:
Name: CWLP
Location: Springfield, IL.
County: Sangamon
Site No.:
AEI No.: 200387

Location:
Coord. System:
Northing: 5216.8
Easting: 703.0

Weather: 43F Sunny

Boring Information:
Boring No: W-8
Well No: AP-9
Surf Elev.: 9.30

Depth Information:
Total: 32.5ft.
Auger: 4.25". HSA
Core: 5ft. Continuous Sampler

Dates:
Start: 2/26/2021
Finish: 2/26/2021

Drilling Contractor:
Contractor Name: Total Drilling Services/Skinner ltd.
City: Hindsboro, IL.
Equipment: CME 850

Personnel:
Geologist: C.M. Latham
Driller: Todd Skinner
Helper(s): A. Bruce

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Run No.	Sample Type	Sample Recov.	Blow Count	qu/su (tsf)	Lithology	Description/Comments	Elev. (MSL)
							Ground Surface	0.0
0–4	1	CB	5/5				**CLAYEY SILT** Dark brown, organic roots and leaves, moist, soft.	
4–5							**CLAYEY SILT** Dark brown, moist, firm, slight mottling with dark grey clay.	
5	2	CB	4.5				**SILTY CLAY** Medium brown, silty clay, soft, high plasticity, moist.	-5.0
10	3	CB	4.5/5				Oxidation at 11' Moderate mottling with dark grey clay at 12 ft.	-10.0
15	4	CB	5/5				**SILTY CLAY** Dark grey, moist, soft, high plasticity.	-15.0
16.5							**CLAY** Light grey clay, moist, soft, mottled with brown clay and oxidation.	
20								-20.0

Notes:

ANDREWS ENGINEERING
3300 Ginger Creek Drive - 217.787.2334
Springfield, IL 62711

FIELD BORING LOG

Boring Information: W-8 Boring No: W-8 Well No: AP-9

Legend: - Continuous Barrel (CB) | - Split Spoon (SS) | - Shelby Tube | - Core | - Blind Drill

Depth (ft)	Run No.	Sample Type	Sample Recov.	Blow Count	qu/su (tsf)	Lithology	Description/Comments	Elev. (MSL)
	5	CB	5/5				**SILTY CLAY** Brown, moist, firm, mottled with oxidation. Mottled with blue clay and oxidation.	
							CLAY Blue clay, moist, firm, high plasticity. Increasing silt content.	
25								-25.0
	6	CB	4.5/5				**CLAYEY SILT WITH SAND** Poorly sorted, moist. Gradation to heavier sand content; poorly sorted, moist.	
							SAND AND GRAVEL Sand and gravel with organic coal fragments; moist, poorly sorted.	
30							**SHALE** Grey, laminated, weathered, shale. Firm, Moist.	-30.0
	7	SS		30 88 4				
							End of Boring = 32.5 Feet	
35								-35.0
40								-40.0

Notes:

PDF 0501

Illinois Environmental Protection Agency — Well Completion Report

Site #: ______ County: Sangamon Well #: AP-9

Site Name: Springfield CWLP Ash Pond Borehole #: W-8

Coordinates: X 703.0 Y 5216.8 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed by: Andrews Engineering, Inc. IL Registration #: ______

Drilling Contractor: Total Drilling Services/Skinner LTD. Consulting Firm: Andrews Engineering, Inc.

Driller: Todd Skinner Geologist: C. M. Latham

Drilling Method: CME 850 4.25 in HSA w/ 5'MC and 2' SS Logged by: C.M. Latham

Drilling Fluids (type): N/A Report Form Completed by: C.M. Latham

Date Well Started: 2/26/2021 Date Well Finished: 2/26/2021 Date Form Completed: 3/2/2021

ANNULAR SPACE DETAILS

Type of surface seal: Concrete

Type of annular sealant: Bentonite Chips

Installation method: Free Drop

Setting time: > 24

Type of bentonite seal: Bentonite Chips

Installation method: Free Drop

Setting time: > 24 hours

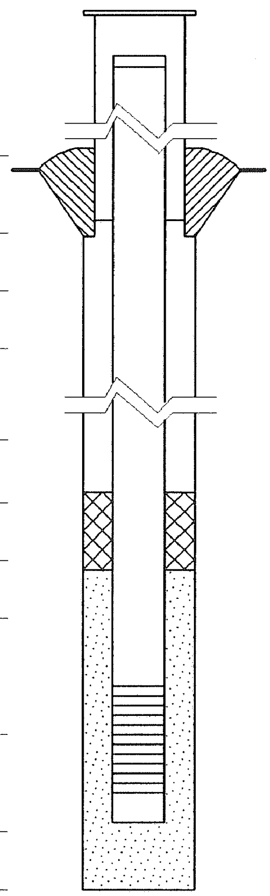
Type of sand pack: Silica Sand Pre-Pack

Grain size: 20/40 (sieve size)

Installation method: Free Drop

Type of backfill material: N/A (if applicable)

Installation method: ______



ELEVATION (MSL)[*]	DEPTH (BGS)[+] (0.01 ft)	
537.20	-2.90	Top of Protective Casing
537.20	-2.90	Top of Riser Pipe
534.30	0.00	Ground Surface
531.30	3.00	Top of Annular Sealant
525.00	9.30	Static Water Level Measured on (after completion)
	3.00	Top of Seal
514.00	20.30	Top of Sandpack
512.00	22.30	Top of Screen
502.24	32.06	Bottom of Screen
501.80	32.50	Bottom of Well
501.80	32.50	Bottom of Borehole

[*] Referenced to a National Geodetic Vertical Datum
[+] positive (+) values below GS, negitive (-) values above GS

CASING MEASUREMENTS

Diameter of Borehole (in)	8.25
ID of Riser Pipe (in)	
Protective Casing Length (ft)	N/A
Riser Pipe Length (ft)	24.91
Bottom of Screen to End Cap (ft)	0.44
Screen Length (1st slot to last slot) (ft)	9.76
Total Length of Casing (ft)	N/A
Screen Slot Size[¥]	#10 (0.01)

[¥] Hand-slotted well screens are unacceptable.

WELL CONSTRUCTION MATERIALS

Protective Casing	N/A
Riser Pipe Above W.T.	PVC
Riser Pipe Below W.T.	PVC
Screen	PVC

ANDREWS ENGINEERING
3300 Ginger Creek Drive - 217.787.2334
Springfield, IL 62711

FIELD BORING LOG

Site Information:
Name: CWLP
Location: Springfield
County: Sangamon
Site No.:
AEI No.: 200387

Location:
Coord. System:
Northing: 4684.0
Easting: 695.6

Weather: 40F Partly cloudy

Boring Information:
Boring No: W-5
Well No: AP-10
Surf Elev.: 6.02

Depth Information:
Total: 34.97
Auger: 4.25" HSA
Core: 5ft. Continous Sampler

Dates:
Start: 2/24/2021
Finish: 2/24/2021

Drilling Contractor:
Contractor Name: Total Drilling Services/Skinner ltd.
City: Hindsboro, Il.
Equipment: CME 850

Personnel:
Geologist: C.M. Latham
Driller: Todd Skinner
Helper(s): A. Bruce

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Run No.	Sample Type	Sample Recov.	Blow Count	qu/su (tsf)	Lithology	Description/Comments	Elev. (MSL)
							Ground Surface	0.0
0	1	CB	2.5/5				**SILTY TOPSOIL** Dark brown, moist, very firm, hard silt in shoe.	
							SILT Medium brown, moist, very firm, hard silt in shoe.	
5	2	CB	4/4				**CLAYEY SILT** Brown, moist, soft, homogenous.	-5.0
							SILTY CLAY Brown, high plasticity, moist, very soft, homogenous. Trace sand seen in top of barrel. Wet from 10'-15' Free water at 12'5"	
10	3	CB	5					-10.0
15	4	CB	5				**SILTY CLAY** Grey, soft, moist. Fine sands, trace gravels at 17'	-15.0
							CLAYEY SILT WITH SAND Blueish grey with trace gravel, soft, moderate sorting.	
20								-20.0

Notes:

ANDREWS ENGINEERING
3300 Ginger Creek Drive - 217.787.2334
Springfield, IL 62711

FIELD BORING LOG

Boring Information: W-5 Boring No: W-5 Well No: AP-10

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Run No.	Sample Type	Sample Recov.	Blow Count	qu/su (tsf)	Lithology	Description/Comments	Elev. (MSL)
	5	CB	5/5				**SANDY GRAVEL** Poorly sorted, sub rounded, saturated, unconsolidated sands. Poorly sorted angular gravel.	
							SILTY CLAY Blue, high plasticity, firm, moist, tight clay. Very thin sand seam, fine grained, saturated at 23' Very thin sand seam, fine grained, saturated at 29.5'	
25	6	CB	5/5					-25.0
30	7	CB	4/5				**DIAMICTON** Blue, subrounded, poorly sorted sandy clay, with angular coal up to 0.3ft. Angular gravels; poorly sorted. Trace silts, saturated. Gradation into larger gravel and sand clasts towards bottom with trace silts and no clay.	-30.0
				33			**SHALE** Grey, moist, with lamination.	
35	8	SS		60			End of Boring = 34.97 Feet	-35.0
40								-40.0

Notes:

PDF 0504

Illinois Environmental Protection Agency — Well Completion Report

Site #: ______ County: Sangamon Well #: AP-10

Site Name: Springfield CWLP Ash Pond Borehole #: W-5

Coordinates: X 695.6 Y 4684.0 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed by: Andrews Engineering, Inc. IL Registration #: ______

Drilling Contractor: Total Drilling Services/Skinner LTD. Consulting Firm: Andrews Engineering, Inc.

Driller: Todd Skinner Geologist: C. M. Latham

Drilling Method: CME 850 4.25 in HSA w/ 5'MC and 2' SS Logged by: C.M. Latham

Drilling Fluids (type): N/A Report Form Completed by: C.M. Latham

Date Well Started: 2/24/2021 Date Well Finished: 2/24/2021 Date Form Completed: 3/2/2021

ANNULAR SPACE DETAILS

Type of surface seal: Concrete

Type of annular sealant: Bentonite Chips

Installation method: Free Drop

Setting time: > 24

Type of bentonite seal: Bentonite Chips

Installation method: Free Drop

Setting time: > 24 hours

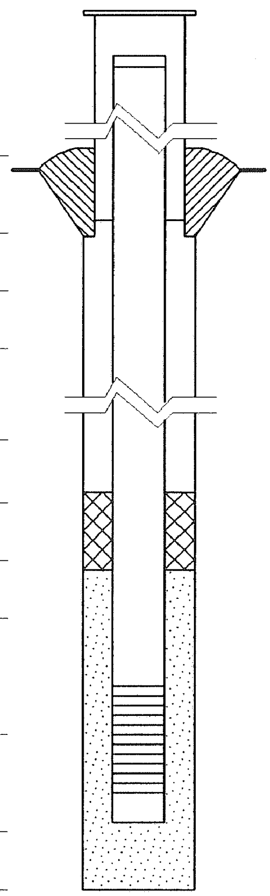
Type of sand pack: Silica Sand Pre-Pack

Grain size: 20/40 (sieve size)

Installation method: Free Drop

Type of backfill material: N/A (if applicable)

Installation method: ______



ELEVATION (MSL)[®]	DEPTH (BGS)[*]	(0.01 ft)
537.50	-3.10	Top of Protective Casing
537.50	-3.10	Top of Riser Pipe
534.40	0.00	Ground Surface
531.40	3.00	Top of Annular Sealant
528.38	6.02	Static Water Level Measured on (after completion)
____	3.00	Top of Seal
511.80	22.60	Top of Sandpack
509.70	24.70	Top of Screen
499.89	34.51	Bottom of Screen
499.43	34.97	Bottom of Well
499.43	34.97	Bottom of Borehole

[®] Referenced to a National Geodetic Vertical Datum
[*] positive (+) values below GS, negitive (-) values above GS

CASING MEASUREMENTS

Diameter of Borehole (in)	8.25
ID of Riser Pipe (in)	
Protective Casing Length (ft)	N/A
Riser Pipe Length (ft)	29.48'
Bottom of Screen to End Cap (ft)	0.46
Screen Length [1st slot to last slot] (ft)	9.71
Total Length of Casing (ft)	N/A
Screen Slot Size[¥]	#10 (0.01)

[¥] Hand-slotted well screens are unacceptable.

WELL CONSTRUCTION MATERIALS

Protective Casing	N/A
Riser Pipe Above W.T.	PVC
Riser Pipe Below W.T.	PVC
Screen	PVC

ANDREWS ENGINEERING
3300 Ginger Creek Drive - 217.787.2334
Springfield, IL 62711

FIELD BORING LOG

Site Information:
Name: CWLP Ash Pond
Location: Springfield, IL
County: Sangamon
Site No.:
AEI No.: 200387-0025

Location:
Coord. System:
Northing: 4150.6
Easting: 524.5

Weather: Clear 40s

Boring Information:
Boring No: W-4
Well No: AP-11
Surf Elev.: NA

Depth Information:
Total: 20.1
Auger: 4.25" HSA
Core: 5ft continous sampler

Dates:
Start: 2/23/2021
Finish: 2/23/2021

Drilling Contractor:
Contractor Name: Total Drilling Services/Skinner LTD
City: Hindsboro
Equipment: CME 850

Personnel:
Geologist: Scott Kangas
Driller: Todd Skinner
Helper(s): Adam Bruce

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Run No.	Sample Type	Sample Recov.	Blow Count	qu/su (tsf)	Lithology	Description/Comments	Elev. (MSL)
							Ground Surface	0.0
0	1	CB	3.5/5				**CLAYEY SILT TOPSILT** Black to dark brown, moist, soft to moderately stiff.	
							CLAYEY SILT Dark brown, moist, stiff to hard, homogenous.	
5	2	CB	3.75/5				Very hard, trace fine sand, and oxidation with depth	-5.0
10	3	CB	5/5					-10.0
							SILTY CLAY Olive gray, moist, soft, heavily oxidated, trace fine sand that increases with depth	
15	4	CB	2.5/5				**CLAYEY SAND** Dark Gray to reddish brown with depth, wet, soft, fine well sorted sand	-15.0
							GRAVEL AND SAND Gray, poorly sorted up to 1" angular pieces, wet	
20								-20.0

Notes:

ANDREWS ENGINEERING
3300 Ginger Creek Drive - 217.787.2334
Springfield, IL 62711

FIELD BORING LOG

Boring Information: W-4 Boring No: W-4 Well No: AP-11

Legend: - Continuous Barrel (CB) | - Split Spoon (SS) | - Shelby Tube | - Core | - Blind Drill

Depth (ft)	Run No.	Sample Type	Sample Recov.	Blow Count	qu/su (tsf)	Lithology	Description/Comments	Elev. (MSL)
							SHALE Weathered, gray	
							End of Boring = 20.1 Feet	
25								-25.0
30								-30.0
35								-35.0
40								-40.0

Notes:

Illinois Environmental Protection Agency — Well Completion Report

PDE 0507

Site #: ______ County: Sangamon Well #: AP-11

Site Name: Springfield CWLP Ash Pond Borehole #: W-4

Coordinates: X 524.5 Y 4150.6 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed by: Andrews Engineering, Inc. IL Registration #: ______

Drilling Contractor: Total Drilling Services/Skinner LTD Consulting Firm: Andrews Engineering, Inc.

Driller: Todd Skinner Geologist: S Kangas

Drilling Method: CME 850 4.25 in HSA w/ 5'MC and 2' SS Logged by: S Kangas

Drilling Fluids (type): N/A Report Form Completed by: S Kangas

Date Well Started: 2/23/2021 Date Well Finished: 2/23/2021 Date Form Completed: 3/2/2021

ANNULAR SPACE DETAILS

Type of surface seal: Concrete

Type of annular sealant: Bentonite Chips

Installation method: Free Drop

Setting time: >24

Type of bentonite seal: Bentonite Chips

Installation method: Free Drop

Setting time: > 24 hours

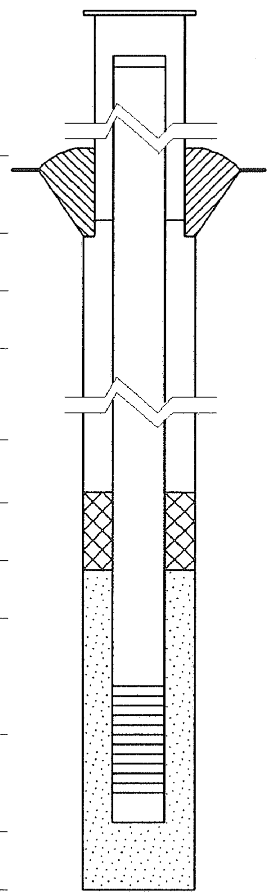
Type of sand pack: Silica Sand Pre-Pack

Grain size: 20/40 (sieve size)

Installation method: Free Drop

Type of backfill material: N/A (if applicable)

Installation method: ______



ELEVATION (MSL)[⊕]	DEPTH (BGS)[*]	(0.01 ft)
538.10	-2.80	Top of Protective Casing
538.10	-2.80	Top of Riser Pipe
535.30	0.00	Ground Surface
531.80	3.50	Top of Annular Sealant
		Static Water Level Measured on (after completion)
531.80	3.50	Top of Seal
527.60	7.70	Top of Sandpack
525.28	10.02	Top of Screen
515.58	19.72	Bottom of Screen
515.15	20.15	Bottom of Well
515.15	20.15	Bottom of Borehole

⊕ Referenced to a National Geodetic Vertical Datum
* positive (+) values below GS, negitive (-) values above GS

CASING MEASUREMENTS

Diameter of Borehole (in)	8.25
ID of Riser Pipe (in)	#2
Protective Casing Length (ft)	N/A
Riser Pipe Length (ft)	14.96
Bottom of Screen to End Cap (ft)	0.43
Screen Length [1st slot to last slot] (ft)	9.70
Total Length of Casing (ft)	N/A
Screen Slot Size[¥]	#10 (0.01)

¥ Hand-slotted well screens are unacceptable.

WELL CONSTRUCTION MATERIALS

Protective Casing	N/A
Riser Pipe Above W.T.	PVC
Riser Pipe Below W.T.	PVC
Screen	PVC

ANDREWS ENGINEERING
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Springfield, IL 62711

FIELD BORING LOG

Site Information:
Name: CWLP Ash Pond
Location: Springfield, IL
County: Sangamon
Site No.:
AEI No.: 200387-0025

Location:
Coord. System:
Northing: 3797.7
Easting: 667.6

Weather: Clear 40s

Boring Information:
Boring No: W-3
Well No: AP-12
Surf Elev.: NA

Depth Information:
Total: 27.3
Auger: 4.25" HSA
Core: 5ft continous sampler

Dates:
Start: 2/23/2021
Finish: 2/23/2021

Drilling Contractor:
Contractor Name: Total Drilling Services/Skinner LTD
City: Hindsboro, IL
Equipment: CME 850

Personnel:
Geologist: Scott Kangas
Driller: Todd Skinner
Helper(s): Adam Bruce

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Run No.	Sample Type	Sample Recov.	Blow Count	qu/su (tsf)	Lithology	Description/Comments	Elev. (MSL)
							Ground Surface	0.0
0	1	CB	4/5				**CLAYEY SILT TOPSOIL** Dark brown, moist, soft to slightly stiff, root structures	
							CLAYEY SILT Brown, moist, stiff to hard, heavily oxidated, homogenous	
5	2	CB	4/5				**SILT** Light gray, moist, firm to hard, heavily oxidated, mottling, homogenous.	-5.0
10	3	CB	5/5				**CLAYEY SILT** Brown, moist, stiff to hard, moderate oxidation Lighter in color, trace fine sand, and increase clay content with depth	-10.0
15	4	CB	4/5					-15.0
							SANDY CLAY Gray, wet, soft, fine sand, well sorted and homgenous	
20								-20.0

Notes:

ANDREWS ENGINEERING
3300 Ginger Creek Drive - 217.787.2334
Springfield, IL 62711

FIELD BORING LOG

Boring Information: W-3 Boring No: W-3 Well No: AP-12

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Run No.	Sample Type	Sample Recov.	Blow Count	qu/su (tsf)	Lithology	Description/Comments	Elev. (MSL)
	5	CB	2.5/ 2.5					
	6	CB	2/2.5				**CLAYEY SAND** Dark gray, wet, stiff, well sorted fine sand	
							GRAVEL AND SAND Gray, poorly sorted, angular to subangular, 1.5" or less in size	
25	7	CB	2.3/ 2.3				**SHALE** Gray, weathered	-25.0
							End of Boring = 27.3 Feet	
30								-30.0
35								-35.0
40								-40.0

Notes:

Illinois Environmental Protection Agency — Well Completion Report

PDF 0510

Site #: ______ County: Sangamon Well #: AP-12

Site Name: Springfield CWLP Ash Pond Borehole #: W-3

Coordinates: X 667.6 Y 3797.7 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed by: Andrews Engineering, Inc. IL Registration #: ______

Drilling Contractor: Total Drilling Services/Skinner LTD. Consulting Firm: Andrews Engineering, Inc.

Driller: Todd Skinner Geologist: C. M. Latham

Drilling Method: CME 850 4.25 in HSA w/ 5'MC and 2' SS Logged by: Scott Krangus

Drilling Fluids (type): N/A Report Form Completed by: C.M. Latham

Date Well Started: 2/23/2021 Date Well Finished: 2/24/2021 Date Form Completed: 3/2/2021

ANNULAR SPACE DETAILS

Type of surface seal: Concrete

Type of annular sealant: Bentonite Chips

Installation method: Free Drop

Setting time: > 24

Type of bentonite seal: Bentonite Chips

Installation method: Free Drop

Setting time: > 24 hours

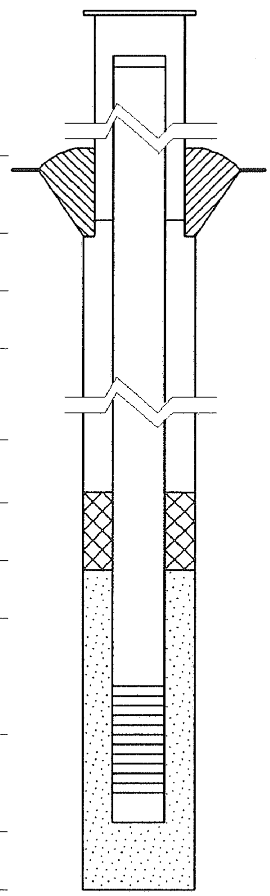
Type of sand pack: Silica Sand Pre-Pack

Grain size: 20/40 (sieve size)

Installation method: Free Drop

Type of backfill material: N/A (if applicable)

Installation method: ______



ELEVATION (MSL)[®]	DEPTH (BGS)[*] (0.01 ft)	
540.70	-2.90	Top of Protective Casing
540.60	-2.80	Top of Riser Pipe
537.80	0.00	Ground Surface
534.80	3.00	Top of Annular Sealant
		Static Water Level Measured on (after completion)
	3.00	Top of Seal
522.80	15.00	Top of Sandpack
520.80	17.00	Top of Screen
510.88	26.92	Bottom of Screen
510.30	27.50	Bottom of Well
510.50	27.30	Bottom of Borehole

[®] Referenced to a National Geodetic Vertical Datum
[*] positive (+) values below GS, negitive (-) values above GS

CASING MEASUREMENTS

Diameter of Borehole (in)	8.25
ID of Riser Pipe (in)	
Protective Casing Length (ft)	N/A
Riser Pipe Length (ft)	24.94
Bottom of Screen to End Cap (ft)	0.38
Screen Length [1st slot to last slot] (ft)	9.70
Total Length of Casing (ft)	N/A
Screen Slot Size[¥]	#10 (0.01)

[¥] Hand-slotted well screens are unacceptable.

WELL CONSTRUCTION MATERIALS

Protective Casing	N/A
Riser Pipe Above W.T.	PVC
Riser Pipe Below W.T.	PVC
Screen	PVC

ANDREWS ENGINEERING 3300 Ginger Creek Drive - 217.787.2334 Springfield, IL 62711

FIELD BORING LOG

Site Information: Name: CWLP Location: Springfield, IL. County: Sangamon Site No.: AEI No.: 200387	**Location:** Coord. System: Northing: 3451.2 Easting: 852.1 Weather: 50F Sunny	**Boring Information:** Boring No: W-2 Well No: AP-13 Surf Elev.: 6.25 **Depth Information:** Total: 27.6 Auger: 4.25" HSA Core: 5ft. Continuous Sampler
Drilling Contractor: Contractor Name: Total Drilling Services/Skinner ltd. City: Hindsboro, IL. Equipment: CME 850	**Personnel:** Geologist: C.M. Latham Driller: Todd Skinner Helper(s): A. Bruce	**Dates:** Start: 2/23/2021 Finish: 2/24/2021

- Continuous Barrel (CB) | - Split Spoon (SS) | - Shelby Tube | - Core | - Blind Drill

Depth (ft)	Run No.	Sample Type	Sample Recov.	Blow Count	qu/su (tsf)	Lithology	Description/Comments	Elev. (MSL)
							Ground Surface	0.0
0		CB					**SILTY TOPSOIL** Dark Brown-black, moist, soft.	
	1	CB	3.5				**CLAYEY SILT** Light brown, firm, moist.	
5							**SILT** Grey, moist, firm, homogenous.	-5.0
	2	CB	4/5				**SILT** Reddish brown, moist, firm, homogenous.	
10								-10.0
	3	CB	5/5				**CLAYEY SILT** Reddish brown, mottled with grey clay, moist, soft-firm, homogenous.	
15								-15.0
	4	CB	5/5					
20								-20.0

Notes:

FIELD BORING LOG

Boring Information: W-2 Boring No: W-2 Well No: AP-13

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Run No.	Sample Type	Sample Recov.	Blow Count	qu/su (tsf)	Lithology	Description/Comments	Elev. (MSL)
	5	CB	1.25/ 2.5				**SAND AND GRAVEL** Dirty olive, saturated, poorly sorted, angular.	
							SHALE Grey, weathered, with lamination.	
25								-25.0
		SS		29 60 4				
							End of Boring = 27.6 Feet	
30								-30.0
35								-35.0
40								-40.0

Notes:

Illinois Environmental Protection Agency — Well Completion Report

PDF 0513

Site #: ______ County: Sangamon Well #: AP-13

Site Name: Springfield CWLP Ash Pond Borehole #: W-2

Coordinates: X 852.1 Y 3451.2 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed by: Andrews Engineering, Inc. IL Registration #: ______

Drilling Contractor: Total Drilling Services/Skinner LTD. Consulting Firm: Andrews Engineering, Inc.

Driller: Todd Skinner Geologist: C. M. Latham

Drilling Method: CME 850 4.25 in HSA w/ 5'MC and 2' SS Logged by: C.M. Latham

Drilling Fluids (type): N/A Report Form Completed by: C.M. Latham

Date Well Started: 2/24/2021 Date Well Finished: 2/24/2021 Date Form Completed: 3/2/2021

ANNULAR SPACE DETAILS

Type of surface seal: Concrete

Type of annular sealant: Bentonite Chips

Installation method: Free Drop

Setting time: > 24

Type of bentonite seal: Bentonite Chips

Installation method: Free Drop

Setting time: > 24 hours

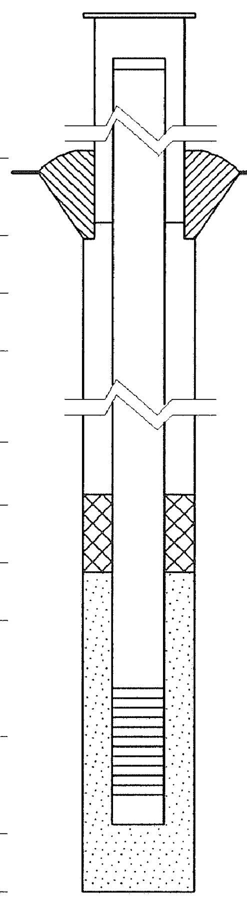
Type of sand pack: Silica Sand Pre-Pack

Grain size: 20/40 (sieve size)

Installation method: Free Drop

Type of backfill material: N/A (if applicable)

Installation method: ______



ELEVATION (MSL)®	DEPTH (BGS)* (0.01 ft)	
542.00	-3.40	Top of Protective Casing
542.00	-3.40	Top of Riser Pipe
538.60	0.00	Ground Surface
355.60	3.00	Top of Annular Sealant
532.35	6.25	Static Water Level Measured on (after completion)
	3.00	Top of Seal
524.08	14.52	Top of Sandpack
522.08	16.52	Top of Screen
511.47	27.13	Bottom of Screen
511.00	27.60	Bottom of Well
511.00	27.60	Bottom of Borehole

® Referenced to a National Geodetic Vertical Datum
* positive (+) values below GS, negitive (-) values above GS

CASING MEASUREMENTS

Diameter of Borehole (in)	8.25
ID of Riser Pipe (in)	
Protective Casing Length (ft)	N/A
Riser Pipe Length (ft)	19.94'
Bottom of Screen to End Cap (ft)	0.47'
Screen Length [1st slot to last slot] (ft)	9.70
Total Length of Casing (ft)	N/A
Screen Slot Size¥	#10 (0.01)

¥Hand-slotted well screens are unacceptable.

WELL CONSTRUCTION MATERIALS

Protective Casing	N/A
Riser Pipe Above W.T.	PVC
Riser Pipe Below W.T.	PVC
Screen	PVC

ANDREWS ENGINEERING
3300 Ginger Creek Drive - 217.787.2334
Springfield, IL 62711

FIELD BORING LOG

Site Information:
Name: CWLP
Location: Springfield, IL
County: Sangamon
Site No.:
AEI No.: 200387

Location:
Coord. System:
Northing: 3171.5
Easting: 1275.2

Weather: 44F Partly Sunny

Boring Information:
Boring No: W-1
Well No: AP-14
Surf Elev.: 2.00

Depth Information:
Total: 27.5
Auger: 4.25" HSA
Core: 5ft Continuous Sampler

Dates:
Start: 2/25/2021
Finish: 2/26/2021

Drilling Contractor:
Contractor Name: Total Drilling Services/Skinner ltd.
City: Hindsboro, IL
Equipment: CME 850 4.25" HSA w/ 5' cont. sampler and 2'SS

Personnel:
Geologist: C.M. Latham
Driller: Todd Skinner
Helper(s): A. Bruce

- Continuous Barrel (CB) - Split Spoon (SS) - Shelby Tube - Core - Blind Drill

Depth (ft)	Run No.	Sample Type	Sample Recov.	Blow Count	qu/su (tsf)	Lithology	Description/Comments	Elev. (MSL)
							Ground Surface	0.0
0	1	CB	3.5/5				**SILTY TOPSOIL** Dark brown, moist, soft, organic leaves	
							SILTY CLAY Some gravel	
5	2	CB	5/5				**CLAYEY SILT** Dark brown, moist, soft, organic leaves and roots, oxidation	-5.0
							SILTY CLAY Medium brown, mottled with grey clay and oxidation, high plasticity, moist, firm.	
10	3	CB	4/5				Groundwater encountered at 14'	-10.0
15	4	CB	5/5				**SILTY CLAY** Grey, moist, firm, high plasticity, oxidation	-15.0
							21-21.5' coal fragments with undifferentiated organic materials	
20								-20.0

Notes:

ANDREWS ENGINEERING
3300 Ginger Creek Drive - 217.787.2334
Springfield, IL 62711

FIELD BORING LOG

Boring Information: W-1 Boring No: W-1 Well No: AP-14

Legend: - Continuous Barrel (CB) | - Split Spoon (SS) | - Shelby Tube | - Core | - Blind Drill

Depth (ft)	Run No.	Sample Type	Sample Recov.	Blow Count	qu/su (tsf)	Lithology	Description/Comments	Elev. (MSL)
	5	CB	3/5				**SILTY CLAY** Some gravel	
							SAND Coarse grained, poorly sorted, unconsolidated, saturated.	
25	6	SS	3/5	30 60 4			**SHALE** Grey, weatherd with lamination	-25.0
							End of Boring = 27.5 Feet	
30								-30.0
35								-35.0
40								-40.0

Notes:

PDE 0516

Illinois Environmental Protection Agency — Well Completion Report

Site #: ______ County: Sangamon Well #: AP-14

Site Name: Springfield CWLP Ash Pond Borehole #: W-1

Coordinates: X 1275.2 Y 3171.5 (or) Latitude: ___° ___' ___" Longitude: ___° ___' ___"

Surveyed by: Andrews Engineering, Inc. IL Registration #: ______

Drilling Contractor: Total Drilling Services/Skinner LTD. Consulting Firm: Andrews Engineering, Inc.

Driller: Todd Skinner Geologist: C. M. Latham

Drilling Method: CME 850 4.25 in HSA w/ 5'MC and 2' SS Logged by: C.M. Latham

Drilling Fluids (type): N/A Report Form Completed by: C.M. Latham

Date Well Started: 2/25/2021 Date Well Finished: 2/26/2021 Date Form Completed: 3/2/2021

ANNULAR SPACE DETAILS

Type of surface seal: Concrete

Type of annular sealant: Bentonite Chips

Installation method: Free Drop

Setting time: > 24

Type of bentonite seal: Bentonite Chips

Installation method: Free Drop

Setting time: > 24 hours

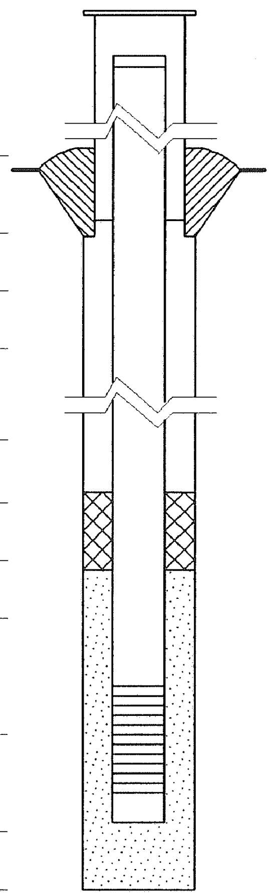
Type of sand pack: Silica Sand Pre-Pack

Grain size: 20/40 (sieve size)

Installation method: Free Drop

Type of backfill material: N/A (if applicable)

Installation method: ______



ELEVATION (MSL)[®]	DEPTH (BGS)[*]	(0.01 ft)
539.60	-2.80	Top of Protective Casing
539.60	-2.80	Top of Riser Pipe
536.80	0.00	Ground Surface
533.80	3.00	Top of Annular Sealant
534.80	2.00	Static Water Level Measured on (after completion)
____	3.00	Top of Seal
521.45	15.35	Top of Sandpack
519.45	17.35	Top of Screen
509.75	27.05	Bottom of Screen
509.30	27.50	Bottom of Well
509.30	27.50	Bottom of Borehole

® Referenced to a National Geodetic Vertical Datum
* positive (+) values below GS, negitive (-) values above GS

CASING MEASUREMENTS

Diameter of Borehole (in)	8.25
ID of Riser Pipe (in)	
Protective Casing Length (ft)	N/A
Riser Pipe Length (ft)	19.94
Bottom of Screen to End Cap (ft)	0.45
Screen Length (1st slot to last slot) (ft)	9.70
Total Length of Casing (ft)	N/A
Screen Slot Size[¥]	#10 (0.01)

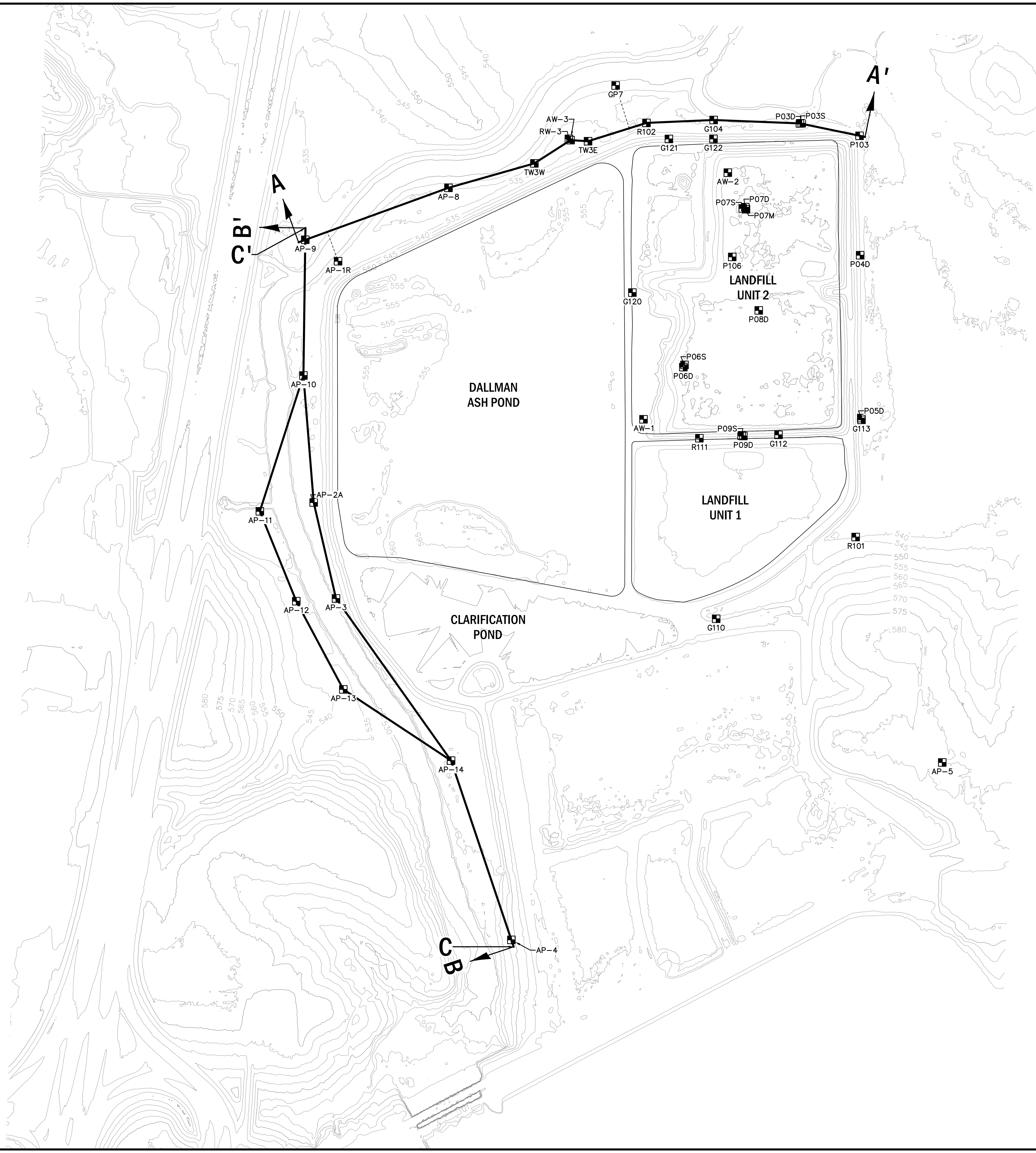
¥ Hand-slotted well screens are unacceptable.

WELL CONSTRUCTION MATERIALS

Protective Casing	N/A
Riser Pipe Above W.T.	PVC
Riser Pipe Below W.T.	PVC
Screen	PVC

APPENDIX B

GEOLOGIC CROSS-SECTIONS



LEGEND

CROSS-SECTION LINE

EXISTING MONITORING WELL LOCATION

NOTES

1. LIDAR DATA DERIVED FROM USGS WEBSITE (FLIGHT DATE: OCTOBER 15, 2018).
2. CONTOUR INTERVAL SHOWN IS 5 FEET.

N

0 200 400 800

SCALE: IN FEET

NO.	DATE	REVISION DESCRIPTION	BY

ANDREWS ENGINEERING
3300 GINGER CREEK DRIVE
SPRINGFIELD, ILLINOIS 62711-7233
PH (217) 787-2334 WWW.ANDREWS-ENG.COM
PONTIAC, IL • LOMBARD, IL • INDIANAPOLIS, IN • WARRENTON, MO

APPROVED BY: BJH DESIGNED BY: SWK DRAWN BY: MPN

GEOLOGIC CROSS-SECTION LOCATIONS MAP

PREPARED FOR

CITY WATER, LIGHT, AND POWER

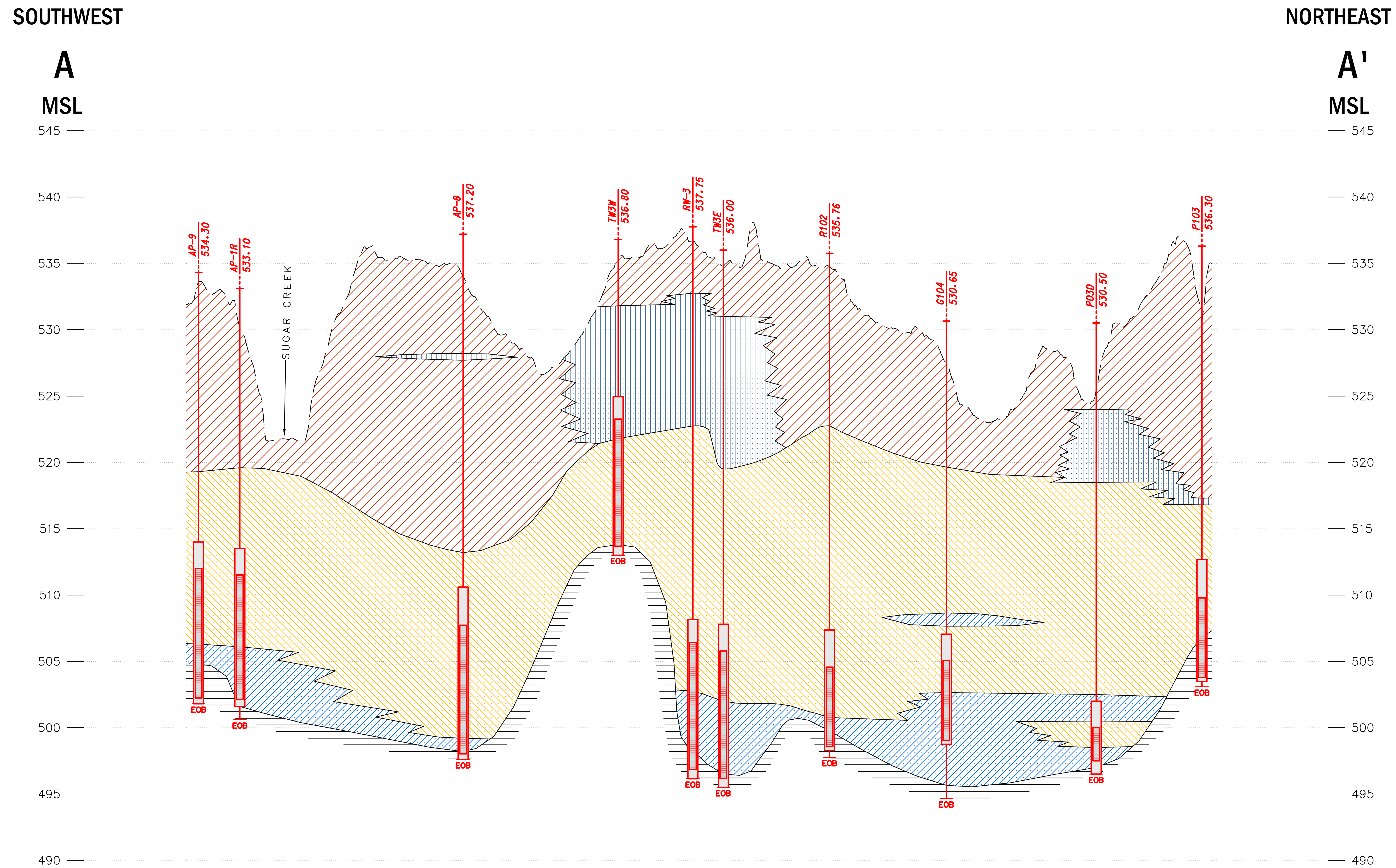
SPRINGFIELD, SANGAMON COUNTY, ILLINOIS

DATE: APRIL 2021

PROJECT ID: 200387/0003

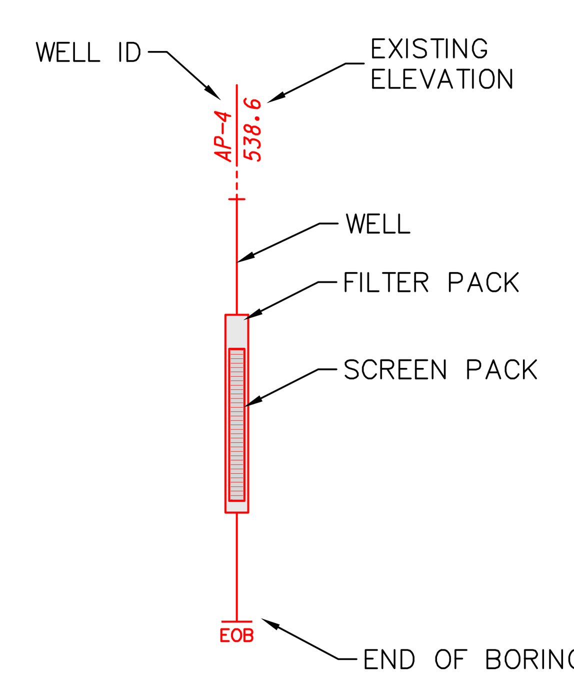
SHEET NUMBER:

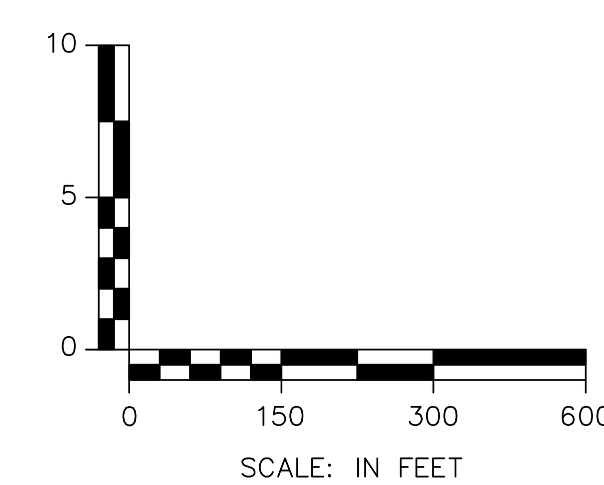
1



LEGEND

- UPPER COHESIVE DEPOSIT
- SHALLOW SAND
- LOWER COHESIVE DEPOSIT
- BASAL SAND
- SHALE





NOTES

1. DEPTH AND THICKNESS OF SUBSURFACE STRATA WERE GENERALIZED FROM AND INTERPOLATED BETWEEN BORINGS. INFORMATION ON ACTUAL SUBSURFACE CONDITIONS EXISTS ONLY AT THE LOCATION OF THE BORING. SEE BORING LOGS FOR DETAILED DESCRIPTION.
2. LIDAR DATA DERIVED FROM USGS WEBSITE (FLIGHT DATE: OCTOBER 15, 2018).

NO.	DATE	REVISION DESCRIPTION	BY

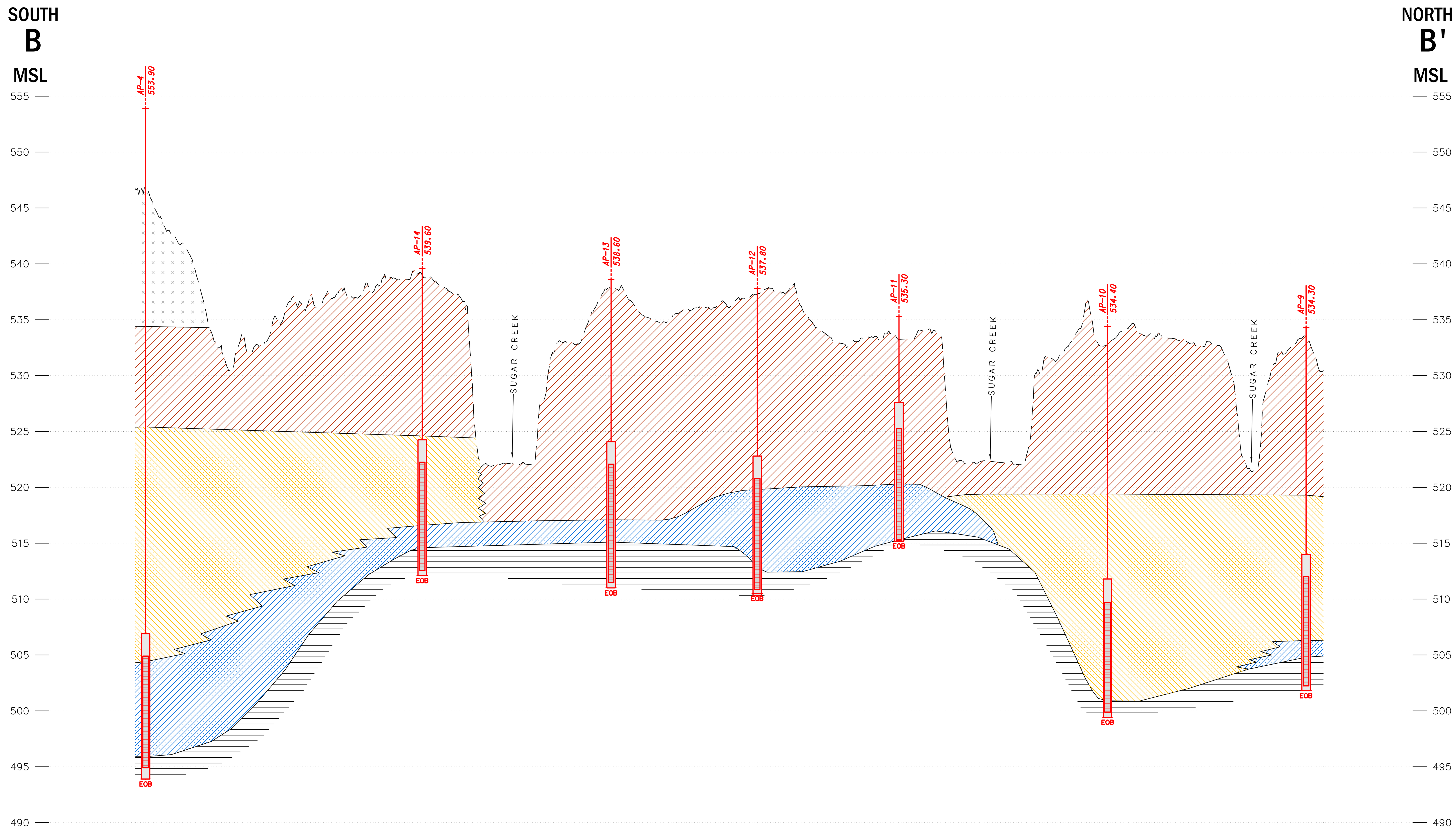
ANDREWS ENGINEERING
3300 GINGER CREEK DRIVE
SPRINGFIELD, ILLINOIS 62711-7233
PH (217) 787-2334 WWW.ANDREWS-ENG.COM
PONTIAC, IL • LOMBARD, IL • INDIANAPOLIS, IN • WARRENTON, MO

APPROVED BY: BJH DESIGNED BY: SWK DRAWN BY: MPN

GEOLOGIC CROSS-SECTION A-A'

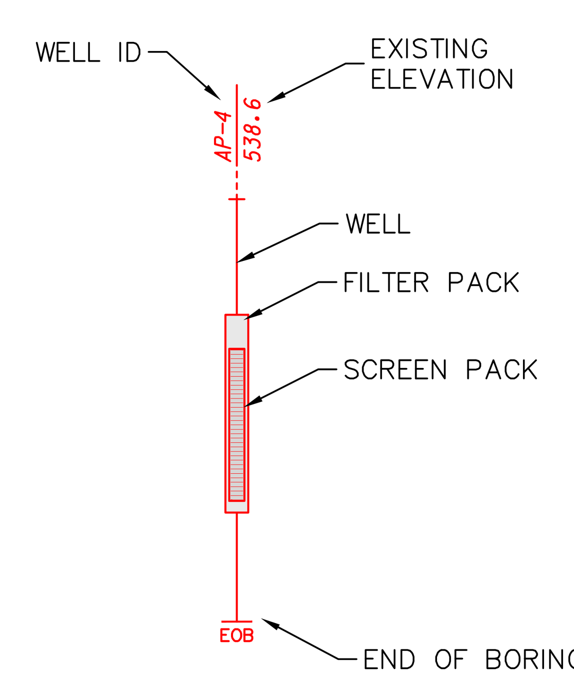
PREPARED FOR
CITY WATER, LIGHT, AND POWER
SPRINGFIELD, SANGAMON COUNTY, ILLINOIS

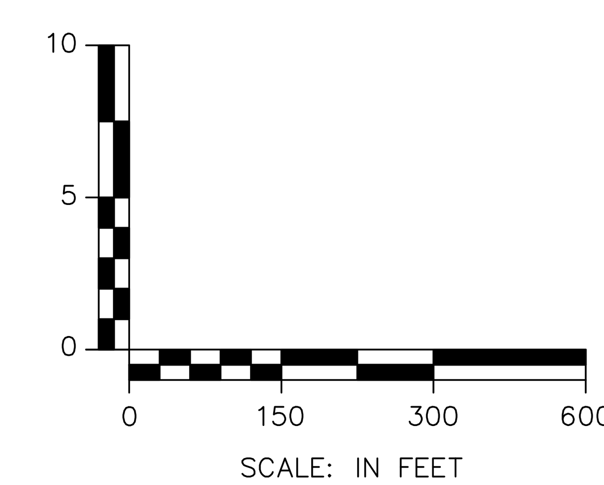
DATE: APRIL 2021
PROJECT ID: 200387/0003
SHEET NUMBER: A-A'



LEGEND

- FILL
- UPPER COHESIVE DEPOSIT
- SHALLOW SAND
- LOWER COHESIVE DEPOSIT
- BASAL SAND
- SHALE





NOTES

1. DEPTH AND THICKNESS OF SUBSURFACE STRATA WERE GENERALIZED FROM AND INTERPOLATED BETWEEN BORINGS. INFORMATION ON ACTUAL SUBSURFACE CONDITIONS EXISTS ONLY AT THE LOCATION OF THE BORING. SEE BORING LOGS FOR DETAILED DESCRIPTION.
2. LIDAR DATA DERIVED FROM USGS WEBSITE (FLIGHT DATE: OCTOBER 15, 2018).

NO.	DATE	REVISION DESCRIPTION	BY

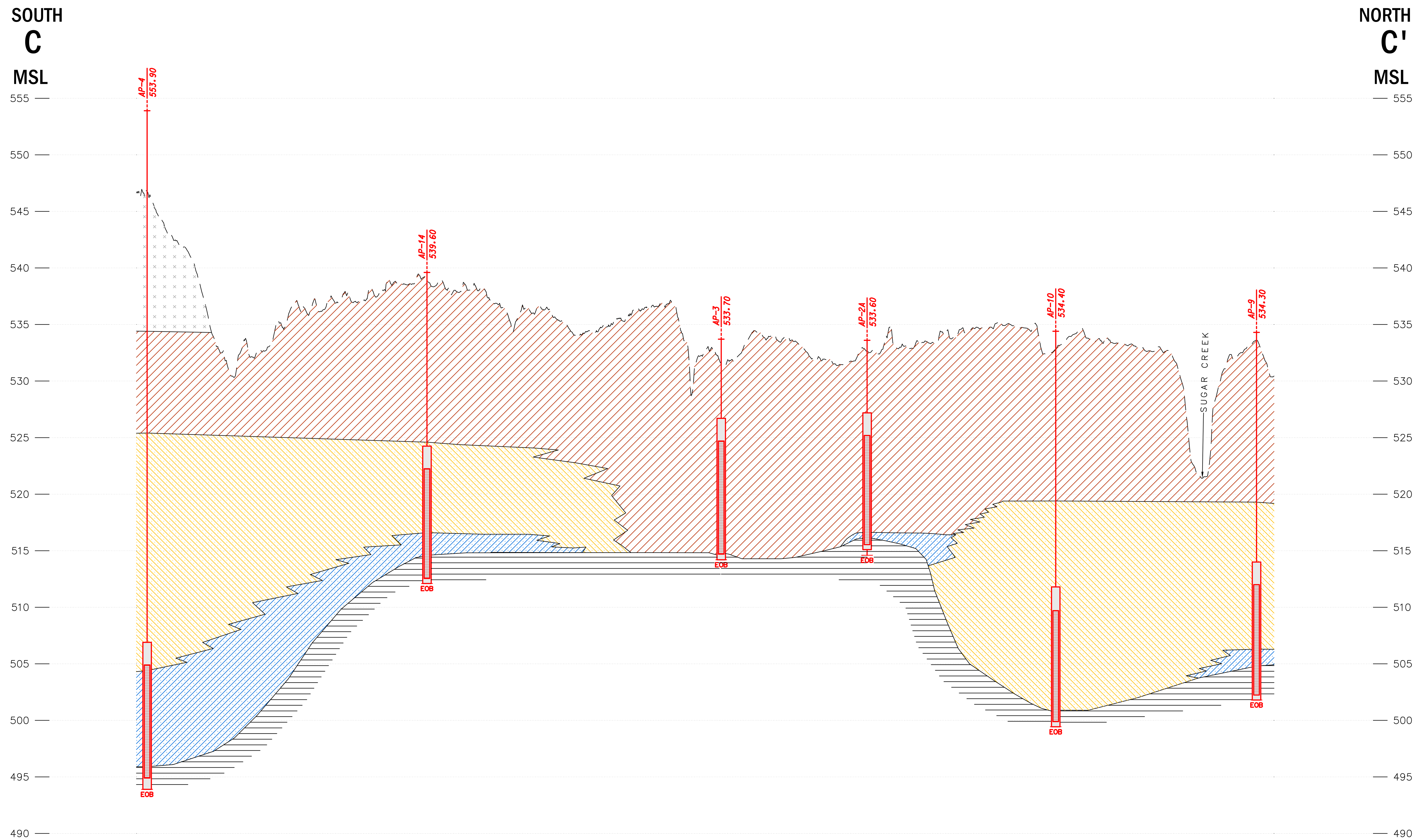
ANDREWS ENGINEERING
3300 GINGER CREEK DRIVE
SPRINGFIELD, ILLINOIS 62711-7233
PH (217) 787-2334 WWW.ANDREWS-ENG.COM
PONTIAC, IL • LOMBARD, IL • INDIANAPOLIS, IN • WARRENTON, MO

APPROVED BY: BJH DESIGNED BY: SWK DRAWN BY: MPN

GEOLOGIC CROSS-SECTION B-B'

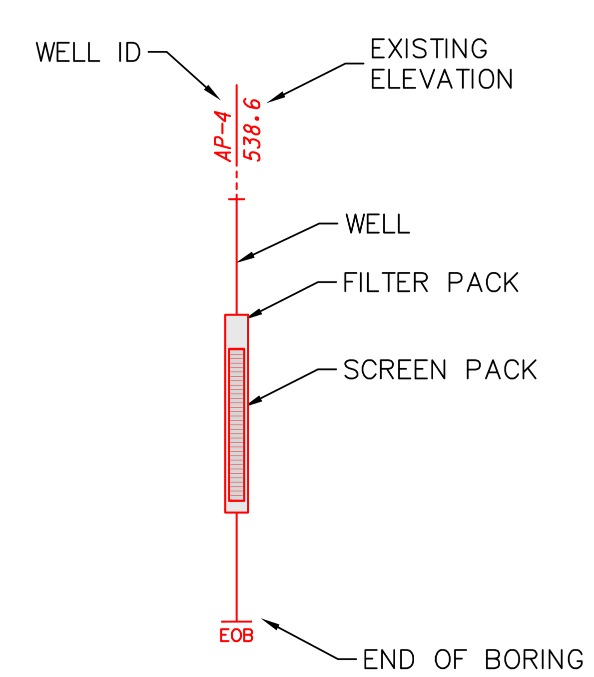
PREPARED FOR
CITY WATER, LIGHT, AND POWER
SPRINGFIELD, SANGAMON COUNTY, ILLINOIS

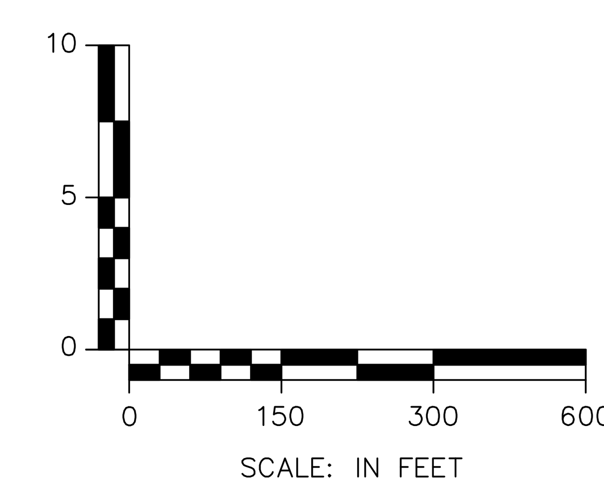
DATE: APRIL 2021
PROJECT ID: 200387/0003
SHEET NUMBER:
B-B'



LEGEND

- FILL
- UPPER COHESIVE DEPOSIT
- SHALLOW SAND
- LOWER COHESIVE DEPOSIT
- BASAL SAND
- SHALE





NOTES

1. DEPTH AND THICKNESS OF SUBSURFACE STRATA WERE GENERALIZED FROM AND INTERPOLATED BETWEEN BORINGS. INFORMATION ON ACTUAL SUBSURFACE CONDITIONS EXISTS ONLY AT THE LOCATION OF THE BORING. SEE BORING LOGS FOR DETAILED DESCRIPTION.
2. LIDAR DATA DERIVED FROM USGS WEBSITE (FLIGHT DATE: OCTOBER 15, 2018).

NO. | DATE | REVISION DESCRIPTION | BY

ANDREWS ENGINEERING
3300 GINGER CREEK DRIVE
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APPROVED BY: BJH DESIGNED BY: SWK DRAWN BY: BCK

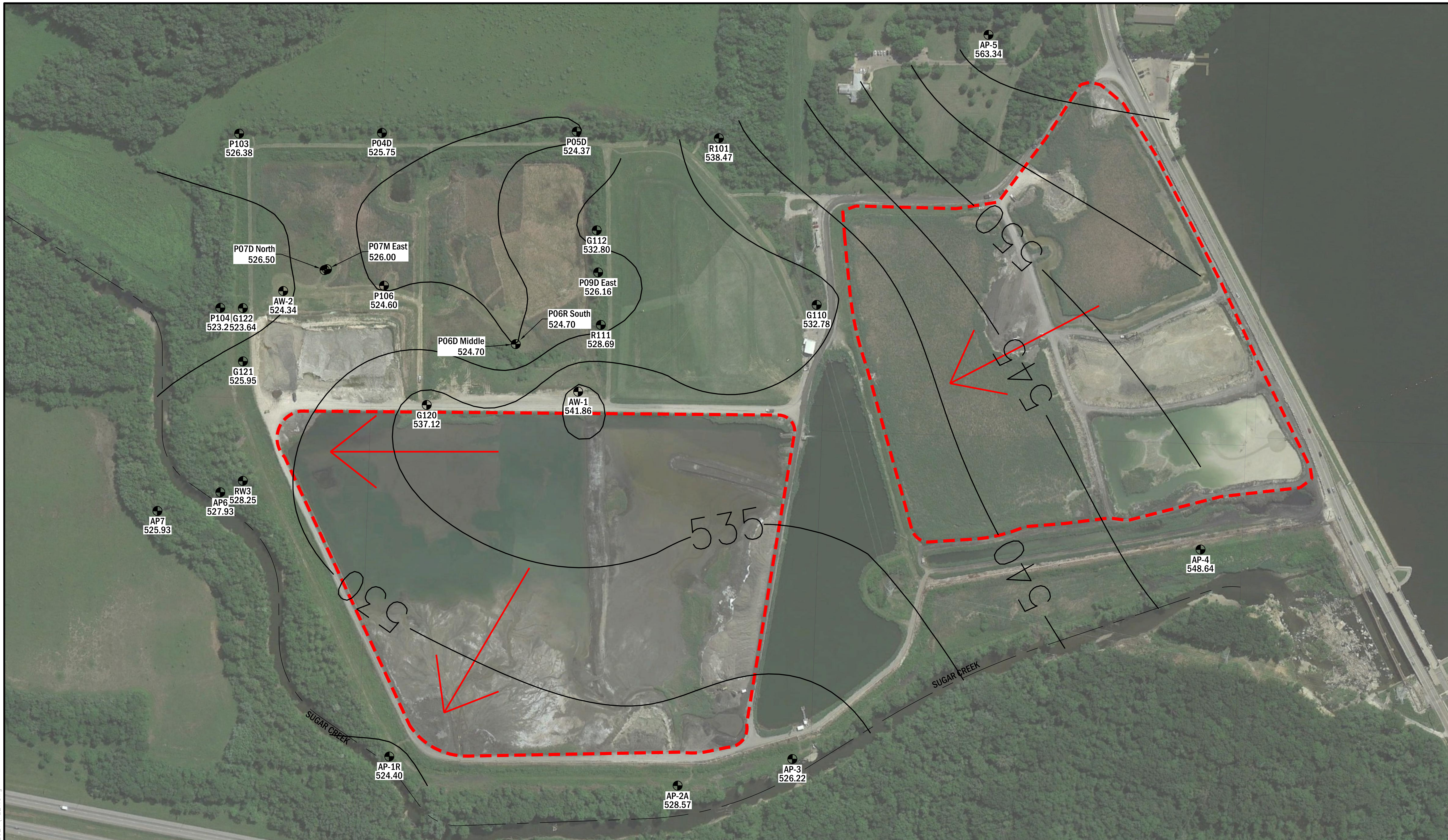
GEOLOGIC CROSS-SECTION C-C'

PREPARED FOR
CITY WATER, LIGHT, AND POWER
SPRINGFIELD, SANGAMON COUNTY, ILLINOIS

DATE: OCTOBER 2021
PROJECT ID: 200387/0003
SHEET NUMBER: C-C'

APPENDIX C

POTENTIOMETRIC SURFACE MAPS



LEGEND

- MONITORING WELL LOCATION
- CCR SURFACE IMPOUNDMENT
- GROUNDWATER FLOW DIRECTION

NOTES

1. SAMPLING DATE: 1/22/2021
2. CONTOUR INTERVAL = 5 FEET
3. IMAGE SOURCE: GOOGLE EARTH PRO, IMAGE DATE MAY 15, 2012
4. ELEVATIONS ARE BASED ON NORTH AMERICAN VERTICAL DATUM (1988).

N

0 150 300 600
SCALE: IN FEET

NO.	DATE	REVISION DESCRIPTION	BY

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SPRINGFIELD, ILLINOIS 62711-7233
PH (217) 787-2334 WWW.ANDREWS-ENG.COM
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APPROVED BY: BJH DESIGNED BY: MTH DRAWN BY: BCK

POTENTIOMETRIC SURFACE MAP
1ST QUARTER 2021

PLANS PREPARED FOR
CITY, WATER, LIGHT, AND POWER
SPRINGFIELD, SANGAMON COUNTY, ILLINOIS

DATE: OCTOBER 2021
PROJECT ID: 150077/0021
SHEET NUMBER:
1Q21

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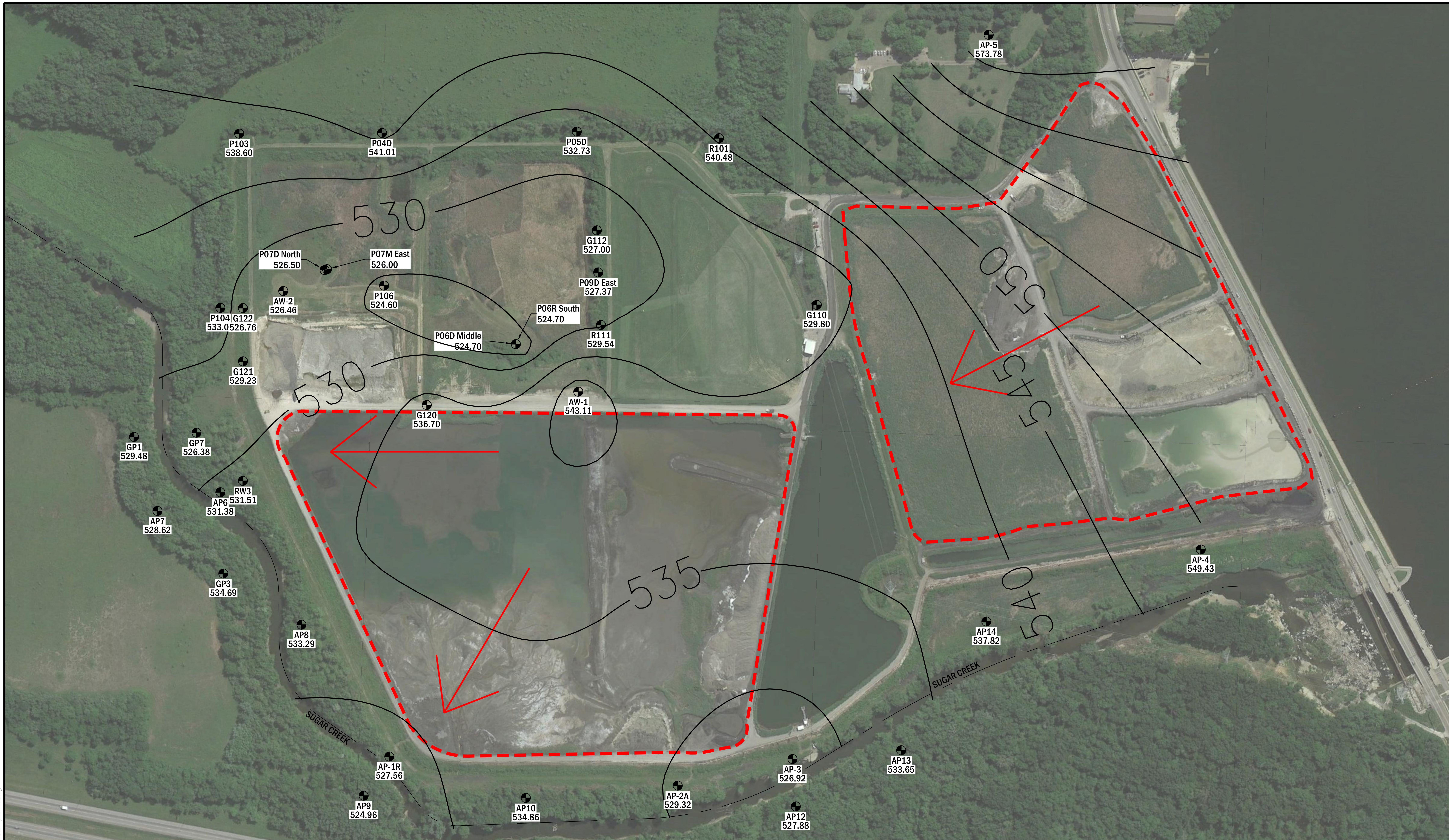

LEGEND

- MONITORING WELL LOCATION
- CCR SURFACE IMPOUNDMENT
- GROUNDWATER FLOW DIRECTION

NOTES

1. SAMPLING DATE: 5/27/2021
2. CONTOUR INTERVAL = 5 FEET
3. IMAGE SOURCE: GOOGLE EARTH PRO, IMAGE DATE MAY 15, 2012
4. ELEVATIONS ARE BASED ON NORTH AMERICAN VERTICAL DATUM (1988).

N

0 150 300 600

SCALE: IN FEET

NO.	DATE	REVISION DESCRIPTION	BY

ANDREWS ENGINEERING
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SPRINGFIELD, ILLINOIS 62711-7233
PH (217) 787-2334 WWW.ANDREWS-ENG.COM
PONTIAC, IL • LOMBARD, IL • INDIANAPOLIS, IN • WARRENTON, MO

APPROVED BY: BJH DESIGNED BY: BJH DRAWN BY: MTH DRAWN BY: BCK

POTENTIOMETRIC SURFACE MAP
2ND QUARTER 2021

PLANS PREPARED FOR
CITY, WATER, LIGHT, AND POWER
SPRINGFIELD, SANGAMON COUNTY, ILLINOIS

DATE: OCTOBER 2021

PROJECT ID: 150077/0021

SHEET NUMBER: 2Q21

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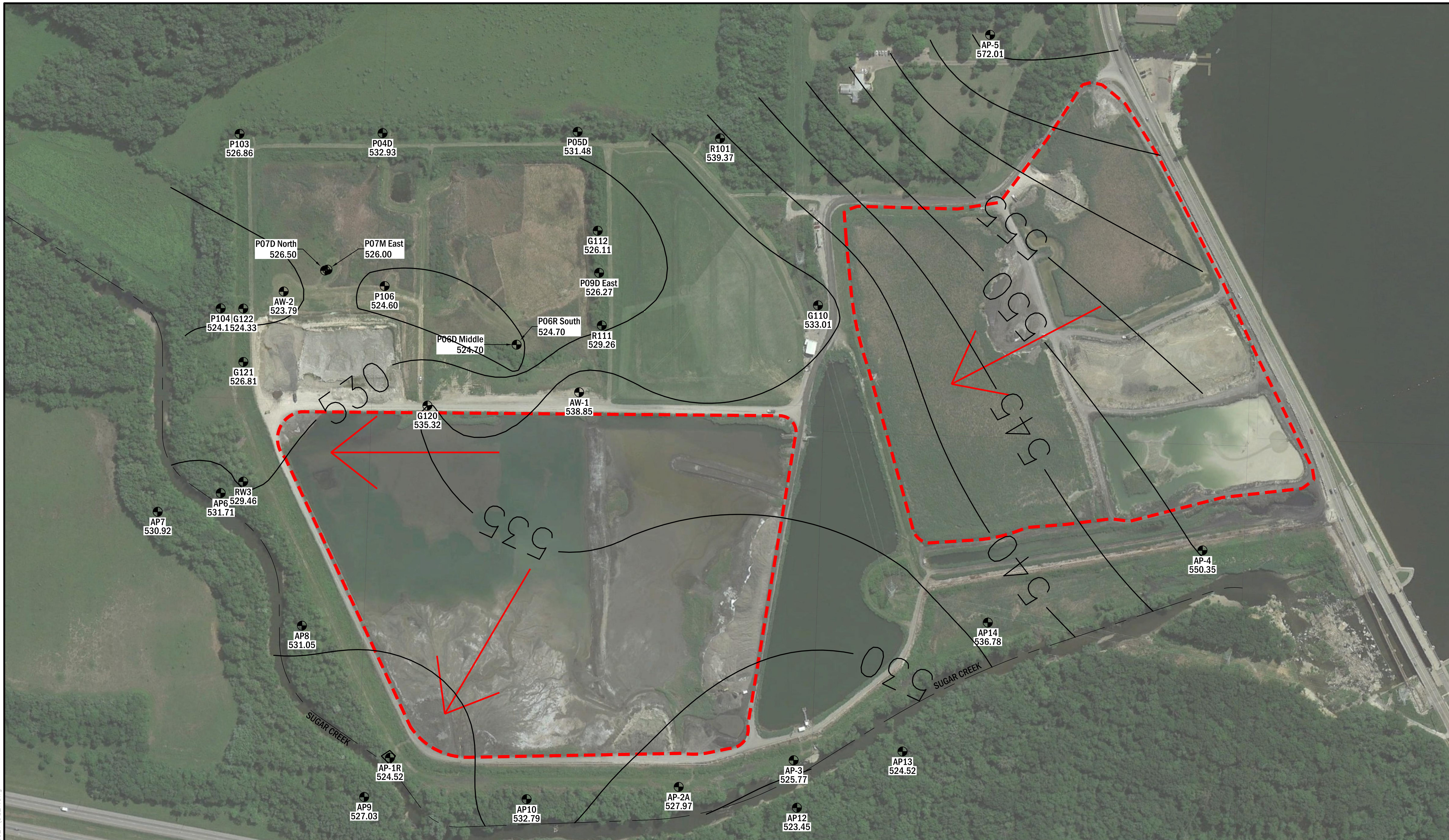

LEGEND

- MONITORING WELL LOCATION
- CCR SURFACE IMPOUNDMENT
- GROUNDWATER FLOW DIRECTION

NOTES

1. SAMPLING DATE: 8/25/2021
2. CONTOUR INTERVAL = 5 FEET
3. IMAGE SOURCE: GOOGLE EARTH PRO, IMAGE DATE MAY 15, 2012
4. ELEVATIONS ARE BASED ON NORTH AMERICAN VERTICAL DATUM (1988).

N

0 150 300 600
SCALE: IN FEET

NO.	DATE	REVISION DESCRIPTION	BY

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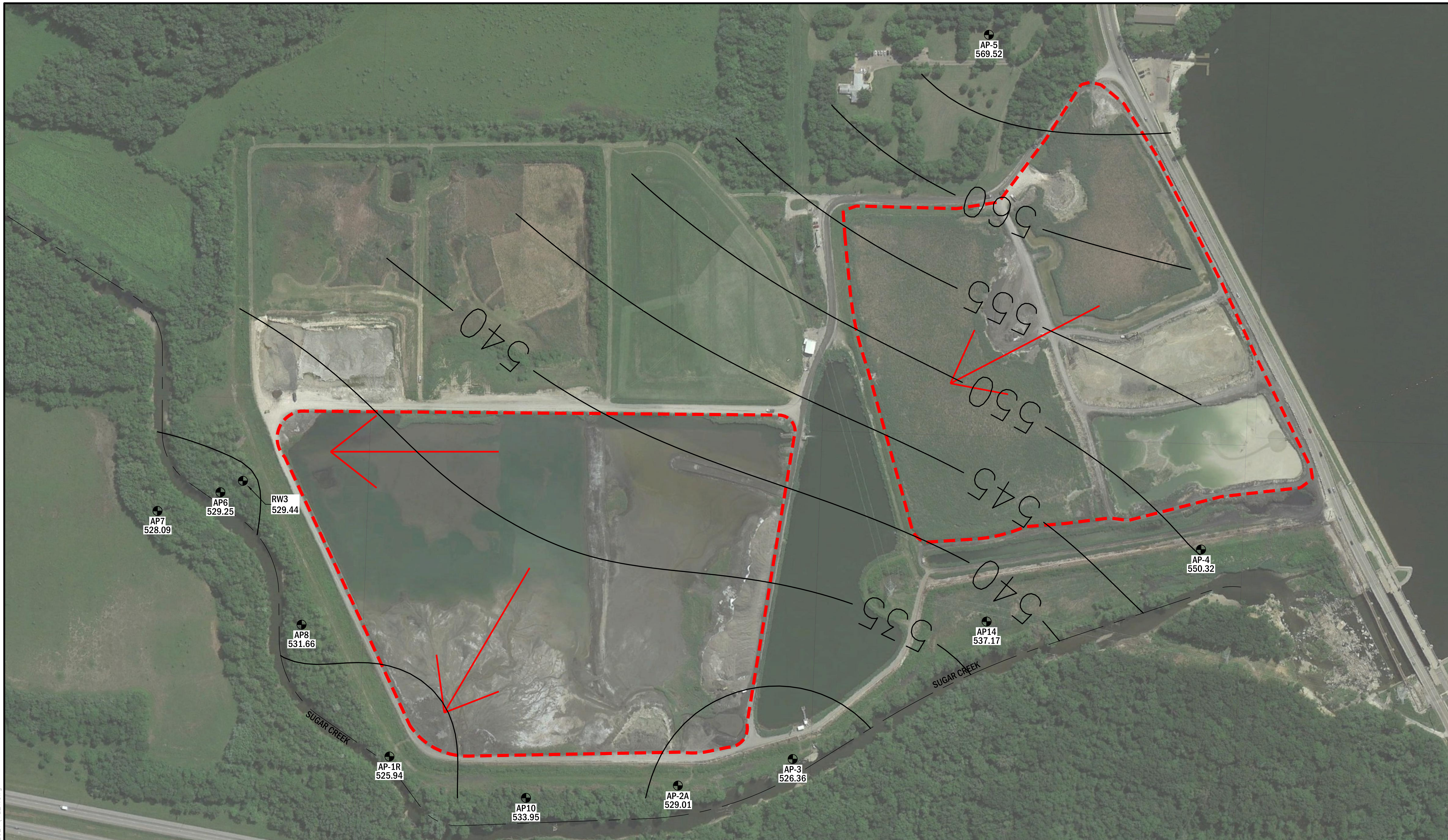
APPROVED BY: BJH DESIGNED BY: MTH DRAWN BY: BCK

POTENTIOMETRIC SURFACE MAP
3RD QUARTER 2021

PLANS PREPARED FOR
CITY, WATER, LIGHT, AND POWER
SPRINGFIELD, SANGAMON COUNTY, ILLINOIS

DATE: OCTOBER 2021
PROJECT ID: 150077/0021
SHEET NUMBER:
3Q21



LEGEND

- MONITORING WELL LOCATION
- CCR SURFACE IMPOUNDMENT
- GROUNDWATER FLOW DIRECTION

NOTES

1. SAMPLING DATE: 10/21/2021
2. CONTOUR INTERVAL = 5 FEET
3. IMAGE SOURCE: GOOGLE EARTH PRO, IMAGE DATE MAY 15, 2012
4. ELEVATIONS ARE BASED ON NORTH AMERICAN VERTICAL DATUM (1988).

N

0 150 300 600
SCALE: IN FEET

NO.	DATE	REVISION DESCRIPTION	BY

ANDREWS ENGINEERING
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APPROVED BY: BJH DESIGNED BY: MTH DRAWN BY: BCK

POTENTIOMETRIC SURFACE MAP
4TH QUARTER 2021

PLANS PREPARED FOR
CITY, WATER, LIGHT, AND POWER
SPRINGFIELD, SANGAMON COUNTY, ILLINOIS

DATE: OCTOBER 2021
PROJECT ID: 150077/0021
SHEET NUMBER: 4Q21

APPENDIX D

POTABLE WATER WELL QUERY

CITY WATER, LIGHT AND POWER

POTABLE WATER WELL SURVEY - CCR SURFACE IMPOUNDMENTS

A potable water well survey was completed in the vicinity of the Dallman and Lakeside Ash Ponds. Based on groundwater elevation data from numerous monitoring wells and piezometers located between and adjacent to the CWLP CCR impoundments, groundwater movement in the vicinity of the CCR impoundments is generally from the south-southwest to the north-northeast, approximately paralleling the Sugar Creek basin. The search extended to the first water well encountered hydraulically downgradient of the impoundments, located near Illinois Route 29 at a distance of approximately 3,400 feet.

The survey was conducted using the Illinois EPA's web-based Geographic Information System (GIS) database[1] in the Source Water Assessment Program (SWAP) for potable water wells downgradient of the CCR impoundments.

The Illinois EPA's SWAP GIS database system identifies community water supply wells and other potable wells (private, semi-private and non-community water supply wells) include data from the following sources:

- Illinois EPA, Division of Public Water Supplies;
- Illinois State Geological Survey (ISGS);
- Illinois State Water Survey; and
- Illinois Department of Public Health.

Based upon this potable water well search, no private, semi-private and non-community water supply wells are located within 2,500 feet downgradient of the CCR impoundments. This search distance is based upon the maximum allowable setback zone for a potable water well as identified in Section 14.3(f) of the Illinois Environmental Protection Act. Included are screen-captures of the Illinois EPA's SWAP GIS database system well query for the subject CCR impoundments and ISGS well records for the wells identified. The screen captures depict the two closest well locations. These wells are discussed below.

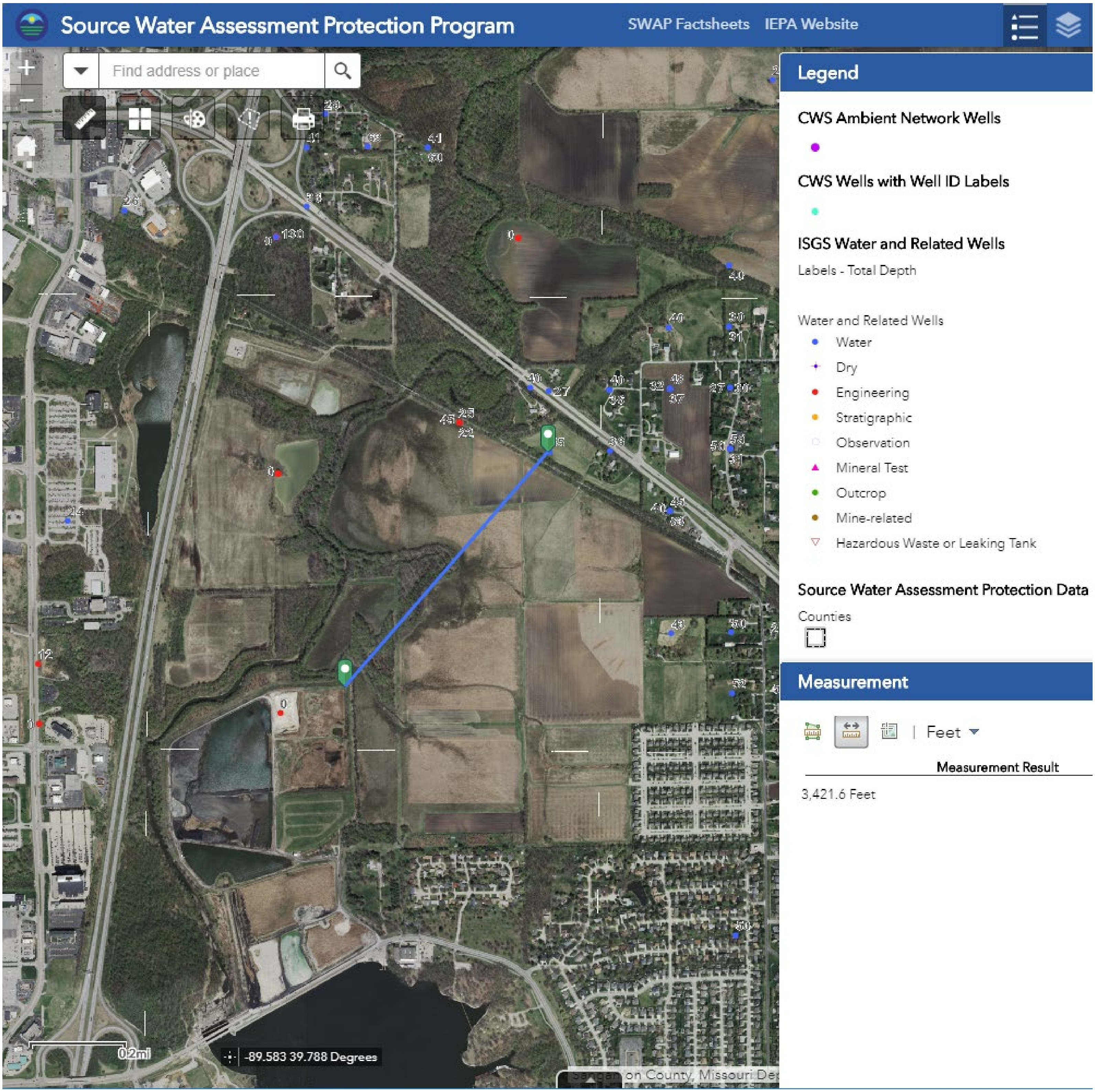
Within the Sugar Creek basin, the nearest downgradient potable water well is located approximately 3,400 feet north-northeast of the CWLP CCR impoundments. The owner of this well at the time of installation, as identified on the ISGS well record, was William Bartels (API 121672620900). Installed September 25, 2001, this well is 55 feet deep and screened within material described as "shale fracture/clay." The Sangamon County Tax Parcel Viewer & Property Tax Web Site (http://gismaps.co.sangamon.il.us/tpv/) identifies this well as being located on improved commercial property.

The other potable water well is located a little more than 2,500 feet north-northwest of the CCR impoundments (API 121670148100). The well was installed December 1, 1965, is 24 feet deep, and screened within material described as "hardpan." A review of the Sangamon County Tax Parcel Viewer & Property Tax Web Site identified the current property owner as the State of Illinois Department of Transportation. While this well is located north of the CCR impoundments, it appears to be just west and outside of the Sugar Creek basin, and as such most likely not hydraulically downgradient of the CCR impoundments.

There is no reason to believe that potable wells exist within 2,500 feet hydraulically downgradient of the CCR impoundments that were not identified as part of this potable water well survey.

[1] (http://illinois-epa.maps.arcgis.com/apps/webappviewer/index.html?id=4d37a05f5ba441f1b30dab54ccb81fc8)

Illinois EPA SWAP GIS Database Query
CWLP – Springfield, Illinois
William Bartels - API 121672620900



ILLINOIS STATE GEOLOGICAL SURVEY

Private Water Well	Top	Bottom
black topsoil	0	5
gray silt	5	11
brown clay (H2o @ 18'-22')	11	22
brown till	22	25
soft gray shale	25	32
hard gray shale fracture @ 43'	32	55
Total Depth		**55**

Casing: 6" PVC SDR 21 from -1' to 18'
36" CONCRETE from 18' to 55'

Grout: HOLE PLUG from 16 to 17.

Grout: BUCKSHOT from 17 to 55.

Water from shale fracture/clay at 18' to 43'.

Owner Address: 3596 East State Rt. 29 Springfield, IL

Address of well: Rt. 29
Springfield, IL

Location source: Location from permit

Permit Date: August 13, 2001 **Permit #:**

COMPANY Wiesenhofer, Andrew

FARM Bartels, William

DATE DRILLED September 25, 2001 **NO.**

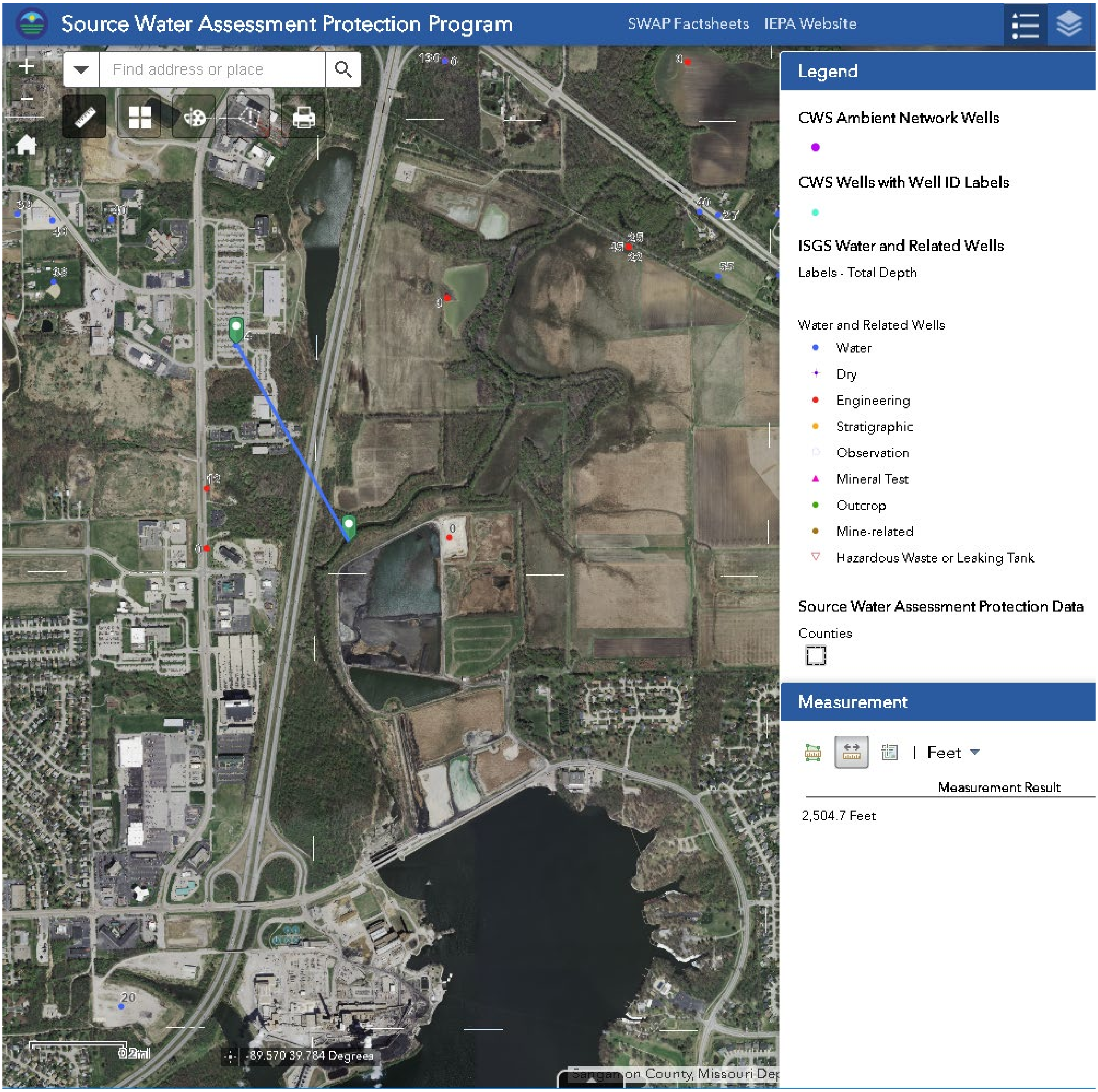
ELEVATION 0 **COUNTY NO.** 26209

LOCATION SW NE SW

LATITUDE 39.777352 **LONGITUDE** -89.587243

COUNTY Sangamon **API** 121672620900 **6 - 15N - 4W**

Illinois EPA SWAP GIS Database Query
CWLP – Springfield, Illinois
IDOT - API 121670148100



ILLINOIS STATE GEOLOGICAL SURVEY

Water Well	Top	Bottom
s.s. #52306	0	0
top soil	0	3
yellow clay	3	18
brown clay	18	19
hardpan	19	24
Total Depth		**24**

Casing: 36" CONCRETE from 0' to 20'

Water from hardpan at 19' to 24'.
Static level 10' below casing top which is 0' above GL
Pumping level 0' when pumping at 20 gpm for 0 hours

Driller's Log filed
Sample set # 52306 (1' - 24')

Owner Address: ,
Location source: Location from the driller

Permit Date: **Permit #:**

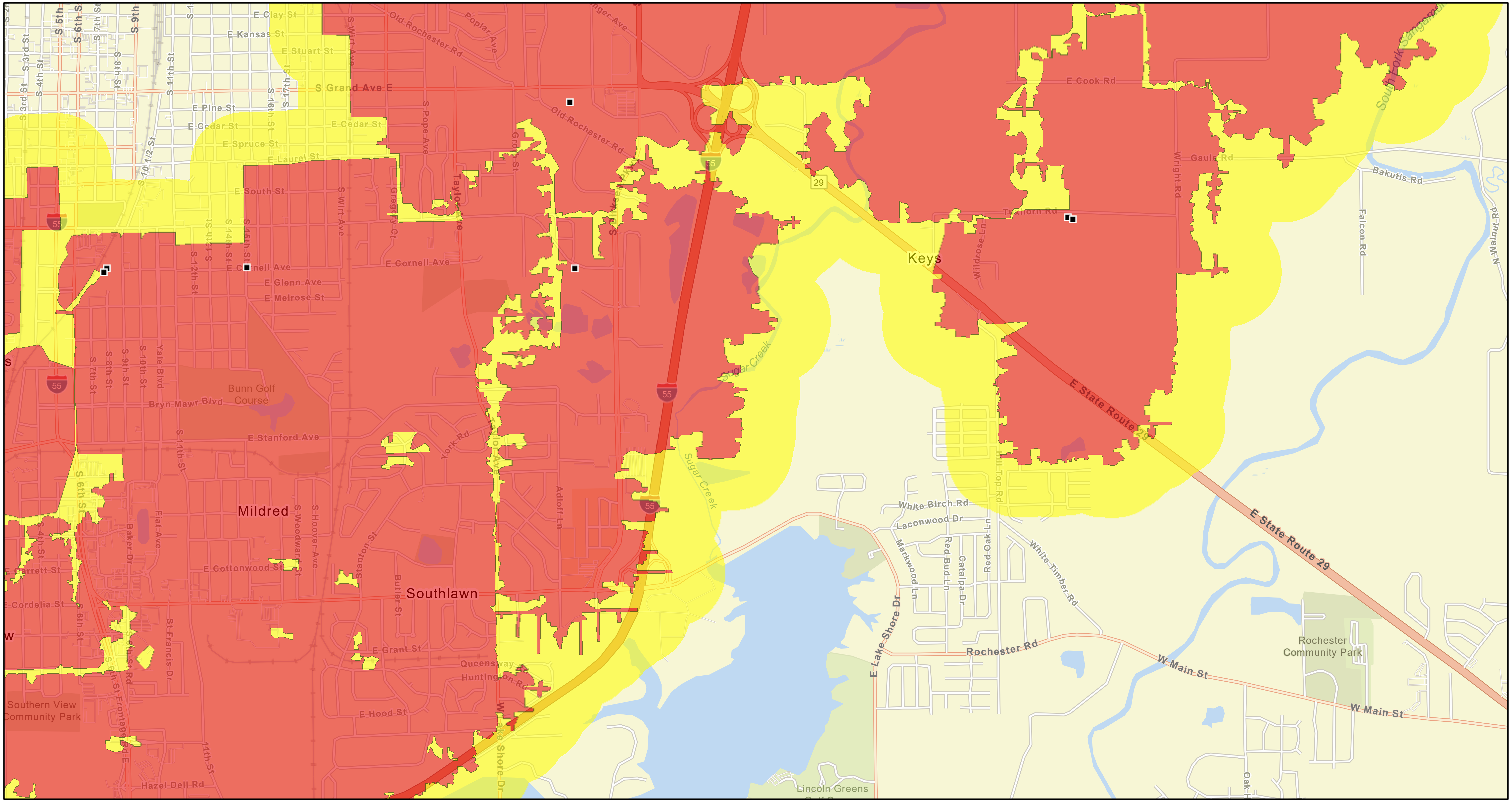
COMPANY owner
FARM Fiskas, Raymond L.
DATE DRILLED January 1, 1965 **NO.** 1
ELEVATION 0 **COUNTY NO.** 01481
LOCATION 430'N line, 320'E line of NW SE SW
LATITUDE 39.775264 **LONGITUDE** -89.606181
COUNTY **Sangamon** **API** **121670148100** **1 - 15N - 5W**

APPENDIX E

UNDERGROUND MINES QUERY

Illinois State Geological Survey -- ILMINES

PDF 0534



10/11/2021, 2:48:19 PM

Underground Mine Buffer Region

Indefinite Underground Mine Boundary

Non Coal Mines

Surface

Underground Coal Mines

Non Coal Mine Shaft

Underground

1:31,640

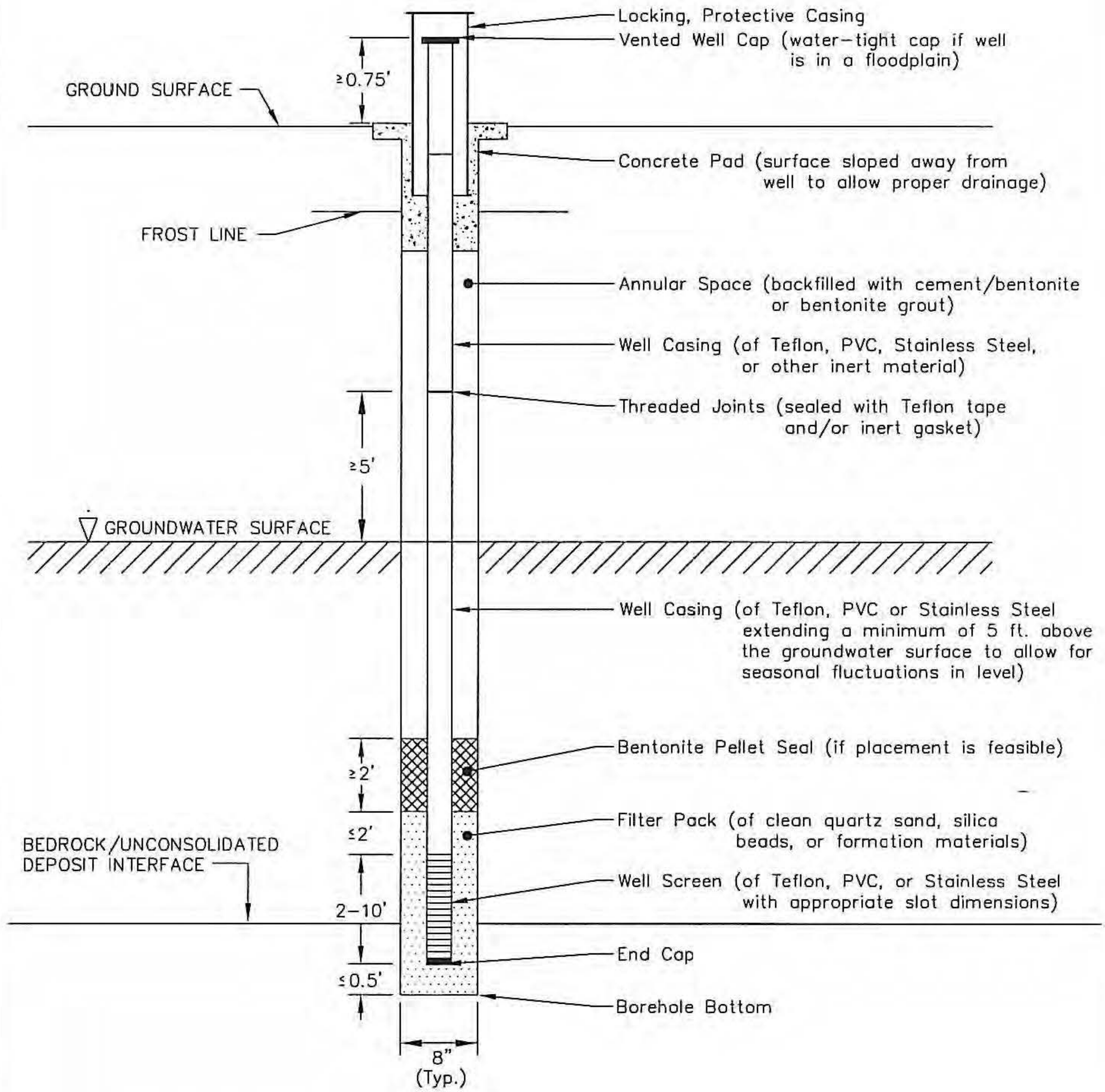
0 1,500 3,000 6,000 ft

0 490 980 1,960 m

Missouri Dept. of Conservation, Missouri DNR, Esri, HERE, Garmin, SafeGraph, INCREMENT P, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, PRI - ISGS

APPENDIX F

WELL CONSTRUCTION DETAIL



NOTE: Detail after 77 IAC 920.170 and I.E.P.A. Administrative Procedure #11

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APPROVED BY:	MTH	DESIGNED BY:	MTH	DRAWN BY:	MPN

GROUNDWATER MONITORING WELL DETAIL

PLANS PREPARED FOR
CWLP
SPRINGFIELD, SANGAMON COUNTY, ILLINOIS

DATE:	NOVEMBER 2011
PROJECT ID:	2011-127
FILE:	GMW DETAIL.DWG
SHEET NUMBER:	1

APPENDIX G

STATISTICAL METHOD FOR DETERMINATION OF BACKGROUNDS

Statistical Analyses Method

1.0 References

1. 35 Illinois Administrative Code 811.320
2. "Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Final Guidance." Office of Solid Waste, USEPA, April 1989.
3. "Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Addendum to Interim Final Guidance." Office of Solid Waste, USEPA, July 1992.

2.0 Statistical Method

The statistical method for determination of an interwell background concentration includes the calculation of the 95% upper confidence limit (95% CL) for each parameter utilizing at least four consecutive quarters of data. Calculation of an intrawell background concentration requires calculation of the 99% upper confidence limit (99% CL). Prior to the calculation of the upper confidence limit, the data set is evaluated for normality, outliers and the percentage of non-detect values. Each of the steps for determining the upper confidence limit is outlined below in Sections 2.1 through 2.4.

2.1 Normality Testing

The distribution of the data is tested for normality using the Shapiro-Wilk normality test. If the data is not found to follow a normal distribution, a nonparametric statistical method shall be utilized. Generally, the highest detected concentration is utilized as the upper confidence limit if the data set is found to be nonparametric. If the data is found to follow a normal distribution, the procedures outlined below are used to determine the upper confidence limit.

2.2 Handling of Outliers

Prior to statistical analyses, the data set is evaluated for outliers. Outliers are defined as data points that vary significantly from the mean value of the data set. Outliers may represent sampling error, contamination from surface run-off, analytical laboratory error, or anomalous site conditions. Outliers, if not removed from the data set, can erroneously increase the background concentration which makes the background concentration less likely to detect an exceedences related to a release from a waste unit. Once a statistical outlier has been identified, the concentrations shall be evaluated to determine the cause. If the outlier is determined to be a result of sampling, laboratory or some other error, the outlier will be removed from the data set. If no specific reason can be documented the point will be considered representative of site conditions and will be included in the statistical analysis. Statistical analysis will then be conducted as described below.

2.3 Handling of Non-Detects (NDs)

Non-detect values (NDs) are handled according to the percentage of Non-Detects (%ND) present in the data set. The data treatment is completed according to the following criteria:

a) For under 0% NDs, no adjustment is made to the values in the data set.
b) For under 15% NDs, the value of one-half (½) the reported Detection Limit (DL) is substituted for the ND value, and the mean and standard deviation are calculated using detected values with the substituted ND values.
c) For 15-50% NDs, Cohen's Adjustment is used to adjust the mean and standard deviation. The adjusted mean and standard deviation are then used to calculate the Confidence Limit.
d) For over 50% but not 100% NDs, the highest recorded concentration is substituted for the prediction limit.
e) For 100% NDs, the Practical Quantitation Limit (PQL) will be substituted for the ND value. The mean and standard deviation will be calculated using the substituted ND values.

2.4 Calculation of the Confidence Limit

After any outliers are removed and the data has been treated for non-detect values, the statistical procedure for calculation of the Confidence Limit will be conducted according to the following steps:

a) Calculate arithmetic mean

The arithmetic mean is calculated using the pooled data for each parameter. The arithmetic mean (X_b) is calculated using the following equation:

$$X_b = \frac{X_1 + X_2 + \ldots + X_n}{n}$$

where: X_b = Average background value

X_n = Individual background value for *n* sample

n = Number of background values

b) Calculate standard deviation

The standard deviation is calculated using the pooled data for each parameter. The standard deviation is calculated using the following equation:

$$S_b = \sqrt{\frac{(X_1 - X_b) + (X_2 - X_b) + \ldots + (X_n - X_b)}{n - 1}}$$

where: S_b = Population standard deviation
X_n = Individual background value for *n* sample
X_b = Mean (1)
n = Number of background samples

c) Calculate the 95% Upper Confidence Limit

The 95% Upper Confidence Limit is calculated for each parameter using the mean (1), the standard deviation (2), the number of background samples, and the Student's t value given for σ = 0.05 (95% Confidence). The Student's t value varies upon the number of background samples. The 95% Upper Confidence Limit is calculated using the following equation:

$$CL = X_b \pm S_b \bullet t \bullet \sqrt{1 + \frac{1}{n}}$$

where: CL = Upper Confidence Limit (Upper and Lower for pH)
X_b = Mean (1)
S_b = Standard Deviation (2)
t = Student's t value at 0.05 significance (95% Confidence)
n = Number of background samples

APPENDIX H

EXISTING GROUNDWATER QUALITY

TABLE 2
CITY WATER, LIGHT AND POWER
EXISTING GROUNDWATER QUALITY

Well	Parameter	Units	35 IAC 845.600	Background AP-4 & AP-5	GWPS	4/25/2012	8/23/2012	11/28/2012	2/21/2013	5/22/2013	8/28/2013	11/20/2013	2/26/2014	5/20/2014	8/26/2014	11/21/2014
AP-1	Boron, total	mg/l	2	0.787	2	10.4	15.2	4.3	3.9	7.76	14.7	18.9	< 2	17.2	18	17.9
AP-2	Boron, total	mg/l	2	0.787	2	5.51	6.88	6.24	10	5.01	5.46	4.78	4.1	4.36	4.84	4.87
AP-3	Boron, total	mg/l	2	0.787	2	18.4	20.9	8.03	29.1	18.7	21.3	20.6	19.3	19.3	19.2	19.5
AP-4	Boron, total	mg/l	2	0.787	2	0.123	0.787	< 2	< 0.687	0.75	0.665	< 2	< 2	0.0899	0.106	0.103
AP-5	Boron, total	mg/l	2	0.787	2	< 0.625	0.782	< 3.2	< 0.687	0.22	0.0954	< 2	< 2	< 0.0625	0.0936	0.0546
AP-6	Boron, total	mg/l	2	0.787	2											
AP-7	Boron, total	mg/l	2	0.787	2											
AW-3/RW-3	Boron, total	mg/l	2	0.787	2	0.162	0.689	< 2	0.706	0.22	0.187	< 2	< 2	0.166	0.144	0.156
AP-8	Boron, total	mg/l	2	0.787	2											
AP-9	Boron, total	mg/l	2	0.787	2											
AP-10	Boron, total	mg/l	2	0.787	2											
AP-11	Boron, total	mg/l	2	0.787	2											
AP-12	Boron, total	mg/l	2	0.787	2											
AP-13	Boron, total	mg/l	2	0.787	2											
AP-14	Boron, total	mg/l	2	0.787	2											
AP-1	Calcium, total	mg/l	na	176.63	176.63											
AP-2	Calcium, total	mg/l	na	176.63	176.63											
AP-3	Calcium, total	mg/l	na	176.63	176.63											
AP-4	Calcium, total	mg/l	na	176.63	176.63											
AP-5	Calcium, total	mg/l	na	176.63	176.63											
AP-6	Calcium, total	mg/l	na	176.63	176.63											
AP-7	Calcium, total	mg/l	na	176.63	176.63											
AW-3/RW-3	Calcium, total	mg/l	na	176.63	176.63											
AP-8	Calcium, total	mg/l	na	176.63	176.63											
AP-9	Calcium, total	mg/l	na	176.63	176.63											
AP-10	Calcium, total	mg/l	na	176.63	176.63											
AP-11	Calcium, total	mg/l	na	176.63	176.63											
AP-12	Calcium, total	mg/l	na	176.63	176.63											
AP-13	Calcium, total	mg/l	na	176.63	176.63											
AP-14	Calcium, total	mg/l	na	176.63	176.63											
AP-1	Chloride, total	mg/l	200	24.2	200	38.2	39.3	40.3	43.6	44.8	45.9	44.7	43.1	45.3	46.5	47.7
AP-2	Chloride, total	mg/l	200	24.2	200	13	19.9	22.8	25.2	19.8	18.9	34.8	22	24.7	24.1	23.4
AP-3	Chloride, total	mg/l	200	24.2	200	46.2	47.7	54.6	55.6	47.5	43.4	46.8	47.7	41.6	43.3	39.1
AP-4	Chloride, total	mg/l	200	24.2	200	9.85	11	10.5	10.8	11	10.7	10.9	10.6	11.2	11.3	11
AP-5	Chloride, total	mg/l	200	24.2	200	7.23	3.32	3.76	3.71	2.61	1.95	2.07	2.83	3.29	4.2	4.03
AP-6	Chloride, total	mg/l	200	24.2	200											
AP-7	Chloride, total	mg/l	200	24.2	200											
AW-3/RW-3	Chloride, total	mg/l	200	24.2	200	23	23.7	23.5	26.2	28.9	27.8	27	23.3	25.1	23.3	24.2
AP-8	Chloride, total	mg/l	200	24.2	200											
AP-9	Chloride, total	mg/l	200	24.2	200											
AP-10	Chloride, total	mg/l	200	24.2	200											
AP-11	Chloride, total	mg/l	200	24.2	200											
AP-12	Chloride, total	mg/l	200	24.2	200											
AP-13	Chloride, total	mg/l	200	24.2	200											
AP-14	Chloride, total	mg/l	200	24.2	200											
AP-1	Fluoride, total	mg/l	4	0.62	4	< 0.5	< 0.5	< 0.5	0.17	0.26	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
AP-2	Fluoride, total	mg/l	4	0.62	4	< 0.5	< 0.5	< 0.5	< 0.5	0.43	0.523	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
AP-3	Fluoride, total	mg/l	4	0.62	4	< 0.5	< 0.5	< 0.5	< 0.5	0.32	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
AP-4	Fluoride, total	mg/l	4	0.62	4	< 0.5	< 0.5	< 0.5	< 0.5	0.2	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
AP-5	Fluoride, total	mg/l	4	0.62	4	< 0.5	< 0.5	< 0.5	< 0.5	0.43	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
AP-6	Fluoride, total	mg/l	4	0.62	4											
AP-7	Fluoride, total	mg/l	4	0.62	4											
AW-3/RW-3	Fluoride, total	mg/l	4	0.62	4	0.43	< 0.5	< 0.5	< 0.5	0.42	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
AP-8	Fluoride, total	mg/l	4	0.62	4											
AP-10	Fluoride, total	mg/l	4	0.62	4											
AP-14	Fluoride, total	mg/l	4	0.62	4											
AP-1	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0	7.10		7.23	7.41	6.95	7.13	6.92	7.03	7.03	6.92	7.15
AP-2	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0	7.65	7	7.58	7.8	6.83	9.94	6.76	6.93	6.99	6.87	7.03
AP-3	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0	7.31	6.88	7.35	7.4	7.07	6.98	6.88	6.25	7.09	7.03	6.63
AP-4	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0	7.07	7.63	7.09	7.04	7.23	7.04	7.1	7.31	7.31	7.1	7.14
AP-5	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0	7.19		7.29	7.23	7.46	7.15	7.32	7.48	7.53	7.31	7.31
AP-6	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0											

TABLE 2
CITY WATER, LIGHT AND POWER
EXISTING GROUNDWATER QUALITY

Well	Parameter	Units	35 IAC 845.600	Background AP-4 & AP-5	GWPS	4/25/2012	8/23/2012	11/28/2012	2/21/2013	5/22/2013	8/28/2013	11/20/2013	2/26/2014	5/20/2014	8/26/2014	11/21/2014
AP-7	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0											
AW-3/RW-3	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0	7.15		7.05	7.68	7.63	7.3	7.31	7.48	7.71	7.18	7.35
AP-8	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0											
AP-9	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0											
AP-10	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0											
AP-11	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0											
AP-12	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0											
AP-13	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0											
AP-14	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0											
AP-1	Sulfate, total	mg/l	400	84.5	400	463	469	488	506	603	597	581	436	615	594	619
AP-2	Sulfate, total	mg/l	400	84.5	400	201	250	293	283	240	280	< 5	252	289	364	463
AP-3	Sulfate, total	mg/l	400	84.5	400	274	315	318	292	347	353	338	298	343	356	362
AP-4	Sulfate, total	mg/l	400	84.5	400	< 5	< 5	< 5	< 5	0.3	< 5	< 5	< 5	< 5	< 5	< 5
AP-5	Sulfate, total	mg/l	400	84.5	400	43.5	76.8	84.5	83.4	55.3	66.8	59.5	63.1	62.5	56.2	68.7
AP-6	Sulfate, total	mg/l	400	84.5	400											
AP-7	Sulfate, total	mg/l	400	84.5	400											
AW-3/RW-3	Sulfate, total	mg/l	400	84.5	400	10.9	5.99	< 5	< 5	40.8	25.8	15	13.7	8.25	11	8.7
AP-8	Sulfate, total	mg/l	400	84.5	400											
AP-9	Sulfate, total	mg/l	400	84.5	400											
AP-10	Sulfate, total	mg/l	400	84.5	400											
AP-11	Sulfate, total	mg/l	400	84.5	400											
AP-12	Sulfate, total	mg/l	400	84.5	400											
AP-13	Sulfate, total	mg/l	400	84.5	400											
AP-14	Sulfate, total	mg/l	400	84.5	400											
AP-1	Total Dissolved Solids	mg/l	1200	597.94	1200	1020	788	1160	1120	1390	1380	1250	1100	1360	1300	1490
AP-2	Total Dissolved Solids	mg/l	1200	597.94	1200	866	836	1100	932	950	1000	748	870	946	1000	1080
AP-3	Total Dissolved Solids	mg/l	1200	597.94	1200	926	1000	928	624	1040	992	870	812	872	880	974
AP-4	Total Dissolved Solids	mg/l	1200	597.94	1200	560	448	574	460	578	548	316	442	510	554	492
AP-5	Total Dissolved Solids	mg/l	1200	597.94	1200	404	316	404	370	410	428	384	358	544	390	446
AP-6	Total Dissolved Solids	mg/l	1200	597.94	1200											
AP-7	Total Dissolved Solids	mg/l	1200	597.94	1200											
AW-3/RW-3	Total Dissolved Solids	mg/l	1200	597.94	1200	470	422	570	724	436	652	408	406	450	454	468
AP-8	Total Dissolved Solids	mg/l	1200	597.94	1200											
AP-9	Total Dissolved Solids	mg/l	1200	597.94	1200											
AP-10	Total Dissolved Solids	mg/l	1200	597.94	1200											
AP-11	Total Dissolved Solids	mg/l	1200	597.94	1200											
AP-12	Total Dissolved Solids	mg/l	1200	597.94	1200											
AP-13	Total Dissolved Solids	mg/l	1200	597.94	1200											
AP-14	Total Dissolved Solids	mg/l	1200	597.94	1200											
AP-1	Antimony, total	mg/l	0.006	0.016	0.016	< 0.006	0.0073	< 0.006	< 0.006	0.0118	< 0.006	< 0.006	< 0.006	< 0.0625	< 0.0312	< 0.0312
AP-2	Antimony, total	mg/l	0.006	0.016	0.016	< 0.006	< 0.006	< 0.006	< 0.006	0.026	0.006	< 0.006	< 0.006	< 0.0625	< 0.0312	< 0.0312
AP-3	Antimony, total	mg/l	0.006	0.016	0.016	< 0.006	< 0.006	< 0.006	0.00805	0.0161	< 0.006	< 0.006	< 0.006	< 0.0625	< 0.0312	< 0.0312
AP-4	Antimony, total	mg/l	0.006	0.016	0.016	< 0.006	< 0.006	< 0.006	< 0.006	0.0152	< 0.006	< 0.006	< 0.006	< 0.0625	< 0.0312	< 0.0312
AP-5	Antimony, total	mg/l	0.006	0.016	0.016	< 0.006	0.0063	< 0.0096	< 0.006	0.0160	< 0.006	< 0.006	< 0.006	< 0.0625	< 0.0312	< 0.0312
AP-6	Antimony, total	mg/l	0.006	0.016	0.016											
AP-7	Antimony, total	mg/l	0.006	0.016	0.016											
AW-3/RW-3	Antimony, total	mg/l	0.006	0.016	0.016	< 0.0075	0.0067	< 0.006	< 0.006	0.0128	< 0.006	< 0.006	< 0.006	< 0.0625	< 0.0312	< 0.0312
AP-8	Antimony, total	mg/l	0.006	0.016	0.016											
AP-9	Antimony, total	mg/l	0.006	0.016	0.016											
AP-10	Antimony, total	mg/l	0.006	0.016	0.016											
AP-11	Antimony, total	mg/l	0.006	0.016	0.016											
AP-12	Antimony, total	mg/l	0.006	0.016	0.016											
AP-13	Antimony, total	mg/l	0.006	0.016	0.016											
AP-14	Antimony, total	mg/l	0.006	0.016	0.016											

TABLE 2
CITY WATER, LIGHT AND POWER
EXISTING GROUNDWATER QUALITY

Well	Parameter	Units	35 IAC 845.600	Background AP-4 & AP-5	GWPS	4/25/2012	8/23/2012	11/28/2012	2/21/2013	5/22/2013	8/28/2013	11/20/2013	2/26/2014	5/20/2014	8/26/2014	11/21/2014
AP-1	Arsenic, total	mg/l	0.01	0.0724	0.0724	< 0.05	0.0141	0.00572	< 0.05	0.00976	< 0.015	< 0.05	0.158	< 0.0625	< 0.0312	< 0.0312
AP-2	Arsenic, total	mg/l	0.01	0.0724	0.0724	< 0.05	0.0331	0.0156	0.0738	0.034	0.0224	< 0.05	< 0.05	< 0.0625	< 0.0312	< 0.0312
AP-3	Arsenic, total	mg/l	0.01	0.0724	0.0724	< 0.05	0.0254	0.0136	0.0784	0.016	< 0.015	< 0.05	< 0.05	< 0.0625	< 0.0312	< 0.0312
AP-4	Arsenic, total	mg/l	0.01	0.0724	0.0724	< 0.05	0.0294	0.00608	< 0.05	0.025	0.0193	< 0.05	< 0.05	< 0.0625	< 0.0312	< 0.0312
AP-5	Arsenic, total	mg/l	0.01	0.0724	0.0724	0.076	0.102	0.0243	< 0.05	0.0094	< 0.015	< 0.05	< 0.05	< 0.0625	0.0662	< 0.0312
AP-6	Arsenic, total	mg/l	0.01	0.0724	0.0724											
AP-7	Arsenic, total	mg/l	0.01	0.0724	0.0724											
AW-3/RW-3	Arsenic, total	mg/l	0.01	0.0724	0.0724	0.149	0.131	0.121	0.104	< 0.015	< 0.015	0.134	0.139	0.138	0.134	0.118
AP-8	Arsenic, total	mg/l	0.01	0.0724	0.0724											
AP-9	Arsenic, total	mg/l	0.01	0.0724	0.0724											
AP-10	Arsenic, total	mg/l	0.01	0.0724	0.0724											
AP-11	Arsenic, total	mg/l	0.01	0.0724	0.0724											
AP-12	Arsenic, total	mg/l	0.01	0.0724	0.0724											
AP-13	Arsenic, total	mg/l	0.01	0.0724	0.0724											
AP-14	Arsenic, total	mg/l	0.01	0.0724	0.0724											
AP-1	Barium, total	mg/l	2	5.24	5.24	< 2	0.255	< 2	< 2	0.306	0.639	< 2	< 2	0.993	0.694	0.952
AP-2	Barium, total	mg/l	2	5.24	5.24	< 2	0.731	< 2	< 2	0.200	0.282	< 2	< 2	0.355	0.242	0.276
AP-3	Barium, total	mg/l	2	5.24	5.24	< 2	0.160	< 2	< 2	0.095	0.125	< 2	< 2	0.144	0.0979	0.0939
AP-4	Barium, total	mg/l	2	5.24	5.24	< 2	0.366	< 2	< 2	0.370	0.385	< 2	< 2	0.352	0.346	0.351
AP-5	Barium, total	mg/l	2	5.24	5.24	< 2	2.760	< 3.2	< 2	0.130	0.228	< 2	< 2	0.278	0.663	0.193
AP-6	Barium, total	mg/l	2	5.24	5.24											
AP-7	Barium, total	mg/l	2	5.24	5.24											
AW-3/RW-3	Barium, total	mg/l	2	5.24	5.24	0.376	0.202	< 2	< 2	0.059	0.0843	< 2	< 2	0.274	0.183	0.18
AP-8	Barium, total	mg/l	2	5.24	5.24											
AP-9	Barium, total	mg/l	2	5.24	5.24											
AP-10	Barium, total	mg/l	2	5.24	5.24											
AP-11	Barium, total	mg/l	2	5.24	5.24											
AP-12	Barium, total	mg/l	2	5.24	5.24											
AP-13	Barium, total	mg/l	2	5.24	5.24											
AP-14	Barium, total	mg/l	2	5.24	5.24											
AP-1	Beryllium, total	mg/l	0.004	0.0164	0.0164	< 0.004	< 0.004	< 0.004	< 0.004	< 0.00375	< 0.004	< 0.004	< 0.004	< 0.0625	< 0.00312	< 0.00312
AP-2	Beryllium, total	mg/l	0.004	0.0164	0.0164	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.0625	< 0.00312	< 0.00312
AP-3	Beryllium, total	mg/l	0.004	0.0164	0.0164	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.0625	< 0.00312	< 0.00312
AP-4	Beryllium, total	mg/l	0.004	0.0164	0.0164	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.0625	< 0.00312	< 0.00312
AP-5	Beryllium, total	mg/l	0.004	0.0164	0.0164	0.0128	0.0092	0.0164	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.0625	0.00735	< 0.00312
AP-6	Beryllium, total	mg/l	0.004	0.0164	0.0164											
AP-7	Beryllium, total	mg/l	0.004	0.0164	0.0164											
AW-3/RW-3	Beryllium, total	mg/l	0.004	0.0164	0.0164	< 0.0075	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.0625	< 0.00312	< 0.00312
AP-8	Beryllium, total	mg/l	0.004	0.0164	0.0164											
AP-9	Beryllium, total	mg/l	0.004	0.0164	0.0164											
AP-10	Beryllium, total	mg/l	0.004	0.0164	0.0164											
AP-11	Beryllium, total	mg/l	0.004	0.0164	0.0164											
AP-12	Beryllium, total	mg/l	0.004	0.0164	0.0164											
AP-13	Beryllium, total	mg/l	0.004	0.0164	0.0164											
AP-14	Beryllium, total	mg/l	0.004	0.0164	0.0164											
AP-1	Cadmium, total	mg/l	0.005	0.0128	0.0128	< 0.005	< 0.0025	< 0.005	< 0.005	< 0.00125	< 0.0025	< 0.005	< 0.005	< 0.0625	< 0.00312	< 0.00312
AP-2	Cadmium, total	mg/l	0.005	0.0128	0.0128	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.0025	< 0.005	< 0.005	< 0.0625	< 0.00312	< 0.00312
AP-3	Cadmium, total	mg/l	0.005	0.0128	0.0128	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.0025	< 0.005	< 0.005	< 0.0625	< 0.00312	< 0.00312
AP-4	Cadmium, total	mg/l	0.005	0.0128	0.0128	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.0025	< 0.005	< 0.005	< 0.0625	< 0.00312	< 0.00312
AP-5	Cadmium, total	mg/l	0.005	0.0128	0.0128	0.0128	0.00575	< 0.008	< 0.005	< 0.005	< 0.0025	< 0.005	< 0.005	< 0.0625	0.00525	< 0.00312
AP-6	Cadmium, total	mg/l	0.005	0.0128	0.0128											
AP-7	Cadmium, total	mg/l	0.005	0.0128	0.0128											
AW-3/RW-3	Cadmium, total	mg/l	0.005	0.0128	0.0128	< 0.005	< 0.0025	< 0.00005	< 0.005	< 0.005	< 0.0025	< 0.005	< 0.005	< 0.0625	< 0.00312	< 0.00312
AP-8	Cadmium, total	mg/l	0.005	0.0128	0.0128											
AP-9	Cadmium, total	mg/l	0.005	0.0128	0.0128											
AP-10	Cadmium, total	mg/l	0.005	0.0128	0.0128											
AP-11	Cadmium, total	mg/l	0.005	0.0128	0.0128											
AP-12	Cadmium, total	mg/l	0.005	0.0128	0.0128											
AP-13	Cadmium, total	mg/l	0.005	0.0128	0.0128											
AP-14	Cadmium, total	mg/l	0.005	0.0128	0.0128											

TABLE 2
CITY WATER, LIGHT AND POWER
EXISTING GROUNDWATER QUALITY

Well	Parameter	Units	35 IAC 845.600	Background AP-4 & AP-5	GWPS	4/25/2012	8/23/2012	11/28/2012	2/21/2013	5/22/2013	8/28/2013	11/20/2013	2/26/2014	5/20/2014	8/26/2014	11/21/2014
AP-1	Chromium, total	mg/l	0.1	0.811	0.811	< 0.1	< 0.0175	< 0.1	< 0.1	0.0024	< 0.01	< 0.1	< 0.1	< 0.0625	< 0.0312	< 0.0312
AP-2	Chromium, total	mg/l	0.1	0.811	0.811	< 0.1	0.111	< 0.1	< 0.1	0.0091	0.018	< 0.1	< 0.1	< 0.0625	< 0.0312	< 0.0312
AP-3	Chromium, total	mg/l	0.1	0.811	0.811	< 0.1	< 0.0175	< 0.1	< 0.1	< 0.1	< 0.01	< 0.1	< 0.1	< 0.0625	< 0.0312	< 0.0312
AP-4	Chromium, total	mg/l	0.1	0.811	0.811	< 0.1	< 0.0175	< 0.1	< 0.1	0.0039	< 0.01	< 0.1	< 0.1	< 0.0625	< 0.0312	< 0.0312
AP-5	Chromium, total	mg/l	0.1	0.811	0.811	0.328	0.449	0.42	< 0.1	0.016	0.0431	0.113	< 0.1	< 0.0625	0.174	< 0.0312
AP-6	Chromium, total	mg/l	0.1	0.811	0.811											
AP-7	Chromium, total	mg/l	0.1	0.811	0.811											
AW-3/RW-3	Chromium, total	mg/l	0.1	0.811	0.811	0.0443	< 0.0175	< 0.1	< 0.1	< 0.1	< 0.01	< 0.1	< 0.1	< 0.0625	< 0.0312	< 0.0312
AP-8	Chromium, total	mg/l	0.1	0.811	0.811											
AP-9	Chromium, total	mg/l	0.1	0.811	0.811											
AP-10	Chromium, total	mg/l	0.1	0.811	0.811											
AP-11	Chromium, total	mg/l	0.1	0.811	0.811											
AP-12	Chromium, total	mg/l	0.1	0.811	0.811											
AP-13	Chromium, total	mg/l	0.1	0.811	0.811											
AP-14	Chromium, total	mg/l	0.1	0.811	0.811											
AP-1	Cobalt, total	mg/l	0.006	0.297	0.297	< 1	< 0.0175	< 1	< 1	< 0.0075	< 0.015	< 1	< 1	< 0.0313	< 0.0156	< 0.0156
AP-2	Cobalt, total	mg/l	0.006	0.297	0.297	< 1	0.0528	< 1	< 1	0.0093	< 0.015	< 1	< 1	< 0.0313	< 0.0156	< 0.0156
AP-3	Cobalt, total	mg/l	0.006	0.297	0.297	< 1	< 0.0175	< 1	< 1	< 1	< 0.015	< 1	< 1	< 0.0313	< 0.0156	< 0.0156
AP-4	Cobalt, total	mg/l	0.006	0.297	0.297	< 1	< 0.0175	< 1	< 1	< 1	< 0.015	< 1	< 1	< 0.0313	< 0.0156	< 0.0156
AP-5	Cobalt, total	mg/l	0.006	0.297	0.297	< 1	0.297	< 1.6	< 1	0.0086	0.0223	< 1	< 1	< 0.0313	0.11	< 0.0156
AP-6	Cobalt, total	mg/l	0.006	0.297	0.297											
AP-7	Cobalt, total	mg/l	0.006	0.297	0.297											
AW-3/RW-3	Cobalt, total	mg/l	0.006	0.297	0.297	0.0278	< 0.0175	< 1	< 1	< 1	< 0.015	< 1	< 1	< 0.0313	< 0.0156	< 0.0156
AP-8	Cobalt, total	mg/l	0.006	0.297	0.297											
AP-9	Cobalt, total	mg/l	0.006	0.297	0.297											
AP-10	Cobalt, total	mg/l	0.006	0.297	0.297											
AP-11	Cobalt, total	mg/l	0.006	0.297	0.297											
AP-12	Cobalt, total	mg/l	0.006	0.297	0.297											
AP-13	Cobalt, total	mg/l	0.006	0.297	0.297											
AP-14	Cobalt, total	mg/l	0.006	0.297	0.297											
AP-1	Lead, total	mg/l	0.0075	0.638	0.638	< 0.0075	< 0.005	< 0.0075	< 0.0075	0.0019	< 0.005	< 0.0075	0.0291	< 0.0625	< 0.0312	< 0.0312
AP-2	Lead, total	mg/l	0.0075	0.638	0.638	0.047	0.0599	0.0433	< 0.0075	0.0048	0.0104	0.015	< 0.0075	< 0.0625	< 0.0312	< 0.0312
AP-3	Lead, total	mg/l	0.0075	0.638	0.638	< 0.0075	0.0118	< 0.0075	< 0.0075	< 0.0075	< 0.005	< 0.0075	< 0.0075	< 0.0625	< 0.0312	< 0.0312
AP-4	Lead, total	mg/l	0.0075	0.638	0.638	< 0.0075	< 0.005	< 0.0075	< 0.0075	0.0036	< 0.005	< 0.0075	< 0.0075	< 0.0625	< 0.0312	< 0.0312
AP-5	Lead, total	mg/l	0.0075	0.638	0.638	0.236	0.312	0.277	0.0244	0.0104	0.0312	0.638	0.032	< 0.0625	0.093	< 0.0312
AP-6	Lead, total	mg/l	0.0075	0.638	0.638											
AP-7	Lead, total	mg/l	0.0075	0.638	0.638											
AW-3/RW-3	Lead, total	mg/l	0.0075	0.638	0.638	0.0371	< 0.005	< 0.0075	< 0.0075	< 0.0075	< 0.005	< 0.0075	< 0.0075	< 0.0625	< 0.0312	< 0.0312
AP-8	Lead, total	mg/l	0.0075	0.638	0.638											
AP-9	Lead, total	mg/l	0.0075	0.638	0.638											
AP-10	Lead, total	mg/l	0.0075	0.638	0.638											
AP-11	Lead, total	mg/l	0.0075	0.638	0.638											
AP-12	Lead, total	mg/l	0.0075	0.638	0.638											
AP-13	Lead, total	mg/l	0.0075	0.638	0.638											
AP-14	Lead, total	mg/l	0.0075	0.638	0.638											
AP-1	Lithium	mg/l	0.04	0.05	0.05											
AP-2	Lithium	mg/l	0.04	0.05	0.05											
AP-3	Lithium	mg/l	0.04	0.05	0.05											
AP-4	Lithium	mg/l	0.04	0.05	0.05											
AP-5	Lithium	mg/l	0.04	0.05	0.05											
AP-6	Lithium	mg/l	0.04	0.05	0.05											
AP-7	Lithium	mg/l	0.04	0.05	0.05											
AW-3/RW-3	Lithium	mg/l	0.04	0.05	0.05											
AP-8	Lithium	mg/l	0.04	0.05	0.05											
AP-9	Lithium	mg/l	0.04	0.05	0.05											
AP-10	Lithium	mg/l	0.04	0.05	0.05											
AP-11	Lithium	mg/l	0.04	0.05	0.05											
AP-12	Lithium	mg/l	0.04	0.05	0.05											
AP-13	Lithium	mg/l	0.04	0.05	0.05											
AP-14	Lithium	mg/l	0.04	0.05	0.05											

TABLE 2
CITY WATER, LIGHT AND POWER
EXISTING GROUNDWATER QUALITY

Well	Parameter	Units	35 IAC 845.600	Background AP-4 & AP-5	GWPS	4/25/2012	8/23/2012	11/28/2012	2/21/2013	5/22/2013	8/28/2013	11/20/2013	2/26/2014	5/20/2014	8/26/2014	11/21/2014
AP-1	Mercury, total	mg/l	0.002	0.0008	0.002	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
AP-2	Mercury, total	mg/l	0.002	0.0008	0.002	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0006
AP-3	Mercury, total	mg/l	0.002	0.0008	0.002	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
AP-4	Mercury, total	mg/l	0.002	0.0008	0.002	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
AP-5	Mercury, total	mg/l	0.002	0.0008	0.002	< 0.0005	0.0007	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
AP-6	Mercury, total	mg/l	0.002	0.0008	0.002											
AP-7	Mercury, total	mg/l	0.002	0.0008	0.002											
AW-3/RW-3	Mercury, total	mg/l	0.002	0.0008	0.002	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
AP-8	Mercury, total	mg/l	0.002	0.0008	0.002											
AP-9	Mercury, total	mg/l	0.002	0.0008	0.002											
AP-10	Mercury, total	mg/l	0.002	0.0008	0.002											
AP-11	Mercury, total	mg/l	0.002	0.0008	0.002											
AP-12	Mercury, total	mg/l	0.002	0.0008	0.002											
AP-13	Mercury, total	mg/l	0.002	0.0008	0.002											
AP-14	Mercury, total	mg/l	0.002	0.0008	0.002											
AP-1	Molybdenum	mg/l	0.1	0.025	0.1											
AP-2	Molybdenum	mg/l	0.1	0.025	0.1											
AP-3	Molybdenum	mg/l	0.1	0.025	0.1											
AP-4	Molybdenum	mg/l	0.1	0.025	0.1											
AP-5	Molybdenum	mg/l	0.1	0.025	0.1											
AP-6	Molybdenum	mg/l	0.1	0.025	0.1											
AP-7	Molybdenum	mg/l	0.1	0.025	0.1											
AW-3/RW-3	Molybdenum	mg/l	0.1	0.025	0.1											
AP-8	Molybdenum	mg/l	0.1	0.025	0.1											
AP-9	Molybdenum	mg/l	0.1	0.025	0.1											
AP-10	Molybdenum	mg/l	0.1	0.025	0.1											
AP-11	Molybdenum	mg/l	0.1	0.025	0.1											
AP-12	Molybdenum	mg/l	0.1	0.025	0.1											
AP-13	Molybdenum	mg/l	0.1	0.025	0.1											
AP-14	Molybdenum	mg/l	0.1	0.025	0.1											
AP-1	Radium-226 + Radium-228	pCi/l	5	7.1	7.1		1.9	2.5	2.9	3.3	1.58	2.29	1.3	-21.9	4	1.66
AP-2	Radium-226 + Radium-228	pCi/l	5	7.1	7.1		2.9	1.66	2.09	4.2	1.29	2.29	1.13	1.49	-0.28	1.98
AP-3	Radium-226 + Radium-228	pCi/l	5	7.1	7.1		2.03	2.05	1.51	1.73	0.98	1.66	1.49	-1.23	1.15	0.72
AP-4	Radium-226 + Radium-228	pCi/l	5	7.1	7.1		1.68	2.71	1.4	1.53	1.97	0.98	1.47	1.73	2.22	2.2
AP-5	Radium-226 + Radium-228	pCi/l	5	7.1	7.1		12.2	2.02	3.2	1.78	1.81	3.5	1.76	0.92	0	2.14
AP-6	Radium-226 + Radium-228	pCi/l	5	7.1	7.1											
AP-7	Radium-226 + Radium-228	pCi/l	5	7.1	7.1											
AW-3/RW-3	Radium-226 + Radium-228	pCi/l	5	7.1	7.1		1.49	1.78	2.1	0.84	1.03	2.8	1.58	1.66	1.4	1.75
AP-8	Radium-226 + Radium-228	pCi/l	5	7.1	7.1											
AP-9	Radium-226 + Radium-228	pCi/l	5	7.1	7.1											
AP-10	Radium-226 + Radium-228	pCi/l	5	7.1	7.1											
AP-11	Radium-226 + Radium-228	pCi/l	5	7.1	7.1											
AP-12	Radium-226 + Radium-228	pCi/l	5	7.1	7.1											
AP-13	Radium-226 + Radium-228	pCi/l	5	7.1	7.1											
AP-14	Radium-226 + Radium-228	pCi/l	5	7.1	7.1											
AP-1	Selenium, total	mg/l	0.05	0.0079	0.05	< 0.05	< 0.0025	< 0.05	< 0.05	0.0204	0.00274	< 0.05	< 0.05	< 0.0625	< 0.0312	< 0.0312
AP-2	Selenium, total	mg/l	0.05	0.0079	0.05	< 0.05	< 0.0025	< 0.05	< 0.05	0.045	< 0.0025	< 0.05	< 0.05	< 0.0625	< 0.0312	< 0.0312
AP-3	Selenium, total	mg/l	0.05	0.0079	0.05	< 0.05	< 0.0025	< 0.05	< 0.05	0.013	< 0.0025	< 0.05	< 0.05	< 0.0625	< 0.0312	< 0.0312
AP-4	Selenium, total	mg/l	0.05	0.0079	0.05	< 0.05	0.00497	< 0.05	< 0.05	0.0079	< 0.0025	< 0.05	< 0.05	< 0.0625	< 0.0312	< 0.0312
AP-5	Selenium, total	mg/l	0.05	0.0079	0.05	< 0.05	0.00585	< 0.08	< 0.05	0.0046	0.00523	< 0.05	< 0.05	< 0.0625	< 0.0312	< 0.0312
AP-6	Selenium, total	mg/l	0.05	0.0079	0.05											
AP-7	Selenium, total	mg/l	0.05	0.0079	0.05											
AW-3/RW-3	Selenium, total	mg/l	0.05	0.0079	0.05	< 0.0025	< 0.0025	< 0.05	< 0.05	0.0025	< 0.0025	< 0.05	< 0.05	< 0.0625	< 0.0312	< 0.0312
AP-8	Selenium, total	mg/l	0.05	0.0079	0.05											
AP-9	Selenium, total	mg/l	0.05	0.0079	0.05											
AP-10	Selenium, total	mg/l	0.05	0.0079	0.05											
AP-11	Selenium, total	mg/l	0.05	0.0079	0.05											
AP-12	Selenium, total	mg/l	0.05	0.0079	0.05											
AP-13	Selenium, total	mg/l	0.05	0.0079	0.05											
AP-14	Selenium, total	mg/l	0.05	0.0079	0.05											

TABLE 2
CITY WATER, LIGHT AND POWER
EXISTING GROUNDWATER QUALITY

Well	Parameter	Units	35 IAC 845.600	Background AP-4 & AP-5	GWPS	4/25/2012	8/23/2012	11/28/2012	2/21/2013	5/22/2013	8/28/2013	11/20/2013	2/26/2014	5/20/2014	8/26/2014	11/21/2014
AP-1	Thallium, total	mg/l	0.002	0.00556	0.0056	< 0.002	< 0.002	< 0.002	< 0.002	0.00095	< 0.002	< 0.002	< 0.002	< 0.0625	< 0.0312	< 0.0312
AP-2	Thallium, total	mg/l	0.002	0.00556	0.0056	< 0.002	< 0.002	< 0.002	< 0.002	0.0018	< 0.002	< 0.002	< 0.002	< 0.0625	< 0.0312	< 0.0312
AP-3	Thallium, total	mg/l	0.002	0.00556	0.0056	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.0625	< 0.0312	< 0.0312
AP-4	Thallium, total	mg/l	0.002	0.00556	0.0056	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.0625	< 0.0312	< 0.0312
AP-5	Thallium, total	mg/l	0.002	0.00556	0.0056	0.00258	0.00302	< 0.0032	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.0625	< 0.0312	< 0.0312
AP-6	Thallium, total	mg/l	0.002	0.00556	0.0056											
AP-7	Thallium, total	mg/l	0.002	0.00556	0.0056											
AW-3/RW-3	Thallium, total	mg/l	0.002	0.00556	0.0056	< 0.0025	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.0625	< 0.0312	< 0.0312
AP-8	Thallium, total	mg/l	0.002	0.00556	0.0056											
AP-9	Thallium, total	mg/l	0.002	0.00556	0.0056											
AP-10	Thallium, total	mg/l	0.002	0.00556	0.0056											
AP-11	Thallium, total	mg/l	0.002	0.00556	0.0056											
AP-12	Thallium, total	mg/l	0.002	0.00556	0.0056											
AP-13	Thallium, total	mg/l	0.002	0.00556	0.0056											
AP-14	Thallium, total	mg/l	0.002	0.00556	0.0056											
AP-1	Turbidity	NTU	NA	NA	NA											
AP-2	Turbidity	NTU	NA	NA	NA											
AP-3	Turbidity	NTU	NA	NA	NA											
AP-4	Turbidity	NTU	NA	NA	NA											
AP-5	Turbidity	NTU	NA	NA	NA											
AP-6	Turbidity	NTU	NA	NA	NA											
AP-7	Turbidity	NTU	NA	NA	NA											
AW-3/RW-3	Turbidity	NTU	NA	NA	NA											
AP-8	Turbidity	NTU	NA	NA	NA											
AP-9	Turbidity	NTU	NA	NA	NA											
AP-10	Turbidity	NTU	NA	NA	NA											
AP-11	Turbidity	NTU	NA	NA	NA											
AP-12	Turbidity	NTU	NA	NA	NA											
AP-13	Turbidity	NTU	NA	NA	NA											
AP-14	Turbidity	NTU	NA	NA	NA											

TABLE 2
CITY WATER, LIGHT AND POWER
EXISTING GROUNDWATER QUALITY

Well	Parameter	Units	35 IAC 845.600	Background AP-4 & AP-5	GWPS	2/24/2015	5/28/2015	8/20/2015	11/13/2015	2/26/2016	5/13/2016	8/4/2016	11/18/2016	2/16/2017	5/31/2017	8/2/2017	11/9/2017
AP-1	Boron, total	mg/l	2	0.787	2	17.9	15.7	17.5	18.8	16.1	17.2	17.9	17.3	22.5	13.9	19.4	20.3
AP-2	Boron, total	mg/l	2	0.787	2	4.12	4.51	5.01		4.62	4.43	4.4	4.28	3.92	3.63	3.58	3.16
AP-3	Boron, total	mg/l	2	0.787	2	17.8	16.4	17.6	20.1	16.9	16.2	16.5	18.6		17.7	18.9	19.2
AP-4	Boron, total	mg/l	2	0.787	2	0.105	0.123	0.0779	0.119	0.0783	0.123	0.131	0.136	0.117	0.12	0.105	0.129
AP-5	Boron, total	mg/l	2	0.787	2	0.0383	0.0379	0.0298	0.053	0.0699	0.0537	0.0779	0.0733	0.0483	0.0443	0.0407	0.073
AP-6	Boron, total	mg/l	2	0.787	2												
AP-7	Boron, total	mg/l	2	0.787	2												
AW-3/RW-3	Boron, total	mg/l	2	0.787	2	0.16	0.157	0.155	0.17	0.179	0.155	0.135	0.2	0.162	0.163	0.173	0.206
AP-8	Boron, total	mg/l	2	0.787	2												
AP-9	Boron, total	mg/l	2	0.787	2												
AP-10	Boron, total	mg/l	2	0.787	2												
AP-11	Boron, total	mg/l	2	0.787	2												
AP-12	Boron, total	mg/l	2	0.787	2												
AP-13	Boron, total	mg/l	2	0.787	2												
AP-14	Boron, total	mg/l	2	0.787	2												
AP-1	Calcium, total	mg/l	na	176.63	176.63		260	241	242	234	209	228	196	266	173	15	259
AP-2	Calcium, total	mg/l	na	176.63	176.63		350	358		312	203	191	185	180	174	238	203
AP-3	Calcium, total	mg/l	na	176.63	176.63		169	168	184	190	154	161	154	198	138	198	176
AP-4	Calcium, total	mg/l	na	176.63	176.63		121	117	125	125	118	118	117	136	117	150	141
AP-5	Calcium, total	mg/l	na	176.63	176.63		103	92.2	124	98.1	77.3	158	201	155	83.5	105	118
AP-6	Calcium, total	mg/l	na	176.63	176.63												
AP-7	Calcium, total	mg/l	na	176.63	176.63												
AW-3/RW-3	Calcium, total	mg/l	na	176.63	176.63		74.6	85.4	90.7	68.6	105	74.3	72.8	96.1	69.9	5.08	77.7
AP-8	Calcium, total	mg/l	na	176.63	176.63												
AP-9	Calcium, total	mg/l	na	176.63	176.63												
AP-10	Calcium, total	mg/l	na	176.63	176.63												
AP-11	Calcium, total	mg/l	na	176.63	176.63												
AP-12	Calcium, total	mg/l	na	176.63	176.63												
AP-13	Calcium, total	mg/l	na	176.63	176.63												
AP-14	Calcium, total	mg/l	na	176.63	176.63												
AP-1	Chloride, total	mg/l	200	24.2	200	46.9	50.7	44.8	68.9	45.8	46.2	48.3	47.3	47.9	44.6	50.2	54.1
AP-2	Chloride, total	mg/l	200	24.2	200	19.6	25.6	28.1		40.7	39.7	40.2	41.1	41.5	42.1	46.6	48.6
AP-3	Chloride, total	mg/l	200	24.2	200	38.7	40.6	34.8	52.1	40.3	37.9	38.8	38.9	39.6	39.9	38.3	40.9
AP-4	Chloride, total	mg/l	200	24.2	200	10.8	15.1	10.2	16.7	11.3	12.3	11.3	9.8	10.6	12	11.9	12.1
AP-5	Chloride, total	mg/l	200	24.2	200	4.02	4.79	< 3	3.27	< 3	< 3	< 3	< 3	< 3	< 3	< 3	< 30
AP-6	Chloride, total	mg/l	200	24.2	200												
AP-7	Chloride, total	mg/l	200	24.2	200												
AW-3/RW-3	Chloride, total	mg/l	200	24.2	200	25.3	24.1	20.9	33	23.7	24.7	22.7	23	22.9	26.8	27.1	26.2
AP-8	Chloride, total	mg/l	200	24.2	200												
AP-9	Chloride, total	mg/l	200	24.2	200												
AP-10	Chloride, total	mg/l	200	24.2	200												
AP-11	Chloride, total	mg/l	200	24.2	200												
AP-12	Chloride, total	mg/l	200	24.2	200												
AP-13	Chloride, total	mg/l	200	24.2	200												
AP-14	Chloride, total	mg/l	200	24.2	200												
AP-1	Fluoride, total	mg/l	4	0.62	4	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
AP-2	Fluoride, total	mg/l	4	0.62	4	< 0.5	< 0.5	< 0.5		< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
AP-3	Fluoride, total	mg/l	4	0.62	4	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
AP-4	Fluoride, total	mg/l	4	0.62	4	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
AP-5	Fluoride, total	mg/l	4	0.62	4	< 0.5	< 0.5	< 0.5	0.88	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
AP-6	Fluoride, total	mg/l	4	0.62	4												
AP-7	Fluoride, total	mg/l	4	0.62	4												
AW-3/RW-3	Fluoride, total	mg/l	4	0.62	4	< 0.5	< 0.5	< 0.5	0.6	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.5	1.1
AP-8	Fluoride, total	mg/l	4	0.62	4												
AP-10	Fluoride, total	mg/l	4	0.62	4												
AP-14	Fluoride, total	mg/l	4	0.62	4												
AP-1	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0	6.73	7.07	6.92	7.13	7.22	6.76	6.57	6.85	6.96	6.72	6.59	6.89
AP-2	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0	7.1	6.86	6.82		6.87	6.69	6.77	6.75	6.8	6.6	6.83	6.78
AP-3	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0	6.98	7	6.88	7.07	7.01	6.78	6.91	6.8	6.92	6.55	6.78	6.95
AP-4	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0	6.82	7.45	7.01	7.14	7.39	7.18	7.13	7.01	7.02	7.08	7.29	7.12
AP-5	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0	7.32	7.16	6.52	7.51	7.66	7.56	6.83	7.62	7.42	7.36	7.77	7.19
AP-6	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0												

TABLE 2
CITY WATER, LIGHT AND POWER
EXISTING GROUNDWATER QUALITY

Well	Parameter	Units	35 IAC 845.600	Background AP-4 & AP-5	GWPS	2/24/2015	5/28/2015	8/20/2015	11/13/2015	2/26/2016	5/13/2016	8/4/2016	11/18/2016	2/16/2017	5/31/2017	8/2/2017	11/9/2017
AP-7	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0												
AW-3/RW-3	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0	7.04	7.19	6.93	7.52	7.29	7.49	7.18	7.48	7.34	7.21	7.26	6.92
AP-8	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0												
AP-9	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0												
AP-10	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0												
AP-11	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0												
AP-12	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0												
AP-13	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0												
AP-14	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0												
AP-1	Sulfate, total	mg/l	400	84.5	400	504	486	550	388	594	597	612	589	645	532	672	664
AP-2	Sulfate, total	mg/l	400	84.5	400	497	686	711		531	418	335	327	279	346	390	348
AP-3	Sulfate, total	mg/l	400	84.5	400	290	332	315	337	310	359	369	339	328	328	368	319
AP-4	Sulfate, total	mg/l	400	84.5	400	< 5	< 5	< 5	6.47	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
AP-5	Sulfate, total	mg/l	400	84.5	400	52.6	48.2	47.4	58.8	54.3	46.8	50.8	52.5	55.5	54.8	48.4	55.3
AP-6	Sulfate, total	mg/l	400	84.5	400												
AP-7	Sulfate, total	mg/l	400	84.5	400												
AW-3/RW-3	Sulfate, total	mg/l	400	84.5	400	5.62	< 5	5.05	< 5	27.5	24.2	17.3	8.74	< 5	7.75	< 5	< 5
AP-8	Sulfate, total	mg/l	400	84.5	400												
AP-9	Sulfate, total	mg/l	400	84.5	400												
AP-10	Sulfate, total	mg/l	400	84.5	400												
AP-11	Sulfate, total	mg/l	400	84.5	400												
AP-12	Sulfate, total	mg/l	400	84.5	400												
AP-13	Sulfate, total	mg/l	400	84.5	400												
AP-14	Sulfate, total	mg/l	400	84.5	400												
AP-1	Total Dissolved Solids	mg/l	1200	597.94	1200	1230	1260	1200	1280	1010	1430	1390	1320	1430	1180	1450	1420
AP-2	Total Dissolved Solids	mg/l	1200	597.94	1200	1250	1460	1520		1200	1160	1020	1070	906	1020	1060	966
AP-3	Total Dissolved Solids	mg/l	1200	597.94	1200	866	900	860	850	712	914	958	940	810	848	920	848
AP-4	Total Dissolved Solids	mg/l	1200	597.94	1200	486	502	476	470	492	514	554	558	482	538	526	544
AP-5	Total Dissolved Solids	mg/l	1200	597.94	1200	384	388	368	290	358	292	474	344	406	426	392	470
AP-6	Total Dissolved Solids	mg/l	1200	597.94	1200												
AP-7	Total Dissolved Solids	mg/l	1200	597.94	1200												
AW-3/RW-3	Total Dissolved Solids	mg/l	1200	597.94	1200	398	420	408	434	370	370	488	474	412	442	462	424
AP-8	Total Dissolved Solids	mg/l	1200	597.94	1200												
AP-9	Total Dissolved Solids	mg/l	1200	597.94	1200												
AP-10	Total Dissolved Solids	mg/l	1200	597.94	1200												
AP-11	Total Dissolved Solids	mg/l	1200	597.94	1200												
AP-12	Total Dissolved Solids	mg/l	1200	597.94	1200												
AP-13	Total Dissolved Solids	mg/l	1200	597.94	1200												
AP-14	Total Dissolved Solids	mg/l	1200	597.94	1200												
AP-1	Antimony, total	mg/l	0.006	0.016	0.016	< 0.0312	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-2	Antimony, total	mg/l	0.006	0.016	0.016	< 0.0312	< 0.025	< 0.025		< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-3	Antimony, total	mg/l	0.006	0.016	0.016	< 0.0312	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-4	Antimony, total	mg/l	0.006	0.016	0.016	< 0.0312	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-5	Antimony, total	mg/l	0.006	0.016	0.016	< 0.0312	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-6	Antimony, total	mg/l	0.006	0.016	0.016												
AP-7	Antimony, total	mg/l	0.006	0.016	0.016												
AW-3/RW-3	Antimony, total	mg/l	0.006	0.016	0.016	< 0.0312	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-8	Antimony, total	mg/l	0.006	0.016	0.016												
AP-9	Antimony, total	mg/l	0.006	0.016	0.016												
AP-10	Antimony, total	mg/l	0.006	0.016	0.016												
AP-11	Antimony, total	mg/l	0.006	0.016	0.016												
AP-12	Antimony, total	mg/l	0.006	0.016	0.016												
AP-13	Antimony, total	mg/l	0.006	0.016	0.016												
AP-14	Antimony, total	mg/l	0.006	0.016	0.016												

TABLE 2
CITY WATER, LIGHT AND POWER
EXISTING GROUNDWATER QUALITY

Well	Parameter	Units	35 IAC 845.600	Background AP-4 & AP-5	GWPS	2/24/2015	5/28/2015	8/20/2015	11/13/2015	2/26/2016	5/13/2016	8/4/2016	11/18/2016	2/16/2017	5/31/2017	8/2/2017	11/9/2017
AP-1	Arsenic, total	mg/l	0.01	0.0724	0.0724	< 0.0312	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-2	Arsenic, total	mg/l	0.01	0.0724	0.0724	< 0.0312	< 0.025	< 0.025		< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-3	Arsenic, total	mg/l	0.01	0.0724	0.0724	< 0.0312	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-4	Arsenic, total	mg/l	0.01	0.0724	0.0724	< 0.0312	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	0.0266
AP-5	Arsenic, total	mg/l	0.01	0.0724	0.0724	< 0.0312	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-6	Arsenic, total	mg/l	0.01	0.0724	0.0724												
AP-7	Arsenic, total	mg/l	0.01	0.0724	0.0724												
AW-3/RW-3	Arsenic, total	mg/l	0.01	0.0724	0.0724	0.105	0.118	0.121	0.151	0.0982	0.0939	0.231	0.224	0.21	0.0856	0.157	0.172
AP-8	Arsenic, total	mg/l	0.01	0.0724	0.0724												
AP-9	Arsenic, total	mg/l	0.01	0.0724	0.0724												
AP-10	Arsenic, total	mg/l	0.01	0.0724	0.0724												
AP-11	Arsenic, total	mg/l	0.01	0.0724	0.0724												
AP-12	Arsenic, total	mg/l	0.01	0.0724	0.0724												
AP-13	Arsenic, total	mg/l	0.01	0.0724	0.0724												
AP-14	Arsenic, total	mg/l	0.01	0.0724	0.0724												
AP-1	Barium, total	mg/l	2	5.24	5.24	0.0683	0.360	0.646	0.303	0.592	0.578	0.682	0.433	0.953	0.253	0.727	0.662
AP-2	Barium, total	mg/l	2	5.24	5.24	0.241	0.254	0.268		0.147	0.0995	0.0795	0.0691	0.0998	0.0892	0.0735	0.0765
AP-3	Barium, total	mg/l	2	5.24	5.24	0.106	0.136	0.0938	0.114	0.131	0.102	0.106	0.1	0.124	0.0849	0.0947	0.0997
AP-4	Barium, total	mg/l	2	5.24	5.24	0.329	0.301	0.348	0.355	0.322	0.373	0.381	0.357	0.413	0.405	0.391	0.41
AP-5	Barium, total	mg/l	2	5.24	5.24	0.0846	0.109	0.0955	0.158	0.0618	0.0628	0.251	0.201	0.137	0.0807	0.043	0.308
AP-6	Barium, total	mg/l	2	5.24	5.24												
AP-7	Barium, total	mg/l	2	5.24	5.24												
AW-3/RW-3	Barium, total	mg/l	2	5.24	5.24	0.166	0.185	0.181	0.213	0.177	0.164	0.208	0.197	0.271	0.202	0.221	0.23
AP-8	Barium, total	mg/l	2	5.24	5.24												
AP-9	Barium, total	mg/l	2	5.24	5.24												
AP-10	Barium, total	mg/l	2	5.24	5.24												
AP-11	Barium, total	mg/l	2	5.24	5.24												
AP-12	Barium, total	mg/l	2	5.24	5.24												
AP-13	Barium, total	mg/l	2	5.24	5.24												
AP-14	Barium, total	mg/l	2	5.24	5.24												
AP-1	Beryllium, total	mg/l	0.004	0.0164	0.0164	< 0.00312	< 0.0025	< 0.0025	< 0.005	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025
AP-2	Beryllium, total	mg/l	0.004	0.0164	0.0164	< 0.00312	< 0.0025	< 0.0025		< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025
AP-3	Beryllium, total	mg/l	0.004	0.0164	0.0164	< 0.00312	< 0.0025	< 0.0025	< 0.005	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025
AP-4	Beryllium, total	mg/l	0.004	0.0164	0.0164	< 0.00312	< 0.0025	< 0.0025	< 0.005	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025
AP-5	Beryllium, total	mg/l	0.004	0.0164	0.0164	< 0.00312	< 0.0025	< 0.0025	< 0.005	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025
AP-6	Beryllium, total	mg/l	0.004	0.0164	0.0164												
AP-7	Beryllium, total	mg/l	0.004	0.0164	0.0164												
AW-3/RW-3	Beryllium, total	mg/l	0.004	0.0164	0.0164	< 0.00312	< 0.0025	< 0.0025	< 0.005	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025
AP-8	Beryllium, total	mg/l	0.004	0.0164	0.0164												
AP-9	Beryllium, total	mg/l	0.004	0.0164	0.0164												
AP-10	Beryllium, total	mg/l	0.004	0.0164	0.0164												
AP-11	Beryllium, total	mg/l	0.004	0.0164	0.0164												
AP-12	Beryllium, total	mg/l	0.004	0.0164	0.0164												
AP-13	Beryllium, total	mg/l	0.004	0.0164	0.0164												
AP-14	Beryllium, total	mg/l	0.004	0.0164	0.0164												
AP-1	Cadmium, total	mg/l	0.005	0.0128	0.0128	< 0.00312	< 0.0025	< 0.0025	< 0.005	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025
AP-2	Cadmium, total	mg/l	0.005	0.0128	0.0128	< 0.00312	< 0.0025	< 0.0025		< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025
AP-3	Cadmium, total	mg/l	0.005	0.0128	0.0128	< 0.00312	< 0.0025	< 0.0025	< 0.005	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025
AP-4	Cadmium, total	mg/l	0.005	0.0128	0.0128	< 0.00312	< 0.0025	< 0.0025	< 0.005	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025
AP-5	Cadmium, total	mg/l	0.005	0.0128	0.0128	< 0.00312	< 0.0025	< 0.0025	< 0.005	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025
AP-6	Cadmium, total	mg/l	0.005	0.0128	0.0128												
AP-7	Cadmium, total	mg/l	0.005	0.0128	0.0128												
AW-3/RW-3	Cadmium, total	mg/l	0.005	0.0128	0.0128	< 0.00312	< 0.0025	< 0.0025	< 0.005	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.0025
AP-8	Cadmium, total	mg/l	0.005	0.0128	0.0128												
AP-9	Cadmium, total	mg/l	0.005	0.0128	0.0128												
AP-10	Cadmium, total	mg/l	0.005	0.0128	0.0128												
AP-11	Cadmium, total	mg/l	0.005	0.0128	0.0128												
AP-12	Cadmium, total	mg/l	0.005	0.0128	0.0128												
AP-13	Cadmium, total	mg/l	0.005	0.0128	0.0128												
AP-14	Cadmium, total	mg/l	0.005	0.0128	0.0128												

TABLE 2
CITY WATER, LIGHT AND POWER
EXISTING GROUNDWATER QUALITY

Well	Parameter	Units	35 IAC 845.600	Background AP-4 & AP-5	GWPS	2/24/2015	5/28/2015	8/20/2015	11/13/2015	2/26/2016	5/13/2016	8/4/2016	11/18/2016	2/16/2017	5/31/2017	8/2/2017	11/9/2017
AP-1	Chromium, total	mg/l	0.1	0.811	0.811	< 0.0312	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-2	Chromium, total	mg/l	0.1	0.811	0.811	< 0.0312	< 0.025	< 0.025		< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-3	Chromium, total	mg/l	0.1	0.811	0.811	< 0.0312	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-4	Chromium, total	mg/l	0.1	0.811	0.811	< 0.0312	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-5	Chromium, total	mg/l	0.1	0.811	0.811	< 0.0312	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	0.0605	0.0432	< 0.025	< 0.025	< 0.025	0.0653
AP-6	Chromium, total	mg/l	0.1	0.811	0.811												
AP-7	Chromium, total	mg/l	0.1	0.811	0.811												
AW-3/RW-3	Chromium, total	mg/l	0.1	0.811	0.811	< 0.0312	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-8	Chromium, total	mg/l	0.1	0.811	0.811												
AP-9	Chromium, total	mg/l	0.1	0.811	0.811												
AP-10	Chromium, total	mg/l	0.1	0.811	0.811												
AP-11	Chromium, total	mg/l	0.1	0.811	0.811												
AP-12	Chromium, total	mg/l	0.1	0.811	0.811												
AP-13	Chromium, total	mg/l	0.1	0.811	0.811												
AP-14	Chromium, total	mg/l	0.1	0.811	0.811												
AP-1	Cobalt, total	mg/l	0.006	0.297	0.297	< 0.0156	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-2	Cobalt, total	mg/l	0.006	0.297	0.297	< 0.0156	< 0.025	< 0.025		< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-3	Cobalt, total	mg/l	0.006	0.297	0.297	< 0.0156	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-4	Cobalt, total	mg/l	0.006	0.297	0.297	< 0.0156	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-5	Cobalt, total	mg/l	0.006	0.297	0.297	< 0.0156	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	0.029	< 0.025	< 0.025	< 0.025	< 0.025	0.0277
AP-6	Cobalt, total	mg/l	0.006	0.297	0.297												
AP-7	Cobalt, total	mg/l	0.006	0.297	0.297												
AW-3/RW-3	Cobalt, total	mg/l	0.006	0.297	0.297	< 0.0156	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-8	Cobalt, total	mg/l	0.006	0.297	0.297												
AP-9	Cobalt, total	mg/l	0.006	0.297	0.297												
AP-10	Cobalt, total	mg/l	0.006	0.297	0.297												
AP-11	Cobalt, total	mg/l	0.006	0.297	0.297												
AP-12	Cobalt, total	mg/l	0.006	0.297	0.297												
AP-13	Cobalt, total	mg/l	0.006	0.297	0.297												
AP-14	Cobalt, total	mg/l	0.006	0.297	0.297												
AP-1	Lead, total	mg/l	0.0075	0.638	0.638	< 0.0312	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-2	Lead, total	mg/l	0.0075	0.638	0.638	< 0.0312	< 0.025	< 0.025		< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-3	Lead, total	mg/l	0.0075	0.638	0.638	< 0.0312	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-4	Lead, total	mg/l	0.0075	0.638	0.638	< 0.0312	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-5	Lead, total	mg/l	0.0075	0.638	0.638	< 0.0312	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	0.0286	0.0254	< 0.025	< 0.025	< 0.025	0.0287
AP-6	Lead, total	mg/l	0.0075	0.638	0.638												
AP-7	Lead, total	mg/l	0.0075	0.638	0.638												
AW-3/RW-3	Lead, total	mg/l	0.0075	0.638	0.638	< 0.0312	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-8	Lead, total	mg/l	0.0075	0.638	0.638												
AP-9	Lead, total	mg/l	0.0075	0.638	0.638												
AP-10	Lead, total	mg/l	0.0075	0.638	0.638												
AP-11	Lead, total	mg/l	0.0075	0.638	0.638												
AP-12	Lead, total	mg/l	0.0075	0.638	0.638												
AP-13	Lead, total	mg/l	0.0075	0.638	0.638												
AP-14	Lead, total	mg/l	0.0075	0.638	0.638												
AP-1	Lithium	mg/l	0.04	0.05	0.05		< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
AP-2	Lithium	mg/l	0.04	0.05	0.05		< 0.05	< 0.05		< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
AP-3	Lithium	mg/l	0.04	0.05	0.05		< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
AP-4	Lithium	mg/l	0.04	0.05	0.05		< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
AP-5	Lithium	mg/l	0.04	0.05	0.05		< 0.05	< 0.05	< 0.25	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
AP-6	Lithium	mg/l	0.04	0.05	0.05												
AP-7	Lithium	mg/l	0.04	0.05	0.05												
AW-3/RW-3	Lithium	mg/l	0.04	0.05	0.05		< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
AP-8	Lithium	mg/l	0.04	0.05	0.05												
AP-9	Lithium	mg/l	0.04	0.05	0.05												
AP-10	Lithium	mg/l	0.04	0.05	0.05												
AP-11	Lithium	mg/l	0.04	0.05	0.05												
AP-12	Lithium	mg/l	0.04	0.05	0.05												
AP-13	Lithium	mg/l	0.04	0.05	0.05												
AP-14	Lithium	mg/l	0.04	0.05	0.05												

TABLE 2
CITY WATER, LIGHT AND POWER
EXISTING GROUNDWATER QUALITY

Well	Parameter	Units	35 IAC 845.600	Background AP-4 & AP-5	GWPS	2/24/2015	5/28/2015	8/20/2015	11/13/2015	2/26/2016	5/13/2016	8/4/2016	11/18/2016	2/16/2017	5/31/2017	8/2/2017	11/9/2017
AP-1	Mercury, total	mg/l	0.002	0.0008	0.002	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
AP-2	Mercury, total	mg/l	0.002	0.0008	0.002	< 0.0005	< 0.0005	< 0.0005		< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
AP-3	Mercury, total	mg/l	0.002	0.0008	0.002	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
AP-4	Mercury, total	mg/l	0.002	0.0008	0.002	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
AP-5	Mercury, total	mg/l	0.002	0.0008	0.002	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
AP-6	Mercury, total	mg/l	0.002	0.0008	0.002												
AP-7	Mercury, total	mg/l	0.002	0.0008	0.002												
AW-3/RW-3	Mercury, total	mg/l	0.002	0.0008	0.002	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
AP-8	Mercury, total	mg/l	0.002	0.0008	0.002												
AP-9	Mercury, total	mg/l	0.002	0.0008	0.002												
AP-10	Mercury, total	mg/l	0.002	0.0008	0.002												
AP-11	Mercury, total	mg/l	0.002	0.0008	0.002												
AP-12	Mercury, total	mg/l	0.002	0.0008	0.002												
AP-13	Mercury, total	mg/l	0.002	0.0008	0.002												
AP-14	Mercury, total	mg/l	0.002	0.0008	0.002												
AP-1	Molybdenum	mg/l	0.1	0.025	0.1		< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-2	Molybdenum	mg/l	0.1	0.025	0.1		< 0.025	< 0.025		< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-3	Molybdenum	mg/l	0.1	0.025	0.1		< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-4	Molybdenum	mg/l	0.1	0.025	0.1		< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-5	Molybdenum	mg/l	0.1	0.025	0.1		< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-6	Molybdenum	mg/l	0.1	0.025	0.1												
AP-7	Molybdenum	mg/l	0.1	0.025	0.1												
AW-3/RW-3	Molybdenum	mg/l	0.1	0.025	0.1		< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-8	Molybdenum	mg/l	0.1	0.025	0.1												
AP-9	Molybdenum	mg/l	0.1	0.025	0.1												
AP-10	Molybdenum	mg/l	0.1	0.025	0.1												
AP-11	Molybdenum	mg/l	0.1	0.025	0.1												
AP-12	Molybdenum	mg/l	0.1	0.025	0.1												
AP-13	Molybdenum	mg/l	0.1	0.025	0.1												
AP-14	Molybdenum	mg/l	0.1	0.025	0.1												
AP-1	Radium-226 + Radium-228	pCi/l	5	7.1	7.1	3.4	1.62	2.3	3.8	4.8	0.26	1.94	1.79	1.53	1.34	1.18	1.99
AP-2	Radium-226 + Radium-228	pCi/l	5	7.1	7.1	2.4	1.57	2		2.9	-2.01	1.46	1.19	1.25	1.38	1.01	2.17
AP-3	Radium-226 + Radium-228	pCi/l	5	7.1	7.1	2.4	1.17	2	2	2.6	-0.06	1.37	1.34	2.06	1.07	1.21	1.4
AP-4	Radium-226 + Radium-228	pCi/l	5	7.1	7.1	2	1.07	2	2	3.2	1.15	1.6	2.31	2.52	1.36	2.03	1.99
AP-5	Radium-226 + Radium-228	pCi/l	5	7.1	7.1	2	2	2	2.5	2	0.36	1.3	2.54	1.19	1.75	2.9	3.2
AP-6	Radium-226 + Radium-228	pCi/l	5	7.1	7.1												
AP-7	Radium-226 + Radium-228	pCi/l	5	7.1	7.1												
AW-3/RW-3	Radium-226 + Radium-228	pCi/l	5	7.1	7.1	2	1.11	2	2	2.6	1.57	2.33	1.53	1.16	0.8	2.51	1.48
AP-8	Radium-226 + Radium-228	pCi/l	5	7.1	7.1												
AP-9	Radium-226 + Radium-228	pCi/l	5	7.1	7.1												
AP-10	Radium-226 + Radium-228	pCi/l	5	7.1	7.1												
AP-11	Radium-226 + Radium-228	pCi/l	5	7.1	7.1												
AP-12	Radium-226 + Radium-228	pCi/l	5	7.1	7.1												
AP-13	Radium-226 + Radium-228	pCi/l	5	7.1	7.1												
AP-14	Radium-226 + Radium-228	pCi/l	5	7.1	7.1												
AP-1	Selenium, total	mg/l	0.05	0.0079	0.05	< 0.0312	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-2	Selenium, total	mg/l	0.05	0.0079	0.05	< 0.0312	< 0.025	< 0.025		< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-3	Selenium, total	mg/l	0.05	0.0079	0.05	< 0.0312	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-4	Selenium, total	mg/l	0.05	0.0079	0.05	< 0.0312	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-5	Selenium, total	mg/l	0.05	0.0079	0.05	< 0.0312	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-6	Selenium, total	mg/l	0.05	0.0079	0.05												
AP-7	Selenium, total	mg/l	0.05	0.0079	0.05												
AW-3/RW-3	Selenium, total	mg/l	0.05	0.0079	0.05	< 0.0312	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-8	Selenium, total	mg/l	0.05	0.0079	0.05												
AP-9	Selenium, total	mg/l	0.05	0.0079	0.05												
AP-10	Selenium, total	mg/l	0.05	0.0079	0.05												
AP-11	Selenium, total	mg/l	0.05	0.0079	0.05												
AP-12	Selenium, total	mg/l	0.05	0.0079	0.05												
AP-13	Selenium, total	mg/l	0.05	0.0079	0.05												
AP-14	Selenium, total	mg/l	0.05	0.0079	0.05												

TABLE 2
CITY WATER, LIGHT AND POWER
EXISTING GROUNDWATER QUALITY

Well	Parameter	Units	35 IAC 845.600	Background AP-4 & AP-5	GWPS	2/24/2015	5/28/2015	8/20/2015	11/13/2015	2/26/2016	5/13/2016	8/4/2016	11/18/2016	2/16/2017	5/31/2017	8/2/2017	11/9/2017
AP-1	Thallium, total	mg/l	0.002	0.00556	0.0056	< 0.0312	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-2	Thallium, total	mg/l	0.002	0.00556	0.0056	< 0.0312	< 0.025	< 0.025		< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-3	Thallium, total	mg/l	0.002	0.00556	0.0056	< 0.0312	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-4	Thallium, total	mg/l	0.002	0.00556	0.0056	< 0.0312	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-5	Thallium, total	mg/l	0.002	0.00556	0.0056	< 0.0312	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-6	Thallium, total	mg/l	0.002	0.00556	0.0056												
AP-7	Thallium, total	mg/l	0.002	0.00556	0.0056												
AW-3/RW-3	Thallium, total	mg/l	0.002	0.00556	0.0056	< 0.0312	< 0.025	< 0.025	< 0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
AP-8	Thallium, total	mg/l	0.002	0.00556	0.0056												
AP-9	Thallium, total	mg/l	0.002	0.00556	0.0056												
AP-10	Thallium, total	mg/l	0.002	0.00556	0.0056												
AP-11	Thallium, total	mg/l	0.002	0.00556	0.0056												
AP-12	Thallium, total	mg/l	0.002	0.00556	0.0056												
AP-13	Thallium, total	mg/l	0.002	0.00556	0.0056												
AP-14	Thallium, total	mg/l	0.002	0.00556	0.0056												
AP-1	Turbidity	NTU	NA	NA	NA												
AP-2	Turbidity	NTU	NA	NA	NA												
AP-3	Turbidity	NTU	NA	NA	NA												
AP-4	Turbidity	NTU	NA	NA	NA												
AP-5	Turbidity	NTU	NA	NA	NA												
AP-6	Turbidity	NTU	NA	NA	NA												
AP-7	Turbidity	NTU	NA	NA	NA												
AW-3/RW-3	Turbidity	NTU	NA	NA	NA												
AP-8	Turbidity	NTU	NA	NA	NA												
AP-9	Turbidity	NTU	NA	NA	NA												
AP-10	Turbidity	NTU	NA	NA	NA												
AP-11	Turbidity	NTU	NA	NA	NA												
AP-12	Turbidity	NTU	NA	NA	NA												
AP-13	Turbidity	NTU	NA	NA	NA												
AP-14	Turbidity	NTU	NA	NA	NA												

TABLE 2
CITY WATER, LIGHT AND POWER
EXISTING GROUNDWATER QUALITY

Well	Parameter	Units	35 IAC 845.600	Background AP-4 & AP-5	GWPS	5/4/2018	6/21/2018	7/9/2018	2/13/2019	8/1/2019	2/28/2020	8/5/2020	1/21/20221	5/27/2021	8/24/2021
AP-1	Boron, total	mg/l	2	0.787	2	15.8		19.1	5.03	21	18	21.5	21.7	22.10	22.00
AP-2	Boron, total	mg/l	2	0.787	2	2.94		3.63	4.21	5.62	5.23	4.95	3.67	4.42	4.73
AP-3	Boron, total	mg/l	2	0.787	2	18.5		18.8	20.7	18.7	18.5	17.5	16.8	17.10	17.3
AP-4	Boron, total	mg/l	2	0.787	2	0.117		0.128	0.11	0.0677	0.0986	0.0939	0.0996	0.0928	0.0949
AP-5	Boron, total	mg/l	2	0.787	2	0.0616		0.0585	0.0275	0.116	0.033	0.044	0.0256	< 0.02	< 0.02
AP-6	Boron, total	mg/l	2	0.787	2						0.319	0.246	0.254		0.275
AP-7	Boron, total	mg/l	2	0.787	2						0.385	0.452	0.409	0.3870	0.387
AW-3/RW-3	Boron, total	mg/l	2	0.787	2	0.188	0.214	0.203	0.191	1.6	0.293	0.185	0.169	0.1740	0.180
AP-8	Boron, total	mg/l	2	0.787	2									0.0942	0.0887
AP-9	Boron, total	mg/l	2	0.787	2										0.0836
AP-10	Boron, total	mg/l	2	0.787	2									3.65	3.43
AP-11	Boron, total	mg/l	2	0.787	2										0.262
AP-12	Boron, total	mg/l	2	0.787	2										0.0267
AP-13	Boron, total	mg/l	2	0.787	2										0.0527
AP-14	Boron, total	mg/l	2	0.787	2									23.20	23.2
AP-1	Calcium, total	mg/l	na	176.63	176.63	190		223	98.1	243	215	242	233	242	233
AP-2	Calcium, total	mg/l	na	176.63	176.63	216		262	322	335	291	287	202	289	294
AP-3	Calcium, total	mg/l	na	176.63	176.63	145		158	180	166	158	157	139	148	148
AP-4	Calcium, total	mg/l	na	176.63	176.63	121		123	146	97.2	127	125	117	128	126
AP-5	Calcium, total	mg/l	na	176.63	176.63	99.7		101	95.1	132	78.5	357	75.4	89.1	77.8
AP-6	Calcium, total	mg/l	na	176.63	176.63						85.7	68.9	62.7		68.1
AP-7	Calcium, total	mg/l	na	176.63	176.63						66.7	63.6	55.7	63.9	65
AW-3/RW-3	Calcium, total	mg/l	na	176.63	176.63	69.7	85.2	78.9	84.1	175	247	73.8	68.2	73.74	69.7
AP-8	Calcium, total	mg/l	na	176.63	176.63									102	97.4
AP-9	Calcium, total	mg/l	na	176.63	176.63										77.6
AP-10	Calcium, total	mg/l	na	176.63	176.63									152	136
AP-11	Calcium, total	mg/l	na	176.63	176.63										0
AP-12	Calcium, total	mg/l	na	176.63	176.63										213
AP-13	Calcium, total	mg/l	na	176.63	176.63										105
AP-14	Calcium, total	mg/l	na	176.63	176.63									254	219
AP-1	Chloride, total	mg/l	200	24.2	200	45.4		51.7	40.9	52.1	49	60	58	51	55
AP-2	Chloride, total	mg/l	200	24.2	200	41.6		47	39.2	37.2	35	36	39	34	19
AP-3	Chloride, total	mg/l	200	24.2	200	38.4		36.7	36	36.3	36	35	37	33	36
AP-4	Chloride, total	mg/l	200	24.2	200	12		12.2	12.8	1.9	13	14	13	13	14
AP-5	Chloride, total	mg/l	200	24.2	200	< 5		< 5	4.45	< 12.5	< 5	7	< 4	3	5
AP-6	Chloride, total	mg/l	200	24.2	200						40	27	35		34
AP-7	Chloride, total	mg/l	200	24.2	200						50	78	67	67	66
AW-3/RW-3	Chloride, total	mg/l	200	24.2	200	28.8	28.8	29.8	28.1	25.5	36	28	26	26	28
AP-8	Chloride, total	mg/l	200	24.2	200									24	26
AP-9	Chloride, total	mg/l	200	24.2	200										29
AP-10	Chloride, total	mg/l	200	24.2	200									27	32
AP-11	Chloride, total	mg/l	200	24.2	200										99
AP-12	Chloride, total	mg/l	200	24.2	200										133
AP-13	Chloride, total	mg/l	200	24.2	200										78
AP-14	Chloride, total	mg/l	200	24.2	200									45	50
AP-1	Fluoride, total	mg/l	4	0.62	4	< 0.5		< 0.5	< 0.25	0.26	0.18	0.2	0.2	0.22	
AP-2	Fluoride, total	mg/l	4	0.62	4	< 0.5		< 0.5	< 0.25	0.28	0.21	0.22	0.22	0.25	
AP-3	Fluoride, total	mg/l	4	0.62	4	< 0.5		< 0.5	< 0.25	0.28	0.19	0.23	0.21	0.23	
AP-4	Fluoride, total	mg/l	4	0.62	4	< 0.5		< 0.5	< 0.25	0.43	0.12	0.14	0.12	0.16	
AP-5	Fluoride, total	mg/l	4	0.62	4	< 0.5		< 0.5	0.3	< 0.25	0.37	0.34	0.34	0.35	
AP-6	Fluoride, total	mg/l	4	0.62	4						0.51	0.39	0.45		
AP-7	Fluoride, total	mg/l	4	0.62	4						0.55	0.62	0.58	0.59	
AW-3/RW-3	Fluoride, total	mg/l	4	0.62	4	< 0.5	0.54	0.54	0.54	< 0.25	0.32	0.45	0.42	0.49	
AP-8	Fluoride, total	mg/l	4	0.62	4									0.33	
AP-10	Fluoride, total	mg/l	4	0.62	4									0.36	
AP-14	Fluoride, total	mg/l	4	0.62	4									0.31	
AP-1	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0	6.65		6.71	7.07	6.68	6.74	6.8	6.69	6.46	6.73
AP-2	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0	6.62		6.52	6.59	6.57	6.54	6.66	6.58	6.43	6.40
AP-3	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0	6.77		6.61	6.76	6.77	6.67	6.78	6.73	6.69	6.52
AP-4	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0	7.17		7	7.01	7.07	7.01	6.67	6.97	6.74	6.92
AP-5	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0	7.23		7.05	7.42	7.32	7.46	7.36	7.27	7.05	7.08
AP-6	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0						7.11	7.45	7.21		7.10

TABLE 2
CITY WATER, LIGHT AND POWER
EXISTING GROUNDWATER QUALITY

Well	Parameter	Units	35 IAC 845.600	Background AP-4 & AP-5	GWPS	5/4/2018	6/21/2018	7/9/2018	2/13/2019	8/1/2019	2/28/2020	8/5/2020	1/21/20221	5/27/2021	8/24/2021
AP-7	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0						7.24	7.3	7.2	7.03	7.11
AW-3/RW-3	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0	7.41	7.31	6.82	7.52	7.34	7.23	7.29	7.13	7.00	6.73
AP-8	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0									6.90	6.92
AP-9	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0										6.89
AP-10	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0									6.53	6.73
AP-11	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0										6.60
AP-12	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0										6.47
AP-13	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0										6.68
AP-14	pH (field)	units	6.5-9.0	6.76-7.63	6.5-9.0									7.21	6.98
AP-1	Sulfate, total	mg/l	400	84.5	400	573		674	179	673	616	683	976	721	734
AP-2	Sulfate, total	mg/l	400	84.5	400	467		656	725	816	686	709	367	660	707
AP-3	Sulfate, total	mg/l	400	84.5	400	355		401	402	354	345	342	388	347	371
AP-4	Sulfate, total	mg/l	400	84.5	400	< 5		< 5	< 1.5	44.7	< 10	< 10	< 10	10	< 10
AP-5	Sulfate, total	mg/l	400	84.5	400	66.8		61.7	60.8	< 1.5	37	49	46	53	65
AP-6	Sulfate, total	mg/l	400	84.5	400						< 10	18	< 10		< 10
AP-7	Sulfate, total	mg/l	400	84.5	400						< 10	< 10	< 10	10	< 10
AW-3/RW-3	Sulfate, total	mg/l	400	84.5	400	23.7	15	7.81	8.45	215	27	20	15	14	14
AP-8	Sulfate, total	mg/l	400	84.5	400									10	< 10
AP-9	Sulfate, total	mg/l	400	84.5	400										35
AP-10	Sulfate, total	mg/l	400	84.5	400									99	93
AP-11	Sulfate, total	mg/l	400	84.5	400										83
AP-12	Sulfate, total	mg/l	400	84.5	400										471
AP-13	Sulfate, total	mg/l	400	84.5	400										150
AP-14	Sulfate, total	mg/l	400	84.5	400									642	680
AP-1	Total Dissolved Solids	mg/l	1200	597.94	1200	1300		1520	550	1510	1220	1320	1500	1450	1420
AP-2	Total Dissolved Solids	mg/l	1200	597.94	1200	1170		1650	1720	1860	1430	1400	1090	1390	1460
AP-3	Total Dissolved Solids	mg/l	1200	597.94	1200	894		778	1090	913	830	794	846	784	824
AP-4	Total Dissolved Solids	mg/l	1200	597.94	1200	482		500	536	416	498	480	492	486	494
AP-5	Total Dissolved Solids	mg/l	1200	597.94	1200	404		482	420	518	314	580	362	358	422
AP-6	Total Dissolved Solids	mg/l	1200	597.94	1200						630	165	388		396
AP-7	Total Dissolved Solids	mg/l	1200	597.94	1200						432	444	478	454	462
AW-3/RW-3	Total Dissolved Solids	mg/l	1200	597.94	1200	400	438	482	412	871	880	335	364	390	404
AP-8	Total Dissolved Solids	mg/l	1200	597.94	1200									512	508
AP-9	Total Dissolved Solids	mg/l	1200	597.94	1200										434
AP-10	Total Dissolved Solids	mg/l	1200	597.94	1200									724	716
AP-11	Total Dissolved Solids	mg/l	1200	597.94	1200										636
AP-12	Total Dissolved Solids	mg/l	1200	597.94	1200										1150
AP-13	Total Dissolved Solids	mg/l	1200	597.94	1200										534
AP-14	Total Dissolved Solids	mg/l	1200	597.94	1200									1250	1270
AP-1	Antimony, total	mg/l	0.006	0.016	0.016	< 0.025		< 0.025	< 0.016	< 0.016	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0010
AP-2	Antimony, total	mg/l	0.006	0.016	0.016	< 0.025		< 0.025	< 0.016	< 0.016	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0010
AP-3	Antimony, total	mg/l	0.006	0.016	0.016	< 0.025		< 0.025	< 0.016	< 0.016	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0010
AP-4	Antimony, total	mg/l	0.006	0.016	0.016	< 0.025		< 0.025	< 0.016	< 0.016	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0010
AP-5	Antimony, total	mg/l	0.006	0.016	0.016	< 0.025		< 0.025	< 0.016	< 0.016	< 0.001	0.0011	< 0.001	< 0.001	< 0.0005
AP-6	Antimony, total	mg/l	0.006	0.016	0.016						< 0.001	< 0.001	< 0.001	< 0.001	< 0.0010
AP-7	Antimony, total	mg/l	0.006	0.016	0.016						< 0.001	< 0.001	< 0.001	< 0.001	< 0.0010
AW-3/RW-3	Antimony, total	mg/l	0.006	0.016	0.016	< 0.025	< 0.025	< 0.025	< 0.016	< 0.016	< 0.004	< 0.001	< 0.001	< 0.001	< 0.0010
AP-8	Antimony, total	mg/l	0.006	0.016	0.016									< 0.001	< 0.0010
AP-9	Antimony, total	mg/l	0.006	0.016	0.016										< 0.0010
AP-10	Antimony, total	mg/l	0.006	0.016	0.016									< 0.001	< 0.0010
AP-11	Antimony, total	mg/l	0.006	0.016	0.016										< 0.0010
AP-12	Antimony, total	mg/l	0.006	0.016	0.016										< 0.0100
AP-13	Antimony, total	mg/l	0.006	0.016	0.016										< 0.0100
AP-14	Antimony, total	mg/l	0.006	0.016	0.016									< 0.001	< 0.0010

TABLE 2
CITY WATER, LIGHT AND POWER
EXISTING GROUNDWATER QUALITY

Well	Parameter	Units	35 IAC 845.600	Background AP-4 & AP-5	GWPS	5/4/2018	6/21/2018	7/9/2018	2/13/2019	8/1/2019	2/28/2020	8/5/2020	1/21/20221	5/27/2021	8/24/2021
AP-1	Arsenic, total	mg/l	0.01	0.0724	0.0724	< 0.025		< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.0250
AP-2	Arsenic, total	mg/l	0.01	0.0724	0.0724	< 0.025		< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.0250
AP-3	Arsenic, total	mg/l	0.01	0.0724	0.0724	< 0.025		< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.0250
AP-4	Arsenic, total	mg/l	0.01	0.0724	0.0724	< 0.025		< 0.025	< 0.025	< 0.025	0.0264	< 0.025	0.0359	< 0.025	< 0.0250
AP-5	Arsenic, total	mg/l	0.01	0.0724	0.0724	< 0.025		< 0.025	< 0.025	< 0.025	< 0.025	0.0937	< 0.025	< 0.025	< 0.0250
AP-6	Arsenic, total	mg/l	0.01	0.0724	0.0724						0.059	< 0.025	< 0.025	<	< 0.0250
AP-7	Arsenic, total	mg/l	0.01	0.0724	0.0724						< 0.025	0.0429	0.0415	< 0.025	< 0.0250
AW-3/RW-3	Arsenic, total	mg/l	0.01	0.0724	0.0724	0.0826	0.0935	0.136	0.124	< 0.025	0.497	0.253	0.116	0.119	0.1050
AP-8	Arsenic, total	mg/l	0.01	0.0724	0.0724									< 0.025	0.0359
AP-9	Arsenic, total	mg/l	0.01	0.0724	0.0724										< 0.0250
AP-10	Arsenic, total	mg/l	0.01	0.0724	0.0724									< 0.025	< 0.0250
AP-11	Arsenic, total	mg/l	0.01	0.0724	0.0724										< 0.0250
AP-12	Arsenic, total	mg/l	0.01	0.0724	0.0724										< 0.0250
AP-13	Arsenic, total	mg/l	0.01	0.0724	0.0724										< 0.0250
AP-14	Arsenic, total	mg/l	0.01	0.0724	0.0724									< 0.025	< 0.0250
AP-1	Barium, total	mg/l	2	5.24	5.24	0.0611		0.662	0.188	0.579	0.375	0.464	0.368	0.352	0.2040
AP-2	Barium, total	mg/l	2	5.24	5.24	0.264		0.109	0.155	0.203	0.0922	0.0994	0.0661	0.0927	0.0944
AP-3	Barium, total	mg/l	2	5.24	5.24	0.0999		0.122	0.123	0.129	0.099	0.0953	0.0858	0.0849	0.0948
AP-4	Barium, total	mg/l	2	5.24	5.24	0.356		0.359	0.416	0.0842	0.41	0.422	0.474	0.454	0.4560
AP-5	Barium, total	mg/l	2	5.24	5.24	0.0956		0.106	0.06	0.428	0.042	1.18	0.0429	0.0552	0.0473
AP-6	Barium, total	mg/l	2	5.24	5.24						0.512	0.179	0.126		0.1320
AP-7	Barium, total	mg/l	2	5.24	5.24						0.17	0.167	0.153	0.133	0.1380
AW-3/RW-3	Barium, total	mg/l	2	5.24	5.24	0.182	0.268	0.226	0.221	0.3	1.61	0.189	0.155	0.15	0.1530
AP-8	Barium, total	mg/l	2	5.24	5.24									0.363	0.3660
AP-9	Barium, total	mg/l	2	5.24	5.24										0.2960
AP-10	Barium, total	mg/l	2	5.24	5.24									0.594	0.5650
AP-11	Barium, total	mg/l	2	5.24	5.24										0.1580
AP-12	Barium, total	mg/l	2	5.24	5.24										0.2490
AP-13	Barium, total	mg/l	2	5.24	5.24										0.2620
AP-14	Barium, total	mg/l	2	5.24	5.24									0.165	0.0632
AP-1	Beryllium, total	mg/l	0.004	0.0164	0.0164	< 0.0025		< 0.0025	< 0.0025	< 0.016	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
AP-2	Beryllium, total	mg/l	0.004	0.0164	0.0164	< 0.0025		< 0.0025	< 0.0025	< 0.016	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
AP-3	Beryllium, total	mg/l	0.004	0.0164	0.0164	< 0.0025		< 0.0025	< 0.0025	< 0.016	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
AP-4	Beryllium, total	mg/l	0.004	0.0164	0.0164	< 0.0025		< 0.0025	< 0.0025	< 0.016	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
AP-5	Beryllium, total	mg/l	0.004	0.0164	0.0164	< 0.0025		< 0.0025	< 0.0025	< 0.016	< 0.0005	0.0084	< 0.0005	< 0.0005	< 0.0005
AP-6	Beryllium, total	mg/l	0.004	0.0164	0.0164						0.0056	0.0007	< 0.0005		< 0.0005
AP-7	Beryllium, total	mg/l	0.004	0.0164	0.0164						< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
AW-3/RW-3	Beryllium, total	mg/l	0.004	0.0164	0.0164	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.016	0.0278	< 0.0005	< 0.0005	< 0.0005	< 0.0005
AP-8	Beryllium, total	mg/l	0.004	0.0164	0.0164									< 0.0005	< 0.0005
AP-9	Beryllium, total	mg/l	0.004	0.0164	0.0164										< 0.0005
AP-10	Beryllium, total	mg/l	0.004	0.0164	0.0164									< 0.0005	< 0.0005
AP-11	Beryllium, total	mg/l	0.004	0.0164	0.0164										< 0.0005
AP-12	Beryllium, total	mg/l	0.004	0.0164	0.0164										0.0023
AP-13	Beryllium, total	mg/l	0.004	0.0164	0.0164										0.0020
AP-14	Beryllium, total	mg/l	0.004	0.0164	0.0164									0.0011	< 0.0005
AP-1	Cadmium, total	mg/l	0.005	0.0128	0.0128	< 0.0025		< 0.0025	< 0.0025	< 0.012	< 0.002	< 0.002	< 0.002	< 0.002	< 0.0020
AP-2	Cadmium, total	mg/l	0.005	0.0128	0.0128	< 0.0025		< 0.0025	< 0.0025	< 0.012	< 0.002	< 0.002	< 0.002	< 0.002	< 0.0020
AP-3	Cadmium, total	mg/l	0.005	0.0128	0.0128	< 0.0025		< 0.0025	< 0.0025	< 0.012	< 0.002	< 0.002	< 0.002	< 0.002	< 0.0020
AP-4	Cadmium, total	mg/l	0.005	0.0128	0.0128	< 0.0025		< 0.0025	< 0.0025	< 0.012	< 0.002	< 0.002	< 0.002	< 0.002	< 0.0020
AP-5	Cadmium, total	mg/l	0.005	0.0128	0.0128	< 0.0025		< 0.0025	< 0.0025	< 0.012	< 0.002	0.005	< 0.002	< 0.002	< 0.0020
AP-6	Cadmium, total	mg/l	0.005	0.0128	0.0128						< 0.002	< 0.002	< 0.002		< 0.0020
AP-7	Cadmium, total	mg/l	0.005	0.0128	0.0128						< 0.002	< 0.002	< 0.002	< 0.002	< 0.0020
AW-3/RW-3	Cadmium, total	mg/l	0.005	0.0128	0.0128	< 0.0025	< 0.0025	< 0.0025	< 0.0025	< 0.012	0.0059	< 0.002	< 0.002	< 0.002	< 0.0020
AP-8	Cadmium, total	mg/l	0.005	0.0128	0.0128									< 0.002	< 0.0020
AP-9	Cadmium, total	mg/l	0.005	0.0128	0.0128										< 0.0020
AP-10	Cadmium, total	mg/l	0.005	0.0128	0.0128									< 0.002	< 0.0020
AP-11	Cadmium, total	mg/l	0.005	0.0128	0.0128										< 0.0020
AP-12	Cadmium, total	mg/l	0.005	0.0128	0.0128										< 0.0020
AP-13	Cadmium, total	mg/l	0.005	0.0128	0.0128										< 0.0020
AP-14	Cadmium, total	mg/l	0.005	0.0128	0.0128									< 0.002	< 0.0020

TABLE 2
CITY WATER, LIGHT AND POWER
EXISTING GROUNDWATER QUALITY

Well	Parameter	Units	35 IAC 845.600	Background AP-4 & AP-5	GWPS	5/4/2018	6/21/2018	7/9/2018	2/13/2019	8/1/2019	2/28/2020	8/5/2020	1/21/20221	5/27/2021	8/24/2021
AP-1	Chromium, total	mg/l	0.1	0.811	0.811	< 0.025		< 0.025	< 0.025	< 0.025	< 0.005	< 0.005	< 0.005	< 0.0050	< 0.0050
AP-2	Chromium, total	mg/l	0.1	0.811	0.811	< 0.025		< 0.025	< 0.025	< 0.025	< 0.005	< 0.005	< 0.005	< 0.0050	< 0.0050
AP-3	Chromium, total	mg/l	0.1	0.811	0.811	< 0.025		< 0.025	< 0.025	< 0.025	< 0.005	< 0.005	< 0.005	< 0.0050	< 0.0050
AP-4	Chromium, total	mg/l	0.1	0.811	0.811	< 0.025		< 0.025	< 0.025	< 0.025	< 0.005	< 0.005	< 0.005	0.0062	0.0068
AP-5	Chromium, total	mg/l	0.1	0.811	0.811	< 0.025		< 0.025	< 0.025	< 0.025	< 0.005	0.198	< 0.005	< 0.0050	< 0.0050
AP-6	Chromium, total	mg/l	0.1	0.811	0.811						0.147	0.0151	< 0.005		< 0.0050
AP-7	Chromium, total	mg/l	0.1	0.811	0.811						< 0.005	< 0.005	< 0.005	< 0.0050	< 0.0050
AW-3/RW-3	Chromium, total	mg/l	0.1	0.811	0.811	< 0.025	0.0413	< 0.025	< 0.025	< 0.025	0.807	0.0052	< 0.005	< 0.0050	< 0.0050
AP-8	Chromium, total	mg/l	0.1	0.811	0.811									< 0.0050	< 0.0050
AP-9	Chromium, total	mg/l	0.1	0.811	0.811										< 0.0050
AP-10	Chromium, total	mg/l	0.1	0.811	0.811									0.0067	< 0.0050
AP-11	Chromium, total	mg/l	0.1	0.811	0.811										0.0068
AP-12	Chromium, total	mg/l	0.1	0.811	0.811										0.0608
AP-13	Chromium, total	mg/l	0.1	0.811	0.811										< 0.0020
AP-14	Chromium, total	mg/l	0.1	0.811	0.811									0.0290	< 0.0050
AP-1	Cobalt, total	mg/l	0.006	0.297	0.297	< 0.025		< 0.025	< 0.025	< 0.025	< 0.005	< 0.005	< 0.005	< 0.0050	< 0.0050
AP-2	Cobalt, total	mg/l	0.006	0.297	0.297	< 0.025		< 0.025	< 0.025	< 0.025	0.0134	0.0139	0.0097	0.0135	0.0131
AP-3	Cobalt, total	mg/l	0.006	0.297	0.297	< 0.025		< 0.025	< 0.025	< 0.025	0.0058	< 0.005	< 0.005	< 0.0050	< 0.0050
AP-4	Cobalt, total	mg/l	0.006	0.297	0.297	< 0.025		< 0.025	< 0.025	< 0.025	< 0.005	< 0.005	< 0.005	0.0052	< 0.0050
AP-5	Cobalt, total	mg/l	0.006	0.297	0.297	< 0.025		< 0.025	< 0.025	< 0.025	< 0.005	0.134	< 0.005	< 0.0050	< 0.0050
AP-6	Cobalt, total	mg/l	0.006	0.297	0.297						0.089	0.0106	< 0.005		< 0.0050
AP-7	Cobalt, total	mg/l	0.006	0.297	0.297						< 0.005	< 0.005	< 0.005	< 0.0050	< 0.0050
AW-3/RW-3	Cobalt, total	mg/l	0.006	0.297	0.297	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	0.453	< 0.005	< 0.005	< 0.0050	< 0.0050
AP-8	Cobalt, total	mg/l	0.006	0.297	0.297									< 0.0050	< 0.0050
AP-9	Cobalt, total	mg/l	0.006	0.297	0.297										< 0.0050
AP-10	Cobalt, total	mg/l	0.006	0.297	0.297									< 0.0050	< 0.0050
AP-11	Cobalt, total	mg/l	0.006	0.297	0.297										< 0.0050
AP-12	Cobalt, total	mg/l	0.006	0.297	0.297										0.0356
AP-13	Cobalt, total	mg/l	0.006	0.297	0.297										0.0400
AP-14	Cobalt, total	mg/l	0.006	0.297	0.297									0.0143	< 0.0050
AP-1	Lead, total	mg/l	0.0075	0.638	0.638	< 0.025		< 0.025	< 0.025	< 0.025	< 0.015	< 0.015	< 0.015	< 0.0150	< 0.0150
AP-2	Lead, total	mg/l	0.0075	0.638	0.638	< 0.025		< 0.025	< 0.025	< 0.025	< 0.015	< 0.015	< 0.015	< 0.0150	< 0.0150
AP-3	Lead, total	mg/l	0.0075	0.638	0.638	< 0.025		< 0.025	< 0.025	< 0.025	< 0.015	< 0.015	< 0.015	< 0.0150	< 0.0150
AP-4	Lead, total	mg/l	0.0075	0.638	0.638	< 0.025		< 0.025	< 0.025	< 0.025	< 0.015	< 0.015	< 0.015	< 0.0150	< 0.0150
AP-5	Lead, total	mg/l	0.0075	0.638	0.638	< 0.025		< 0.025	< 0.025	< 0.025	< 0.015	0.132	< 0.015	< 0.0150	< 0.0150
AP-6	Lead, total	mg/l	0.0075	0.638	0.638						0.0769	< 0.015	< 0.015		< 0.0150
AP-7	Lead, total	mg/l	0.0075	0.638	0.638						< 0.015	< 0.015	< 0.015	< 0.0150	< 0.0150
AW-3/RW-3	Lead, total	mg/l	0.0075	0.638	0.638	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	0.442	< 0.015	< 0.015	< 0.0150	< 0.0150
AP-8	Lead, total	mg/l	0.0075	0.638	0.638									< 0.0150	< 0.0150
AP-9	Lead, total	mg/l	0.0075	0.638	0.638										< 0.0150
AP-10	Lead, total	mg/l	0.0075	0.638	0.638									< 0.0150	< 0.0150
AP-11	Lead, total	mg/l	0.0075	0.638	0.638										< 0.0150
AP-12	Lead, total	mg/l	0.0075	0.638	0.638										< 0.0342
AP-13	Lead, total	mg/l	0.0075	0.638	0.638										< 0.0277
AP-14	Lead, total	mg/l	0.0075	0.638	0.638									< 0.0169	< 0.0150
AP-1	Lithium	mg/l	0.04	0.05	0.05	0.00912		0.0142	< 0.05	< 0.05	0.0104	0.0098	0.0101	0.0092	0.0100
AP-2	Lithium	mg/l	0.04	0.05	0.05	0.00725		0.00762	< 0.05	< 0.05	0.0065	0.0071	0.0063	0.0057	0.0068
AP-3	Lithium	mg/l	0.04	0.05	0.05	0.006		0.00675	< 0.05	< 0.05	0.006	0.0051	0.0052	< 0.0050	< 0.0050
AP-4	Lithium	mg/l	0.04	0.05	0.05	0.00712		0.00775	< 0.05	< 0.05	0.0071	0.0071	0.0087	0.0108	0.0113
AP-5	Lithium	mg/l	0.04	0.05	0.05	0.0125		0.0131	< 0.05	< 0.05	< 0.005	0.143	< 0.005	0.006	0.0068
AP-6	Lithium	mg/l	0.04	0.05	0.05						0.153	0.0195	0.0081		0.0080
AP-7	Lithium	mg/l	0.04	0.05	0.05						0.0115	0.0137	0.0112	0.0098	0.0101
AW-3/RW-3	Lithium	mg/l	0.04	0.05	0.05	0.0119	0.0359	0.0315	< 0.05	< 0.05	0.771	0.0098	0.0071	0.0068	0.0066
AP-8	Lithium	mg/l	0.04	0.05	0.05									0.0077	0.0072
AP-9	Lithium	mg/l	0.04	0.05	0.05										0.0054
AP-10	Lithium	mg/l	0.04	0.05	0.05									0.0145	0.0091
AP-11	Lithium	mg/l	0.04	0.05	0.05										0.0104
AP-12	Lithium	mg/l	0.04	0.05	0.05										0.0546
AP-13	Lithium	mg/l	0.04	0.05	0.05										0.0610
AP-14	Lithium	mg/l	0.04	0.05	0.05									0.0253	0.0100

TABLE 2
CITY WATER, LIGHT AND POWER
EXISTING GROUNDWATER QUALITY

Well	Parameter	Units	35 IAC 845.600	Background AP-4 & AP-5	GWPS	5/4/2018	6/21/2018	7/9/2018	2/13/2019	8/1/2019	2/28/2020	8/5/2020	1/21/20221	5/27/2021	8/24/2021
AP-1	Mercury, total	mg/l	0.002	0.0008	0.002	< 0.0005		< 0.0005	< 0.0005	< 0.0005	< 0.0002	< 0.0002	< 0.0002	< 0.00020	< 0.00020
AP-2	Mercury, total	mg/l	0.002	0.0008	0.002	< 0.0005		< 0.0005	< 0.0005	< 0.0005	< 0.0002	< 0.0002	< 0.0002	< 0.00020	< 0.00020
AP-3	Mercury, total	mg/l	0.002	0.0008	0.002	< 0.0005		< 0.0005	< 0.0005	< 0.0005	< 0.0002	< 0.0002	< 0.0002	< 0.00020	< 0.00020
AP-4	Mercury, total	mg/l	0.002	0.0008	0.002	< 0.0005		< 0.0005	< 0.0005	< 0.0005	< 0.0002	< 0.0002	< 0.0002	< 0.00020	< 0.00020
AP-5	Mercury, total	mg/l	0.002	0.0008	0.002	< 0.0005		< 0.0005	< 0.0005	< 0.0005	< 0.0002	0.0003	< 0.0002	< 0.00020	< 0.00020
AP-6	Mercury, total	mg/l	0.002	0.0008	0.002						< 0.0002	< 0.0002	< 0.0002		< 0.00020
AP-7	Mercury, total	mg/l	0.002	0.0008	0.002						< 0.0002	< 0.0002	< 0.0002	< 0.00020	< 0.00020
AW-3/RW-3	Mercury, total	mg/l	0.002	0.0008	0.002	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0005	< 0.0002	< 0.0002	< 0.00020	< 0.00020
AP-8	Mercury, total	mg/l	0.002	0.0008	0.002									< 0.00020	< 0.00020
AP-9	Mercury, total	mg/l	0.002	0.0008	0.002										< 0.00020
AP-10	Mercury, total	mg/l	0.002	0.0008	0.002									< 0.00020	< 0.00020
AP-11	Mercury, total	mg/l	0.002	0.0008	0.002										< 0.00020
AP-12	Mercury, total	mg/l	0.002	0.0008	0.002										< 0.00020
AP-13	Mercury, total	mg/l	0.002	0.0008	0.002										< 0.00020
AP-14	Mercury, total	mg/l	0.002	0.0008	0.002									< 0.00020	< 0.00020
AP-1	Molybdenum	mg/l	0.1	0.025	0.1	< 0.025		< 0.025	< 0.025	< 0.025	< 0.01	< 0.01	< 0.01	< 0.0100	< 0.0100
AP-2	Molybdenum	mg/l	0.1	0.025	0.1	< 0.025		< 0.025	< 0.025	< 0.025	< 0.01	< 0.01	< 0.01	< 0.0100	< 0.0100
AP-3	Molybdenum	mg/l	0.1	0.025	0.1	< 0.025		< 0.025	< 0.025	< 0.025	< 0.01	< 0.01	< 0.01	< 0.0100	< 0.0100
AP-4	Molybdenum	mg/l	0.1	0.025	0.1	< 0.025		< 0.025	< 0.025	< 0.025	< 0.01	< 0.01	< 0.01	< 0.0100	< 0.0100
AP-5	Molybdenum	mg/l	0.1	0.025	0.1	< 0.025		< 0.025	< 0.025	< 0.025	< 0.01	< 0.01	< 0.01	< 0.0100	< 0.0100
AP-6	Molybdenum	mg/l	0.1	0.025	0.1						< 0.01	< 0.01	< 0.01		< 0.0100
AP-7	Molybdenum	mg/l	0.1	0.025	0.1						0.0119	0.0106	< 0.01	< 0.0100	< 0.0100
AW-3/RW-3	Molybdenum	mg/l	0.1	0.025	0.1	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	0.022	0.0116	0.0109	0.0105	< 0.0100
AP-8	Molybdenum	mg/l	0.1	0.025	0.1									< 0.0100	< 0.0100
AP-9	Molybdenum	mg/l	0.1	0.025	0.1										< 0.0100
AP-10	Molybdenum	mg/l	0.1	0.025	0.1									< 0.0100	< 0.0100
AP-11	Molybdenum	mg/l	0.1	0.025	0.1										< 0.0100
AP-12	Molybdenum	mg/l	0.1	0.025	0.1										< 0.0100
AP-13	Molybdenum	mg/l	0.1	0.025	0.1										< 0.0100
AP-14	Molybdenum	mg/l	0.1	0.025	0.1									< 0.0100	< 0.0100
AP-1	Radium-226 + Radium-228	pCi/l	5	7.1	7.1	4.1		1.96	0.93	1.85	1.37	2.86	0.377	1.088	0.8400
AP-2	Radium-226 + Radium-228	pCi/l	5	7.1	7.1	2.15		1.35	2.61	1.134	0.657	1.73	1.66	1.33	1.0080
AP-3	Radium-226 + Radium-228	pCi/l	5	7.1	7.1	1.83		1.15	2.48	1.51	0.73	0.185	0.926	0.457	0.2528
AP-4	Radium-226 + Radium-228	pCi/l	5	7.1	7.1	1.5		2.36	2.57	0.59	1.47	1.96	1.96	2.38	0.4489
AP-5	Radium-226 + Radium-228	pCi/l	5	7.1	7.1	1.61		1.63	0.83	1.25	0.455	5.87	0.869	0.0571	1.5200
AP-6	Radium-226 + Radium-228	pCi/l	5	7.1	7.1						9.45	3.03	0.309	0.677	0.3600
AP-7	Radium-226 + Radium-228	pCi/l	5	7.1	7.1						1.12	1.07	1.09	0.914	0.6570
AW-3/RW-3	Radium-226 + Radium-228	pCi/l	5	7.1	7.1	2.49	2.02	3.16	1.1	0.794	18	3.81	1.37	0.573	0.7380
AP-8	Radium-226 + Radium-228	pCi/l	5	7.1	7.1									1.573	2.7900
AP-9	Radium-226 + Radium-228	pCi/l	5	7.1	7.1										
AP-10	Radium-226 + Radium-228	pCi/l	5	7.1	7.1									1.61	2.3900
AP-11	Radium-226 + Radium-228	pCi/l	5	7.1	7.1										
AP-12	Radium-226 + Radium-228	pCi/l	5	7.1	7.1										
AP-13	Radium-226 + Radium-228	pCi/l	5	7.1	7.1										
AP-14	Radium-226 + Radium-228	pCi/l	5	7.1	7.1									1.127	0.8070
AP-1	Selenium, total	mg/l	0.05	0.0079	0.05	< 0.025		< 0.025	< 0.025	< 0.025	< 0.001	< 0.001	< 0.001	< 0.0010	< 0.0010
AP-2	Selenium, total	mg/l	0.05	0.0079	0.05	< 0.025		< 0.025	< 0.025	< 0.025	< 0.001	< 0.001	< 0.001	< 0.0010	< 0.0010
AP-3	Selenium, total	mg/l	0.05	0.0079	0.05	< 0.025		< 0.025	< 0.025	< 0.025	< 0.001	< 0.001	< 0.001	< 0.0010	< 0.0010
AP-4	Selenium, total	mg/l	0.05	0.0079	0.05	< 0.025		< 0.025	< 0.025	< 0.025	< 0.001	< 0.001	< 0.001	< 0.0010	< 0.0010
AP-5	Selenium, total	mg/l	0.05	0.0079	0.05	< 0.025		< 0.025	< 0.025	< 0.025	< 0.001	< 0.001	< 0.001	< 0.0010	< 0.0005
AP-6	Selenium, total	mg/l	0.05	0.0079	0.05						< 0.001	< 0.001	< 0.001		< 0.0010
AP-7	Selenium, total	mg/l	0.05	0.0079	0.05						< 0.001	< 0.001	< 0.001	< 0.0010	< 0.0010
AW-3/RW-3	Selenium, total	mg/l	0.05	0.0079	0.05	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.001	< 0.001	< 0.001	< 0.0010	< 0.0010
AP-8	Selenium, total	mg/l	0.05	0.0079	0.05									< 0.0010	< 0.0010
AP-9	Selenium, total	mg/l	0.05	0.0079	0.05										< 0.0010
AP-10	Selenium, total	mg/l	0.05	0.0079	0.05									< 0.0010	< 0.0010
AP-11	Selenium, total	mg/l	0.05	0.0079	0.05										< 0.0010
AP-12	Selenium, total	mg/l	0.05	0.0079	0.05										< 0.0010
AP-13	Selenium, total	mg/l	0.05	0.0079	0.05										< 0.0010
AP-14	Selenium, total	mg/l	0.05	0.0079	0.05									< 0.0010	< 0.0010

TABLE 2
CITY WATER, LIGHT AND POWER
EXISTING GROUNDWATER QUALITY

Well	Parameter	Units	35 IAC 845.600	Background AP-4 & AP-5	GWPS	5/4/2018	6/21/2018	7/9/2018	2/13/2019	8/1/2019	2/28/2020	8/5/2020	1/21/20221	5/27/2021	8/24/2021
AP-1	Thallium, total	mg/l	0.002	0.00556	0.0056	< 0.025		< 0.025	< 0.005	< 0.005	< 0.002	< 0.002	< 0.002	< 0.0020	0.0031
AP-2	Thallium, total	mg/l	0.002	0.00556	0.0056	< 0.025		< 0.025	< 0.005	< 0.005	< 0.002	< 0.002	< 0.002	< 0.0020	< 0.0020
AP-3	Thallium, total	mg/l	0.002	0.00556	0.0056	< 0.025		< 0.025	< 0.005	< 0.005	< 0.002	< 0.002	< 0.002	< 0.0020	< 0.0020
AP-4	Thallium, total	mg/l	0.002	0.00556	0.0056	< 0.025		< 0.025	< 0.005	< 0.005	< 0.002	< 0.002	< 0.002	< 0.0020	< 0.0020
AP-5	Thallium, total	mg/l	0.002	0.00556	0.0056	< 0.025		< 0.025	< 0.005	< 0.005	< 0.002	< 0.002	< 0.002	< 0.0020	0.0019
AP-6	Thallium, total	mg/l	0.002	0.00556	0.0056						< 0.002	< 0.002	< 0.002		< 0.0020
AP-7	Thallium, total	mg/l	0.002	0.00556	0.0056						< 0.002	< 0.002	< 0.002	< 0.0020	0.0026
AW-3/RW-3	Thallium, total	mg/l	0.002	0.00556	0.0056	< 0.025	< 0.025	< 0.025	< 0.005	< 0.005	< 0.008	< 0.002	< 0.002	< 0.0020	< 0.0020
AP-8	Thallium, total	mg/l	0.002	0.00556	0.0056									0.0020	< 0.0020
AP-9	Thallium, total	mg/l	0.002	0.00556	0.0056										< 0.0020
AP-10	Thallium, total	mg/l	0.002	0.00556	0.0056									0.0027	< 0.0020
AP-11	Thallium, total	mg/l	0.002	0.00556	0.0056										< 0.0020
AP-12	Thallium, total	mg/l	0.002	0.00556	0.0056										< 0.0200
AP-13	Thallium, total	mg/l	0.002	0.00556	0.0056										< 0.0200
AP-14	Thallium, total	mg/l	0.002	0.00556	0.0056									0.0020	< 0.0020
AP-1	Turbidity	NTU	NA	NA	NA										15.73
AP-2	Turbidity	NTU	NA	NA	NA										9.95
AP-3	Turbidity	NTU	NA	NA	NA										6.58
AP-4	Turbidity	NTU	NA	NA	NA										93.21
AP-5	Turbidity	NTU	NA	NA	NA										4.98
AP-6	Turbidity	NTU	NA	NA	NA										9.11
AP-7	Turbidity	NTU	NA	NA	NA										6.79
AW-3/RW-3	Turbidity	NTU	NA	NA	NA										15.43
AP-8	Turbidity	NTU	NA	NA	NA										7.77
AP-9	Turbidity	NTU	NA	NA	NA										18.61
AP-10	Turbidity	NTU	NA	NA	NA										15.73
AP-11	Turbidity	NTU	NA	NA	NA										45.77
AP-12	Turbidity	NTU	NA	NA	NA										1580.98
AP-13	Turbidity	NTU	NA	NA	NA										1267.13
AP-14	Turbidity	NTU	NA	NA	NA										57.82

Notes:
1. Yellow shading indicates an exceedence of the GWPS.

2. Constituents with method detection limits above the GWPS that were non-detect are not interpreted as an exceedance.

3. Section 845.600 requires Radium-226 and Radium-228 concentrations to be combined, with a GWPS of 5 pCi/L. However, these parameters require two separate analysis and have been reported separately by the analytical laboratory individually. The sum of the values has been provided and compared to the GWPS. Background values have been calculated for the individual parameters. A value of 7.1 pCi/L was calculated for Radium 226. Therefore, 7.1 pCi/L is listed as the GWPS for Radium 226 and 228 combined.

4. Well AW-3 was replaced by well RW-3 prior to the May 2018 monitoring event.

5. "<" indicates no detection at the concentration listed.

6. A blank space indicates testing was not conducted on the parameter. The well may not have been installed at that time.

ATTACHMENT 12 – INITIAL POST CLOSURE CARE PLAN

City Water, Light & Power
Ash Impoundments
Springfield, Sangamon County, Illinois

Post-Closure Plan for Coal Combustion Residuals Surface Impoundments

October 2021

Prepared for:
City Water, Light & Power
3100 Stevenson Drive
Springfield, Illinois 62703

ANDREWS ENGINEERING

3300 Ginger Creek Drive, Springfield, IL 62711 | 217.787.2334

ILLINOIS | MISSOURI | INDIANA

TABLE OF CONTENTS

APPENDICES

1. INTRODUCTION

City Water, Light and Power (CWLP) Lakeside Ash Pond and Dallman Ash Pond are coal combustion residuals (CCR) surface impoundments. The locations of these CCR units are shown in Appendix A of this Plan. This post-closure plan was prepared according to the requirements under 35 IAC Part 845.780(d):

In accordance with the post-closure care regulations, the operator is responsible for maintaining and monitoring the CCR units for a minimum 30-year period following the closure of the unit. The items that must be contained in the Post-Closure Plan include procedures for: (1) Maintaining the integrity and effectiveness of the final cover system, including making repairs to the final cover as necessary to correct the effects of settlement, subsidence, erosion, or other events, and preventing run-on and run-off from eroding or otherwise damaging the final cover; and (2) Maintaining the groundwater monitoring system and monitoring the groundwater in accordance with the requirements of 35 IAC Parts 846.630 through 846.650. Each of these individual aspects is detailed in this Post-Closure Plan. This Plan shall be implemented when all items in the Closure Plan have been completed and certified.

2. POST-CLOSURE PLAN

2.1 Inspection and Maintenance

The purpose of the inspections and maintenance is to ensure proper functioning of all items that remain after closure. The inspections and maintenance are discussed in more detail in the following sections.

2.1.1 Inspections

A walking, visual inspection of the entire site should be conducted at least quarterly with a written record of the inspection made and preserved. The inspector will assess the condition and the need for repair of final cover, vegetation, fencing, monitoring devices, and drainage structures. These inspections will be conducted at least quarterly for a minimum of five years after closure. After five years, the operator may reduce the frequency to annual inspections until settling has stopped and there are no eroded or scoured areas visible. Annual inspections must be continued for a minimum of 30 years after closure, i.e., the entire proposed post-closure care period. Inspections will be conducted as necessary, particularly subsequent to heavy precipitation events. Each inspection shall be documented and the records kept at the facility office.

In general, the following guidelines will be followed when assessing the need for remedial actions/maintenance:

a) All rills, gullies, and crevices six inches or deeper in the final cover will be filled. Areas identified by the operator as particularly susceptible to erosion may be recontoured to alleviate the problem.

b) All reworked surfaces, and areas with failed or eroded vegetation in excess of 100 square feet cumulatively, shall be revegetated in accordance with the approved Closure Plan.

c) Brush, trees, or similar vegetation with tap roots growing in areas not so designated will be controlled.

d) Holes and depressions created by settling will be filled and recontoured so as to prevent standing water.

e) Eroded and scoured drainage channels will be repaired and lining material will be replaced if necessary.

If the final cover system requires significant repair or augmentation, such activities will be conducted pursuant to Section 2.3 of the Closure Plan, including soils types, regrading and compaction, testing, and certification.

2.1.2 Maintenance

Erosion and differential settlement may cause the need for cover repairs. The majority of settlement should be realized prior to the placement of the final cover system. Any areas where ponding occurs or erosion cuts appear will be promptly repaired in order to maintain the integrity of the final cover system as described in the Closure Plan. While recently filled and covered areas will require the most maintenance, the disposal unit will stabilize with time such that little, if any, maintenance will ultimately be required. Earthen material for cover repairs will be made available from predetermined borrow areas proximate to the waste unit.

All maintenance conducted at the site will be documented; records will be retained at the facility office.

2.1.3 Groundwater Monitoring

The ash ponds are existing CCR Units and must initiate a groundwater sampling and analysis program by October 17, 2017. A groundwater monitoring program installed around the surface impoundments was approved by the Illinois EPA, Bureau of Water in December, 2011. This groundwater monitoring will continue for a minimum period of 30 years after closure pursuant to 35 IAC 845.780(c)

The exterior condition of all groundwater monitoring devices will be inspected quarterly during the quarterly site inspections referenced in Section 2.1.1 above. The inspection will include the condition of the concrete cap, protective casing and lock, and the condition of the area immediately surrounding the device. The monitoring devices will be further inspected at the time of sampling, which will include the well casing and cap. The inspections shall be recorded, as well as any maintenance conducted at a device.

2.2 Contact Information

The name, address, telephone number, and email address of the person or office to contact about the facility during the post-closure care period is:

P.J. Becker
City Water Light and Power
201 E. Lake Shore Drive
Springfield Illinois 62712
(217) 757-8610 ext 1110

PJ.Becker@cwlp.com

2.3 Final Cover System

The final end use of the closed ash ponds is planned to be a natural area with passive vegetation and native grasses. The end use is planned to serve as open space that will not disturb the integrity of the final cover, liner, environmental systems, or monitoring equipment.

3. STATEMENT

This Post-Closure Plan for Coal Combustion Residuals Surface Impoundments was completed for CWLP by Andrews Engineering, Inc. in accordance with the requirements under 35 IAC Part 845.780.

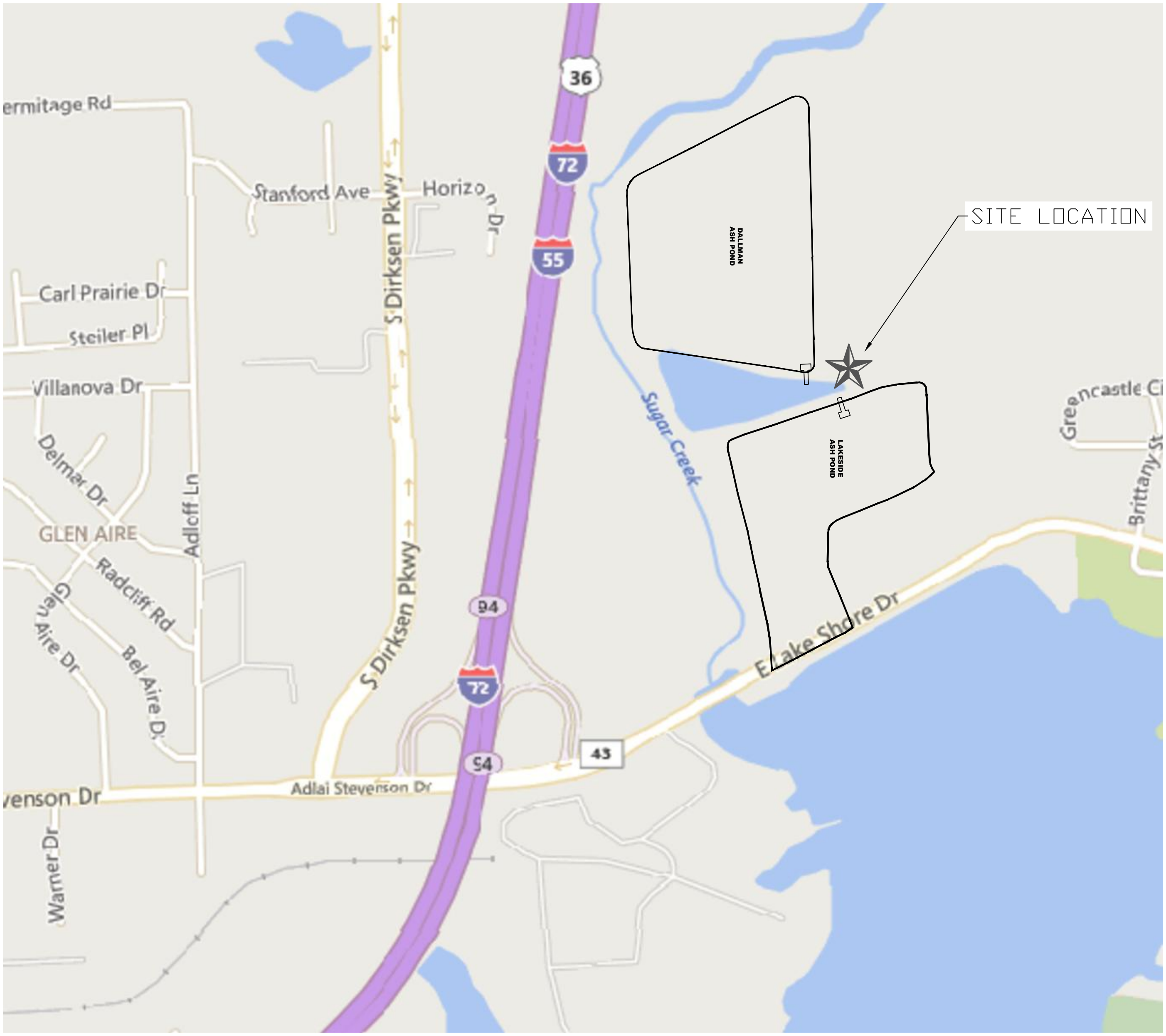
10-20-21

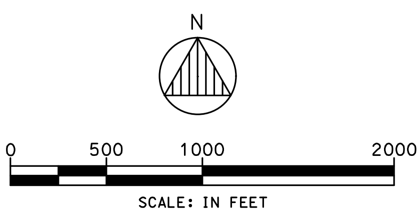
Paul M. Van Metre, P.E. Date

STATE OF ILLINOIS
PAUL
VAN METRE
062-064175
REGISTERED
PROFESSIONAL ENGINEER

APPENDIX A

Site Map





NOTE:
BASE IMAGE DERIVED FROM BING

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Professional Design Engineering and Land Surveying Firm #184-001541

SITE LOCATION MAP

PLANS PREPARED FOR

CWLP

SPRINGFIELD, SANGAMON COUNTY, ILLINOIS

DATE: OCTOBER 2016

PROJECT ID: 150077/0011

SHEET NUMBER:

FIG. 1

APPROVED BY: PMV | DESIGNED BY: PMV | DRAWN BY: RMC

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PROFESSIONAL DESIGN ENGINEERING AND LAND SURVEYING FIRM #184-001541

APPROVED BY: PMV DESIGNED BY: PMV DRAWN BY: MPN

CWLP COAL COMBUSTION RESIDUALS SURFACE IMPOUNDMENTS

PLANS PREPARED FOR
CITY, WATER, LIGHT & POWER
SPRINGFIELD, SANGAMON COUNTY, ILLINOIS

DATE: OCTOBER 2016
PROJECT ID: 150077/0011
SHEET NUMBER:
FIG. 2

J:\S\Springfield CWLP\CWLP\dwg\SURFACE IMPOUNDMENTS.dwg Tab: FIGURE 2 (2) Last Saved: October 6, 2016, by Ryan Curtis Plotted: Thursday, October 06, 2016 8:24:42 AM

ATTACHMENT 13 – LINER STATUS CERTIFICATION

City Water, Light & Power
Ash Impoundments
Springfield, Sangamon County, Illinois

Liner Status Report for Coal Combustion Residuals Surface Impoundments

October 2021

Prepared for:
City Water, Light & Power
3100 Stevenson Drive
Springfield, Illinois 62703

ANDREWS ENGINEERING

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ILLINOIS | MISSOURI | INDIANA

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1. INTRODUCTION

City Water, Light and Power (CWLP) ash ponds are coal combustion residuals (CCR) surface impoundments, which include both the Lakeside and Dallman ash ponds. A review of the construction history for the CCR surface impoundments was conducted as required by 35 IAC Part 845.400:

Andrews Engineering, Inc. (AEI) performed the review of information, which included the following documents:

- Coal Ash Impoundment Site Assessment Final Report (May 2011)
- Historical Aerial Photographs (April 1995 – March 2014)
- Engineering Report: Proposed Embankment Modification; CWLP Ash Disposal Area (July 1987)
- Construction Grading Plan for the Dallman Ash Pond (August 1976)

2. CCR UNIT INFORMATION

Both the Lakeside Ash Pond and the Dallman Ash Pond are owned and operated by CWLP. The ponds are operated under National Pollutant Discharge Elimination System (NPDES) Permit Number IL0024767.

The Lakeside Ash Pond is primarily a diked embankment with some incising along the east perimeter and was placed into service prior to 1958. The Lakeside Ash Pond ceased receiving ash in 2009. It has been divided into four separate ponds, three lime softening ponds and the settling pond consisting of approximately 35.0 acres in total.

The second impoundment, the Dallman Ash Pond, which is a diked embankment, was placed into service in approximately 1976 and is approximately 34.5 acres. Fly ash and bottom ash are sluiced to the Dallman Ash Pond with raw lake water.

Pursuant to the aforementioned NPDES permit, settled water from both the Dallman Ash Pond and Lakeside Ash Pond flow into opposite sides of a Clarification Pond before being discharged to Sugar Creek at Outfall 004.

3. CONSTRUCTION

The ash ponds were constructed on in-place soils within the Sugar Creek floodplain. The Sugar Creek historically meandered across the site, generally from the south to the north. During the construction of the ash ponds, the creek was abandoned and relocated to the west of the site. The old creek bed was filled with different types of soil, ranging from cohesive soils characterized as silty clays, to granular fill characterized as poorly graded silty to clayey sands. Most of the soil analysis was performed during hydrogeological investigations performed for the east adjacent CCR landfill.

The cohesive soils of the creek fill were tested and exhibited a range of hydraulic conductivity from 7.6×10^{-8} cm/sec to 2.1×10^{-5} cm/sec. The upper layer of soil at the site consists of mainly brown, light brown, and brownish-gray silty clays and clayey silts having soft to stiff consistency.

This includes all eolian soils (loess) deposited near the surface, isolated pockets and lenses of fine grained silty to clayey sand at some locations and alluvial silts and silty clays. Recompacted silty clay samples from the native soils have exhibited permeability values between 1 x 10^{-7} to 1 x 10^{-9} cm/sec. The in-place creek sediment's soils permeability typically range from 1 x 10^{-6} to 1 x 10^{-8} cm/sec.

4. LINER STATUS

Both the Lakeside Ash Pond and the Dallman Ash pond were built on top of in-place clayey soils. While the vertical hydraulic conductivity is generally low, soils were not compacted beneath the impoundments except for sections where the dikes of the Dallman Ash Pond were built atop the existing creek bed. No composite liner or alternate composite liner as specified in 35 IAC Part 845.400, was used to line the bottom of either ash pond.

5. STATEMENT

The Lakeside and Dallman ash ponds are existing CWLP CCR surface impoundments. After review of the construction history of the impoundments, it has been determined that neither of the existing ash ponds contain liners that meet the requirements specified in 35 IAC Part 845.400(b) or (c).

10.20.21

Paul M. Van Metre, P.E.   Date

ATTACHMENT 14 – SAFETY AND HEALTH PLAN

HEALTH AND SAFETY PLAN
DALLMAN AND LAKESIDE ASH PONDS

OFFICE OF PUBLIC UTILITIES
ENVIRONMENTAL HEALTH & SAFETY OFFICE
CITY OF SPRINGFIELD, IL

OCTOBER 2021

HEALTH AND SAFETY PLAN
DALLMAN AND LAKESIDE ASH PONDS
ACKNOWLEDGEMENT AND AGREEMENT FORM

This Health and Safety Plan (HASP) has been developed for the purpose of proactively aiding City Water, Light and Power (CWLP) employees, contract workers and third-party contractors in identifying, understanding, and mitigating the risks/hazards they are likely to encounter at the site. This HASP may also be used as a guidance document by properly trained and experienced CWLP employees, contract workers and third-party contractors. The CWLP Environmental Health & Safety Office (EH&S) is readily available to assist contract workers and third-party contractors in identifying and addressing their own employees' risks. However, contract workers and third-party contractors at the site must develop their own HASP to address the hazards faced by their own employees.

Your signature below confirms the following: you have read and understand the hazards and associated mitigation measures discussed in this HASP; you have received training required pursuant to this HASP; you understand that contract workers and third-party contractors must develop their own HASP for their employees; and you understand that you could be prohibited by CWLP personnel from working on this project for not complying with any aspect of this HASP.

Name	Signature	Company	Date

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Appendices

1.0 Introduction

This HASP has been prepared to assist CWLP employees, contract workers and third-party contractors in identifying, understanding, and mitigating the risks/hazards they are likely to encounter at the Coal Combustion Residuals (CCR) facility owned and operated by the City of Springfield, Office of Public Utilities, formally known as the Dallman and Lakeside Ash Ponds.

Title 35 of the Illinois Administrative Code Part 845.530 requires the owner or operator of a CCR facility to inform employees, contract workers and third-party contractors of the development of the HASP, to conduct on-going worker hazard analysis and to ensure all parties are aware of said analysis. The HASP shall be updated at least annually and as needed based on worker hazard analysis. Additionally, the plan and all amendments shall be placed in the facilities operating record and placed on the owner/operators publically accessible internet site.

All CWLP employees, contract workers and third-party contractors are required to successfully complete a training program that informs them of the hazards at the facility prior to undertaking any activity to construct, operate or close a CCR Surface Impoundment. An outline of the training program that is used as well as a description of the training program updates must be maintained at the facility.

At a minimum, the training program is designed to ensure that employees, contract workers and third-party contractors understand and are able to respond effectively to the following:

- Procedures for using, inspecting, repairing and replacing facility emergency and monitoring equipment;
- Communications and alarm systems
- Response to fires or explosions;
- Response to a spill or release of Coal Combustion Residuals
- Occupational Safety and Health Standards in 29 CFR 1910.120, 1926.65 and OSHA 10-hour or 30-hour construction safety training;
- Information about chemical hazards and hazardous materials at the site; and
- Use of engineering controls, administrative controls and personal protective equipment.

2.0 Health and Safety Plan Administration

The CWLP EH&S will be responsible for the management and administration of the HASP.

2.1 Organization and Responsibilities

Although CWLP EH&S directs and supervises the overall HASP for the Dallman and Lakeside Ash Ponds, the responsibility for Health and Safety extends to all CWLP employees, contract workers and third-party contractors. For this reason, it is each person’s duty to immediately notify CWLP personnel and/or their respective supervisors of hazardous conditions that are identified. In the event the hazardous conditions represent and immediate threat to life or health, any personnel are authorized to stop work until the condition can be corrected.

The following personnel are responsible for the day to day implementation of this HASP:

CWLP

Bill Antonacci	Technical Specialist	217-361-4948
Eric Staley	Technical Specialist	217-836-1266
Justin Olson	Technical Specialist	217-622-7934

Subcontractor
To be determined

2.2 Location of the Health and Safety Plan

The HASP will be maintained by the CWLP EH&S Office at 3100 Adlai Stevenson Drive. Copies of the plan will be kept at various locations, including construction trailers and/or break rooms at the Dallman and Lakeside Ash Ponds. Additionally, and electronic copy will be maintained on the publically accessible internet site at https://www.cwlp.com/IllinoisCCRCompliance.aspx.

2.3 Plan Review and Updates

The HASP will be reviewed and updated as needed and no less frequently than on an annual basis. CWLP employees, contract workers and third-party contractors will be included in the regular review and updates. All updates and/or changes to the HASP will be logged herein.

Table 1-2 HASP Review Log

By	Date	Activity	Comment

3.0 Background Information

CWLP is a municipal electric and water utility that owns and operates two existing coal combustion residual CCR surface impoundments, operating as a single multi-unit system for purposes of groundwater monitoring and closure. These CCR surface impoundments are identified as the Lakeside Ash Pond and the Dallman Ash Pond and are located northeast of the power plant complex in Springfield, Illinois. All material going to these ponds are wet-generated, not dry.

The Lakeside Ash Pond was placed in service prior to 1958 and ceased receiving ash in 2009. The 35 acre pond has been divided into four separate ponds; three lime sludge ponds and one settling pond. The Lakeside Ash Pond currently receives lime sludge from the CWLP Water Purification Plant, scrubber wastewater treatment plant clarifier blowdown and water from miscellaneous floor drains. The Dallman Ash Pond was placed into service in 1976 and is approximately 34.5 acres. The Dallman Ash Pond currently receives fly ash and bottom ash, which are sluiced with raw lake water, industrial wastewater treatment plant clarifier blowdown and landfill leachate. Settled water from both the Lakeside Ash Pond and Dallman Ash Pond flow into opposite sides of a Clarification Pond for final polishing before being discharged to Sugar Creek at Outfall 004.

A general facility detail is provided in Appendix A.

4.0 Scope of Health and Safety Plan

This HASP is intended to cover daily operations by CWLP City employees, contract workers and third-party contractors at the facility for activities including, but not limited to:

- Operation of heavy equipment
- Loading of trucks with CCR material
- Excavation of lime and ash ponds
- Grading of placed material
- Maintenance of berms, ditches and other structures

Once construction activities for impoundment closure commence, this HASP will be updated to address the additional hazards that CWLP employees, contract workers and third-party contractors will be exposed to.

Contract workers and third-party contractors may also be subject to their respective employers' Health and Safety Plan HASPs while engaged in work at the facility.

5.0 Hazard Analysis

CWLP employees, contract workers and third-party contractors may be exposed to certain physical, environmental and chemical hazards while working at the site.

5.1 Physical Hazards

Physical hazards associated with work at the site include:

- Slips, trips and falls
- Pinch points
- Struck by/caught between
- Exposure to vehicle traffic
- Manual handling of materials
- Exposure to heavy equipment
- Noise exposure

5.2 Environmental Hazards

Environmental hazards associated with work at the site include:

- Cold weather and related effects (frost bite)
- Hot weather and related effects (heat stroke, heat exhaustion, dehydration)
- Severe weather such as heavy rains, tornados, lightning
- Spill or release of CCR material

5.3 Chemical Hazards

Potential exposure to chemicals and chemical substances at the site include:

- Airborne/Respirable dust
- Exposure to CCR materials
- Exposure to landfill leachate
- Exposure to CCR surface water
- No RCRA hazardous chemicals or materials at the facility

5.4 Job Hazard Analysis

To reduce exposure to certain hazards, a Job Hazard Analysis (JHA) will be conducted to identify necessary engineering controls, administrative controls and Personal Protective Equipment (PPE) to be utilized by CWLP employees. As needed, Industrial Hygiene

Audits may be conducted to determine and quantify potential worker exposure to job site hazards such as respirable dust, noise exposure, etc. CWLP has previously conducted industrial hygiene audits on workers operating heavy equipment at the Dallman and Lakeside Ash Ponds for exposure to respirable dust. The results of these audits indicated exposure to respirable dust and crystalline silica were below the limits of detection.

The results of the JHA and/or new Industrial Hygiene Audit will be shared with employees, contract workers and third party contractors prior to the initiation of work.

Completed JHAs that document protective measures to reduce or eliminate worker exposure to identified hazards are provided in Appendix B. As new hazards or tasks are identified, Appendix B will be updated with a new JHA. Employees, contract workers and third-party contractors will be made aware of a new JHA no later than the next work day.

Contract workers and third-party contractors may be subject to their respective employers' JHA requirements.

5.5 Minimum PPE

CWLP employees, contract workers and third-party contractors engaged in work at the facility will be required to wear, at a minimum, OSHA defined Level D PPE, which includes a work uniform of long sleeves and long pants, safety footwear that meets ASTM F2431-11, hard hat, safety glasses and leather or heavy cloth gloves as needed.

CWLP employees covered under the Respiratory Protection Program will be provided with negative pressure respirators and appropriate cartridges. Contract workers and third party contractors must be covered by their respective employers' respiratory protection program.

Any additional PPE identified as warranted by a JHA will be provided to CWLP employees. PPE for contract workers and third party contractors must be provided by their respective employers.

6.0 Emergency Response

At CWLP, the Supervisor of Generation (SOG) is the primary contact in the event of any emergency and will serve as the Incident Commander. All SOGs are trained in hazardous materials response and the National Incident Management System to allow our personnel to work in conjunction with local emergency responders. A SOG is present at the Generating Facility 24-hours per day, 365 days per year.

In Springfield, IL, all requests for emergency responders such as the fire department, police department or private ambulance services are handled though the 911 system. In the event of an emergency situation at the Dallman and Lakeside Ash Ponds, CWLP encourages our employees to contact 911 immediately and relay as much information as possible to the 911 dispatcher. It is of upmost importance that the reporting employee then contact the SOG as soon as possible with information pertaining to the location and nature of the emergency. The SOG or designee can the send appropriate personnel to assist in the response and/or to direct emergency responders. The SOG or designee shall contact the EH&S 24-hour contact line. It is the responsibility of the EH&S to contact any state or federal regulatory agencies, environmental response contractors, or other pertinent state and local officials.

CONTACT	TELEPHONE #
Police Department	911
Fire Department	911
Ambulance Services	911
Supervisor of Generation – 24 Hour	217-741-1938
Environmental Health & Safety Office – 24 Hour	217-652-6864

Specific responses to emergencies that may arise at the facility are covered under the site specific Personnel Training Program.

7.0 Personnel Training Program

CWLP will provide the minimum training required under this HASP to contract workers and third-party contractors. These employees will also be subject to their respective employers' site-specific HASP programs and procedures while engaged in work at the facility.

At a minimum, the site-specific training to all workers will include:

- Procedures for using, inspecting, repairing and replacing facility emergency and monitoring equipment;
- Communications and alarm systems
- Response to fires or explosions;
- Response to a spill or release of Coal Combustion Residuals
- Occupational Safety and Health Standards in 29 CFR 1910.120, 1926.65 and OSHA 10-hour or 30-hour construction safety training;
- Information about chemical hazards at the site; and
- Use of engineering controls, administrative controls and personal protective equipment

The training Power Point is provided in Appendix D.

All CWLP employees conducting work at the facility related to the construction, operation, maintenance or closure of the CCR Surface Impoundments will be provided the minimum training required under this HASP and will also receive the CWLP training outlined in Table 7-1.

Table 7.1
Minimum Required Topics for CWLP employees engaged in Construction, Operation, Maintenance or Closure of CCR Surface Impoundments

Item/Reference	Description	Comments
Dallman and Lakeside Ash Ponds Health and Safety Plan	Site specific Health and Safety Plan for operation, maintenance and construction activities at the ash ponds	
Procedure SLC.50.001	Accident Reporting and Response Procedure	
CWLP Safety Manual	Personal Protective Equipment Requirements	
Procedure ADM.71.002	Site Entry Procedure	
Procedure ADM.82.003	Emergency Procedure for Fire	
Program EHS.30.007	Hazard Communication Program	
Program EHS.30.011	Respiratory Protection Program	
Program EHS.30.001	Arsenic Compliance Program	
Program EHS.30.014	Beryllium Compliance Program	
Program EHS.30.013	Respirable Crystalline Silica Compliance Program	
Program EHS.30.008	Hexavalent Chromium Compliance Program	
Program EHS.30.009	Lead and other Heavy Metals Compliance Program	

Visitors to the facility, who are otherwise not engaged in the construction, operation or closure of the CCR Surface Impoundment may be trained on portions of this HASP which are specific to their work at the facility. Such visitors will be escorted at all times by a competent person who has undergone the complete training designated by CWLP EH&S or the construction contractor.

7.1 Using, Inspecting, Repairing and Replacing Facility Emergency and Monitoring Equipment

It is anticipated that emergency and monitoring equipment used at the facility will evolve as the nature of work being conducted progresses from routine operation and maintenance to closure activities.

As monitoring equipment such as instruments that measure pressure, seepage, internal movement, vibration and air quality are introduced at the facility, this HASP will be updated to include procedures and training for inspecting, repairing and replacing these types of equipment.

CWLP employees have been trained on the inspection and replacement of emergency equipment such as Automated External Defibrillators and fire extinguishers. A monthly inspection of these devices owned by CWLP will be conducted and documented.

Contract workers and third-party contractors at the facility shall be responsible for training their employees on using, inspecting, repairing and replacing such equipment owned by their respective employers.

7.2 Communications and Alarm Systems

The nature of work conducted at Dallman and Lakeside Ash Pond will often require employees to be working in heavy equipment or outside and away from fixed buildings or construction trailers. For this reason, communications and alarm systems shall consist of two-way radios, CB radios and cell phones. The EH&S Office shall ensure that CWLP employees have the proper equipment and cell phone numbers to communicate in this manner with contract workers and third-party contractors.

7.3 Emergency Evacuation

CWLP Employees are trained on the Generating Facilities Emergency Evacuation Plan ADM 82.002 on an annual basis. Evacuations can be declared for a variety of reasons. The most obvious reason is the traditional sense of using an evacuation as a way to prevent employees from becoming harmed or injured. Even though many incidents such as a fire, flooding, spill or release of coal combustion residuals, severe weather or medical emergency may only affect a portion of the facility, it may be prudent to declare an emergency evacuation so that all personnel that are on site can be accounted for. We do not want to jeopardize rescue personnel to save someone that doesn’t need to be saved.

All CWLP employees, contract workers and third party contractors should maintain awareness of potential or possible hazardous conditions for all areas of the facility, be knowledgeable in what constitutes normal operating conditions and where primary and secondary escape routes are located for your work area and be alert to any signs or indications suggesting abnormal conditions.

Given the size of the facility, nature of work and absence of a readily available paging system, communication of an emergency evacuation will be relayed through two-way radios, CB radios and cell phones. CWLP employees, contract workers and third-party contractors will ensure these means of communication are maintained and readily available to all employees on site.

In the event an emergency evacuation is declared, all employees on site should immediately report to their designated assembly areas. For CWLP employees, contract workers and third-party contractors, the designated assembly area shall be the nearest fixed building or construction trailer on site.

Once all employees have assembled at each area, the SOG or designee will contact each respective location to ensure all employees are accounted for. It is the responsibility of each contract worker and third-party contractor to designate their own person/supervisor that will have a daily working knowledge of their staff on site that will communicate with the SOG or designee. Employees should remain at the designated assembly areas and await further instruction from the SOG or designee.

If an emergency should occur where it is determined that all CWLP employees, contract workers and third party contractors must evacuate the facility, the designated assembly area shall be the parking lot of the CWLP Property Management Center located across the road at 200 E Lake Shore Drive. Once all employees have assembled at the off-site assembly area, the designated CWLP employee will contact the SOG or designee with an accounting of all employees assembled at the off-site location.

7.4 Response to Fires or Explosions

CWLP Employees are trained on the Generating Facilities Emergency Procedure for Fire ADM 82.003 on an annual basis. The purpose of the Emergency Procedure for Fire is to maintain a workplace free of uncontrolled hazards that may cause fire, and in case of fire, how to respond to protect personnel and property. As with any safety subject, the first line of defense will be prevention. CWLP employees are to engage only in firefighting activities when the event can be contained with their level of knowledge and equipment available.

Given the nature of work at the facility, any fire would likely be limited to an individual piece of equipment or a specific area such as a construction trailer. Fire extinguishers will be located at fixed buildings at the facility and on pieces of individual equipment.

In the event of a large and uncontrolled fire, call 911 for the Fire Department and then contact the SOG with information pertaining to the location and status of the scene. Otherwise, notify the SOG and the SOG or designee will notify the Fire Department of the situation. The SOG or designee will then notify Security at 757-8600 so they can provide an escort for the response vehicles.

In the event of a small and/or contained fire, employees may choose to extinguish the fire based on their level of training. If at any time it becomes apparent that the small and/or contained fire cannot readily be extinguished, employees should evacuate the area and call 911 for the Fire Department and contact the SOG with information pertaining to the location and status of the scene.

7.5 Response to a Spill or Release of Coal Combustion Residuals

In the event of a catastrophic failure of an impoundment resulting in a large spill or release of coal combustion residuals into the environment, all employees shall evacuate the area immediately, report to their designated assembly areas identified under the emergency evacuation plan and notify the SOG with information on the location and nature of the spill or release of coal combustion residual materials.

CWLP has developed an Emergency Action Plan for Lake Springfield, Dallman and Lakeside Ash Ponds. The emergency response procedures under the Emergency Action Plan will be implemented by CWLP employees and administration.

Contract workers and third party contractors should remain in their designated assembly areas and await further instructions from the SOG or other CWLP personnel.

7.6 Response to a Medical Emergency

CWLP Employees are trained on the Generating Facilities Responding to a Medical Emergency Procedure ADM 82.004 on an annual basis. The purpose of the Responding to a Medical Emergency Procedure is to provide guidelines for CWLP employees to respond to a medical emergency within their scope and level of training.

A medical emergency may result for many reasons. Incidents may range from work-related failure of equipment and processes to heart attacks or even major catastrophes. Each incident will possess its own challenges. In the event of a medical emergency, it is imperative that EMS be contacted immediately. Employees helping the victim should stay calm and assist in the situation as best as possible.

In the event of a medical emergency, call 911 for the Fire Department and ambulance and then contact the SOG with information pertaining to the location and status of the scene. Otherwise, notify the SOG and the SOG or designee will notify the Fire Department of the situation. The SOG or designee will then notify Security at 757-8600 so they can provide an escort for the response vehicles.

First Aid Kits and an Automated External Defibrillator will be kept at the CWLP trailer. Contractor workers and third-party contractors may also have these items in their company vehicles or trailers.

7.7 Occupational Safety and Health Standards in 29 CFR 1910.120, 1926.65 and OSHA 10-hour or 30-hour construction safety training;

CWLP employees engaged in the operation, maintenance, construction and closure of the Dallman and Lakeside Ash Ponds have received the HAZWOPER training under 29 CFR 1910.120 for General Industry. CWLP is not regulated under 29 CFR 1926.65. Additionally, these employees have received the 10-hour Construction Safety and Health training.

It is the responsibility of the employers of contract workers and third-party contractors to provide and document that their respective employees working at the facility have received the required OSHA training.

7.8 Information about Chemical Hazards at the Site

Dallman and Lakeside Ash Ponds are CCR surface impoundments that have been historically operated to store bottom ash, fly ash and flue gas desulfurization wastes. These materials can be encountered at the facility in solid form, as airborne dust or in waters that have come in contact with the CCR.

Coal ash, both bottom and fly ash, can contain heavy metals including arsenic, lead, mercury, cadmium, chromium and selenium, as well as aluminum, antimony, barium, beryllium, boron, chlorine, cobalt, manganese, molybdenum, nickel, thallium, vanadium, zinc and respirable crystalline silica. Based upon exposure and route of entry, these substances have the potential to cause illness and disease.

Flue gas desulfurization wastes can contain arsenic, lead, mercury, cadmium, chromium and selenium, as well as aluminum, antimony, barium, beryllium, boron, chlorine, cobalt, manganese, molybdenum, nickel, thallium, vanadium, and zinc. Based upon exposure and route of entry, these substances have the potential to cause illness and disease.

Safety Data Sheets have been developed for bottom ash, fly ash and flue gas desulfurization wastes and are provided in Appendix C.

Exposure to these materials can be reduced and/or eliminated through the use of engineering controls, administrative controls and personal protective equipment as discussed below.

7.9 Use of Engineering Controls, Administrative Controls and Personal Protective Equipment

CWLP has developed several controls to reduce and/or eliminate employee exposure to contaminants in the work place.

Engineering Controls

Engineering controls are used to control potential hazards at the source or to design the work area to eliminate hazards and reduce employee exposure to such hazards. Common engineering controls consist of process control, encapsulation, isolation, shielding, and ventilation.

The most common type of engineering controls used at the facility for operation and maintenance are the use of water to limit air born dust, the natural moisture content of the CCR material, speed limits of 10 miles per hour on the roadways and termination of work if conditions exist for air borne dust to be carried beyond the work area or facility boundaries.

JHA’s conducted for work at the facility will aid in determination of any additional engineering controls warranted as the scope of work changes from operation and maintenance to closure activities.

Administrative Controls

Administrative controls are changes in work place procedures, policies, rules, supervision and training with the goal of reducing the frequency, duration and/or severity of employee exposure to hazardous situations or chemicals. CWLP has developed several administrative controls to reduce employee exposure to potentially harmful contaminants. All CWLP employees engaged in work at the facility have received training on the programs and procedures outlined in the table below.

Table 7.9
CWLP Administrative Controls

CWLP Safety Manual	Personal Protective Equipment Requirements
Procedure ADM 82.003	Emergency Procedure for Fire
Program EHS.30.007	Hazard Communication Program
Program EHS.30.011	Respiratory Protection Program
Program EHS.30.001	Arsenic Compliance Program
Program EHS.30.014	Beryllium Compliance Program
Program EHS.30.013	Respirable Crystalline Silica Compliance Program
Program EHS.30.008	Hexavalent Chromium Compliance Program
Program EHS.30.009	Lead and other Heavy Metals Compliance Program

These programs and administrative provide guidelines for housekeeping, work practice controls, respiratory protection and proper selection of personal protective equipment to further reduce employee exposure to hazardous conditions.

Contract workers and third-party contractors will be required to follow their respective employers' administrative controls while engaged in work at the facility.

Personal Protective Equipment

CWLP employees, contract workers and third-party contractors shall wear at a minimum OSHA Level D PPE while engaged in work at the facility. Level D PPE includes long sleeves and long pants, safety footwear that meets ASTM F2431-11, hard hat, safety glasses and leather or heavy cloth gloves as needed. Respiratory protection will be provided to CWLP employees covered under the Respiratory Protection Program that is appropriate for the work being conducted. Additional PPE identified as warranted through a JHA or industrial hygiene audit will be provided and required for use while engaged in those specific work activities.

Contract workers and third party contractors must be covered by their respective employers' respiratory protection program.

Appendix A

Site Plan

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NO.	DATE	REVISIONS DESCRIPTION	BY

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PROFESSIONAL DESIGN ENGINEERING AND LAND SURVEYING FIRM #184-001541

APPROVED BY: PMV DESIGNED BY: PMV DRAWN BY: MPN

CWLP COAL RESIDUAL COMBUSTION UNITS

PLANS PREPARED FOR
CITY, WATER, LIGHT & POWER
SPRINGFIELD, SANGAMON COUNTY, ILLINOIS

DATE: JANUARY 2016
PROJECT ID: 150077/0011
SHEET NUMBER:
FIG. 1

Appendix B

Job Hazard Analysis Forms

Completed JHAs

CWLP Job Hazard Analysis – Dallman and Lakeside Ash Ponds

Job Description:	**JHA Number:**
Date Completed:	**Revision:**
Person Completing this JHA:	**Person(s) Assisting with this JHA:**

Considerations

What are the hazards?	How can accidents/injuries occur?
Are there obvious unsafe conditions?	How can accidents/injuries be avoided?
Have employees been trained for the task?	Are special tools/equipment needed?
Is PPE needed?	How would employees be rescued?

Hazards Present

SB - Struck by	CI - Caught in	TF - Trip/Fall
SA - Struck against	CB - Caught between	ET – Exposure to
CW - Contact with	O - Overexertion	CO - Caught on

Job Task	Hazards Present	Corrective Action

CWLP Job Hazard Analysis – Dallman and Lakeside Ash Ponds

Discussion items:

Name/Signature:

Appendix C

Safety Data Sheets

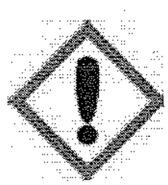
Safety Data Sheet

Section 1: Identification

IDENTITY *(As Used on Label and List)* **Bottom Ash**	Manufacturer's Name **City Water, Light and Power**
Appearance: Dark Solid; odorless	Emergency Telephone Number **(217) 652-6864**
Use of Product: Bottom Ash has been used by manufacturers as a component of roofing shingles.	Address **201 E. Lake Shore Drive** **Springfield, IL 62712**
	Telephone Number for Information **(217) 757-8610**

Section 2: Hazard(s) Identification

Route(s) of Entry:	Inhalation? Yes	Skin and Eye? Yes	Ingestion? Yes
Health Hazards *(Acute and Chronic)*:			
Acute Symptoms of Exposure: Excessive inhalation of dust may cause upper respiratory tract irritation including sneezing and coughing. Eye contact can cause redness and pain. Skin contact (especially on moist skin) can cause moderate irritation.			
Chronic Health Effects: Prolonged exposure to respirable crystalline silica may result in progressive lung damage (silicosis), resulting in fibrotic changes and breathing restrictions. Crystalline silica has produced tumors in laboratory animals. Iron (III) oxide is regarded as an equivocal tumorigenic agent by RTECS criteria; tumors produced at the site of application subcutaneously in rats. Note: Aluminum oxide present in this material is a non-fibrous form and is not listed under section 313 of the Emergency Planning and Community Right-To-Know Act (SARA TITLE III).			
Carcinogenicity:			
Crystalline silica is listed as both an IARC and NTP carcinogen. PEL limits for OSHA regulated materials are given in Section 3.			
Signs and Symptoms of Exposure			
See Acute Symptoms of Exposure and Chronic Symptoms listed above under Hazards Identification.			
Medical Conditions Generally Aggravated by Exposure			
Pre-existing lung disorders. Skin and eye conditions may be aggravated by repeated or prolonged exposure.			



CAUTION

Irritant - Causes eye, skin and inhalation irritation

Toxic – Harmful by inhalation (Contains crystalline silica)

Use proper engineering controls, work practices, and personal protective equipment to prevent exposure to wet or dry material.

N/D = Not Determined; N/E = Not Established; N/A = Not Applicable

Section 3: Composition/Information on Ingredients

Component	CAS No.	% by Wt.	OSHA PEL	ACGIH TLV	OSHA/ACGIH STEL
Silica, Amorphous	7631-86-9	40 – 50	80 mg/m^3 / (%SiO_2)^{Total}	N/E	N/E
Iron (III) Oxide	1309-37-1	25 – 35	10 mg/m^3	5 mg/m^3	N/E
Aluminum Oxide	1344-28-1	10 – 20	15 mg/m^3 ^{Total} 5 mg/m^3 ^{Respirable}	10 mg/m^3	N/E
Calcium Oxide	1305-78-8	4 – 9	5 mg/m^3	2 mg/m^3	N/E
Silica, Crystalline (Quartz)	14808-60-7	<0.2	30 mg/m^3 / (%SiO_2+2)^{Total} 10 mg/m^3 / (%SiO_2+2)^{Respirable}	0.05 mg/m^3 $^{Resp.}$	N/E

Percent Metals (calculated as oxides) based on analysis after ignition:
(1% – 2%) Potassium, Sodium
(0.1% - 1%) Phosphorus, Manganese, Magnesium, Titanium
(0.01% - 0.1%) Tin, Chromium, Zinc, Vanadium, Copper, Strontium, Barium
(<0.01%) Arsenic, Thallium, Selenium, Molybdenum, Antimony, Lead, Cobalt, Cadmium, Nickel, Beryllium, Silver

Section 4: First Aid Measures

Eyes	Immediately flush eyes with a copious amount of water for at least 15 minutes, lifting upper and lower eyelids occasionally. Seek medical attention if irritation persists.
Skin	Wash skin with soap and water. Wash clothing before re-use. Seek medical attention if irritation develops.
Inhalation	Remove to fresh air. Seek medical attention for any breathing difficulty.
Ingestion	If large amounts were swallowed, administer water and seek medical advice.

Section 5: Fire-Fighting Measures

Extinguishing Media – Use any means suitable for surrounding fire.

Special Fire Fighting Procedures – Use protective clothing and breathing equipment appropriate for the surrounding fire.

Unusual Fire and Explosion Hazards – Not considered to be a fire or explosion hazard.

Section 6: Accidental Release Measures

Steps to Be Taken in Case Material is Released or Spilled

Small Spill: Shovel or sweep and containerize for reclamation or disposal. Vacuuming or wet sweeping may be used to avoid dust dispersal.

Large Spill: Using protective equipment listed in Section 8, contain as described for small spills. Avoid dust generation and run-off to sewers or drains.

Special Spill Considerations: Processing or contamination may change waste disposal options.

N/D = Not Determined; N/E = Not Established; N/A = Not Applicable

Section 7: Handling & Storage

Precautions to be taken in handling and storing
General Precautions: Avoid prolonged inhalation of high concentration of dust. Handling Precautions: Use with adequate ventilation. Avoid contact with eyes, skin and clothing. Avoid breathing dusts. Wash with soap and water after handling. Keep containers closed. Storage Precautions: Store away from incompatibles, such as acids, strong oxidizers or fluorine containing compounds, in closed containers. Protect from physical damage.
Other Precautions: NA

NFPA Rating (assigned):

Health	1
Flammability	0
Reactivity	0

Section 8: Exposure Controls/Personal Protection

Refer to Section 3 for OSHA PEL's, ACGIH TLV's and other regulated or recommended exposure limits.

Respiratory Protection
If exposure limits are exceeded, appropriate NIOSH-approved respiratory protection must be worn.

Ventilation	Local Exhaust – preferred to insure employee exposures are below airborne exposure limits in Section 3.	Special – N/A
	Mechanical (General) – should be sufficient to minimize dust.	Other – N/A

Protective Gloves – Protective gloves may be worn, including impervious gloves, for prolonged or repeated skin contact.	Eye Protection – Use chemical goggles in high dust areas. Maintain eye wash fountain and quick-drench facilities in work area.

Other Protective Clothing or Equipment – Disposable coveralls may be worn over regular work clothing for operations which generate high concentrations of dust.

Work/Hygienic Practices – Wash thoroughly after handling. Minimize dust generation. Remove dust from clothing using HEPA vacuuming procedures. Launder contaminated clothing before re-use. Do not eat in areas contaminated with dust.

Protection:
The following is recommended to be used when handling fly ash.

Section 9: Physical & Chemical Properties

Boiling Point	**N/A**	Specific Gravity (H_2O = 1)	**2.6 (Silica)**

N/D = Not Determined; N/E = Not Established; N/A = Not Applicable

Vapor Pressure (mm Hg.)	**N/A**	Melting Point	**N/A**
Vapor Density (AIR = 1)	**N/A**	Evaporation Rate (Butyl Acetate = 1)	**N/A**
Solubility in Water - Very slightly soluble			
Flash Point (Method Used) – **N/A**	Flammable Limits:	LEL – **N/A**	UEL – **N/A**
Appearance and Odor – Dark solid; odorless.			

Section 10: Stability and Reactivity

Stability	Unstable		Conditions to Avoid – None known.
	Stable	**X**	Stable under normal conditions of use and storage.
Incompatibility *(Materials to Avoid)* – Strong acids (including hydrofluoric), strong oxidizers, fluorine containing compounds, phosphorus oxide.			
Hazardous Decomposition or Byproducts – Not determined.			
Hazardous Polymerization	May Occur		Conditions to Avoid – Will not polymerize.
	Will Not Occur	**X**	

Section 11: Toxicological Information

There is no toxicological information reported for this material. Refer to individual constituent toxicological information.

Section 12: Ecological Information

There is no ecological information reported for this material. Refer to individual constituent ecological information.

Section 13: Disposal Considerations

Waste Disposal Method

Recover or recycle material to minimize disposal. Processing or contamination may change waste disposal options. State and local disposal regulation may differ from federal regulations. Consult with environmental agencies for guidance on acceptable disposal practices. Dispose of waste and containers in compliance with applicable Federal, State, and Local regulations.

Section 14: Transport Information

This material is not classified as a Hazardous Material under U.S. DOT regulations.

Section 15: Regulatory Information

TSCA	One or more constituents of this material appears on the EPA Toxic Substances Control Act Inventory.
RCRA	One or more constituents of this material is (are) classified as a hazardous waste under the Resource Conservation and Recovery Act Regulations.

N/D = Not Determined; N/E = Not Established; N/A = Not Applicable

CERCLA	One or more constituents of this material is (are) classified as a hazardous substance under regulations of the Comprehensive Environmental Response Compensation and Liability Act.
OSHA/MSHA	One or more constituents of this material is (are) consider to be a hazardous chemical and should be included in the Hazard Communication Program.
EPCRA SARA Title III	This material qualifies as a hazardous substance with delayed health effects.
EPCRA SARA Sec. 313	One or more constituents of this material is (are) on the TSCA inventory list.

Other regulations may apply. Comply with all Federal, State, and Local authorities

Section 16: Other Information

Date of Issue	November, 2014	Previous Version	March 12, 2004

This information has been compiled from sources considered to be dependable and is, to the best of our knowledge and belief, accurate and reliable as of the date compiled. However, no representation, warranty (either expressed or implied) or guarantee is made to the accuracy, reliability or completeness of the information contained herein. This information relates to the specific material designated and may not be valid for such material used in combination with any other materials or in any process.

It is the user's responsibility to be satisfied as to the suitability and completeness of this information for their own particular use.

We do not accept liability for any loss or damage that may occur, whether it be direct, indirect, incidental or consequential, from the use of this information, nor do we offer warranty against patent infringement. Additional information is available by calling the telephone number designated for this purpose.

N/D = Not Determined; N/E = Not Established; N/A = Not Applicable

Safety Data Sheet

Section 1: Identification

IDENTITY *(As Used on Label and List)* **Composite Fly/Bottom Ash**	Manufacturer's Name **City Water, Light and Power**
Appearance: Fine, dark grey powder	Emergency Telephone Number **(217) 652-6864**
Use of Product: Fly/Bottom ash produced from the combustion of coal is a mixture of alumina, silica, unburned carbon, and various metallic oxides.	Address **201 E. Lake Shore Drive** **Springfield, IL 62712**
	Telephone Number for Information **(217) 757-8610**

Section 2: Hazard(s) Identification

Route(s) of Entry:	Inhalation? Yes	Skin and Eye? Yes	Ingestion? Yes
Health Hazards *(Acute and Chronic):*			
Acute Symptoms of Exposure: Excessive inhalation of dust may cause upper respiratory tract irritation including sneezing and coughing. Eye contact can cause redness and pain. Skin contact (especially on moist skin) can cause moderate irritation.			
Chronic Health Effects: Prolonged exposure to respirable crystalline silica may result in progressive lung damage (silicosis), resulting in fibrotic changes and breathing restrictions. Crystalline silica has produced tumors in laboratory animals. Iron (III) oxide is regarded as an equivocal tumorigenic agent by RTECS criteria; tumors produced at the site of application subcutaneously in rats. Note: Aluminum oxide present in this material is a non-fibrous form and is not listed under section 313 of the Emergency Planning and Community Right-To-Know Act (SARA TITLE III).			
Carcinogenicity:			
Crystalline silica is listed as both an IARC and NTP carcinogen. PEL limits for OSHA regulated materials are given in Section 3.			
Signs and Symptoms of Exposure			
See Acute Symptoms of Exposure and Chronic Symptoms listed above under Hazards Identification.			
Medical Conditions Generally Aggravated by Exposure			
Pre-existing lung disorders. Skin and eye conditions may be aggravated by repeated or prolonged exposure.			

CAUTION

Irritant - Causes eye, skin and inhalation irritation

Toxic – Harmful by inhalation (Contains crystalline silica)

Use proper engineering controls, work practices, and personal protective equipment to prevent exposure to wet or dry material.

N/D = Not Determined; N/E = Not Established; N/A = Not Applicable

Section 3: Composition/Information on Ingredients

Component	CAS No.	% by Wt.	OSHA PEL	ACGIH TLV	OSHA/ACGIH STEL
Silica, Crystalline (Quartz)	14808-60-7	10 – 20	30 mg/m^3 / ($\%SiO_2$+2)^{Total} 10 mg/m^3 / ($\%SiO_2$+2)^{Respirable}	0.05 mg/m^3 $^{Resp.}$	N/E
Iron (III) Oxide	1309-37-1	25 – 35	10 mg/m^3	5 mg/m^3	N/E
Calcium Oxide	1305-78-8	2 - 5	5 mg/m^3	2 mg/m^3	N/E
Silica, Amorphous	7631-86-9	30 – 40	80 mg/m^3 / ($\%SiO_2$)^{Total}	N/E	N/E
Aluminum Oxide	1344-28-1	10 – 15	15 $mg/m^{3\ Total}$ 5 $mg/m^{3\ Respirable}$	10 mg/m^3	N/E

Percent Metals (calculated as oxides) based on analysis after ignition:
(2% – 3%) Potassium, Sodium
(0.1% - 1%) Phosphorus, Zinc, Magnesium, Titanium
(0.01% - 0.1%) Molybdenum, Chromium, Nickel, Manganese, Vanadium, Copper, Strontium, Barium, Zinc
(<0.01%) Arsenic, Tin, Thallium, Selenium, Antimony, Lead, Cobalt, Cadmium, Beryllium, Silver

Section 4: First Aid Measures

Eyes	Immediately flush eyes with a copious amount of water for at least 15 minutes, lifting upper and lower eyelids occasionally. Seek medical attention if irritation persists.
Skin	Wash skin with soap and water. Wash clothing before re-use. Seek medical attention if irritation develops.
Inhalation	Remove to fresh air. Seek medical attention for any breathing difficulty.
Ingestion	If large amounts were swallowed, administer water and seek medical advice.

Section 5: Fire-Fighting Measures

Extinguishing Media – Use any means suitable for surrounding fire.

Special Fire Fighting Procedures – Use protective clothing and breathing equipment appropriate for the surrounding fire.

Unusual Fire and Explosion Hazards – Not considered to be a fire or explosion hazard.

Section 6: Accidental Release Measures

Steps to Be Taken in Case Material is Released or Spilled

Small Spill: Shovel or sweep and containerize for reclamation or disposal. Vacuuming or wet sweeping may be used to avoid dust dispersal.

Large Spill: Using protective equipment listed in Section 8, contain as described for small spills. Avoid dust generation and run-off to sewers or drains.

Special Spill Considerations: Processing or contamination may change waste disposal options.

N/D = Not Determined; N/E = Not Established; N/A = Not Applicable

Section 7: Handling & Storage

Precautions to be taken in handling and storing
General Precautions: Avoid prolonged inhalation of high concentration of dust. Handling Precautions: Use with adequate ventilation. Avoid contact with eyes, skin and clothing. Avoid breathing dusts. Wash with soap and water after handling. Keep containers closed. Storage Precautions: Store away from incompatibles, such as acids, strong oxidizers or fluorine containing compounds, in closed containers. Protect from physical damage.
Other Precautions: NA

NFPA Rating (assigned):

Health	1
Flammability	0
Reactivity	0

Section 8: Exposure Controls/Personal Protection

Refer to Section 3 for OSHA PEL's, ACGIH TLV's and other regulated or recommended exposure limits.		
Respiratory Protection If exposure limits are exceeded, appropriate NIOSH-approved respiratory protection must be worn.		
Ventilation	Local Exhaust – preferred to insure employee exposures are below airborne exposure limits in Section 3.	Special – N/A
	Mechanical (General) – should be sufficient to minimize dust.	Other – N/A

Protective Gloves – Protective gloves may be worn, including impervious gloves, for prolonged or repeated skin contact.	Eye Protection – Use chemical goggles in high dust areas. Maintain eye wash fountain and quick-drench facilities in work area.
Other Protective Clothing or Equipment – Disposable coveralls may be worn over regular work clothing for operations which generate high concentrations of dust.	
Work/Hygienic Practices – Wash thoroughly after handling. Minimize dust generation. Remove dust from clothing using HEPA vacuuming procedures. Launder contaminated clothing before re-use. Do not eat in areas contaminated with dust.	

Protection:
The following is recommended to be used when handling composite fly/bottom ash.

Section 9: Physical & Chemical Properties

Boiling Point	**N/A**	Specific Gravity (H_2O = 1)	**2.6 (Silica)**
Vapor Pressure (mm Hg.)	**N/A**	Melting Point	**N/A**

N/D = Not Determined; N/E = Not Established; N/A = Not Applicable

Vapor Density (AIR = 1)	**N/A**	Evaporation Rate (Butyl Acetate = 1)	**N/A**
Solubility in Water - Very slightly soluble			
Flash Point (Method Used) – **N/A**	Flammable Limits:	LEL – **N/A**	UEL – **N/A**
Appearance and Odor – Dark solid; odorless.			

Section 10: Stability and Reactivity

Stability	Unstable		Conditions to Avoid – None known.
	Stable	**X**	Stable under normal conditions of use and storage.
Incompatibility *(Materials to Avoid)* – Strong acids (including hydrofluoric), strong oxidizers, fluorine containing compounds, phosphorus oxide.			
Hazardous Decomposition or Byproducts – Not determined.			
Hazardous Polymerization	May Occur		Conditions to Avoid – Will not polymerize.
	Will Not Occur	**X**	

Section 11: Toxicological Information

There is no toxicological information reported for this material. Refer to individual constituent toxicological information.

Section 12: Ecological Information

There is no ecological information reported for this material. Refer to individual constituent ecological information.

Section 13: Disposal Considerations

Waste Disposal Method
Recover or recycle material to minimize disposal. Processing or contamination may change waste disposal options. State and local disposal regulation may differ from federal regulations. Consult with environmental agencies for guidance on acceptable disposal practices. Dispose of waste and containers in compliance with applicable Federal, State, and Local regulations.

Section 14: Transport Information

This material is not classified as a Hazardous Material under U.S. DOT regulations.

Section 15: Regulatory Information

TSCA	One or more constituents of this material appears on the EPA Toxic Substances Control Act Inventory.
RCRA	One or more constituents of this material is (are) classified as a hazardous waste under the Resource Conservation and Recovery Act Regulations.
CERCLA	One or more constituents of this material is (are) classified as a hazardous substance under regulations of the Comprehensive Environmental Response Compensation and Liability Act.

N/D = Not Determined; N/E = Not Established; N/A = Not Applicable

OSHA/MSHA	One or more constituents of this material is (are) consider to be a hazardous chemical and should be included in the Hazard Communication Program.
EPCRA SARA Title III	This material qualifies as a hazardous substance with delayed health effects.
EPCRA SARA Sec. 313	One or more constituents of this material is (are) on the TSCA inventory list.

Other regulations may apply. Comply with all Federal, State, and Local authorities

Section 16: Other Information

Date of Issue	July, 2014	Previous Version	March 12, 2004

This information has been compiled from sources considered to be dependable and is, to the best of our knowledge and belief, accurate and reliable as of the date compiled. However, no representation, warranty (either expressed or implied) or guarantee is made to the accuracy, reliability or completeness of the information contained herein. This information relates to the specific material designated and may not be valid for such material used in combination with any other materials or in any process.

It is the user's responsibility to be satisfied as to the suitability and completeness of this information for their own particular use.

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N/D = Not Determined; N/E = Not Established; N/A = Not Applicable

Safety Data Sheet

Section 1: Identification

IDENTITY *(As Used on Label and List)* **Scrubber By-Product**	Manufacturer's Name **City Water, Light and Power**
Appearance: Light tan solid	Emergency Telephone Number **(217) 652-6864**
Use of Product: Scrubber By-Product has been used by manufacturers as a component of cement and drywall products.	Address **201 E. Lake Shore Drive** **Springfield, IL 62712**
	Telephone Number for Information **(217) 757-8610**

Section 2: Hazard(s) Identification

Route(s) of Entry:	Inhalation? Yes	Skin and Eye? Yes	Ingestion? Yes

Health Hazards *(Acute and Chronic)*:

Acute Symptoms of Exposure: Excessive concentrations of nuisance dust may cause coughing, sneezing and nasal irritation. Eye discomfort from mechanical irritation can occur. Ingestion may produce excess carbon dioxide and hardening in the stomach causing pain and distress. May cause dry skin and mild irritation.

Chronic Health Effects: Prolonged exposure to respirable crystalline silica may result in progressive lung damage (silicosis), resulting in fibrotic changes and breathing restrictions. Crystalline silica has produced tumors in laboratory animals.

Carcinogenicity:

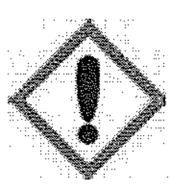
Crystalline silica is listed as both an IARC and NTP carcinogen. Permissible Exposure Limits (PEL's) for OSHA regulated materials are given in Section 3.

Signs and Symptoms of Exposure.

See Acute Symptoms of Exposure and Chronic Symptoms listed above under Hazards Identification.

Medical Conditions Generally Aggravated by Exposure.

Pre-existing lung disorders. Skin and eye conditions may be aggravated by repeated or prolonged exposure.



CAUTION

Irritant - Causes eye, skin and inhalation irritation.

Toxic – Harmful by inhalation (Contains crystalline silica)

Use proper engineering controls, work practices, and personal protective equipment to prevent exposure to wet or dry material.

N/D = Not Determined; N/E = Not Established; N/A = Not Applicable

Section 3: Composition/Information on Ingredients

Component	CAS No.	% by Wt.	OSHA PEL	ACGIH TLV	OSHA/ACGIH STEL
Calcium Sulfate	1317-65-3	82 – 98	15 Total / 5 Respirable mg/m^3	10 mg/m^3	N/E
Calcium Carbonate	7778-18-9	1 – 10	15 Total / 5 Respirable mg/m^3	10 mg/m^3	N/E
Silica, Crystalline (Quartz)	14808-60-7	1 – 3	30 mg/m^3 / $(\%SiO_2+2)^{Total}$ 10 mg/m^3 / $(\%SiO_2+2)^{Respirable}$	0.05 mg/m^3 Resp.	N/E

Percent Metals (calculated as oxides) based on analysis after ignition. (Calcium metal calculated as sulfate and carbonate salt base on sulfur analysis.):
(0.1% - 1%) Phosphorus, Iron, Magnesium, Aluminum, Potassium, Amorphous silica
(0.015% - 0.1%) Zinc, Manganese, Vanadium, Sodium
(<0.015%) Arsenic, Tin, Thallium, Selenium, Molybdenum, Chromium, Antimony, Lead, Cobalt, Cadmium, Nickel, Beryllium, Copper, Silver, Titanium, Strontium, Barium

Section 4: First Aid Measures

Eyes	Immediately flush eyes with a copious amount of water for at least 15 minutes, lifting upper and lower eyelids occasionally. Seek medical attention if irritation persists.
Skin	Wash skin with soap and water. Wash clothing before re-use. Seek medical attention if irritation develops.
Inhalation	Remove to fresh air. Seek medical attention for any breathing difficulty.
Ingestion	If large amounts were swallowed, administer water and seek medical advice.

Note to Physician: Drinking glycerin, gelatin solutions, or large volumes of water may delay hardening of calcium sulfate in the stomach.

Section 5: Fire-Fighting Measures

Extinguishing Media – Use any means suitable for surrounding fire.

Special Fire Fighting Procedures – Use protective clothing and breathing equipment appropriate for the surrounding fire.

Unusual Fire and Explosion Hazards – Calcium carbonate may ignite and burn fiercely in contact with fluorine. When a mixture of calcium carbonate and magnesium is heated in a stream of hydrogen, a violent explosion may occur. Calcium sulfate mixed with phosphorous may ignite at high temperatures. When heated to decomposition calcium sulfate may emit toxic fumes of oxides of sulfur and calcium. A violent or explosive reaction may occur upon heating when calcium sulfate is mixed with aluminum powder.

Section 6: Accidental Release Measures

Steps to Be Taken in Case Material is Released or Spilled

Small Spill: Shovel or sweep and containerize for reclamation or disposal. Vacuuming or wet sweeping may be used to avoid dust dispersal.

Large Spill: Using protective equipment listed in Section 8, contain as described for small spills. Avoid dust generation and run-off to sewers or drains.

Special Spill Considerations: Processing or contamination may change waste disposal options.

N/D = Not Determined; N/E = Not Established; N/A = Not Applicable

Section 7: Handling & Storage

Precautions to be taken in handling and storing

General Precautions: Avoid prolonged inhalation of high concentration of dust.
Handling Precautions: Use with adequate ventilation. Avoid contact with eyes, skin and clothing. Avoid breathing dusts. Wash with soap and water after handling. Keep containers closed.
Storage Precautions: Store away from incompatibles, such as acids, strong oxidizers or fluorine containing compounds, in closed containers. Protect from physical damage.

Other Precautions: NA

NFPA Rating (assigned):

Health	1
Flammability	0
Reactivity	0

Section 8: Exposure Controls/Personal Protection

Refer to Section 3 for OSHA PEL's, ACGIH TLV's and other regulated or recommended exposure limits.

Respiratory Protection
If exposure limits are exceeded, appropriate NIOSH-approved respiratory protection must be worn.

Ventilation	Local Exhaust – preferred to insure employee exposures are below airborne exposure limits in Section 3.	Special – N/A
	Mechanical (General) – should be sufficient to minimize dust.	Other – N/A

Protective Gloves – Protective gloves may be worn, including impervious gloves, for prolonged or repeated skin contact.	Eye Protection – Use chemical goggles in high dust areas. Maintain eye wash fountain and quick-drench facilities in work area.

Other Protective Clothing or Equipment – Disposable coveralls may be worn over regular work clothing for operations which generate high concentrations of dust.

Work/Hygienic Practices – Wash thoroughly after handling. Minimize dust generation. Remove dust from clothing using HEPA vacuuming procedures. Launder contaminated clothing before re-use. Do not eat in areas contaminated with dust.

Protection:
The following is recommended to be used when handling lime sludge.




Section 9: Physical & Chemical Properties

Boiling Point	N/A	Specific Gravity (H_2O = 1)	2.3 (calcium carbonate)
Vapor Pressure (mm Hg.)	N/A	Melting Point	N/A

N/D = Not Determined; N/E = Not Established; N/A = Not Applicable

Vapor Density (AIR = 1)	N/A	Evaporation Rate (Butyl Acetate = 1)	N/A
Solubility in Water - Very slightly soluble			

Flash Point (Method Used) – **N/A**	Flammable Limits:	LEL – **N/A**	UEL – **N/A**
Appearance and Odor – Light tan solid; odorless			

Section 10: Stability and Reactivity

Stability	Unstable		Conditions to Avoid – Moisture and incompatibles.
	Stable	**X**	Stable under normal conditions of use and storage.
Incompatibility *(Materials to Avoid)* – Acids, oxidizing agents, aluminum, phosphorus, fluorine and ammonium salts.			
Hazardous Decomposition or Byproducts – When heated to decomposition, oxides of sulfur, calcium and carbon may be liberated.			
Hazardous Polymerization	May Occur		Conditions to Avoid – Will not polymerize.
	Will Not Occur	**X**	

Section 11: Toxicological Information

There is no toxicological information reported for this material. Refer to individual constituent toxicological information.

Section 12: Ecological Information

There is no ecological information reported for this material. Refer to individual constituent ecological information.

Section 13: Disposal Considerations

Waste Disposal Method

Recover or recycle material to minimize disposal. Processing or contamination may change waste disposal options. State and local disposal regulation may differ from federal regulations. Consult with environmental agencies for guidance on acceptable disposal practices. Dispose of waste and containers in compliance with applicable Federal, State, and Local regulations.

Section 14: Transport Information

This material is not classified as a Hazardous Material under U.S. DOT regulations.

Section 15: Regulatory Information

TSCA	One or more constituents of this material appears on the EPA Toxic Substances Control Act Inventory.

N/D = Not Determined; N/E = Not Established; N/A = Not Applicable

RCRA	One or more constituents of this material is (are) classified as a hazardous waste under the Resource Conservation and Recovery Act Regulations.
CERCLA	One or more constituents of this material is (are) classified as a hazardous substance under regulations of the Comprehensive Environmental Response Compensation and Liability Act.
OSHA/MSHA	One or more constituents of this material is (are) consider to be a hazardous chemical and should be included in the Hazard Communication Program.
EPCRA SARA Title III	This material qualifies as a hazardous substance with delayed health effects.
EPCRA SARA Sec. 313	One or more constituents of this material is (are) on the TSCA inventory list.

Other regulations may apply. Comply with all Federal, State, and Local authorities

Section 16: Other Information

Date of Issue	October, 2014	Previous Version	March 12, 2004

This information has been compiled from sources considered to be dependable and is, to the best of our knowledge and belief, accurate and reliable as of the date compiled. However, no representation, warranty (either expressed or implied) or guarantee is made to the accuracy, reliability or completeness of the information contained herein. This information relates to the specific material designated and may not be valid for such material used in combination with any other materials or in any process.

It is the user's responsibility to be satisfied as to the suitability and completeness of this information for their own particular use.

We do not accept liability for any loss or damage that may occur, whether it be direct, indirect, incidental or consequential, from the use of this information, nor do we offer warranty against patent infringement. Additional information is available by calling the telephone number designated for this purpose.

N/D = Not Determined; N/E = Not Established; N/A = Not Applicable

Appendix D

Training Documents

Health and Safety Plan

Dallman and Lake Side Ash Ponds

Illinois Rule: 35 IAC 845.530 HASP

- Procedures for using, inspecting, repairing and replacing facility emergency and monitoring equipment;
- Communications and alarm systems
- Response to fires or explosions;
- Response to a spill or release of Coal Combustion Residuals
- Occupational Safety and Health Standards in 29 CFR 1910.120, 1926.65 and OSHA 10-hour or 30-hour construction safety training;
- Information about chemical hazards and hazardous materials at the site; and
- Use of engineering controls, administrative controls and personal protective equipment

HASP Administration

- Environmental Health and Safety Office
- Day to day implementation of HASP
  - Bill Antonacci
  - Eric Staley
  - Justin Olson
- Official Copy kept at EH&S Office
- Copies at various trailers at facility
- Electronic copy on CWLP intranet
  - https://www.cwlp.com/IllinoisCCRCompliance.aspx
- Updated as needed but no less frequently than annually
- Contract workers and third-party contractors subject to respective HASP as well

Background Information

Lakeside Ash Pond

- Placed into service prior to 1958
- Ceased accepting ash in 2009
- Approximately 35 acres in size
- Divided into four lime ponds and one settling pond
- Receives from Water Purification Plant, FGD WWTP, misc. floor drains

Background Information

Dallman Ash Pond Ash Pond

- Placed into service in 1976
- Approximately 35 acres in size
- Receives fly ash and bottom ash from Dallman 31, 32 and 33, GF WWTP sludge, landfill leachate, misc. storm water from FGD Landfill area


N
0 150 300 600
SCALE: IN FEET
LANDFILL UNIT 2
LANDFILL UNIT 1
ACTIVE CELL OF UNIT 2
LAKESIDE ASH POND
LIME SOFTENING POND
LIME SOFTENING POND
LIME SOFTENING POND
DALLMAN ASH POND
ANDREWS ENGINEERING, INC.
CWLP COAL RESIDUAL COMBUSTION UNITS
PLANS PREPARED FOR
CITY, WATER, LIGHT & POWER
SPRINGFIELD, SANGAMON COUNTY, ILLINOIS
DATE: JANUARY 2016
SHEET NUMBER:
FIG. 1

Scope of Health and Safety Plan

- Covers daily operations by CWLP, contractor workers and third-party contractors
  - Operation of heavy equipment
  - Loading of trucks with CCR material
  - Excavation of lime and ash ponds
  - Grading of placed material
  - Maintenance of berms, ditches and other structures

Hazard Analysis

Physical Hazards

- Slips, trips and falls
- Pinch points
- Struck by/caught between
- Exposure to vehicle traffic
- Manual handling of materials
- Exposure to heavy equipment
- Noise exposure

Hazard Analysis

Environmental Hazards

- Cold weather and related effects (frost bite)
- Hot weather and related effects (heat stroke, heat exhaustion, dehydration)
- Severe weather such as heavy rains, tornados, lightning
- Spill or release of CCR material

Hazard Analysis

Chemical Hazards

- Airborne/Respirable dust
- Exposure to CCR materials
- Exposure to landfill leachate
- Exposure to CCR surface water
- No RCRA hazardous chemicals or materials at the facility

Job Hazard Analysis

- JHA will be utilized for routine tasks and as new tasks arise
- Identify necessary administrative or engineering controls
- Identify appropriate PPE
- Identify need for Industrial Hygiene Audit
- JHAs will be shared with all employees
- New JHAs shared by the next work day
- Previous Industrial Hygiene audits conducted
  - Below detection limits for respirable dust and crystalline silica

Personal Protective Equipment

Minimum PPE for CWLP is OSHA Level D

- Long pants
- Long sleeved shirt
- Safety footwear
- Hard hat
- Safety glasses

Additional PPE warranted by JHA will be provided to CWLP employees

- Respiratory protection
- Level B or C PPE

Emergency Response

Do not hesitate to call 911

- Provide as much information as possible
  - Type of emergency
  - Number of people affected

ALWAYS contact the SOG 217-741-1938

- SOGs are trained as incident commanders
- SOGs can send additional resources and support
- Level B or C PPE

Contact EH&S 24-hour on call number 217-652-6864

- EH&S will contact regulatory agencies and appropriate administration

Training

- Using, inspecting, repairing and replacing facility emergency and monitoring equipment;
- Communications and alarm systems
- Emergency Evacuation
- Response to fires or explosions;
- Response to a spill or release of Coal Combustion Residuals
- Response to a Medical Emergency
- Occupational Safety and Health Standards in 29 CFR 1910.120, 1926.65 and OSHA 10-hour or 30-hour construction safety training;
- Information about chemical hazards and hazardous materials at the site; and
- Use of engineering controls, administrative controls and personal protective equipment

Training – Specific to CWLP

Item/Reference	Description
Dallman and Lakeside Ash Ponds Health and Safety Plan	Site specific Health and Safety Plan for operation, maintenance and construction activities at the ash ponds
Procedure SLC.50.001	Accident Reporting and Response Procedure
CWLP Safety Manual	Personal Protective Equipment Requirements
Procedure ADM.71.002	Site Entry Procedure
Procedure ADM.82.003	Emergency Procedure for Fire
Program EHS.30.007	Hazard Communication Program
Program EHS.30.011	Respiratory Protection Program
Program EHS.30.001	Arsenic Compliance Program
Program EHS.30.014	Beryllium Compliance Program
Program EHS.30.013	Respirable Crystalline Silica Compliance Program
Program EHS.30.008	Hexavalent Chromium Compliance Program
Program EHS.30.009	Lead and other Heavy Metals Compliance Program

Training

Inspecting, repairing, replacing facility emergency and monitoring equipment;

- Anticipate installation of equipment to monitor stability/integrity of ash ponds as closure begins
- Most likely will be overseen by contractors
- CWLP will have AED and Fire Extinguishers at facility trailer
- CWLP will conduct monthly inspections on AED and Fire Extinguishers
- Contractor workers and third-party contractors will be trained by their employers on their specific equipment

Training

Communications and alarm systems

- No fixed buildings to accommodate Gai-Tronics system
- CWLP employees will rely on two-way radios, CB radios and cell phones
- EH&S will ensure pertinent numbers are posted at facility trailer
  - Will ensure contract workers and third-part contractors have all pertinent contacts and numbers
- If and when new types of communications or alarm systems are introduced at the facility, all CWLP employees, contract workers and third-party contractors will be trained in their use

Training

Emergency Evacuation

- Emergency evacuation can be declared for many reasons
  - Fire
  - Flood
  - Spill or release of CCR
  - Medical emergency
  - Severe weather

- Communication limited to two-way radios, CB radios and cell phones

Training

Emergency Evacuation

- Evacuation will follow guidelines for Generating Facilities
  1. Immediately evacuate the area and report to designated assembly area
  2. Contact 911 if needed
  3. Contact SOG with information on nature of emergency
  4. Conduct accountability of employees at the facility
  5. Remain in assembly area and await further instructions

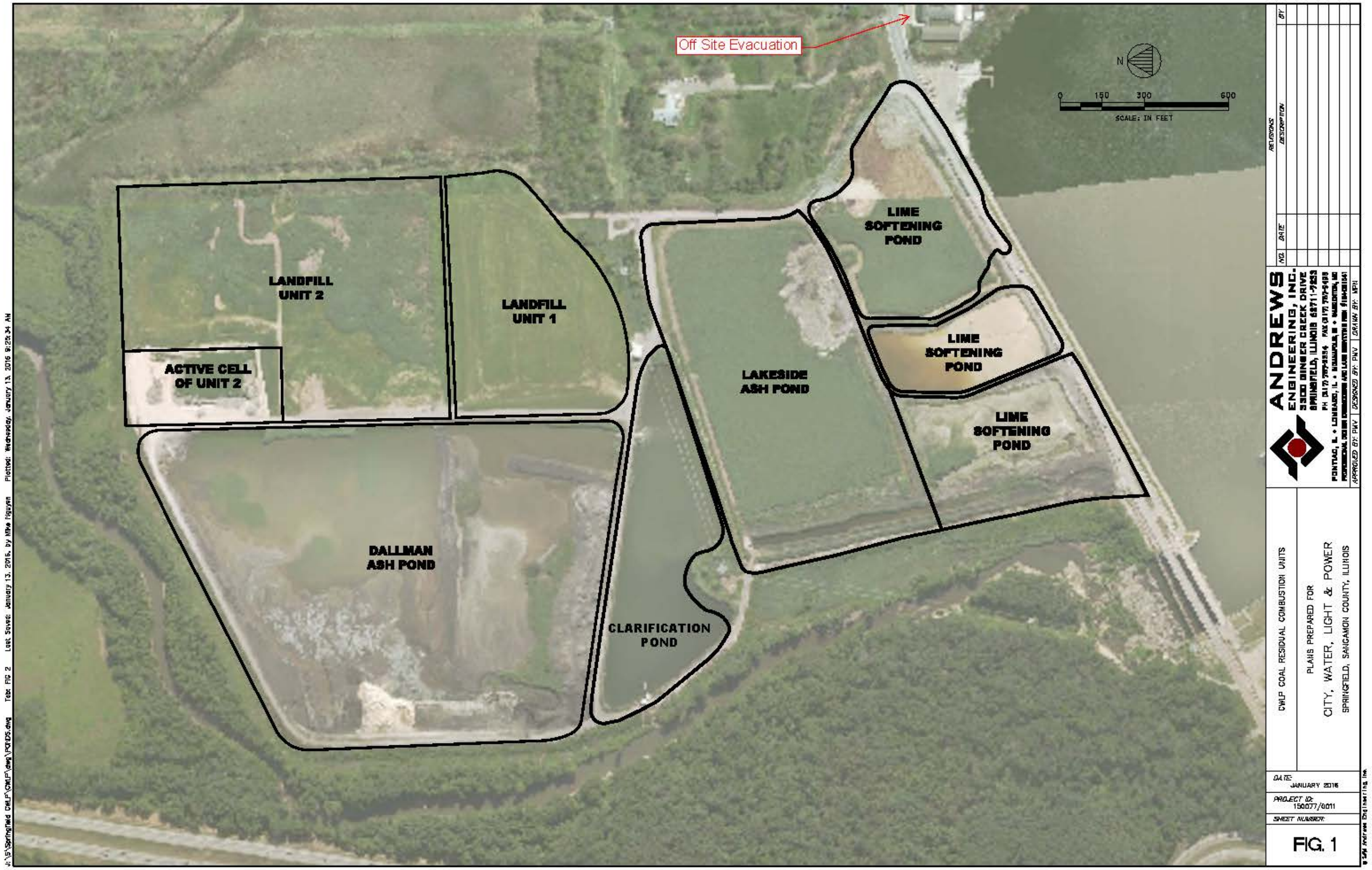
- Assembly area shall be the closest fixed building or construction trailer on the site

Training

Emergency Evacuation - Offsite

- Off-site assembly area shall be the PMC parking lot
- 200 E Lake Shore Drive
- Follow the same guidelines
  1. Immediately evacuate the area and report to off-site assembly area
  2. Contact 911 if needed
  3. Contact SOG with information on nature of emergency
  4. Conduct accountability of employees at the facility
  5. Remain in assembly area and await further instructions

Training


Off Site Evacuation
N
0 150 300 600
SCALE: IN FEET
LANDFILL UNIT 2
LANDFILL UNIT 1
ACTIVE CELL OF UNIT 2
LAKESIDE ASH POND
LIME SOFTENING POND
LIME SOFTENING POND
LIME SOFTENING POND
DALLMAN ASH POND
CLARIFICATION POND
ANDREWS ENGINEERING, INC.
CWLP COAL RESIDUAL COMBUSTION UNITS
PLANS PREPARED FOR
CITY, WATER, LIGHT & POWER
SPRINGFIELD, SANGAMON COUNTY, ILLINOIS
DATE: JANUARY 2016
FIG. 1

Training

Response to fire or explosions

- CWLP employees are trained annually on emergency procedures for responding to fires
- For work at ash ponds, most likely to encounter fire in fixed building or a piece of heavy equipment
- Fire extinguishers are located in fixed buildings and construction trailers
- For large fires
  - Evacuate the area and call 911
  - Second call to SOG with pertinent information
- For small fires
  - Employees may choose to fight fire based on their level of training
  - Always notify SOG incase small fire becomes a large fire

Training

Response to a spill or release of Coal Combustion Residuals

- In the event of catastrophic release of CCR, evacuate the area immediately
  - Emergency evacuation procedures to be followed
- Call SOG immediately with pertinent information
- CWLP has developed an Emergency Action Plan that will be implemented with local and state emergency responders and officials
- EH&S will implement Emergency Action Plan

- For small spills or releases on roadways, CCR may be cleaned up with heavy equipment
  - May also use water truck and hoses to control dust

Training

Response to a Medical Emergency

- CWLP employees are trained annually on responding to medical emergencies
- Many are also trained on CPR/AED and First Aid
- Employees should call 911 immediately if emergencies are life threatening
  - Uncontrolled bleeding, unconsciousness, electric shock, etc.
  - CWLP employees should never transport a person with life threatening emergencies to a medical facility
  - Only transport out of the area of the scene is unsafe
- Also must call SOG with pertinent information
- For non-life threatening medical needs, contact SOG with pertinent information and follow accident and reporting procedures

Training

Occupational Safety and Health Standards in 29 CFR 1910.120, 1926.65 and OSHA 10-hour or 30-hour construction safety training;

- CWLP employees engaged in work at the ash ponds have received HAZWOPER training are designated first responders in a HAZMAT situation
- CWLP employees engaged in work at the ash ponds have also received the 10-hour construction safety training
- Contract workers and third-party contractors will be required to be trained under their respective employers' programs before engaging in work at the facility

Training

Information about chemical hazards and hazardous materials at the site

- Surface impoundments have been historically operated to store bottom ash, fly ash and flue gas desulfurization wastes
- These materials are at the facility in solid form, in airborne respirable dust and in waters that have come into contact with CCR
- Can contain heavy metals such as arsenic, lead, mercury, cadmium, chromium and selenium
- Also contain aluminum, antimony, barium, beryllium, boron, chlorine, cobalt, manganese, molybdenum, nickel, thallium, vanadium, zinc
- Based upon exposure and route of entry, these substances have the potential to cause illness and disease.

Training

Information about chemical hazards and hazardous materials at the site

- Flue gas desulfurization wastes can contain arsenic, lead, mercury, cadmium, chromium and selenium
- Also contain aluminum, antimony, barium, beryllium, boron, chlorine, cobalt, manganese, molybdenum, nickel, thallium, vanadium, zinc
- Based upon exposure and route of entry, these substances have the potential to cause illness and disease.

Training

Information about chemical hazards and hazardous materials at the site

- Safety Data Sheets (SDS) have been developed for bottom ash, fly ash and flue gas desulfurization wastes
- SDS provides information on the properties and physical/chemical hazards of these substances
- SDS are available in the CWLP intranet site www.int.cwlp.com
- Hard copies are kept with the HASP
- Exposure to these materials can be reduced and/or eliminated through the use of engineering controls, administrative controls and personal protective equipment

Training

Use of engineering controls, administrative controls and PPE

- CWLP has developed several programs and procedures to reduce and/or eliminate employee exposure to contaminants in the work place
- These programs and procedures provide guidelines for housekeeping, work practice controls, engineering controls, administrative controls, respiratory protection and selection of personal protective equipment to further reduce employee exposure to hazardous conditions
- Contract workers and third-party contractors will be required to follow their respective employers’ programs and procedures while engaged in work at the facility

Training

Engineering Controls

- CWLP has developed several engineering controls to reduce and/or eliminate employee exposure to contaminants in the work place
- Include use of water trucks and/or hoses to limit generation of airborne dust when excavating CCR materials
- Use of water trucks to wet roadways
- 10 mile per hour speed limit on roadways
- Authority to terminate work when airborne dust may be carried beyond work area or facility boundary

Training

Administrative Controls

- CWLP has developed several administrative controls to reduce and/or eliminate employee exposure to hazards and contaminants in the work place

CWLP Safety Manual	Personal Protective Equipment Requirements
Procedure ADM 82.003	Emergency Procedure for Fire
Program EHS.30.007	Hazard Communication Program
Program EHS.30.011	Respiratory Protection Program
Program EHS.30.001	Arsenic Compliance Program
Program EHS.30.014	Beryllium Compliance Program
Program EHS.30.013	Respirable Crystalline Silica Compliance Program
Program EHS.30.008	Hexavalent Chromium Compliance Program
Program EHS.30.009	Lead and other Heavy Metals Compliance Program

Training

Administrative Controls

- These programs and administrative provide guidelines for housekeeping, work practice controls, respiratory protection and proper selection of personal protective equipment to further reduce employee exposure to hazardous conditions.
- Contract workers and third-party contractors will be required to follow their respective employers' administrative controls while engaged in work at the facility.

Training

Personal Protective Equipment

- CWLP employees , contract workers and third-party contractors shall wear at a minimum OSHA Level D PPE while engaged in work at the facility
- Includes long sleeves and long pants, safety footwear that meets ASTM F2431-11, hard hat, safety glasses and leather or heavy cloth gloves as needed
- Respiratory protection will be provided to CWLP employees covered under the Respiratory Protection Program
- Contract workers and third party contractors must be covered by their respective employers' respiratory protection program
- Additional PPE identified through a JHA will be required while engaged in those specific work activities

Questions?

ATTACHMENT 15 – HAZARD POTENTIAL CLASSIFICATION ASSESSMENT AND ACCOMPANYING CERTIFICATION

City Water, Light & Power
Ash Impoundments
Springfield, Sangamon County, Illinois

Initial Hazard Potential Classification Assessment Report for Coal Combustion Residuals Surface Impoundments

October 2021

Prepared for:
City Water, Light & Power
3100 Stevenson Drive
Springfield, Illinois 62703

ANDREWS ENGINEERING

3300 Ginger Creek Drive, Springfield, IL 62711 | 217.787.2334

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TABLE OF CONTENTS

1. INTRODUCTION

City Water, Light and Power (CWLP) Lakeside Ash Pond and Dallman Ash Pond are coal combustion residuals (CCR) surface impoundments. An assessment of the hazard potential classification for the CCR surface impoundments was conducted as required by 35 IAC Part 845.440(a):

Andrews Engineering, Inc. (AEI) reviewed aerial maps and current hazard potential classification status information regarding the Lakeside Ash Pond and Dallman Ash Pond as part of this initial hazard potential classification assessment. A summary of this information, as well as conclusions for the assessment is provided below.

2. CCR UNIT INFORMATION

Both the Lakeside Ash Pond and the Dallman Ash Pond are owned and operated by CWLP. The ponds are operated under National Pollutant Discharge Elimination System (NPDES) Permit Number IL0024767.

The Lakeside Ash Pond is primarily a diked embankment with some incising along the east perimeter and was placed into service prior to 1958. The original Lakeside Ash Pond has been divided into four separate ponds since it was expanded vertically in 1988, including three lime softening ponds and the settling pond. The vertical expansion consists of berms built on top and inside of the existing embankments. The current Lakeside Ash Pond is approximately 27.6 acres and ceased receiving ash in 2009.

The second impoundment, the Dallman Ash Pond, which is a diked embankment, was placed into service in approximately 1976 and is approximately 34.5 acres. Fly ash and bottom ash are sluiced to the Dallman Ash Pond with raw lake water.

Settled water from both the Dallman Ash Pond and Lakeside Ash Pond flow into opposite sides of a Clarification Pond before being discharged to Sugar Creek at Outfall 004 pursuant to the aforementioned NPDES permit.

3. CURRENT CLASSIFICATION

The Dallman Ash Pond and the original (lower) portion of the Lakeside Ash Pond are not regulated by a state agency and were never designated a potential hazard rating. The expansion portion of the Lakeside Ash Pond is regulated by the Illinois Department of Natural Resources (IDNR) and was assigned a Hazard Classification of “Class III,” which corresponds to U.S. Corps of Engineers (USACE) “Low Hazard Potential” category. Additionally, Lakeside Ash Pond is listed in the National Inventory of Dams (NID) with a Hazard Classification of “Low.”

This rating was determined by IDNR under the following classification system provided by 17 Ill. Adm. Code 3702.30(a)(1):

> *Dams will be categorized in one of three classes, according to the degree of threat to life and property in the event of a dam failure. The three classes of dams are:*

A) *Class I − Dams located where failure has a high probability for causing loss of life or substantial economic loss in excess of that which would naturally occur downstream of the dam if the dam had not failed. A dam has a high probability for causing loss of life or substantial economic loss if it is located where its failure may cause additional damage to such structures as a home, a hospital, a nursing home, a highly traveled roadway, a shopping center, or similar type facilities where people are normally present downstream of the dam. This is similar to U.S. Army Corps of Engineers HIGH HAZARD POTENTIAL category as defined in the Corps Guidelines, and the U.S. Soil Conservation Service Class (c) dams as defined in Soil Conservation Service Technical Release No. 60.*

B) *Class II – Dams located where failure has a moderate probability for causing loss of life or may cause substantial economic loss in excess of that which would naturally occur downstream of the dam if the dam had not failed. A dam has a moderate probability for causing loss of life or substantial economic loss if it is located where its failure may cause additional damage to such structures as a water treatment facility, a sewage treatment facility, a power substation, a city park, a U.S. Route or Illinois Route highway, a railroad or similar type facilities where people are downstream of the dam for only a portion of the day or on a more sporadic basis. This is similar to U.S. Army Corps of Engineers SIGNIFICANT HAZARD POTENTIAL category and the U.S. Soil Conservation Service Class (b) dams.*

C) *Class III – Dams located where failure has low probability for causing loss of life, where there are no permanent structures for human habitation, or minimal economic loss in excess of that which would naturally occur downstream of the dam if the dam had not failed. A dam has a low probability for causing loss of life or minimal economic loss if it is located where its failure may cause additional damage to agricultural fields, timber areas, township roads or similar type areas where people seldom are present and where there are few structures. This corresponds to U.S. Army Corps of Engineers LOW HAZARD POTENTIAL category and U.S. Soil Conservation Service Class (a) dams.*

4. CLASSIFICATION ANALYSIS

The following information was considered for the hazard potential classification analysis of the CWLP surface impoundments performed by Paul Van Metre, P.E., in October 2016:

4.1 Downstream Conditions

Both the Dallman Ash Pond and Lakeside Ash Pond are immediately adjacent to Sugar Creek. There are no homes, recreational facilities, businesses, roads, or other permanent structures immediately downstream of the impoundments. The floodplain area adjacent to the immediate downstream Sugar Creek is entirely comprised of agricultural fields and timber areas. The closest structures downstream along Sugar Creek from the ash ponds are a pedestrian bridge servicing the Lost Bridge Trail system at more than 4,000 feet downstream from Dallman Ash Pond, and a vehicle bridge for IL Route 29 at more than a mile downstream from Dallman Ash Pond.

4.2 Safety Factor Assessment

A Safety Factor Assessment was performed by Andrews for both the Dallman Ash Pond and Lakeside Ash Pond. This assessment included slope stability analyses for critical sections in the surface impoundments, including the constructed berms and underlying soils. Although there is a lack of construction records for the impoundments, conservative parameters derived from published literature, available geotechnical data from subsurface drilling and testing programs, and field surveys were used to assess factors of safety. The assessment concluded that all applicable factors of safety under 257.73(e) for both surface impoundments were exceeded by the results of these analyses.

4.3 Additional Information

The eastern portion of the original Lakeside Ash Pond is incised. The entire ash pond abuts the Lake Springfield dam to the south. The northern portion of the ash pond is separated by a roadway from the Unit 1 landfill and the clarification pond. The only portions of the Lakeside Ash Pond with open downstream slopes are the west dike of the original ash pond and the vertical expansion berms, which were constructed on the east, west and south boundaries of the ash pond.

The entire Dallman Ash Pond is partially incised. Material from the center of the ash pond were excavated and utilized in the construction of the dikes. The Dallman Ash Pond abuts the CWLP landfills to the east and the clarification pond to the south. The only open downstream slopes of the Dallman Ash Pond are on the west and south dikes.

A stability analysis was performed by Testing Service Corporation (TSC) in 1994 for the design of the adjacent Unit 2 Landfill. The landfill is located in the northeastern half of the site which is directly adjacent to the east of the Dallman Ash Pond and north of the Lakeside Ash Pond. This analysis included a review of all of the subsurface studies performed at the site (72 borings in total) as well as five additional borings drilled as part of the stability analysis study. Laboratory testing completed on cohesive soil samples from these five borings included analyses on: moisture content, in-place dry density, unconfined compressive strength, and Atterberg limits. In addition, one sample was selected for triaxial shear testing, and another for direct shear testing.

The TSC analysis for Unit 2 included an evaluation of settlement and bearing capacity for the foundation, and mass stability for the various excavated and constructed slopes of the landfill. Both static and seismic conditions for short- and long-term scenarios were evaluated using the geologic data acquired from the aforementioned study. The safety factors resulting from these analyses exceeded all requirements for new solid waste landfills in Illinois under 35 Ill. Adm. Code 811.304.

The geologic characteristics at the site were determined via subsurface boring programs related to permitting and monitoring of the landfill units as well as the drilling conducted for the monitoring program currently implemented for the ash impoundments. The geologic characteristics were determined to be consistent throughout the site. The structural characteristics of the soils also apply to the entire site, which includes the ash ponds.

4.4 Hazard Classification

Based on the information presented in this report, there is a low probability of a failure for either unit. In addition, there is a low probability of a failure to cause loss of life, and a failure would cause minimal economic loss. Therefore, both the Dallman Ash Pond and the entire Lakeside

Ash Pond qualify as "**Low Hazard Potential CCR Surface Impoundments**" under the qualifications described in Ill. Adm. Code 3702.30(a)(1), quoted in Section 3.

5. STATEMENT

This Initial Hazard Potential Classification Assessment Report for Coal Combustion Residuals Surface Impoundments was completed for CWLP by Andrews Engineering, Inc. in accordance with the requirements under 35 IAC Part 845.440(a).

[signature]	10-20-21
Paul M. Van Metre, P.E.	Date

STATE OF ILLINOIS
PAUL
VAN METRE
062-064175
REGISTERED
PROFESSIONAL ENGINEER

ATTACHMENT 16 – STRUCTURAL STABILITY ASSESSMENT AND ACCOMPANYING CERTIFICATION

City Water, Light & Power
Ash Impoundments
Springfield, Sangamon County, Illinois

Structural Stability Assessment for Coal Combustion Residuals Surface Impoundments

October 2021

Prepared for:
City Water, Light & Power
3100 Stevenson Drive
Springfield, Illinois 62703

ANDREWS ENGINEERING

3300 Ginger Creek Drive, Springfield, IL 62711 | 217.787.2334

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TABLE OF CONTENTS

1. INTRODUCTION

City Water, Light and Power (CWLP) Lakeside Ash Pond and Dallman Ash Pond are coal combustion residuals (CCR) surface impoundments. An assessment of the structural stability for the CCR surface impoundments was conducted as required by 35 IAC Part 450(c):

Analysis performed herein for the Initial Structural Stability Assessment of the existing ash ponds at Springfield City Water, Light and Power, Lakeside and Dallman Ash Ponds, Springfield, Illinois, as required per 40 CFR 257.73(d). Information reviewed for this report includes the following documents:

- Coal Ash Impoundment Site Assessment Final Report (May 2011)
- Historical Aerial Photographs (April 1995 – March 2014)
- Engineering Report: Proposed Embankment Modification; CWLP Ash Disposal Area (July 1987).
- Construction Grading Plan for the Dallman Ash Pond (August 1976)

2. CCR UNIT INFORMATION

Both the Lakeside Ash Pond and the Dallman Ash Pond are owned and operated by CWLP. The ponds are operated under National Pollutant Discharge Elimination System (NPDES) Permit Number IL0024767.

The Lakeside Ash Pond is primarily a diked embankment with some incising along the east perimeter and was placed into service prior to 1958. The original Lakeside Ash Pond was been divided into four separate ponds since it was expanded vertically in 1988: three lime softening ponds and the settling pond. The current Lakeside Ash Pond is approximately 27.6 acres and ceased receiving ash in 2009.

The eastern portion of the original Lakeside Ash Pond is incised. The entire ash pond abuts the Lake Springfield dam to the south. The original portion of the ash pond abuts the Unit 1 landfill and the clarification pond to the north. The only portions of the Lakeside Ash Pond with open downstream slopes are the west dike of the original ash pond, and the vertical expansion berms, which were constructed on the east, west and south boundaries of the ash pond.

The second impoundment, the Dallman Ash Pond, which is a diked embankment, was placed into service in approximately 1976 and is approximately 34.5 acres. Fly ash and bottom ash are sluiced to the Dallman Ash Pond with raw lake water.

The entire Dallman Ash Pond is partially incised. Material from the center of the ash pond was excavated and utilized in the construction of the dikes. The Dallman Ash Pond abuts the CWLP landfills to the east and the clarification pond to the south. The only open downstream slopes of the Dallman Ash Pond are on the west and south dikes.

Settled water from both the Dallman Ash Pond and Lakeside Ash Pond flow into opposite sides of a Clarification Pond before being discharged to Sugar Creek at Outfall 004 pursuant to the aforementioned NPDES permit.

3. FOUNDATION

The Sugar Creek historically meandered across the site, generally from the west to east with an overall flow direction to the north. During the construction of the ash ponds, the creek was abandoned and relocated to the west of the site. The old creek bed was filled with different types of soil, ranging from cohesive soils characterized as silty clays, to granular fill characterized as poorly graded silty to clayey sands. Prior to the area development, the upper layer of soil at the site consisted of mainly brown, light brown, and brownish-gray silty clays and clayey silts having soft to stiff consistency. This includes all eolian soils (loess) deposited near the surface, isolated pockets and lenses of fine grained silty to clayey sand at some locations and alluvial silts and silty clays.

According to the construction plan drawings for the Dallman Ash Pond, dikes were constructed on areas of the old creek bed. According to notes on these drawings, the creek bed in these areas was over-excavated by at least 4.0 feet below the existing channel banks and bottom. These excavations were then filled in with cohesive material and compacted to at least 90 percent of optimum density as determined under AASHTO-T99 at optimum moisture.

Although design information is limited for the surface impoundments, a stability analysis was performed by Testing Service Corporation (TSC) in 1994 for the design of the adjacent Unit 2 Landfill. The landfill is located in the northeastern half of the site, which is directly adjacent to the east of the Dallman Ash Pond and north of the Lakeside Ash Pond. This analysis included a review of all of the subsurface studies performed at the site (72 borings in total) as well as five additional borings drilled as part of the stability analysis study. Laboratory testing completed on cohesive soil samples from these five borings included analyses on: moisture content, in-place dry density, unconfined compressive strength, and Atterberg limits. In addition, one sample was selected for triaxial shear testing, and another for direct shear testing.

The TSC analysis for Unit 2 included an evaluation of settlement and bearing capacity for the foundation, and mass stability for the various excavated and constructed slopes of the landfill. Both static and seismic conditions for short- and long-term scenarios were evaluated using the geologic data acquired from the aforementioned study. The safety factors resulting from these analyses exceeded all requirements for new solid waste landfills in Illinois under 35 Ill. Adm. Code 811.304.

The geologic characteristics at the site were determined via subsurface boring programs related to permitting and monitoring of the landfill units as well as the drilling conducted for the monitoring program currently implemented for the ash impoundments. The geologic characteristics were determined to be consistent throughout the site as described in the initial paragraph to this Section. The structural characteristics of the soils also apply to the entire site, which includes the ash ponds.

4. SLOPE PROTECTION

4.1 Lakeside Ash Pond

Both the upstream and downstream slopes of the Lakeside Ash Pond are vegetated to protect the slopes against surface erosion. During the 2021 Annual Inspection, no significant signs of erosion were observed on any of the slopes and no observations of significant erosion was noted during any of the weekly inspections prior to the Annual Inspection.

4.2 Dallman Ash Pond

The downstream slope of the Dallman Ash Pond is vegetated to protect against surface erosion. Riprap was placed on the bottom portion of the downstream slope. Ruts and gullies on the downstream slopes, when observed, are immediately filled with soil and monitored during the weekly inspections. During the 2021 Annual Inspection, no significant signs of erosion were observed on any the upstream slopes and no observations of significant erosion on the upstream slopes was noted during any of the weekly inspections prior to the Annual Inspection.

5. DIKE COMPACTION

5.1 Documentation

5.1.1 Lakeside Ash Pond

No as-built construction documentation is available for the Lakeside Ash Pond. No construction plans are available for the original construction of the Lakeside Ash Pond. Construction plans for the vertical expansion (Engineering Report: Proposed Embankment Modification; CWLP Ash Disposal Area, July 1987) do call for the expansion berms to be constructed by placing cohesive material in thin lifts of 6 to 8 inches and compacted.

5.1.2 Dallman Ash Pond

No as-built construction documentation is available for the Dallman Ash Pond. Notes in the construction plan drawings do call for dike materials to be compacted to “at least 90% of the minimum density at optimum moisture as determined by AASHTO-T99.”

5.2 Slope Stability Analyses

A slope stability analyses was performed as part of the Initial Safety Factor Assessment performed by Andrews Engineering, Inc. (AEI) for both the Lakeside Ash Pond and Dallman Ash Pond using available geotechnical data for the site. The analyses indicate that Lakeside and Dallman Ash Ponds provide factors of safety equal to or greater than minimum values as required by 35 IAC 845.460.

6. VEGETATED SLOPE HEIGHT

6.1 Lakeside Ash Pond

No as-built construction documentation is available for the Lakeside Ash Pond. No construction plans are available for the original construction of the Lakeside Ash Pond. Construction plans for the vertical expansion (Engineering Report: Proposed Embankment Modification; CWLP Ash Disposal Area, July 1987) do not specify a thickness for the vegetated slope layer.

6.2 Dallman Ash Pond

No as-built construction documentation is available for the Dallman Ash Pond. Notes in the construction plan drawings do call for a 6-inch layer of seeded topsoil be placed on the top of all upstream and downstream slopes.

7. SPILLWAYS

Neither ash pond has constructed or natural spillways.

8. HYDRAULIC STRUCTURES

8.1 Lakeside Ash Pond

During the vertical expansion, an outlet structure was constructed through the northern berm of the Lakeside Ash Pond, which drains into the adjacent clarification pond. The outlet is constructed with a 24-inch diameter reinforced concrete pipe (RCP). The length of the pipe is approximately 60 feet. The pipe was bedded in compacted cohesive material and an anti-seep collar at approximately halfway through the berm. The outlet appears to be structurally sound, with no observed signs of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, or debris.

8.2 Dallman Ash Pond

An outlet structure was constructed through the southern dike of the Dallman Ash Pond, which drains into the adjacent clarification pond. The outlet is constructed with a 24-inch diameter high density polyethylene (HDPE) pipe. The length of the pipe is approximately 120 feet. No other details are available on the installation of the outlet. The outlet appears to be structurally sound, with no observed signs of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, or debris.

9. ADJACENT BODIES OF WATER

Both Lakeside Ash Pond and Dallman Ash Pond are adjacent to the Clarification Pond to the south and the north, respectively. In addition, the Sugar Creek is adjacent to both ash ponds to the west. The Initial Safety Factor Assessment was performed by AEI, which determined the safety factors for the Dallman Ash Pond and Lakeside Ash pond for both long- and short-term scenarios. These analyses were performed with the assumptions that the Clarification Pond was drained, and also that the Sugar Creek had nearly zero flow at approximately 520 feet.

10. OBSERVATIONS

As reported in the 2021 Annual Inspection, no visual indications of actual or potential structural weaknesses of the surface impoundments have been observed. Based on the review of historical aerial photographs completed during the 2016 Annual Inspection, there were no observed indications of mass movement on any of the constructed berms for the surface impoundments.

11. STATEMENT

This Structural Stability Assessment for Coal Combustion Residuals Surface Impoundments was completed for CWLP by Andrews Engineering, Inc. in accordance with the requirements under 35 IAC Part 845.450.

Paul M. Van Metre, P.E.

10-20-21
Date

STATE OF ILLINOIS
PAUL
VAN METRE
062-064175
REGISTERED
PROFESSIONAL ENGINEER

ATTACHMENT 17 – SAFETY FACTOR ASSESSMENT AND ACCOMPANYING CERTIFICATION

City Water, Light & Power
Ash Impoundments
Springfield, Sangamon County, Illinois

Initial Safety Factor Assessment for Coal Combustion Residuals Surface Impoundments

October 2021

Prepared for:
City Water, Light & Power
3100 Stevenson Drive
Springfield, Illinois 62703

ANDREWS ENGINEERING

3300 Ginger Creek Drive, Springfield, IL 62711 | 217.787.2334

ILLINOIS | MISSOURI | INDIANA

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TABLES

APPENDICES

1. INTRODUCTION

City Water, Light and Power (CWLP) Lakeside Ash Pond and Dallman Ash Pond are coal combustion residuals (CCR) surface impoundments. An Initial Safety Factor Assessment of the CCR surface impoundments was conducted as required by 35 CFR Part 845.460:

Analysis is performed herein for the Initial Safety Factor Assessment of the existing ash ponds at Springfield City Water, Light and Power, Lakeside and Dallman Ash Ponds, Springfield, Illinois, as required per 40 CFR 257.73(e). Based upon historical geotechnical data and the existing conditions of the ash ponds, all factors of safety exceed the regulatory minimums as demonstrated within this report.

Information reviewed for this report includes the following documents:

- Coal Ash Impoundment Site Assessment Final Report (May 2011)
- Historical Aerial Photographs (April 1995 – March 2014)
- Engineering Report: Proposed Embankment Modification; CWLP Ash Disposal Area (July 1987).
- Construction Grading Plan for the Dallman Ash Pond (August 1976)

2. BACKGROUND

CWLP operates a series of ash and lime sludge clarification or settling ponds east of the power plant complex in Springfield, Illinois. The ponds are operated under National Pollutant Discharge Elimination System (NPDES) Permit Number IL0024767.

The Lakeside Ash Pond is primarily a diked embankment with some incising along the east perimeter and was placed into service prior to 1958. The original Lakeside Ash Pond was been divided into four separate ponds since it was expanded vertically in 1988: three lime softening ponds and the settling pond. The current Lakeside Ash Pond is approximately 27.6 acres and ceased receiving ash in 2009.

The second impoundment, the Dallman Ash Pond, which is a diked embankment, was placed into service in approximately 1976 and is approximately 34.5 acres. Fly ash and bottom ash are sluiced to the Dallman Ash Pond with raw lake water.

Settled water from both the Dallman Ash Pond and Lakeside Ash Pond flow into opposite sides of a Clarification Pond before being discharged, typically, to Sugar Creek at Outfall 004.

3. GEOMETRY OF THE STRUCTURES

According to personal interviews with CWLP staff, the most recent change made to the CCR surface impoundment was a vertical expansion to the Lakeside Ash Pond system in 1988. The vertical expansion consists of berms built on top and inside of the existing embankments in such a way that the toe of the outer slope of the expansion berms match up with the top of the inner slope of the existing embankments, typically identified as upstream construction. The vertical expansion berms are approximately ten feet in height.

A site map drawing containing an aerial photograph and approximate boundaries for all of the CWLP CCR Units, including the ash and lime softening ponds, is provided in Appendix A.

No changes to the geometry of the structures are applicable for this report. No changes are apparent due to structure movement or deformation.

4. GEOTECHNICAL INFORMATION

4.1 Lakeside Ash Pond Geotechnical Data

A review of the historical documents found a previous geotechnical investigation and stability analysis, which was conducted prior to the upstream construction of Lakeside Ash Pond. The results of that geotechnical investigation are utilized within this assessment of the safety factors. Additionally, a literature review of technical papers was conducted to determine the geotechnical parameters for the fly ash within the impoundments. Provided in Table 1 are highly conservative geotechnical parameters based upon the previous geotechnical investigation utilized in the static and seismic slope stability model.

Included in Appendix B are copies of the historical soils logs and cross sections that support the geotechnical parameters provided in Table 1. Technical papers supporting the ash geotechnical parameters are included in Appendix C.

TABLE 1

Lakeside Ash Pond

Soil Description	Density (pcf)	Total Strengths (Short Term)		Effective Strengths (Long Term)	
		ϕ (degrees)	c (psf)	ϕ' (degrees)	c (psf)
Ash	100	15	0	25	0
Embankment	120	0	1,400	32	145
Sandy Silty Clay w/Clayey Silt	120	0	1,800	32	190
Sandy Silty Clay	120	0	1,000	32	190
Shale	130	0	2,000	0	2,000

4.2 Dallman Ash Pond Geotechnical Data

A review of the historical documents revealed the original construction plans, with cross sections provided, was completed. More recent site investigations have been conducted in the area during the installation of piezometers, which provide the stratigraphic and in situ strengths of earthen materials that correlate well with the Lakeside Ash Ponds geotechnical data. The historical data have been used to develop conservative geotechnical parameters for slope stability analysis as provided below in Table 2.

Included in Appendix D are copies of the boring log and cross section that support the geotechnical parameters provided in Table 2.

TABLE 2

Dallman Ash Pond

Soil Description	Density (pcf)	Total Strengths (Short Term)		Effective Strengths (Long Term)	
		ϕ (degrees)	c (psf)	ϕ' (degrees)	c (psf)
Ash	100	15	0	25	0
Embankment	120	0	1,400	32	145
Rip-Rap	140	40	0	40	0
Silty Clay	120	0	1,800	32	190
Clayey Silt	120	0	1,400	32	190
Sandy Silty Clay	120	0	1,000	32	190
Sand w/Silt	120	34	0	34	0
Shale	130	0	2,000	0	2,000

4.3 Seismic Ground Motion

CWLP is susceptible to potential seismic activity as provided by the USGS Earthquake Hazards Program. Included in Appendix E of this geotechnical engineering report is the 2008 National Seismic Hazard Mapping Program's Probabilistic Seismic Hazard Analysis for the site (Latitude 39.762 North, Longitude 89.597 West). The Peak Horizontal Ground Acceleration is approximately 0.09965 g. The maximum acceleration of (aHmax = 0.10g) was selected for use in stability calculations.

5. SLOPE STABILITY ANALYSIS

The static and seismic slope stability model utilized for the following analysis was the Morgenstern and Price Circular Search Method within the Slope/W computer-based slope stability modeling software. Morgenstern and Price satisfies all conditions of equilibrium.

The periodic safety factor assessment requires that each CCR unit document whether the calculated factors of safety for each CCR unit achieve the minimum safety factors. The calculated static factor of safety under the long-term, maximum storage pool loading condition must equal or exceed 1.50. The calculated static factor of safety under the maximum surcharge pool loading condition must equal or exceed 1.40. The calculated seismic factor of safety must equal or exceed 1.00. For dikes constructed of soils that have susceptibility to liquefaction, the calculated liquefaction factor of safety must equal or exceed 1.20.

The Lakeside and Dallman Ash Ponds are not susceptible to liquefaction since the embankments are constructed of a sandy silty clay, thus analyses for each are not included below. Liquefaction occurs in fine grained non-cohesive soils. The embankments at CWLP are constructed of cohesive soils.

5.1 Lakeside Ash Pond Slope Stability

The slope stability analysis was performed on a critical cross section, previously identified as Section 2 in the Engineering Report: Proposed Embankment Modification; CWLP Ash Disposal Area (July 1987)., Based upon a review of this report and existing conditions, Section 2 appears to remain the critical cross section. Section 2 is located on the north side of the Lakeside Ash Pond next to the Clarification Pond. For a very conservative analysis, the slope was analyzed as if the Clarification Pond was drained and dredged back to the pre-existing grades of approximately 535 feet MSL.

The Lakeside Ash Pond is not susceptible to liquefaction since the embankment is constructed of a sandy silty clay; thus, analysis is not included below.

5.1.1 Long-Term Static Slope Stability Analysis

The long-term static slope stability analysis was performed on the Lakeside Ash Pond cross section using the geotechnical parameters as provided in Table 1. The long-term analysis utilizes the effective shear strength parameters, which are the drained condition. The long-term static slope stability analysis found that the factor of safety for the most critical failure surface was 1.532. The critical failure surface and stability report are included in Appendix F-1. This analysis verifies that Lakeside exceeds the factor of safety for the long-term, maximum storage pool loading condition and the maximum surcharge pool loading condition since the analysis was performed filled with ash and the pool elevation matching the top of the embankment.

5.1.2 Short-Term Static Slope Stability Analysis

The short-term static slope stability analysis was performed on the Lakeside Ash Pond cross section using the geotechnical parameters as provided in Table 1. The short-term analysis utilizes the total shear strength parameters, which are the undrained condition. The short-term static slope stability analysis found that the factor of safety for the most critical failure surface was 1.640. The critical failure surface and stability report are included in Appendix F-2.

5.1.3 Seismic Slope Stability Analysis

The seismic slope stability analysis was performed on the Lakeside Ash Pond cross section using the geotechnical parameters as provided in Table 1. The seismic analysis utilizes the total shear strength parameters, which are the undrained condition since a seismic event occurs in a short period of time. In addition, a horizontal acceleration of 0.10g was utilized within the modeling to represent the peak horizontal ground acceleration anticipated for CWLP. The seismic slope stability analysis found that the factor of safety for the most critical failure surface was 1.260. The critical failure surface and stability report are included in Appendix F-3. This analysis verifies that Lakeside exceeds the seismic factor of safety with maximum surcharge pool loading condition.

5.2 Dallman Ash Pond Slope Stability

The slope stability analysis was performed on a critical cross section based upon a review of the historical construction diagrams, cross sections and the available stratigraphic data. Section 10+00 is located on the north side of the Dallman Ash Pond near the relocated Sugar Creek.

For a very conservative analysis, the slope was analyzed as if Sugar Creek had nearly zero flow at approximately 520 feet MSL.

5.2.1 Long-Term Static Slope Stability Analysis

The long-term static slope stability analysis was performed on the Dallman Ash Pond cross section using the geotechnical parameters as provided in Table 2. The long-term analysis utilizes the effective shear strength parameters, which are the drained condition. The long-term static slope stability analysis found that the factor of safety for the most critical failure surface was 2.245. The critical failure surface and stability report are included in Appendix G-1. This analysis verifies that Dallman exceeds the factor of safety for the long term, maximum storage pool loading condition and the maximum surcharge pool loading condition since the analysis was performed filled with ash and the pool elevation matching the top of the embankment.

5.2.2 Short-Term Static Slope Stability Analysis

The short-term static slope stability analysis was performed on the Dallman Ash Pond cross section using the geotechnical parameters as provided in Table 2. The short-term analysis utilizes the total shear strength parameters, which are the undrained condition. The short-term static slope stability analysis found that the factor of safety for the most critical failure surface was 2.897. The critical failure surface and stability report are included in Appendix G-2.

5.2.3 Seismic Slope Stability Analysis

The seismic slope stability analysis was performed on the Dallman Ash Pond cross section using the geotechnical parameters as provided in Table 2. The seismic analysis utilizes the total shear strength parameters, which are the undrained condition since a seismic event occurs in a short period of time. In addition, a horizontal acceleration of 0.10g was utilized within the modeling to represent the peak horizontal ground acceleration anticipated for CWLP. The seismic slope stability analysis found that the factor of safety for the most critical failure surface was 1.754. The critical failure surface and stability report are included in Appendix G-3. This analysis verifies that Dallman exceeds the seismic factor of safety with maximum surcharge pool loading condition.

6. SUMMARY

The analyses indicate that Lakeside and Dallman Ash Ponds provide factors of safety equal to or greater than minimum values as required by 40 CFR 257.73(e). This is predicated upon the assumption that cohesive and frictional shear strengths of materials meet or exceed those used in the analyses. Table 3 below provides a summary of the slope stability results.

TABLE 3

Slope Stability Results

Cross Section	Stability Model Results	40 CFR 257.73 Minimum F.S.
Lakeside Long Term Static	1.532	1.5
Dallman Long Term Static	2.245	
Lakeside Short Term Static	1.640	1.4
Dallman Short Term Static	2.897	

Lakeside Seismic	1.26	1.0
Dallman Seismic	1.754	

7. STATEMENT

This Initial Safety Factor Assessment for Coal Combustion Residuals Surface Impoundments was completed for CWLP by Andrews Engineering, Inc. in accordance with the requirements under 35 IAC 845.460.

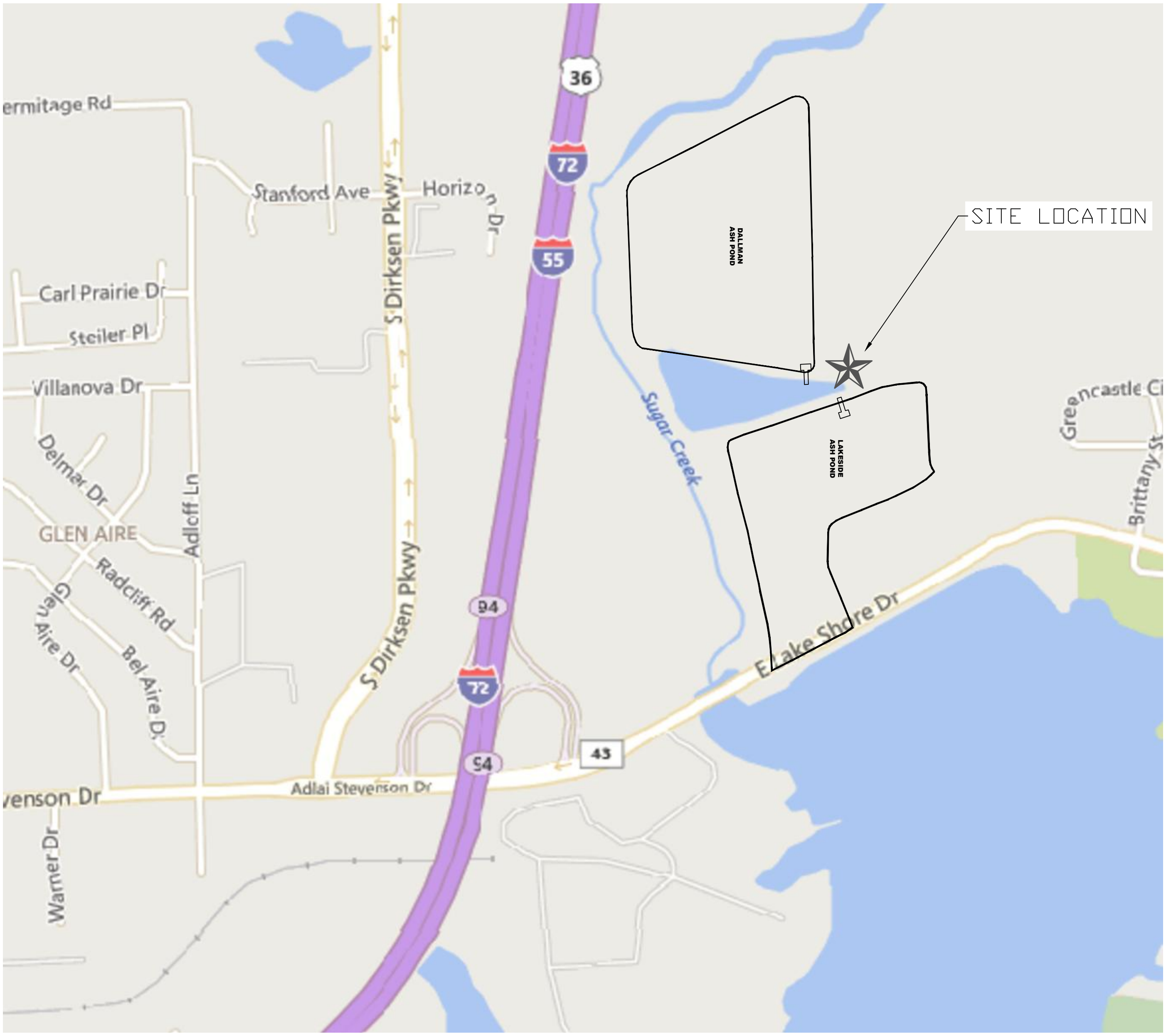
10-20-21

Paul M. Van Metre, P.E. Date

STATE OF ILLINOIS
PAUL
VAN METRE
062-064175
REGISTERED
PROFESSIONAL ENGINEER

APPENDIX A

Site Map



SITE LOCATION

N

0 500 1000 2000

SCALE: IN FEET

NOTE:
BASE IMAGE DERIVED FROM BING

ANDREWS ENGINEERING, INC.
3300 Ginger Creek Drive, Springfield, IL 62711-7233
Tel (217) 787-2334 Fax (217) 787-9495
Pontiac, IL • Naperville, IL • Indianapolis, IN • Warrenton, MO
Professional Design Engineering and Land Surveying Firm #184-001541

APPROVED BY: PMV | DESIGNED BY: PMV | DRAWN BY: RMC

SITE LOCATION MAP

PLANS PREPARED FOR

CWLP

SPRINGFIELD, SANGAMON COUNTY, ILLINOIS

DATE: OCTOBER 2016

PROJECT ID: 150077/0011

SHEET NUMBER:

FIG. 1

NO.	DATE	REVISIONS DESCRIPTION	BY

ANDREWS ENGINEERING, INC.
3300 GINGER CREEK DRIVE
SPRINGFIELD, ILLINOIS 62711-7233
PH (217) 787-2334 FAX (217) 787-9495
PONTIAC, IL • LOMBARD, IL • INDIANAPOLIS, IN • WARRENTON, MO
PROFESSIONAL DESIGN ENGINEERING AND LAND SURVEYING FIRM #184-001541

APPROVED BY: PMV DESIGNED BY: PMV DRAWN BY: MPN

CWLP COAL COMBUSTION RESIDUALS SURFACE IMPOUNDMENTS

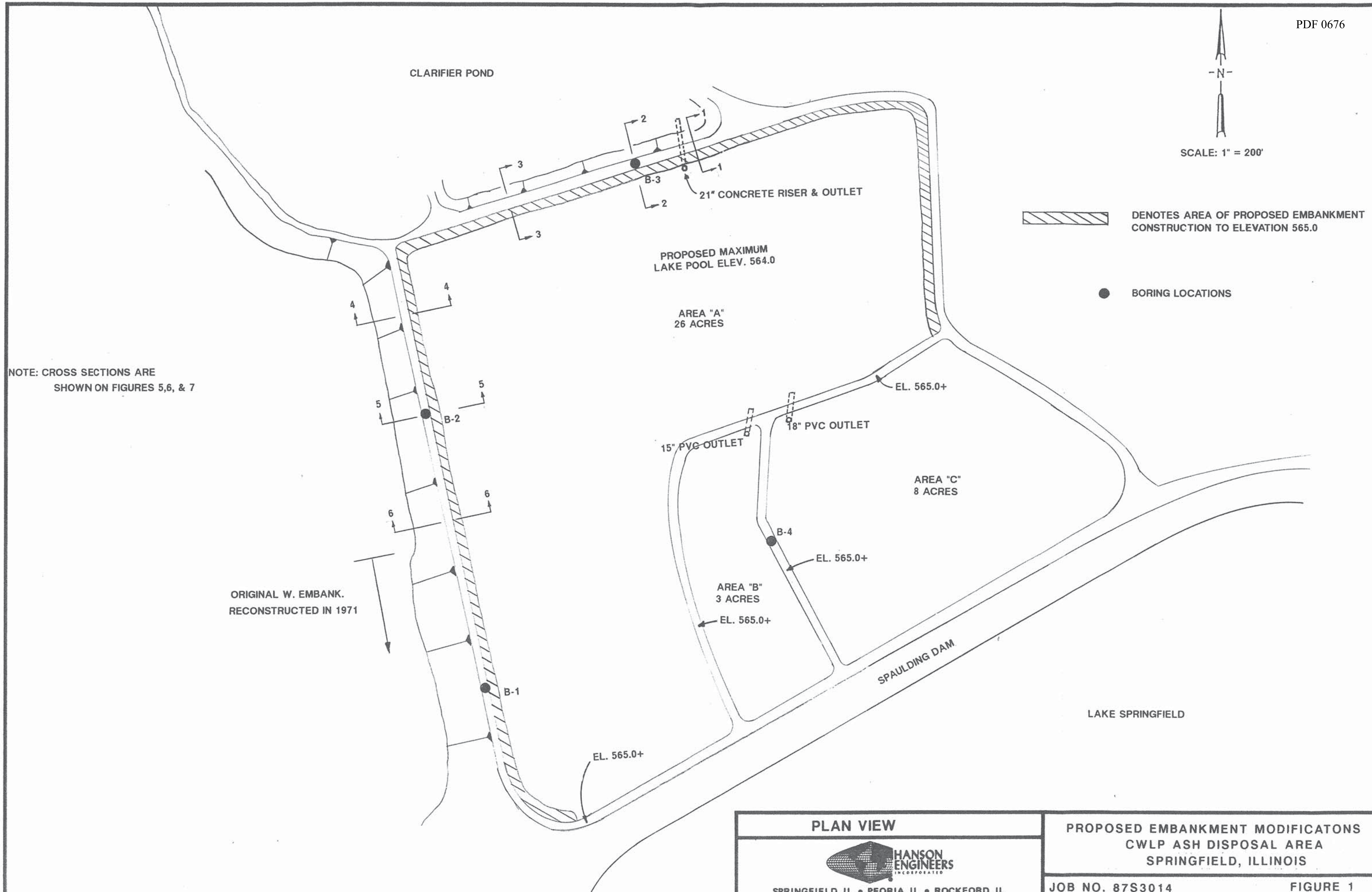
PLANS PREPARED FOR
CITY, WATER, LIGHT & POWER
SPRINGFIELD, SANGAMON COUNTY, ILLINOIS

DATE: OCTOBER 2016
PROJECT ID: 150077/0011
SHEET NUMBER:

FIG. 2

APPENDIX B

Lakeside Soils Logs and Cross Section



PLAN VIEW

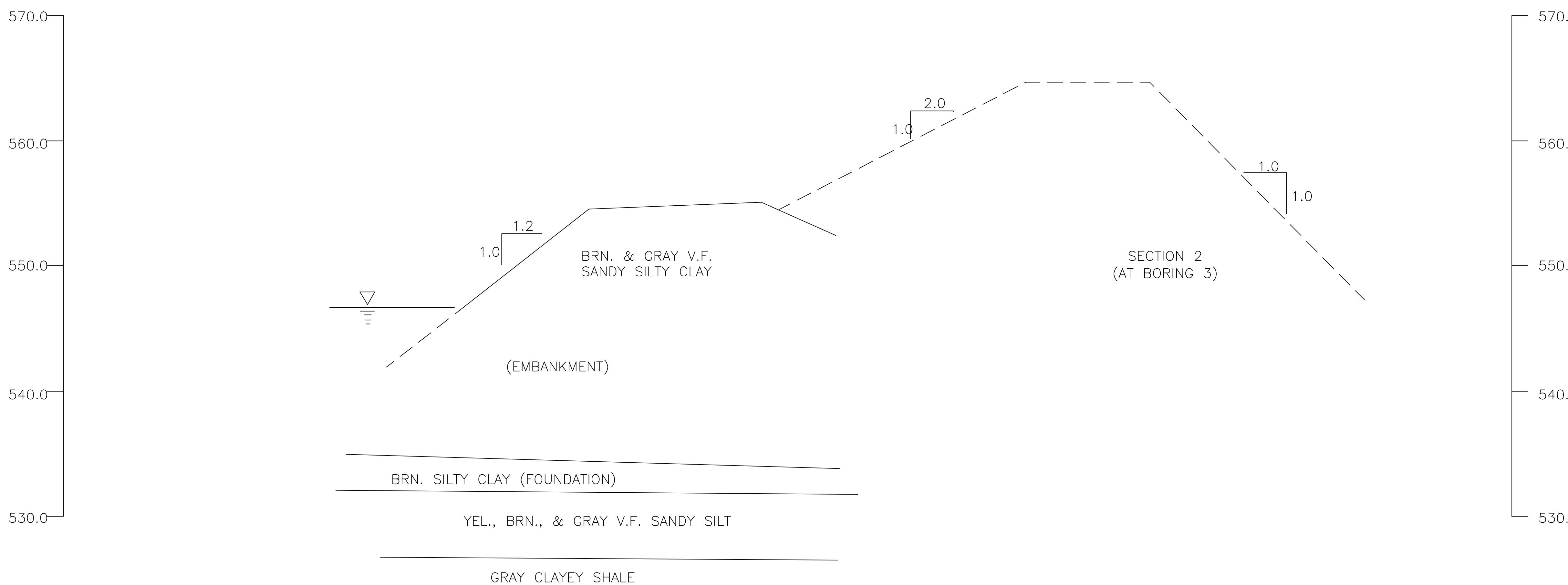
HANSON ENGINEERS INCORPORATED

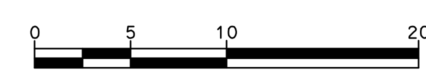
SPRINGFIELD, IL • PEORIA, IL • ROCKFORD, IL

PROPOSED EMBANKMENT MODIFICATONS
CWLP ASH DISPOSAL AREA
SPRINGFIELD, ILLINOIS

JOB NO. 87S3014

FIGURE 1





NOTES:
CROSS-SECTION BASED ON CONSTRUCTION PLAN DRAWINGS INCLUDED IN ENGINEERING REPORT PROPOSED EMBANKMENT MODIFICATIONS, HANSON ENGINEERS, INC., JULY 1987

NO.	DATE	REVISIONS DESCRIPTION	BY

ANDREWS ENGINEERING, INC.
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SPRINGFIELD, ILLINOIS 62711-7233
PH (217) 787-2334 FAX (217) 787-9495
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PROFESSIONAL DESIGN ENGINEERING AND LAND SURVEYING FIRM #184001541

APPROVED BY: PMV | DESIGNED BY: PMV | DRAWN BY: RMC

LAKESIDE ASH POND CROSS-SECTION 2

PLANS PREPARED FOR
CITY, WATER, LIGHT & POWER
SPRINGFIELD, SANGAMON COUNTY, ILLINOIS

DATE: OCTOBER 2016
PROJECT ID: 150077/0011
SHEET NUMBER: X-SEC.

HANSON ENGINEERS INCORPORATED

LABORATORY SOIL TEST DATA

OPERATOR CMP

DATE June-2-1987

JOB NO.

PROJECT NAME AND LOCATION
CWL&P
Ash Pond Study
Springfield, Illinois

BOR.	SAMP.	DEPTH	ELEV.	N	STRENGTH TESTS Qu	M	P	W	γw	γD	SPECIAL TESTS	SAMPLE DESCRIPTION
Ground Surface Elev-557.6												
1	1	2'-6"	555.1	14				6				Bottom Ash
	2	5'-0"	552.6	3				10				" "
	3	7'-6"	550.1	5				31				" " / dk. gray v.f. sandy silt
	4	10'-0"	547.6	1				79				Drk. gray v.f. sandy silt.
	5	12'-6"	545.1	4	0.92	B	0.8	33				Gray v.f. sandy silty clay.
	6	15'-0"	542.6	4			3.6	67				Gray silty f. sand. (fly ash).
	7	17'-6"	540.1	9				46				Fly ash.
	8	20'-0"	537.6	8				61				" " .
	9	22'-6"	535.1	5	0.71	Sh	1.3	26				Yel. brn. & gray v.f. sandy silty clay / ox. spots.
	10	25'-0"	532.6	15	2.27	B	1.8 / 3.8	21				Mix colored v.f. sandy silty clay (tr. f.-c. sand & f. gravel)
	11	27'-6"	530.1	9	1.86	B	2.4	27				Drk. gray v.f. sandy silty clay.
	12	30'-0"	527.6	8	0.50	B	0.6	33				" " " " " " " .
Ground Surface Elev = 555.5												
2	1	2'-6"	553.0	21	5.89	BSp	4.5+	14				Brn. gray v.f. sandy silty clay / ox. spots.
	2	5'-0"	550.5	20	2.27	B	2.4	27				Yel. brn. & gray v.f. sandy silty clay (tr. ox. spots.)
	3	7'-6"	548.0	10	1.86	B	2.2	29				Grn. & drk. brn. v.f. sandy silty clay (tr. ox. spots.)
	4	10'-0"	545.5	12	2.68	BSh	2.4	25				Yel. brn. & gray v.f. sandy silty clay / ox. spots.
	5	12'-6"	543.0	13	2.68	B	2.9	27				Grn. gray clay (tr. silt & ox. spots.)
	6	15'-0"	540.5	12	2.33	B	2.4	28				Brn. gray v.f. sandy silty clay / ox. spots.
	7	17'-6"	538.0	15	1.94	BSh	2.6	27				Yel. brn. & gray v.f. sandy silty clay (tr. chard. pts.)
	8	20'-0"	535.5	14	2.27	B	2.5	28				" " & " " " " " " (" " ".)
	9	22'-6"	533.0	15	2.68	B	2.8	28				" " & " " " " " " (" " ".)
	10	25'-0"	530.5	9	1.16	B	1.1	26				" " & " " " " clayey silt / chard. pts.
	11	27'-6"	528.0	8	0.54	B	0.6	23				" " & " " " " silt (tr. chard pts.)
	12	30'-0"	525.5	6	0.89	B	0.7	24				" " & " " " " " / chard. pts.
	13	35'-0"	520.5	5	0.78	B	0.8	23				" " & " " " " " & brn. f.-m. sand.
	14	40'-0"	515.5	19				14				Brn. gray f.-m. sand.
	14A	40'	515.5	19				29				Gray shaley clay.

Figure 3

OPERATOR CMP

DATE June-2-1987

JOB NO.

HANSON ENGINEERS INCORPORATED

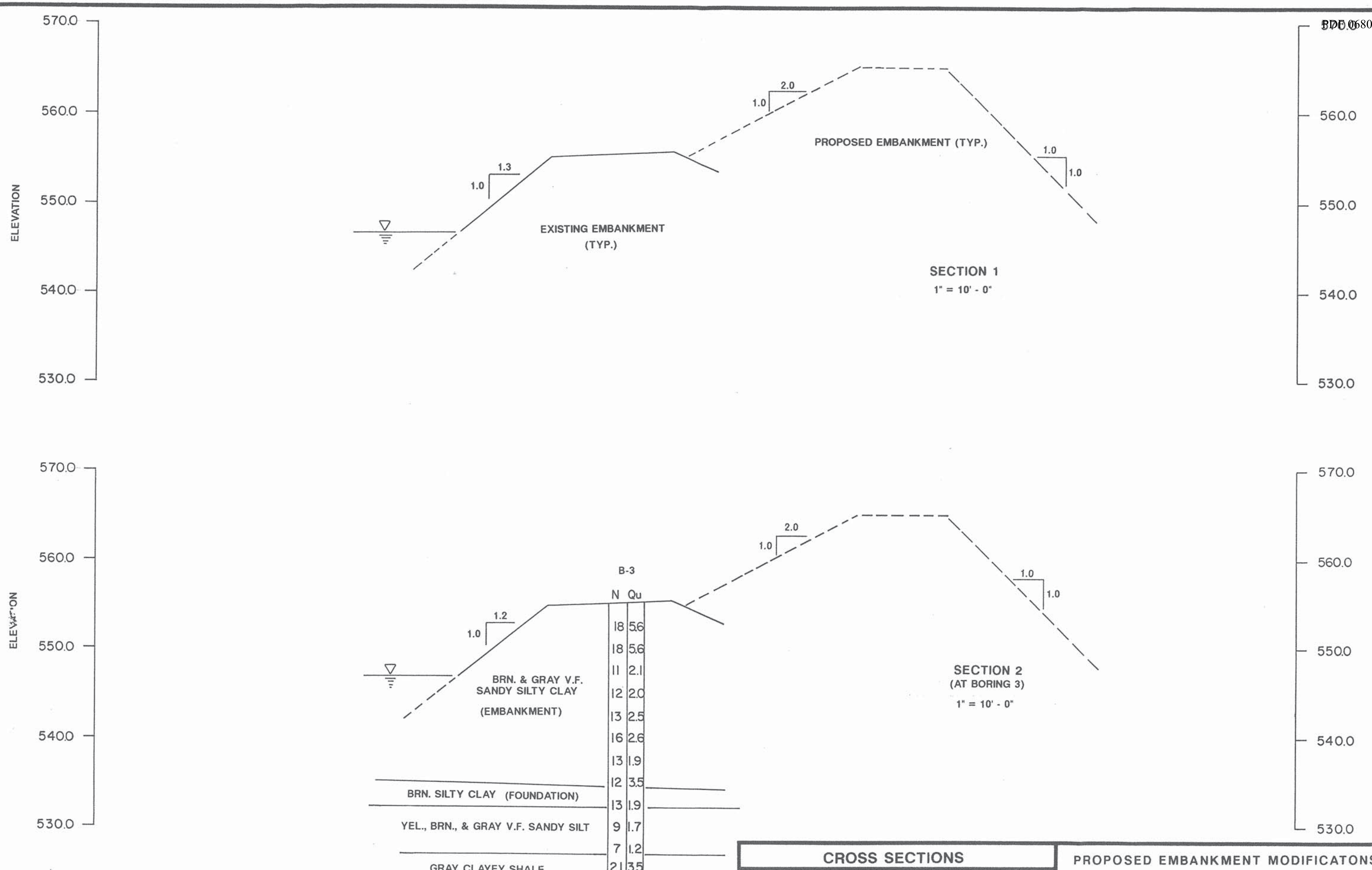
LABORATORY SOIL TEST DATA

PROJECT NAME AND LOCATION
CWL&P
Ash Pond Study
Springfield, Illinois

BOR.	SAMP.	DEPTH	ELEV.	N	STRENGTH TESTS Qu	M	P	W	γw	γD	SPECIAL TESTS	SAMPLE DESCRIPTION
	Ground Surface Elev=555.2											
3	1	2'6"	552.7	18	5.56	BSh	4.5+	21				Brn.&drk.brn.v.f. sandy silty clay (tr. chard.pts. & sm.roots)
	2	5'0"	550.2	18	5.62	BSp	4.5+	22				Drk.gray clay (tr. chard.pts. & sm.roots.)
	3	7'6"	547.7	11	2.13	BSh	2.4	26				Yel.brn.&gray. v.f. sandy silty clay (tr. chard pts.)
	4	10'0"	545.2	12	1.94	BSh	2.1	29				" " & drk.gray clay (tr. ox. spots.)
	5	12'6"	542.7	13	2.52	B	2.6	25				" " & gray v.f. sandy silty clay (tr. chard. pts.)
	6	15'0"	540.2	16	2.62	B	2.6	26				Drk. gray v.f. sandy silty clay.
	7	17'6"	537.7	13	1.86	B	1.6	28				Yel. brn. & gray v.f. sandy silty clay (tr. chard. pts.)
	8	20'0"	535.2	12	3.50	BSh	3.0/4.5+	21				Drk.gray v.f. sandy silty clay.
	9	22'6"	532.7	13	1.94	B	2.2	28				Yel brn & gray v.f. sandy silty clay & clayey silt/chard pts
	10	25'0"	530.2	9	1.71	B	1.7	26				" " & " " " " silt/chard. pts.
	11	27'6"	527.7	7	1.24	B	1.2	27				" " & " " " " " / " ".
	12	30'0"	525.2	21	3.49	B	3.6	26				Brn. gray clay.
	Ground Surface Elev=566.2											
4	1	2'6"	563.7	5	3.05	Sh	2.8	20				Yel.brn.&gray v.f. sandy silt.
	2	5'0"	561.2	11	1.71	Sp	2.7	25				" " & " " " " " & fly ash.
	3	7'6"	558.7	7	1.65	BSh	2.2	13				" " & " v.f.-m. sandy silt (tr. c. sand.)
	4	10'0"	556.2	10	1.47	BSh	1.9	22				" " & " clay/brn. silty f.sand (tr. fly ash.)
	5	12'6"	553.7	8				18				Fly ash.
	6	15'0"	551.2	7				27				" ".
	7	17'6"	548.7	1				94				Drk. gray silty v.f. sand (fly ash.)
	8	20'0"	546.2	2				108				" " " " " " (" ")
	9	25'0"	541.2	1				129				" " " " " " (" ")
	10	30'0"	536.2	16	2.68	B	2.3	31				" " v.f. sandy silty clay.

PDF 0679

Figure 4



CROSS SECTIONS

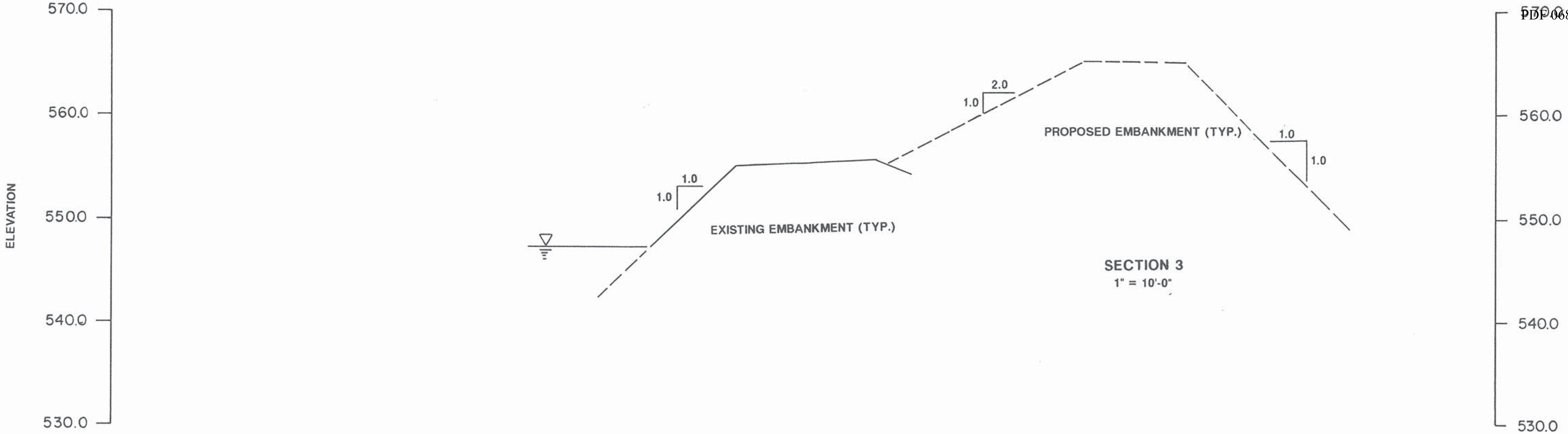
HANSON ENGINEERS INCORPORATED

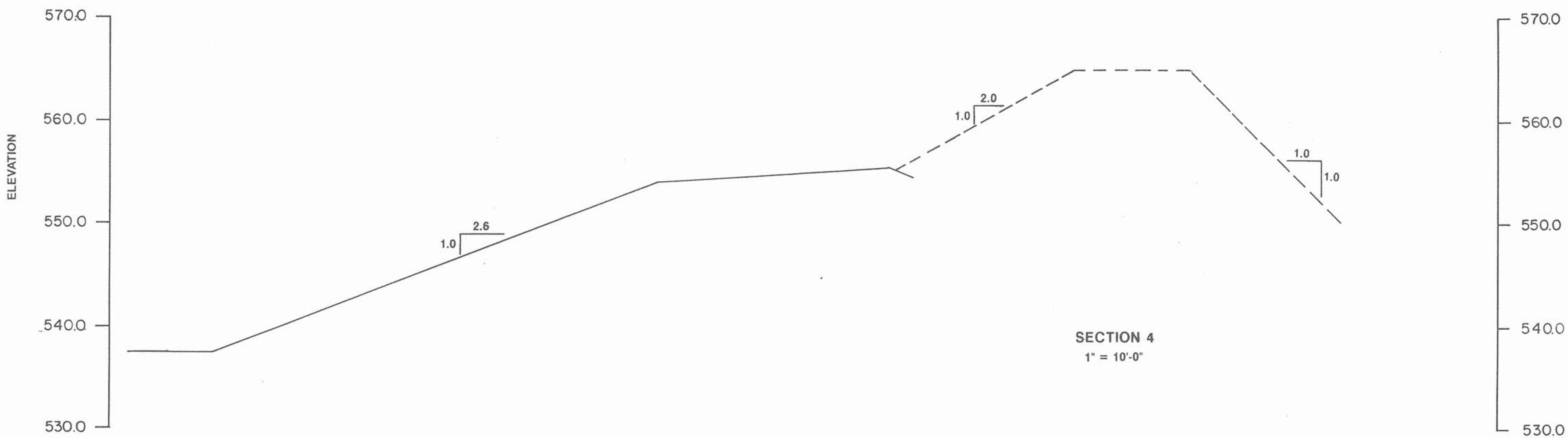
SPRINGFIELD, IL • PEORIA, IL • ROCKFORD, IL

PROPOSED EMBANKMENT MODIFICATONS
CWLP ASH DISPOSAL AREA
SPRINGFIELD, ILLINOIS

JOB NO. 87S3014

FIGURE 5





CROSS SECTIONS

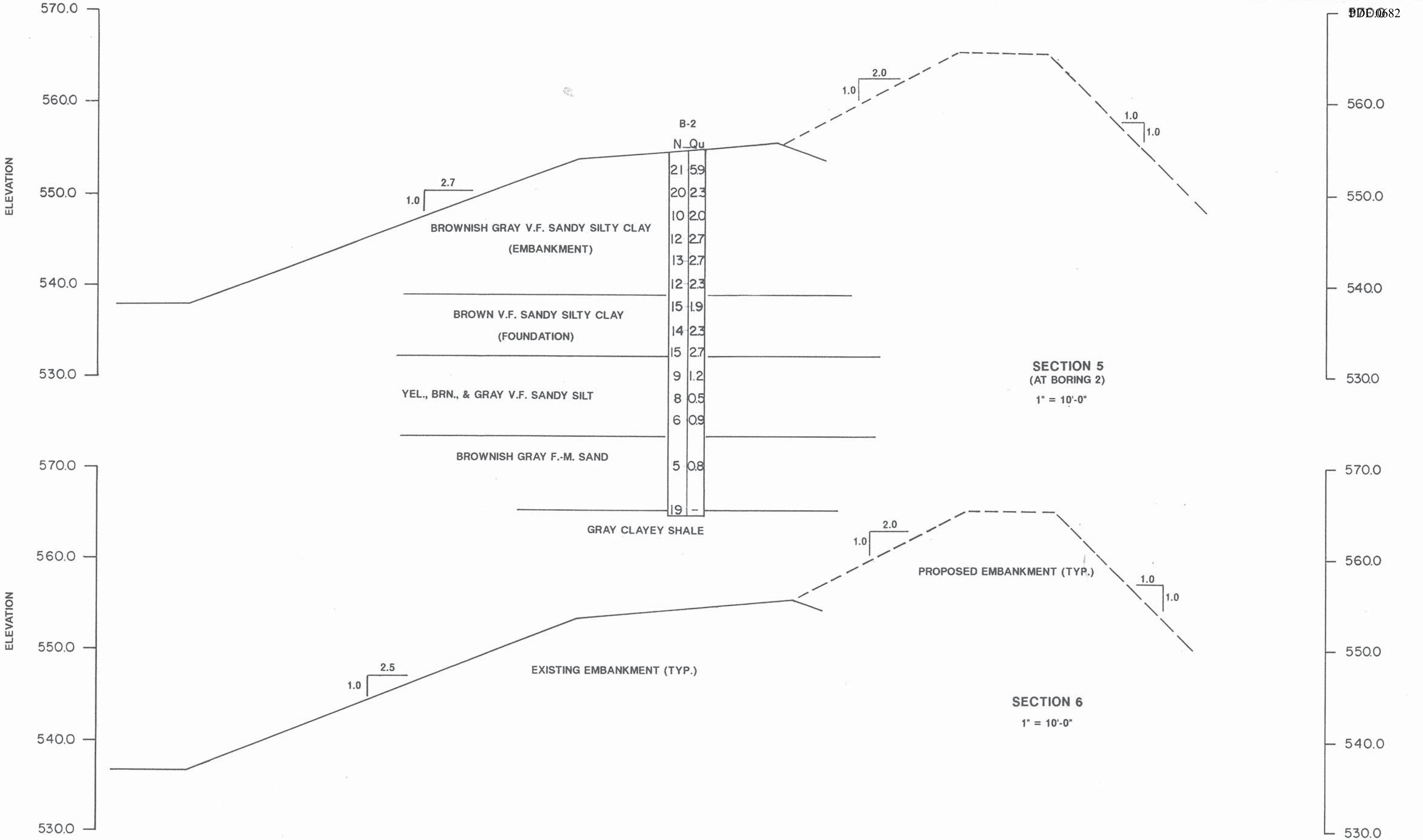
HANSON ENGINEERS INCORPORATED

SPRINGFIELD, IL • PEORIA, IL • ROCKFORD, IL

PROPOSED EMBANKMENT MODIFICATONS
CWLP ASH DISPOSAL AREA
SPRINGFIELD, ILLINOIS

JOB NO. 87S3014

FIGURE 6



CROSS SECTIONS

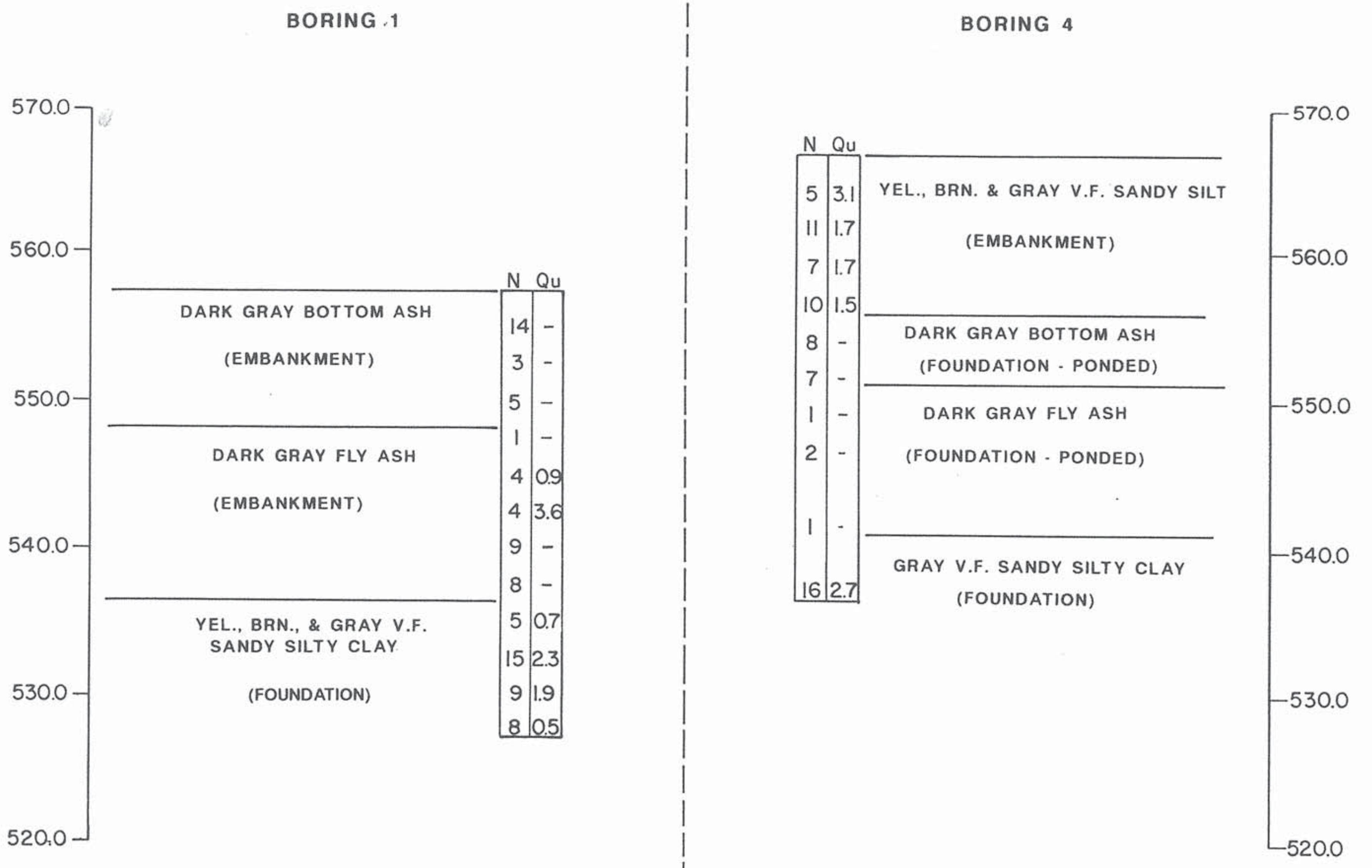
HANSON ENGINEERS INCORPORATED

SPRINGFIELD, IL • PEORIA, IL • ROCKFORD, IL

PROPOSED EMBANKMENT MODIFICATONS
CWLP ASH DISPOSAL AREA
SPRINGFIELD, ILLINOIS

JOB NO. 87S3014

FIGURE 7



BORING PROFILES

HANSON ENGINEERS INCORPORATED

SPRINGFIELD, IL • PEORIA, IL • ROCKFORD, IL

PROPOSED EMBANKMENT MODIFICATONS
CWLP ASH DISPOSAL AREA
SPRINGFIELD, ILLINOIS

JOB NO. 87S3014

FIGURE 8

APPENDIX A

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

PDF 0685

LOG OF BORING

CONTRACTED WITH: HANSON ENGINEERS
BORING NO.: B-1
PROJECT NAME: CWLP ASH POND
CONTRACT NO.:
LOCATION: PER PLAN
DATUM:
HAMMER WT.: 140#
HAMMER DROP: 30"
HOLE DIA.: 6"
SURFACE ELEV.:
CORE DIA.:
CASING:
DATE STARTED: 5-18-87
COMPLETED: 5-18-87
DRILLING METHOD: HSA

ELEV.	DESCRIPTION	STRATA DEPTH	DEPTH SCALE	SAMPLES BLOWS FT.	NO.	TYPE	RECOV.	QP		NOTES
		0.0	30							
	Blk. bot. ash, tr. f. gravel			6-7-7	1	ss	14"	--		
	fill moist-wet		5	3-2-1	2	ss	8	--		
				3-2-3	3	ss	10	--		WATER 5-18-87 DD 5.0' 8:45am BAR 20.5' 10:15am AAR 4.6' 10:35am
		9.2		2-1-0	4	ss	12	--		DWL 4.0' 6:35pm
	Blk. fly ash		10							
				2-2-2	5	ss	15	0.8		
	wet		15	6-2-2	6	ss	14	0.9		
				4-4-5	7	ss	18	--		
			20	3-5-3	8	ss	18	--		

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LOG OF BORING

CONTRACTED WITH HANSON ENGINEERS BORING NO. B-1
PROJECT NAME CWLP ASH POND CONTRACT NO.
LOCATION PER PLAN
DATUM HAMMER WT. 140# HAMMER DROP 30" HOLE DIA. 6"
SURFACE ELEV. CORE DIA. CASING
DATE STARTED 5-18-87 COMPLETED 5-18-87 DRILLING METHOD HSA

ELEV.	DESCRIPTION	STRATA DEPTH	DEPTH SCALE	SAMPLES BLOWS FT.	NO.	TYPE	RECOV.	QP		NOTES
		0.0	30							
				3-2-3	9	ss	18"	1.2		
		23.1								
	Green gray silty clay, tr. f.m. sand, tr. f. gravel moist	25.7	25	6-8-7	10	ss	18	4.5+		
	Dk. gray silty clay moist			4-4-	11	ss	18	3.1		
		30.0	30	3-4-4	12	ss	18	2.0		
	END OF BORING 30.0'									

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LOG OF BORING

CONTRACTED WITH HANSON ENGINEERS BORING NO. B-2
PROJECT NAME CWLP ASH POND CONTRACT NO.
LOCATION
DATUM HAMMER WT. 140# HAMMER DROP 30" HOLE DIA. 6"
SURFACE ELEV. CORE DIA. CASING
DATE STARTED 5-18-87 COMPLETED 5-18-87 DRILLING METHOD HSA

ELEV.	DESCRIPTION	STRATA DEPTH	DEPTH SCALE	SAMPLES BLOWS FT.	NO.	TYPE	RECOV.	QP		NOTES
		0.0	30							
	10" white rock, brn. gray silty clay fill moist	3.3		8-10-11	1	ss	15"	4.5+		
	Light brn. silty clay ~~fill moist~~	5.8	5	8-9-11	2	ss	16	3.0		
	Brn. green blk. silty clay fill moist			3-5-5	3	ss	15	2.1		WATER 5-18-87
			10	3-5-7	4	ss	16	2.4		DD 28.5' 12:00pm BAR 18.5' 1:55pm AAR WCI 15.0' 2:
				3-6-7	5	ss	13	2.0		Dwl 14.0' 6:30pm
			15	3-5-7	6	ss	18	1.7		
				5-6-9	7	ss	18	3.2		
			20	5-6-8	8	ss	18	3.2		

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LOG OF BORING

CONTRACTED WITH: HANSON ENGINEERS — BORING NO.: B-2
PROJECT NAME: CWLP ASH POND — CONTRACT NO.:
LOCATION: PER PLAN
DATUM: — HAMMER WT.: 140# — HAMMER DROP: 30" — HOLE DIA.: 6"
SURFACE ELEV.: — CORE DIA.: — CASING:
DATE STARTED: 5-18-87 — COMPLETED: 5-18-87 — DRILLING METHOD: HSA

ELEV.	DESCRIPTION	STRATA DEPTH	DEPTH SCALE	SAMPLES BLOWS FT.	NO.	TYPE	RECOV.	QP		NOTES
		0.0	30							
		22.7		4-6-9	9	ss	18"	3.5		
	Brn. gray silty clay, tr. f. sand moist	25.4	25	3-3-6	10	ss	18	1.8		
	Brn. gray clayey silt, some f. sand, occas. 1-3" f. sand seams a wet			3-4-4	11	ss	18	1.5		
			30	2-3-3	12	ss	18	0.5		
		31.5								
	Brn. f.m. sand wet		35	2-2-3	13	ss	18	1.2		
	~~Brn. f.m. sand wet~~	39.8 ~~40.0~~	40	11-11-12	14	ss	18	2.5		
	END OF BORING 40.0'									

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LOG OF BORING

CONTRACTED WITH: HANSON ENGINEERS — BORING NO.: B-3
PROJECT NAME: CWLP ASH POND — CONTRACT NO.:
LOCATION: PLAN
DATUM: — HAMMER WT.: 140# — HAMMER DROP: 30" — HOLE DIA.: 6"
SURFACE ELEV.: — CORE DIA.: — CASING:
DATE STARTED: 5-18-87 — COMPLETED: 5-18-87 — DRILLING METHOD: HSA

ELEV.	DESCRIPTION	STRATA DEPTH	DEPTH SCALE	SAMPLES BLOWS FT.	NO.	TYPE	RECOV.	QP		NOTES
		0.0	30							
	5" white rock, brn. gray blk. silty clay fill moist	4.5		7-6-12	1	ss	14"	4.5+		
	Blk. silty clay fill moist	8.3	5	6-9-9	2	ss	18	4.5+		
				5-5-6	3	ss	16	1.7		WATER 5-18-87
	Brn. green blk. silty clay fill moist	17.9	10	3-4-8	4	ss	17	2.5		DD 24.0' 3:50pm BAR 12.4' 4:05pm AAR 10.0' 4:25pm DWL 9.5' 6:45pm
				3-6-7	5	ss	18	2.2		
	Blk. gray silty clay fill moist	20.6	15	3-6-8	6	ss	18	2.4		
				5-6-7	7	ss	18	2.3		
			20	3-4-8	8	ss	18	3.0		

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LOG OF BORING

CONTRACTED WITH HANSON ENGINEERS BORING NO. B-3
PROJECT NAME CWLP ASH POND CONTRACT NO.
LOCATION PER PLAN
DATUM HAMMER WT. 140# HAMMER DROP 30" HOLE DIA. 6"
SURFACE ELEV. CORE DIA. CASING
DATE STARTED 5-18-87 COMPLETED 5-18-87 DRILLING METHOD HSA

ELEV.	DESCRIPTION	STRATA DEPTH	DEPTH SCALE	SAMPLES BLOWS FT.	NO.	TYPE	RECOV.	QP		NOTES
		0.0	30							
	Brn. gray silty clay moist-wet			5-6-9	9	ss	18"	2.0		
			25	3-4-5	10	ss	18	2.0		
		28.2		3-3-4	11	ss	18	1.6		
	Gray brn. clay, little silt moist	30.0	30	6-9-12	12	ss	18	3.8		
	END OF BORING 30.0'									

CENTRAL ILLINOIS DRILLING COMPANY PDF 0691
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BLOOMINGTON, ILLINOIS 61701
(309) 662-5968

LOG OF BORING

CONTRACTED WITH HANSON ENGINEERS BORING NO. B-4
PROJECT NAME CWLP ASH POND CONTRACT NO.
LOCATION PER PLAN
DATUM HAMMER WT. 140# HAMMER DROP 30" HOLE DIA. 6"
SURFACE ELEV. CORE DIA. CASING
DATE STARTED 5-18-87 COMPLETED 5-18-87 DRILLING METHOD HSA

ELEV.	DESCRIPTION	STRATA DEPTH	DEPTH SCALE	SAMPLES: BLOWS FT.	NO.	TYPE	RECOV.	QP		NOTES
		0.0	30							
	Brn. silty clay			3-3-2	1	ss	10"	3.5		
	fill moist	4.0								
	Brn. gray blk. silty clay			4-5-6	2	ss	12	3.2		
			5							
	fill moist			3-3-4	3	ss	10	2.5		WATER 5-18-87
										DD 11.0' 5:15pm BAR 22.0' 6:00pm AAR 9.8' 6:30pm
		10.5	10	3-5-5	4	ss	13	2.5		DWL 9.5' 6:50pm
	Blk. bot, ash			5-4-4	5	ss	18	--		
	fill wet			5-4-3	6	ss	16	--		
		15.2	15							
	Blk. fly ash			1-1-0	7	ss	18	0.2		
	fill wet			0-0-2	8	ss	.8	0.2		
			20							

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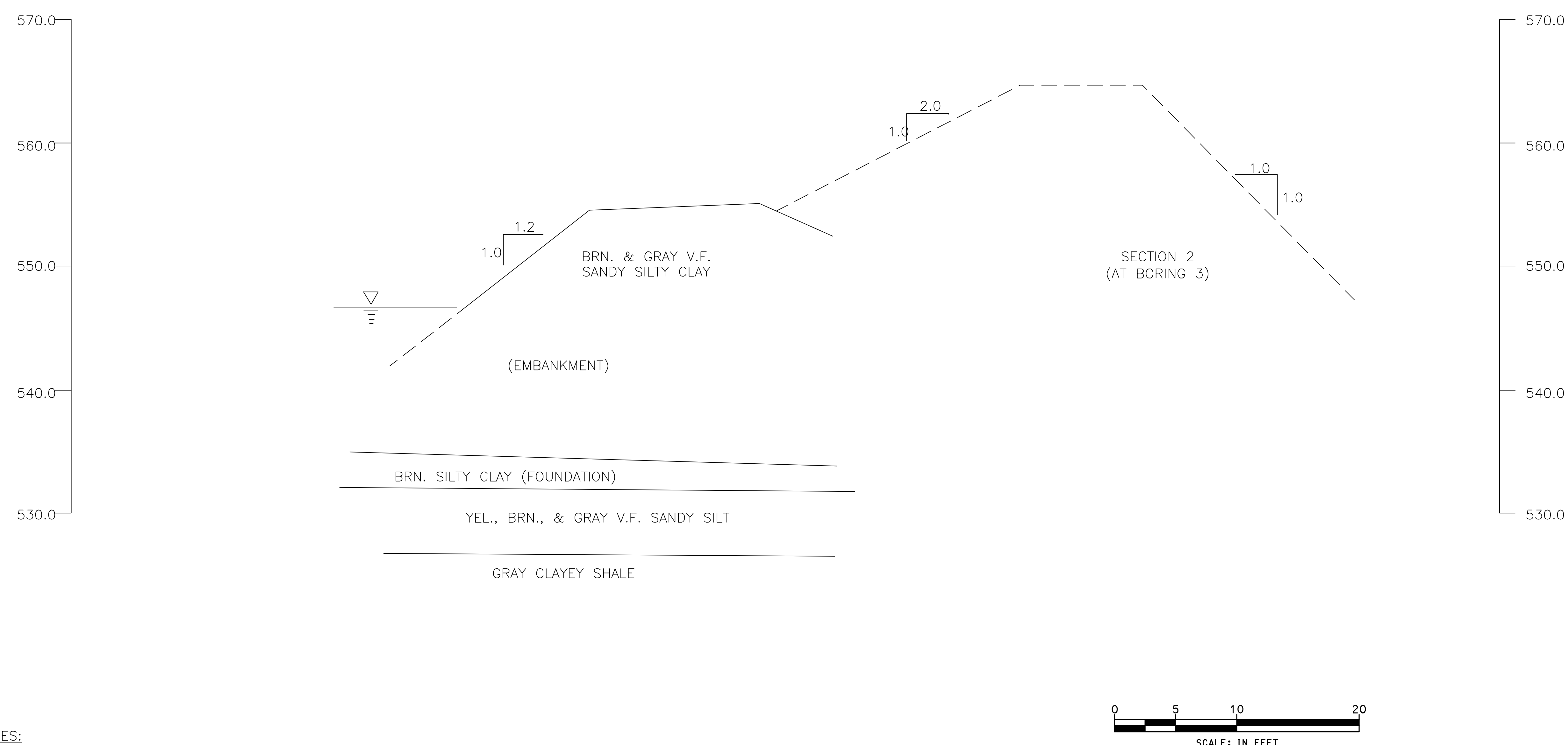
LOG OF BORING

CONTRACTED WITH HANSON ENGINEERS BORING NO. B-4
PROJECT NAME CWLP ASH POND CONTRACT NO.
LOCATION PER PLAN
DATUM HAMMER WT. 140# HAMMER DROP 30" HOLE DIA. 6"
SURFACE ELEV. CORE DIA. CASING
DATE STARTED 5-18-87 COMPLETED 5-18-87 DRILLING METHOD HSA

ELEV.	DESCRIPTION	STRATA DEPTH	DEPTH SCALE	SAMPLES BLOWS FT.	NO.	TYPE	RECOV.	QP		NOTES
		0.0	30							
		25.5	25	1-0-1	9	ss	18"	0.5		
	Blk. gray clay, tr. silt moist	30.0		4-6-10	10	ss	18	3.3		
	END OF BORING 30.0'		30							

PDF 0693



NOTES:
CROSS–SECTION BASED ON CONSTRUCTION PLAN DRAWINGS INCLUDED IN ENGINEERING REPORT PROPOSED EMBANKMENT MODIFICATIONS, HANSON ENGINEERS, INC., JULY 1987

NO.	DATE	REVISIONS DESCRIPTION	BY

ANDREWS ENGINEERING, INC.
3300 GINGER CREEK DRIVE
SPRINGFIELD, ILLINOIS 62711-7233
PH (217) 787-2334 FAX (217) 787-9495
PONTIAC, IL • LOMBARD, IL • INDIANAPOLIS, IN • WARRENTON, MO
PROFESSIONAL DESIGN ENGINEERING AND LAND SURVEYING FIRM #184001541

APPROVED BY: PMV | DESIGNED BY: PMV | DRAWN BY: RMC

LAKESIDE ASH POND CROSS–SECTION 2

PLANS PREPARED FOR
CITY, WATER, LIGHT & POWER
SPRINGFIELD, SANGAMON COUNTY, ILLINOIS

DATE: OCTOBER 2016
PROJECT ID: 150077/0011
SHEET NUMBER: X-SEC.

APPENDIX C

Fly Ash Technical Papers

Engineering Characteristics of Coal Combustion Residuals and a Reconstitution Technique for Triaxial Samples

Nicholas A. Lacour

Thesis submitted to the faculty of the Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of

Master of Science
In
Civil Engineering

Adrián Rodriguez-Marek, Chair
Joseph Dove
James Martin

19 June, 2012
Blacksburg, Virginia

Keywords: coal combustion residuals, fly ash, bottom ash, surface impoundments

Engineering Characteristics of Coal Combustion Residuals and a Reconstitution Technique for Triaxial Samples

Nicholas Alexander Lacour

ABSTRACT

Traditionally, coal combustion residuals (CCRs) were disposed of with little engineering consideration. Initially, common practice was to use a wet-scrubbing system to cut down on emissions of fly ash from the combustion facilities, where the ash materials were sluiced to the disposal facility and allowed to sediment out, forming deep deposits of meta-stable ash. As the life of the disposal facility progressed, new phases of the impoundment were constructed, often using the upstream method. One such facility experienced a massive slope stability failure on December 22, 2008 in Kingston, Tennessee, releasing millions of cubic yards of impounded ash material into the Watts Bar reservoir and damaging surrounding property. This failure led to the call for new federal regulations on CCR disposal areas and led coal burning facilities to seek out geotechnical consultants to review and help in the future design of their disposal facilities. CCRs are not a natural soil, nor a material that many geotechnical engineers deal with on a regular basis, so this thesis focuses on compiling engineering characteristics of CCRs determined by different researchers, while also reviewing current engineering practice when dealing with CCR disposal facilities. Since the majority of coal-burning facilities used the sluicing method to dispose of CCRs at one point, many times it is desirable to construct new "dry-disposal" phases above the retired ash impoundments; since in-situ sampling of CCRs is difficult and likely produces highly disturbed samples, a sample reconstitution technique is also presented for use in triaxial testing of surface impounded CCRs.

Acknowledgments

I would like to thank Dr. Adrián Rodriguez-Marek, my advisor, for his guidance throughout my thesis work and throughout my academic career at Virginia Tech. I would also like to thank my parents for their encouragement and support throughout my entire academic career. Lastly, I would like to thank my grandmother for passing on my great-grandparents' rock collection that first sparked my interest in geology and undoubtedly led to my interest in geotechnical engineering.

Contents

List of Figures

List of Tables

Chapter 1

Introduction and Background

Ever since the promulgation of the Resource Conservation and Recovery Act in 1976, there has been debate on the proper waste classification of coal combustion by-products. They have traditionally been disposed of in a fashion similar to that of mine tailings wastes. However, the failure of the Kingston Fossil Plant's main disposal cell on December 22, 2008 has once again led to discussions on how to properly regulate the disposal of these materials. From an engineering standpoint, geotechnical engineers have very little experience with coal combustion wastes, which have some unique engineering properties that set them apart from naturally occurring soils. A comprehensive literature review and compilation of engineering properties of coal combustion residual materials is consolidated and compared between researchers from different nations. Additionally, a triaxial sample reconstitution technique is proposed for surface impounded coal combustion residuals (different types of coal combustion residuals are addressed in section 1.1) which minimizes particle segregation and ensures constant density across the height of the sample. This chapter presents an introduction to the thesis and presents a brief summary of the December 22, 2008 slope stability failure at the Tennessee Valley Authority’s (TVA’s) Kingston power plant, which served as an inspiration for this thesis.

1.1 Introduction

Coal is the most commonly used fuel in generating electrical energy in the United States. In 2009, coal-powered steam turbines produced 45% of the almost 4 trillion kilowatt-hours of consumed energy in the US (Energy Information Administration 2010). With the burning of such large quantities of coal, there is naturally also a large amount of ash and other byproducts. The four main types of byproducts of burnt coal as described by the Environmental Protection Agency (EPA 2011) are:

Fly Ash: mostly spherical silt to clay-sized particles composed mostly of silica removed from plant exhaust gases through the use of electrostatic precipitators or bag-houses with secondary scrubber systems.

Bottom Ash: coarse, porous, angular fine sand to fine gravel-sized particles of agglomerated ash formed in pulverized ash furnaces.

Boiler Slag: molten bottom ash collected at the base of slag tap and cyclone type furnaces that is quenched with water, causing it to fracture, crystallize, and form pellets. It is composed of hard, black, angular particles that have a smooth, glassy appearance.

Flue Gas Desulfurization (FGD) Material: product of a process used for reducing SO_2 emissions from the gas system of a coal-fired boiler. Depending on the scrubbing process, the material is either predominantly calcium sulfite ($CaSO_3$), calcium sulfate ($CaSO_4$), or a mixture of the two. It consists of small, fine, particles. Calcium Sulfate FGD material can be used in place of gypsum ($CaSO_4 \cdot 2H_2O$) in wallboard manufacturing or in cement production, while calcium sulfite can be used as embankment and road base material.

There are beneficial reuses for each of these byproducts, though generation almost always outweighs demand. In order to avoid confusion, when referring to these byproducts, the definitions outlined by EPA (*Federal Register* 2010) will be used. When referring to burnt-coal byproducts being beneficially used, the term Coal Combustion Products (CCPs) will be used, while Coal Combustion Residuals (CCRs) will be used when referring to byproducts that are destined for disposal.

Use of CCPs are unique to the application in which they are being utilized. Therefore, the focus of this thesis is on the geotechnical engineering properties and design and monitoring considerations for CCR landfills and surface impoundments.

Depending on the type of system used to remove fly ash from and/or to desulfurize the exhaust gases of boilers used in electricity generation, CCRs have traditionally been disposed of using either a dry (or, more accurately, a moisture conditioned) placement method or a hydraulic sluicing method . Again referring to EPA definitions (*Federal Register* 2010), any disposal area where CCRs are disposed of using a dry method will be referred to as a CCR landfill, while any area that CCRs are disposed of hydraulically will be referred to as a CCR surface impoundment. A CCR surface impoundment is a disposal area much akin to a mine tailings dam disposal area, or to a dredge spoil area. While CCR landfill wastes are placed using backhoes or other heavy equipment and compacted in a moist condition, CCR surface impoundment wastes are simply the result of a wet-scrubbing removal system for fly ashes; the effluent from these wet-scrubbing processes is then often mixed with bottom ashes and hydraulically placed in a disposal area contained by some sort of dike system.

As a result of the Kingston Fossil Plant failure, EPA found it necessary to reexamine regulatory policies regarding the disposal of CCRs:

With the promulgation of 42 U.S.C. §6901 (1976), commonly known as the Resource Conservation and Recovery Act (RCRA), CCRs were not initially specified as hazardous (subtitle C) or solid wastes (subtitle D). In 1980, the Solid Waste Disposal Act amendments to RCRA were enacted, one of which was the “Bevill Amendment”, 42 U.S.C. §6921 (b)(3)(A)(i). This amendment temporarily exempted CCRs from subtitle C regulation, classifying them as subtitle D, which is subject to state regulation. In 1988, EPA released a report entitled *Wastes from the Combustion of Coal by Electric Utility Power Plants* in which they concluded that the four above-mentioned CCRs did not exhibit hazardous characteristics according to RCRA regulations and would therefore not be regulated under Subtitle C. However, it was not until August 9, 1993 that EPA issued the final regulatory determination applicable to these CCRs (*Federal Register* 1993), stating that regulation of them as hazardous wastes was unwarranted (Dockter and Jagiella 2005).

Most recently, on June 21, 2010, EPA announced their intent to regulate CCRs generated from the combustion of coal at electric utilities under the RCRA. The EPA announcement introduced two options:

- EPA would reverse the 1993 and 2000 exemptions of CCRs under the Bevill Amendment and list them as special wastes subject to regulation under subtitle C of RCRA when they are destined for disposal in landfills or surface impoundments.
- EPA would leave the Bevill determination in place while regulating the disposal of CCRs under subtitle D of RCRA by issuing national minimum criteria.

Regardless of the chosen alternative, EPA is also proposing to establish dam safety requirements in order to address the stability of CCR surface impoundments to prevent catastrophic releases like that at the TVA Kingston plant. EPA has suggested the adoption of the Hazard Potential Classification System for Dams, developed by the U.S. Army Corps of Engineers, since it would be relatively straightforward in its application to surface impoundments.

The main purpose of this thesis is to consolidate current published material on the properties of CCRs and to quantify the variability within the engineering properties of CCRs between countries, individual power plants, and CCR types. Furthermore, CCR impoundment areas are plentiful across the U.S. and power generating companies would prefer to begin dry disposal of CCRs directly over retired CCR surface impoundments. In order to do this, a geotechnical site investigation must be performed, in which the static and dynamic shear strengths of the surface impounded materials are analyzed. Since CCRs tend to be non-plastic in nature, undisturbed sampling is often difficult, time consuming, costly, and anything but "undisturbed." Therefore, a second objective of this thesis is to analyze a slurry deposition specimen reconstitution technique that is easier and less costly than undisturbed sampling, in order to determine if this specimen reconstitution technique forms samples of uniform relative density without particle segregation.

1.2 Kingston Fossil Plant Failure

The Kingston Fossil Plant is a coal-fired electrical power plant constructed and operated by the Tennessee Valley Authority (TVA). Construction on the facility began in 1951 and the first coal-fired electrical unit began in 1954. Ash slurries were initially released into a slack water area created by a two dikes with a gap in-between to allow water from the Watts Bar Reservoir to enter. The ash slurries and the waters of the reservoir were then allowed to commingle until the two dikes were connected in 1958, separating the reservoir and the ash disposal area. This slack water area collected silt and clay sediments from the period of 1942 to 1954; after 1954, disposed ash was added to the silts and clays being deposited and with the construction of the closure dike, additional clay runoff sediment was deposited along with the runoff silts, reservoir clays, and disposed ash. This formed a slick, weak layer found by AECOM to be a major contribution to the ash disposal area's failure in December of 2008 (Walter and Butler 2009).

The AECOM Root Cause Analysis report attributed the failure as most likely due to creep in the aforementioned weak layer due to active loading in a dredge cell contained within the disposal area. This creep caused an initial failure of various disposal phase dikes founded on older disposed ash deposits, which, in turn, caused progressive failure of upstream ashes, leading to undrained loading and subsequent failure of the downstream ash material and disposal area perimeter dike. The upstream progressive failure stopped upon reaching a former divider dike within the disposal area. The estimated ash released in the failure was 5.4 million cubic yards. Figure 1 provides an aerial photograph of the disposal area before and after the slope failure.

Figure 1: Aerial photographs comparing the Kingston Fossil Plant ash disposal area before and after the massive slope failure on December 22, 2008.

While this failure may have occurred because of a very unique site condition, AECOM did note in their Root Cause Analysis report that "extensive void ratio data in un-failed areas of the Dredge Cells showed a lack of significant consolidation of the wet ash with depth," which would indicate that strength would not increase significantly with depth in the disposed ash material. This property also raises the question of stability of these sort of disposal areas under dynamic loading. If surface-impounded coal ashes do not tend to increase in density with depth, this could leave a very deep, potentially liquefiable layer of CCRs at a given site, rather than just a single liquefaction-prone layer (which is usually the case in naturally-deposited soils).

The entire Root Cause Analysis report and other investigatory data for the Kingston Fossil Plant failure can be accessed on the TVA website at http://www.tva.gov/kingston/rca/.

1.3 Outline

This thesis is composed of eight chapters. The first chapter introduces the background as well as inspiration for the thesis topic. Chapters two and three provide consolidated research results on the static and dynamic engineering properties of CCRs, respectively. Chapter four discusses similarities between mine tailings disposal areas and CCR disposal areas and provides some guidance on how monitoring techniques developed for mine tailings disposal areas can be directly applied or slightly modified so that they can be applied to CCR disposal areas. Chapters five and six address how slope stability and settlement analyses can differ for CCR materials as opposed to naturally occurring soils. Chapter seven provides a review of common triaxial reconstitution techniques used on granular materials, while also analyzing a reconstitution technique to determine if it produces homogenous samples in terms of grain size distribution and relative density with height. Finally, chapter eight provides some final observations for each chapter, as well as a summary of topics that require further research in the future.

Chapter 2

Engineering Characterization of CCRs

Index and mechanical properties of soils provide the basic information required to design earth retaining structures, foundations, and earthen embankments and to perform slope stability analyses; determining the index properties and running field and laboratory tests to determine these properties is the first step in any geotechnical engineering application. In any given region, there is a large body of literature from past projects describing the local soils that engineers can use as a resource to accelerate this initial process. CCRs, however, are not a natural soil and have characteristics that make their behavior in certain situations markedly different than natural soils of similar grain size; additionally, coal ashes can vary considerably from one site to another based on differences in the coal source, coal preparation methods, type of power plant unit, and combustion temperatures (Yudbhir and Honjo 1991). This chapter outlines some of the major differences in the properties of CCRs as compared to other soils and compiles some CCR characteristics obtained from published technical literature. Additionally, test data from engineering reports for five specific coal combustion plants in the U.S. are included; however, information identifying the specific plants has been omitted at the request of the plant operators. These five plants are referred to as Site 1 through Site 5 consistently throughout this thesis.

2.1 Specific Gravity

Perhaps one of the most unusual characteristics of CCRs is their wide range of specific gravities. While some CCRs may have specific gravities of around 2.7 or even 2.8, some have been reported to have specific gravities as low as 1.47. Table 1 provides some values of specific gravity (G_s) determined for CCRs by researchers in different countries.

Table 1: Reported specific gravities of CCRs from different countries

Reference	Type of CCR	Country	G_s
Martin et al. (1990)	Fly Ash	USA	2.03-2.49
Tu et al. (2007)		USA	2.10-2.40
Kim and Prezzi (2008)		USA	2.30-2.81
Site 3		USA	2.42-2.71
Site 4		USA	2.21-2.73
Sridharan et al. (1998)		India	1.95-2.31
Pandian and Balasubramonian (1999)		India	1.97-2.55
Prashanth et al. (1999)		India	2.03-2.67
Sridharan et al. (2001)		India	2.07-2.55
Trivedi and Sud (2004)		India	1.72-2.03
Pandian (2004)		India	1.95-2.55
Das and Yudhbir (2005)		India	2.14-2.62
Prakash and Sridharan (2006)		India	1.95-2.55
Prakash and Sridharan (2009)		India	1.66-2.55
Jakka et al. (2010)		India	2.18-2.27
Raymond (1961)		UK	2.05-2.26
Sherwood (1975)		UK	1.90-2.37
Indraratna and Nutalaya (1991)		Canada	1.90-2.90
		Thailand	2.27-2.45
Kolay and Kismoor (2009)		Malaysia	2.11-2.31
Muhardi et al. (2010)		Malaysia	2.50-2.70
Site 1	Surface Imp.	USA	2.13-2.30
Site 2		USA	2.16-2.26
Site 3		USA	2.55-2.62
Site 4		USA	2.20-2.47
Site 5		USA	2.29-2.61

Reference	Type of CCR	Country	G_s
Sridharan et al. (1998)		India	1.91-2.15
Sridharan et al. (2001)		India	1.96-2.66
Trivedi and Sud (2002)		India	1.60-2.10
Trivedi and Sud (2004)		India	1.98-2.00
Pandian (2004)		India	1.91-2.50
Prakash and Sridharan (2006)		India	1.91-2.50
Bera et al. (2007)		India	2.16-2.23
Prakash and Sridharan (2009)		India	1.64-2.66
Skarzynska et al. (1989)		UK	2.10-2.24
		Poland	1.90-2.31
Seals et al. (1972)	Bottom Ash	USA	2.28-2.78
Sridharan et al. (1998)		India	1.82-2.15
Sridharan et al. (2001)		India	1.98-2.19
Pandian (2004)		India	1.82-2.15
Prakash and Sridharan (2006)		India	1.66-2.17
Prakash and Sridharan (2009)		India	1.47-2.19
Jakka et al. (2010)		India	2.50-2.59
Kolay and Kismoor (2009)		Malaysia	2.09-2.32

Despite the wide range of specific gravities observed for CCRs, most researchers recognize that they usually have a specific gravity lower than that of natural soils (Prakash and Sridharan 2009, Trivedi and Singh 2004b, Tu et al. 2007). It logically follows that since the unit weight of CCRs is less than that of natural soils, horizontal earth pressures in CCRs will be less than that of natural soils as well. Prakash and Sridharan (2009) cite this as a property that makes them ideal for use as backfill material for retaining structures or as a lightweight fill in other construction applications.

Many factors contribute to variability in the specific gravity of coal ashes, such as the parent coal and the combustion and cooling processes. Figure 1 compares variability of the specific gravity of different coal ashes from different countries. Additionally, some of the research studies done on ash from several different plants have a much higher variability than studies done on specific sites, indicating that variability in the specific gravity of CCRs within a given plant is lower than the specific gravity of CCRs within the country where that plant is in. Examining Figure 2, it is interesting to note the clear difference in the mean values of specific gravity between US coal ashes and Indian coal ashes; this may be due to higher iron contents in

US coals. Table 2 provides percentages of major constituent oxides in CCRs from different countries by weight, which shows how much the mineralogy of CCRs can vary between countries, another factor that can account for high variability in the specific gravity of CCRs from different countries (Yudbhir and Honjo 1991). Loss on ignition (LOI) for the CCRs is also reported in Table 2, that is, the loss in mass of the samples upon strong heating.

Table 2: Percentages by weight of major oxide constituents of CCRs from different countries (after Yudbhir and Honjo 1991).

Constituents	USA	UK	Canada	India	Thailand	Japan	Hong Kong	China	Australia	S. Africa	Poland	Germany
SiO_2	28-59	37-54	37-59	13-64	27-34	50-62	38-77	44-55	44-73	40-53	43-52	48
Al_2O_3	7-38	17-33	12-24	14-31	19-28	22-30	14-46	20-32	16-33	24-35	19-34	25
Fe_2O_2	4-42	6-22	3-39	3-24	20-24	4-7	1-18	1-17	3-6	5-11	1-13	7
CaO	0-13	1-27	1-13	1-34	11-16	3-7	0-16	5-9	0-9	5-10	2-9	3
LOI	0-48	0-27	0-10	0-16	0-2	1-6	4-8	3-9	1-9	2-11	2-10	-
Glass Content	54-87	54-87	54-95	-	-	56-58	-	29-40	49-60	29-43	-	-

Note: LOI = loss on ignition

2.2 Consolidation Properties and Volume Stability

CCRs have historically been disposed of in two major ways: collected from boilers hydraulically and diverted to a surface impoundment or collected through electrostatic precipitators or flue gas desulfurization systems and dry-placed into CCR landfills. In either of these disposal alternatives, there is traditionally no defined level of compactive effort used and depending on future uses of the disposal sites, the consolidation characteristics of CCRs can be of interest to geotechnical engineers. Again, since CCRs are not naturally occurring soils, there has been little testing on their consolidation properties and volume stability. Table 3 provides compression and recompression indices and coefficients of consolidation determined by different researchers.

Few researchers report a value for the recompression index; in a disposal area, there would not necessarily be an unloading-reloading process during normal operations. Whenever recompression indices are reported, it is usually in reference to reuse of CCRs in construction applications. Furthermore, the recompression indices reported are extraordinarily low. The reported values of coefficient of consolidation, c_v, are highly variable, as might be expected for materials that have non-typical stress histories. Furthermore, it is important to note that values of

c_v cannot be determined using the traditional Taylor or Casagrande methods, since the majority of deformation for laboratory consolidation tests is complete within one minute; therefore, it is necessary to take deformation readings at very small time intervals (Yudbhir & Honjo 1991). It is also important to note that reported values of c_v mean little independent of the vertical effective stress at which that value was recorded, since the coefficient of consolidation is dependent on both the compressibility of the material and the permeability of the material, based on Terzaghi's original one-dimensional consolidation equation:

$$c_v = \frac{1}{\gamma_w}\frac{k_v}{m_v} \tag{1}$$

where c_v = coefficient of consolidation
γ_w = unit weight of water
k_v = vertical coefficient of permeability
m_v = coefficient of compressibility

Since both k_v and m_v generally decrease with increasing overburden stress, but not necessarily at the same rate, it is hard to relate the coefficient of consolidation to the compression and recompression indices in a general manner. Consequently, the values of c_v reported in Table 3 should not be taken as "typical" values, because of how c_v is mathematically defined.

Some of the variability of compression and recompression indices and coefficient of consolidation of CCRs can be attributed to the type of CCR. For example, it is logical to assume that bottom ash would have a higher coefficient of consolidation, since it has a higher hydraulic conductivity and a lower compressibility than fly ash. For this reason, variability plots for fly ash and surface impounded ash have been presented separately from those for bottom ash. Figures 3 through 5 present variability plots for the compression and recompression indices for different types of CCRs. Since the recompression index of bottom ash is rarely determined by researchers, the variability plot for recompression index includes fly ash, surface impounded ash, and bottom ash. Figure 6 presents a variability plot for the coefficient of consolidation for CCRs at different placement conditions.

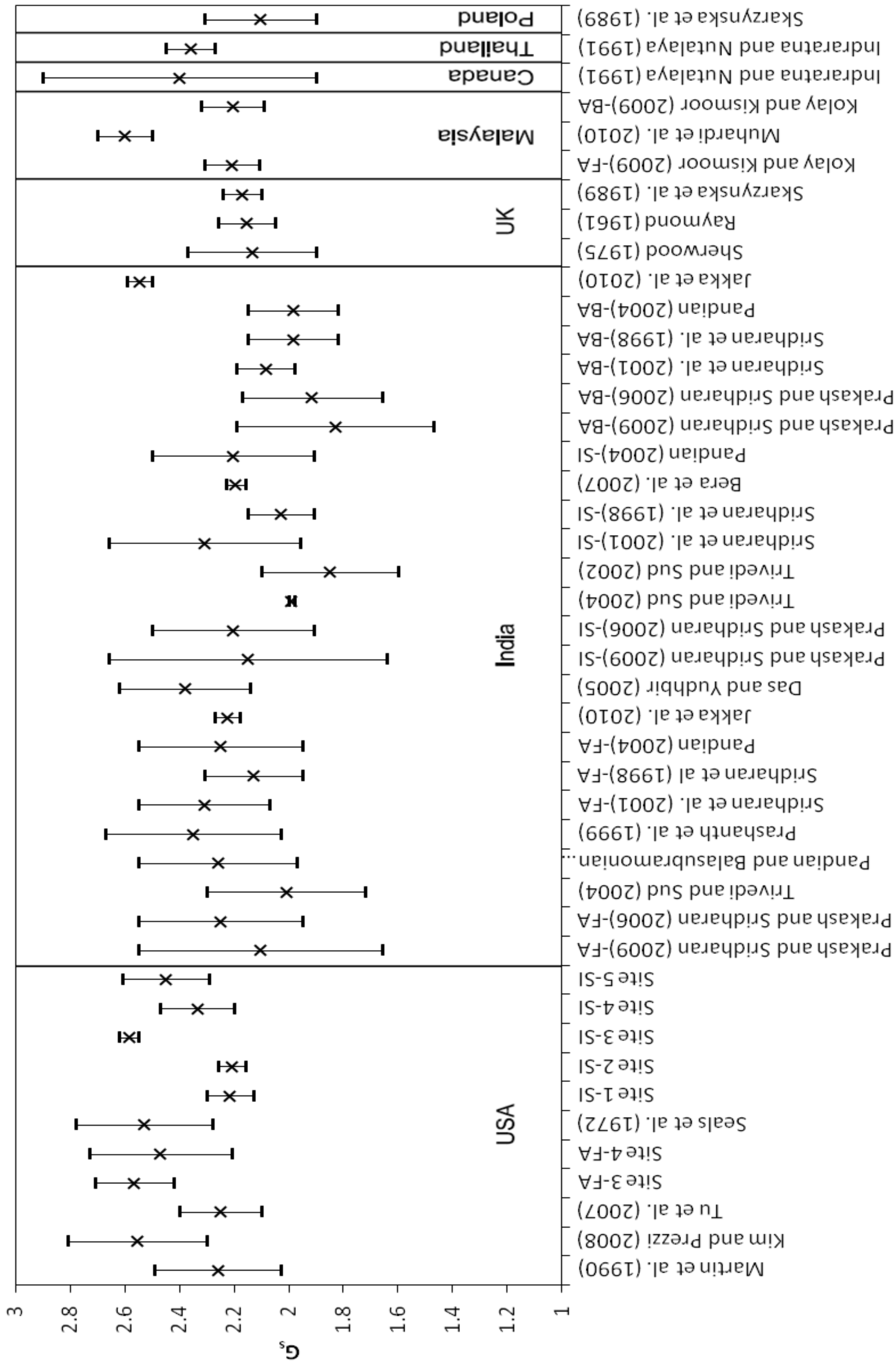


Figure 2: Variability plot for the specific gravities determined by studies performed in different countries.

Table 3: Compression and recompression indices and coefficients of consolidation for CCRs reported by different researchers.

Reference	Type of CCR	Country	C_c	C_r	C_v (cm^2/s)	Vertical Stress (psi)
Tu et al. (2007)	FA Resed.	USA	0.0390-0.0640	0.0035-0.0072	2.00-70.0	0.203-150
Site 1	SI	USA	0.080-0.710	0.0100-0.0300	-	0.694-111
Pandian and Balasubramonian (1999)	FA	India	-	-	0.00200-0.0802	0.73-116
Trivedi and Sud (2002)	SI/MH	India	0.00600-0.0100	0.000300-0.00300	-	3.34-116
Kaniraj and Gayathri (2004)	FA Comp.	India	0.0410-0.0840	0.00800	0.080-2.00	1.42-182
Pandian (2004)	FA	India	0.0490-0.284	-	1.16×10^{-5}-1.27×10^{-4}	7.12-113
	SI	India	0.0520-0.300	-	2.93×10^{-7}-8.17×10^{-4}	0.00-56.9
	BA	India	0.0570-0.484	-	7.57×10^{-7}-3.35×10^{-5}	0.00-56.9
Madhyannapu et al. (2008)	FA Resed.	India	0.100-0.167	0.00400-0.00800	-	
Prakash and Sridharan (2009)	FA Comp.	India	-	-	0.140-3.25	-
	SI Comp.	India	-	-	0.960-10.0	-
	BA Comp.	India	-	-	1.43-10.15	-
Jakka et al. (2010)	FA Comp.	India	0.079-0.246	0.018-0.023	-	7.26-29.0
	BA Comp.	India	0.051-0.059	0.013-0.024	-	7.26-29.0
Kolay and Kismoor (2009)	FA Comp.	Malaysia	0.0490-0.0510	-	-	319-2467
	SI Comp.	Malaysia	0.0780	-	-	319-2468
	BA Comp.	Malaysia	0.103-0.113	-	-	319-2469
Muhardi et al. (2010)	FA Comp.	Malaysia	0.150	-	3.00×10^{-5}-1.53×10^{-4}	-
	BA Comp.	Malaysia	1.54	-	-	-
Yudhbir and Honjo (1991)	FA Comp.	-	0.0300-0.375	-	-	-
	FA SI	-	0.0650-0.610	-	-	-
	FA SID	-	0.610-0.885	-	-	-
CAPCO (1990)	FA Comp.	Hong Kong	-	-	9.51×10^{-3}-1.90^{-2}	-
Haws et al. (1985)	FA Comp.	UK	-	-	9.51×10^{-4}-6.34×10^{-3}	-
Koo (1991)	FA Comp.	Thailand	-	-	3.17×10^{-4}-7.61×10^{-3}	-

FA = fly ash
BA = bottom ash
SI = surface impoundment ash
SID = surface impoundment/loose dry dump ash
MH = mixed hopper ash
Comp. = compacted
Resed. = resedimented

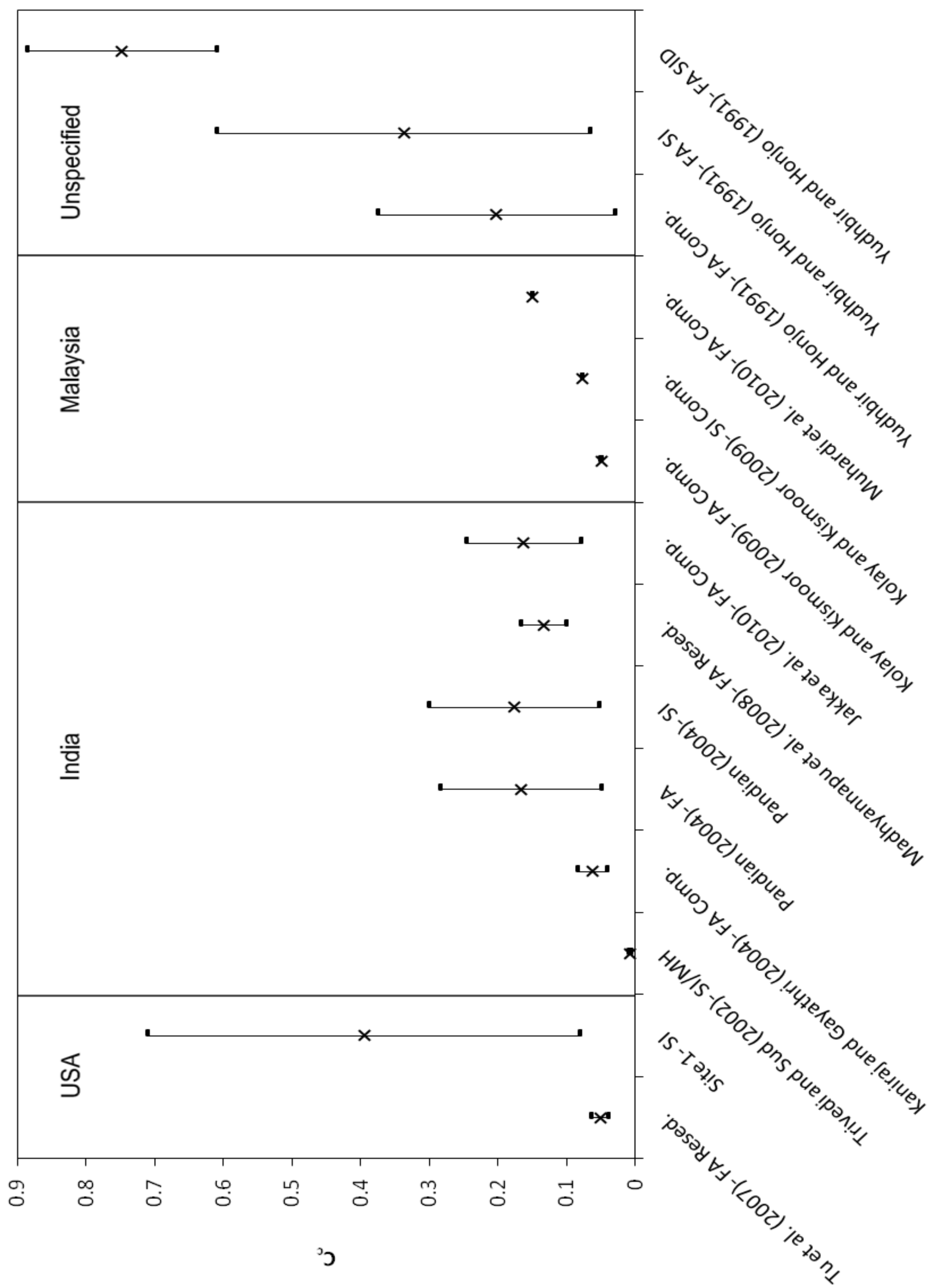


Figure 3: Variability plot for the compression indices of studies done on fly ashes and surface impounded ashes.

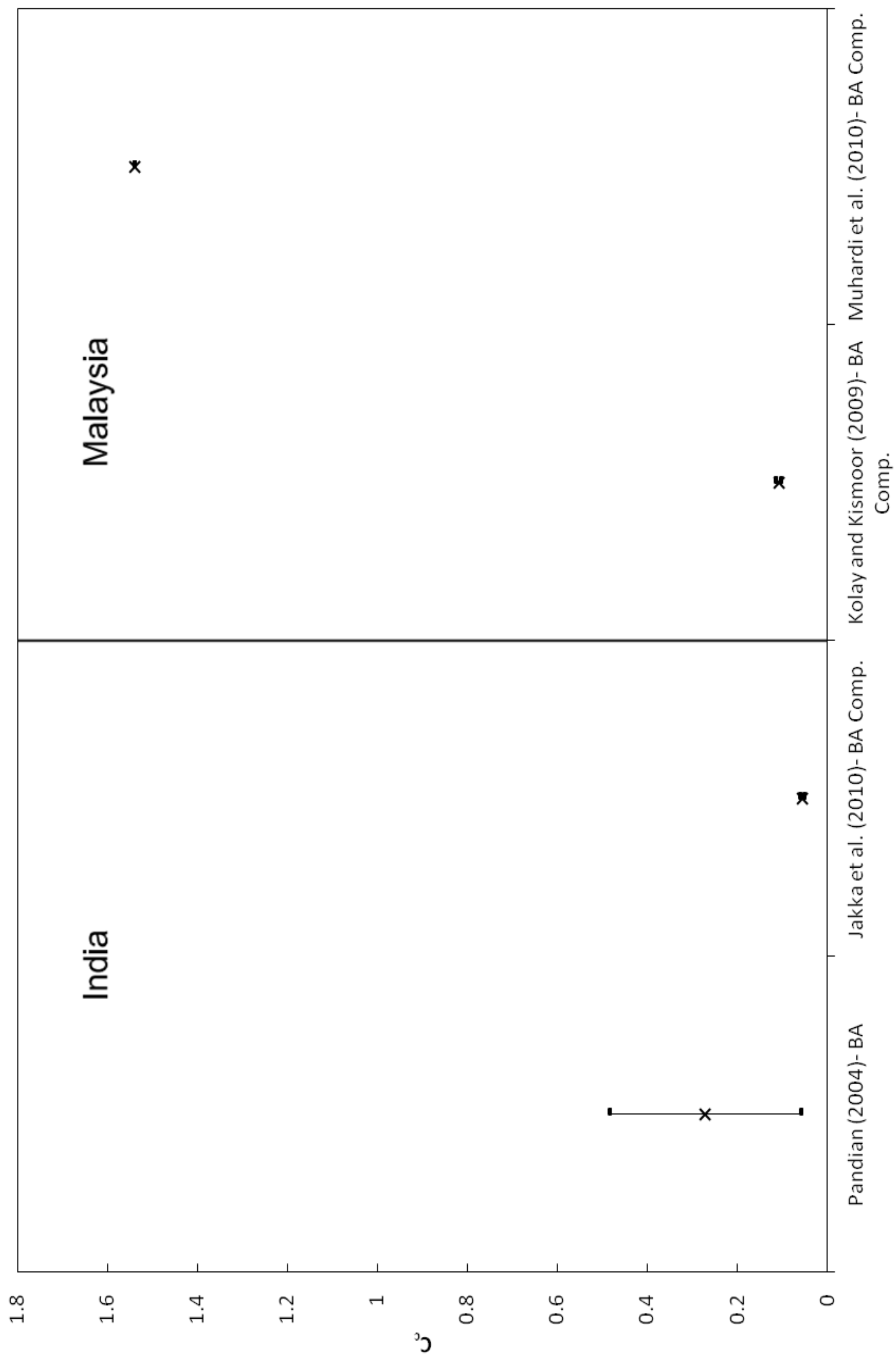


Figure 4: Variability plot of the compression indices for studies done on bottom ashes.

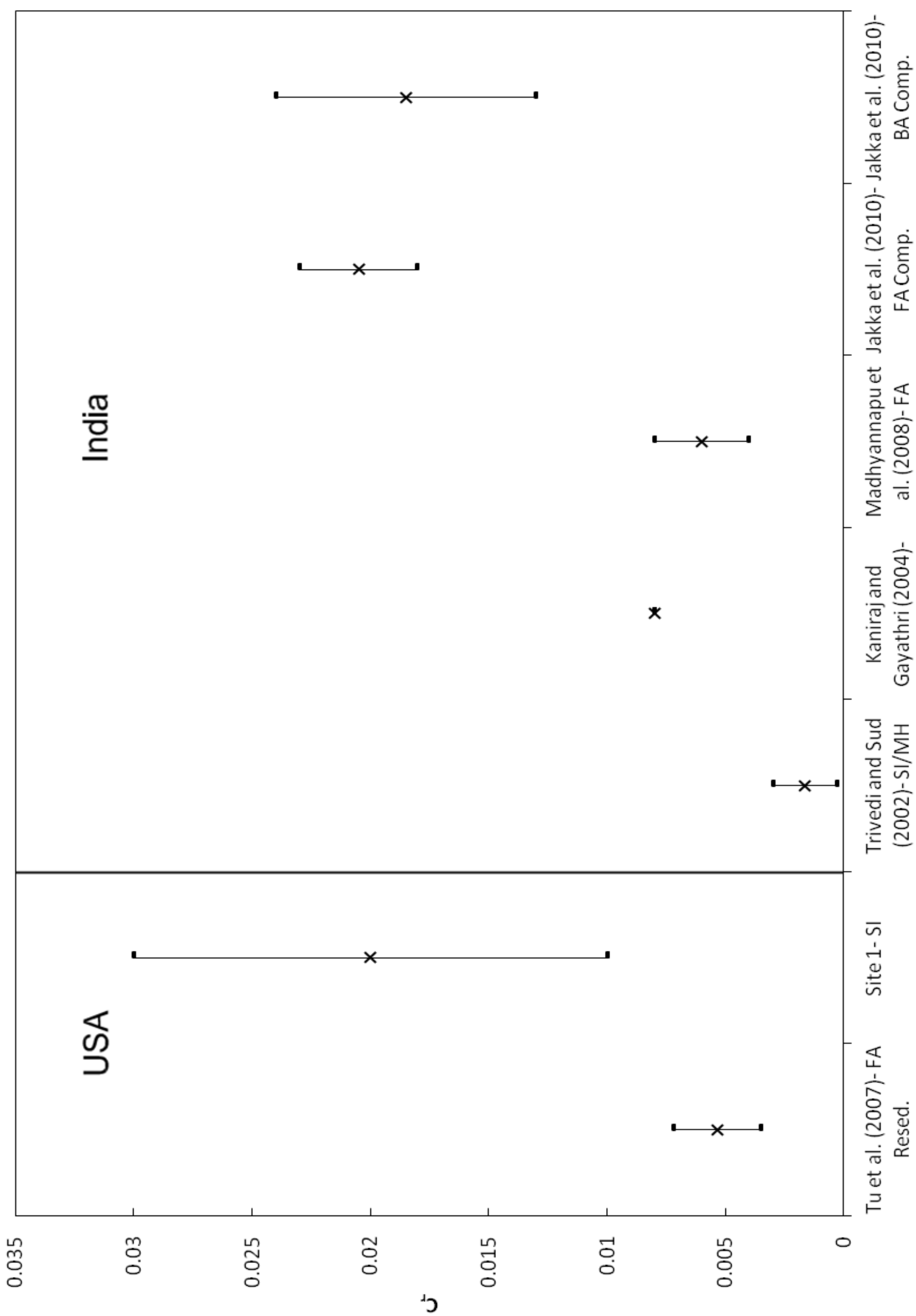


Figure 5: Variability plot of the recompression indices for studies done on fly ashes, bottom ashes, and surface impounded ashes

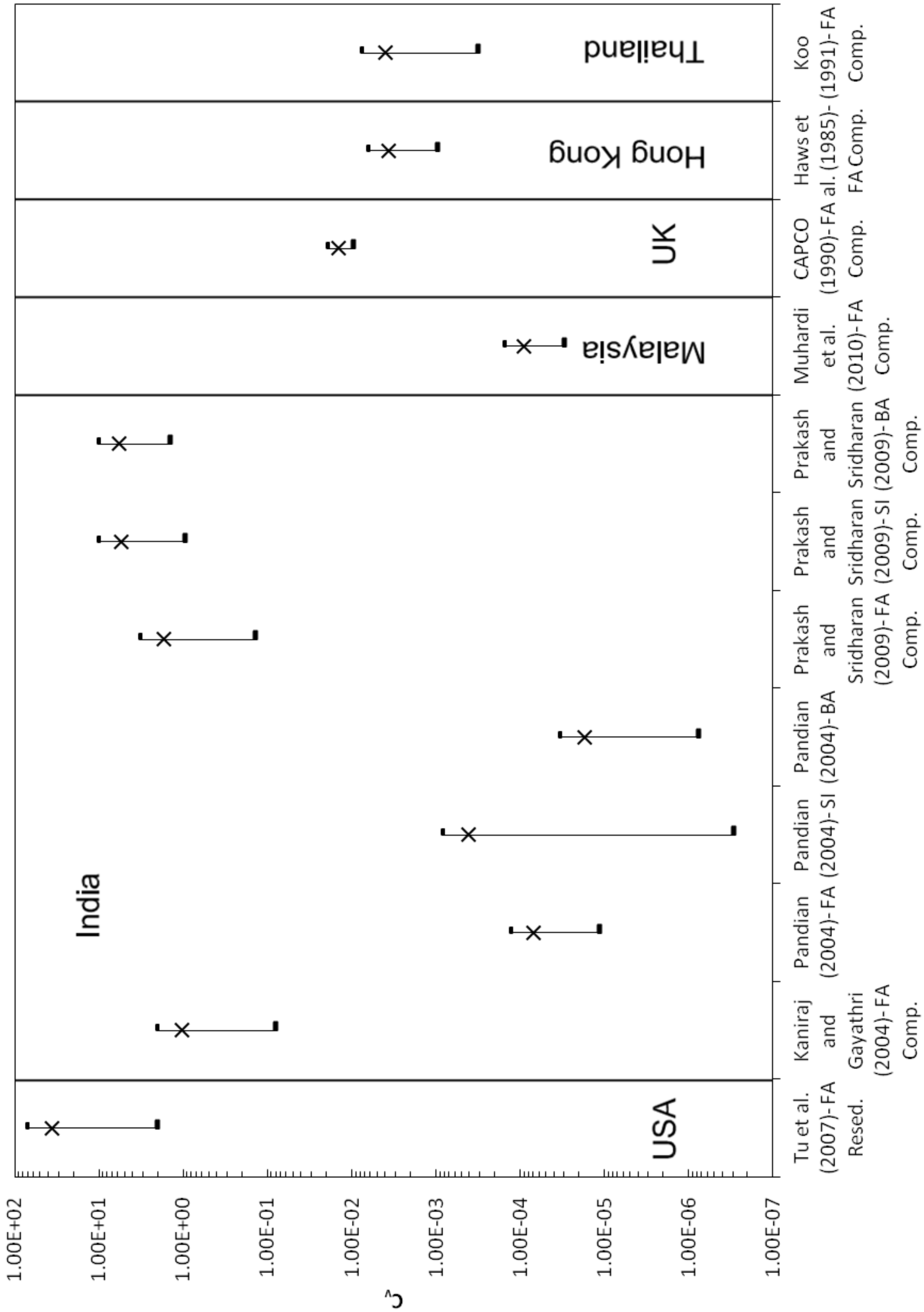


Figure 6: Variability plot for the coefficient of consolidation of studies done on fly ash, bottom ash, and surface impounded ash.

If structures are to be built on former CCR disposal areas or dry-disposed ashes are to be placed on hydraulically-placed deposits, volume stability of CCRs can also be of engineering concern. Swell, shrink, and collapse potentials are the three main types of volume instability examined for soils.

According to Sridharan and Prakash (2009), the swell potential of a soil can be examined through the use of the free swell ratio (FSR) which is defined as

$$FSR = \frac{V_d}{V_k} \tag{2}$$

where V_d = sediment volume of 10 g of oven-dried soil that passes a 425 µm sieve placed in a 100 ml jar which is then filled with de-aired water.

V_k = a sample identical to V_d except the solute is carbon tetrachloride or kerosene.

Note: a fume hood is required if there are any hazardous materials associated with the samples being tested

The swell potential can be determined based on the ranges of FSR as outlined in Table 4:

Table 4: Classification of Soils based on FSR (adapted from Sridharan and Prakash 2000)

FSR	Soil Type	Swell Potential
≤1.0	Nonswelling	Negligible
1.0-1.5	Mixture of swelling and nonswelling	Low
1.5-2.0	Swelling	Moderate
2.0-4.0	Swelling	High
>4.0	Swelling	Very High

Additionally, ASTM D4829 (2003), "Standard Test Method for Expansion Index of Soils," provides a standardized method of determining the swell potential of soils based on the expansion index (EI_{50}). In order to determine the EI_{50} of a soil, a dried soil sample must first be mixed with distilled water to the approximate optimum moisture content and allowed to sit in an air-tight container for at least 16 hours. Then, the conditioned soil is compacted in a 4.01 inch diameter mold in two two-inch lifts using 15 well-distributed blows of a 5.5 lb, 2.00 inch diameter rammer dropped from a height of 12 inches. Once the sample degree of saturation (S) is measured to be within 40% to 60%, the sample is loaded into a consolidometer and consolidated for 10 minutes under a load of 1.0 psi before the initial reading on the dial indicator is taken. The specimen is then inundated with distilled water while periodic readings of the dial indicator are made in accordance with test D2435 (2003) for 24 hours or until the rate of expansion becomes less than 0.0002 inches per hour. The EI of a soil is then defined as

$$EI_{50} = EI_{meas} - (50 - S_{meas}) \cdot \frac{65 + EI_{meas}}{220 - S_{meas}} \tag{3}$$

where S_{meas} = the degree of saturation measured in the test

and

$$EI_{meas} = \frac{\Delta H}{H_1} \cdot 1000 \tag{4}$$

where ΔH = the change in height ($D_2 - D_1$) of the sample, mm
H_1 = initial height, mm
D_1 = initial dial reading, mm
D_2 = final dial reading, mm

The shrink potential of soils is usually assessed based on that soil's shrinkage limit, which is outlined in ASTM D4943 (2002) and calculated according to equation 5:

$$SL = w - \left[\frac{(V - V_d) \cdot \rho_w}{m_s}\right] \cdot 100 \tag{5}$$

where w = moisture content of the soil at the time it was placed in the dish (%)
V = the volume of the wet soil pat = volume of the dish
V_d = volume of the dry soil pat
ρ_w = density of water
m_s = mass of the dry soil pat

However, CCRs are generally non-plastic and ASTM D4943 is only applicable when the soil is cohesive in nature. Based on the fact that CCRs generally have a uniform gradation it can be assumed that they would have a high shrinkage limit (Prakash and Sridharan, 2009).

The collapse potential of a soil is the percent change in volume of a specimen after inundation. It is usually determined using oedometer tests and, as a result, can either be expressed mathematically in terms of height or void ratio, according to equation 6.

$$C_p = \frac{\Delta h}{h_0} = \frac{\Delta e}{(1 + e_0)} \tag{6}$$

where Δh = change in height of the specimen upon inundation
h_0 = the height of the specimen prior to inundation
Δe = change in void ratio of the specimen upon inundation
e_0 = void ratio of the specimen prior to inundation

Since collapse potential can change given different applied stress levels and overconsolidation states, there are any number of typical collapse potential values for a given soil, depending on the in-situ stress and the preconsolidation pressure of the soil. Generally, if the collapse potential is below 1%, there is no danger of collapse of soil structure (Mudhyannapu et al. 2008, Trivedi and Sud 2004).

It is important to note that collapse potential increases dramatically for some dry-disposed coal ashes when tested in a moist condition as opposed to a dry condition; even soils that classify as non-collapsible in a dry condition can become collapsible in a moist condition. This is due to the presence of soluble substances not present in the coal ashes disposed of using wet disposal methods (Trivedi and Sud 2004).

2.3 Hydraulic Conductivity

An important soil property for seepage calculations for earthen embankments is hydraulic conductivity. This is an especially important property for CCR surface impoundments, since they tend to be deposited in a meta-stable structure. In addition, the CCRs are often used to construct embankments as the surface impoundments are raised. Hydraulic conductivity of CCRs deposited in surface impoundments can display anisotropy as a result of its cyclic, lacustrine-style deposition. For engineering purposes, the hydraulic conductivity of both the compacted embankment material and the disposed CCR material will be of interest, as these values are used in erosion analyses. Table 5 presents hydraulic conductivities of different types of CCRs from different countries as determined by various researchers. Due to the fact that there are different disposal methods for CCRs and different types of CCRs that are often co-disposed of, there is a wide variety of placement conditions, each of which can potentially create a different soil fabric and therefore a different range of hydraulic conductivities.

The CCRs were divided into two groups in order to assess variability in hydraulic conductivity: fly ash and surface impounded ash/bottom ash. This was done because oftentimes surface impounded ash is made up of both fly ash and bottom ash; this fact, coupled with its loose placement condition ensures hydraulic conductivity will be at the material's naturally highest value. Figures 7 and 8 are variability plots hydraulic conductivity of fly ashes and surface impounded ash/bottom ash from different countries, as determined by different researchers. It is important to note that not all researchers specified whether it fly ash tested was class c or class f (class c exhibits self-cementing properties); this fact could be a further contributor to the variability in values of hydraulic conductivity of fly ashes.

Table 5: Values of hydraulic conductivity for different CCRs for different countries as determined by different researchers (adapted from Prakash Sridharan 2009)

Reference	Country	CCR Type	Testing Condition	k (cm/s)
Seals et al. (1972)	USA	BA	Relative density = 50%	5.0×10^{-3} to 0.094
McLaren and DiGioia (1987)		Class F FA	$\gamma_{d\,max\_SP}$, $\gamma_{d\,max\_MP}$	1.3×10^{-5}
		Class F FA	SI or poorly compacted	1.8×10^{-5}
		Class C FA	$\gamma_{d\,max\_SP}$, $\gamma_{d\,max\_MP}$	1.1×10^{-5}
Martin et al. (1990)		FA	$\gamma_{d\,max\_SP}$	1.8×10^{-5} to 1.2×10^{-4}
		BA	$\gamma_{d\,max\_SP}$	1.2×10^{-3}
Yudbhir and Honjo (1991)		Class C FA	$\gamma_{d\,max}$	1.0×10^{-7} to 2.0×10^{-7}
		Class F FA	$\gamma_{d\,max}$	2.0×10^{-6} to 6.0×10^{-5}
Glogowski et al. (1992)		Eastern US FA	-	1.9×10^{-5}
		Western US FA	-	3.1×10^{-5}
Site 1		SI	Undisturbed	1.1×10^{-3} to 1.7×10^{-2}
Site 3		FA-SI	Undisturbed	7.0×10^{-7} to 6.5×10^{-7}
		BA	Bulk Recompacted	2.3×10^{-6}
Site 4		FA-Comp.	Undisturbed	1.3×10^{-7} to 8.2×10^{-5}
		SI	Undisturbed	1.6×10^{-5} to 6.3×10^{-5}
Site 5		FA-Comp.	Undisturbed	1.5×10^{-5} to 8.0×10^{-4}
		SI	Undisturbed	4.8×10^{-6} to 4.0×10^{-4}
Pandian and Balasubramonian (1999)	India	FA	Compacted to 0.95 $\gamma_{d\,max}$ and saturated	1.4×10^{-5} to 4.2×10^{-4}
Kaniraj and Gayathri (2004)		FA	$\gamma_{d\,max}$	4.7×10^{-6} to 6.0×10^{-6}
Prakash and Sridharan (2009)		FA	Compacted at $\gamma_{d\,max}$ and saturated	8.0×10^{-6} to 1.9×10^{-4}
		SI	-	5.0×10^{-5} to 9.6×10^{-4}
		BA	-	9.9×10^{-5} to 7.1×10^{-4}
Jakka et al. (2010)		FA	loose	7.0×10^{-7} to 2.1×10^{-6}
		FA	dense	3.5×10^{-7} to 9.4×10^{-7}
		BA	loose	6.0×10^{-6} to 1.3×10^{-5}
		BA	dense	1.4×10^{-6} to 3.7×10^{-6}
Indraratna et al. (1991)	Thailand	Class C FA	$\gamma_{d\,max\_SP}$	4.0×10^{-7} to 7.0×10^{-7}
		Class C FA	$\gamma_{d\,max\_SP}$, 2 weeks curing	$<10^{-7}$
Gray and Lin (1972)	UK	FA	$\gamma_{d\,max}$	5.0×10^{-7} to 8.0×10^{-5}
Porbaha et al. (2000)	Japan	FA	Slurry (e_i = 0.85 to 1.02)	10^{-5} to 10^{-4}
Skarzynska et al. (1989)	Poland	SI	-	1.5×10^{-5} to 5×10^{-5}
Chan et al. (1986)	Canada	FA	in situ	10^{-7} to 10^{-4}
		BA	-	4.8×10^{-4} to 3.4×10^{-3}
Gitari et al. (2009)	South Africa	FA	Air flush core samples, constant head	4.6×10^{-5} to 6.9×10^{-5}
		BA	Air flush core samples, constant head	8.1×10^{-5} to 4.9×10^{-4}
		FA/BA Dry Dump	Field Slug Tests	2.3×10^{-5} to 9.6×10^{-3}

Note: FA = fly ash; SI = surface impoundment ash; BA = bottom ash; OMC = optimum moisture content; e_i = initial void ratio; FA-SI = surface impounded fly ash; FA-DS = dry-stacked fly ash; FA Comp. = field-compacted fly ash

Figure 7: Variability plot of the hydraulic conductivity of fly ashes from different countries, as determined by different researchers.

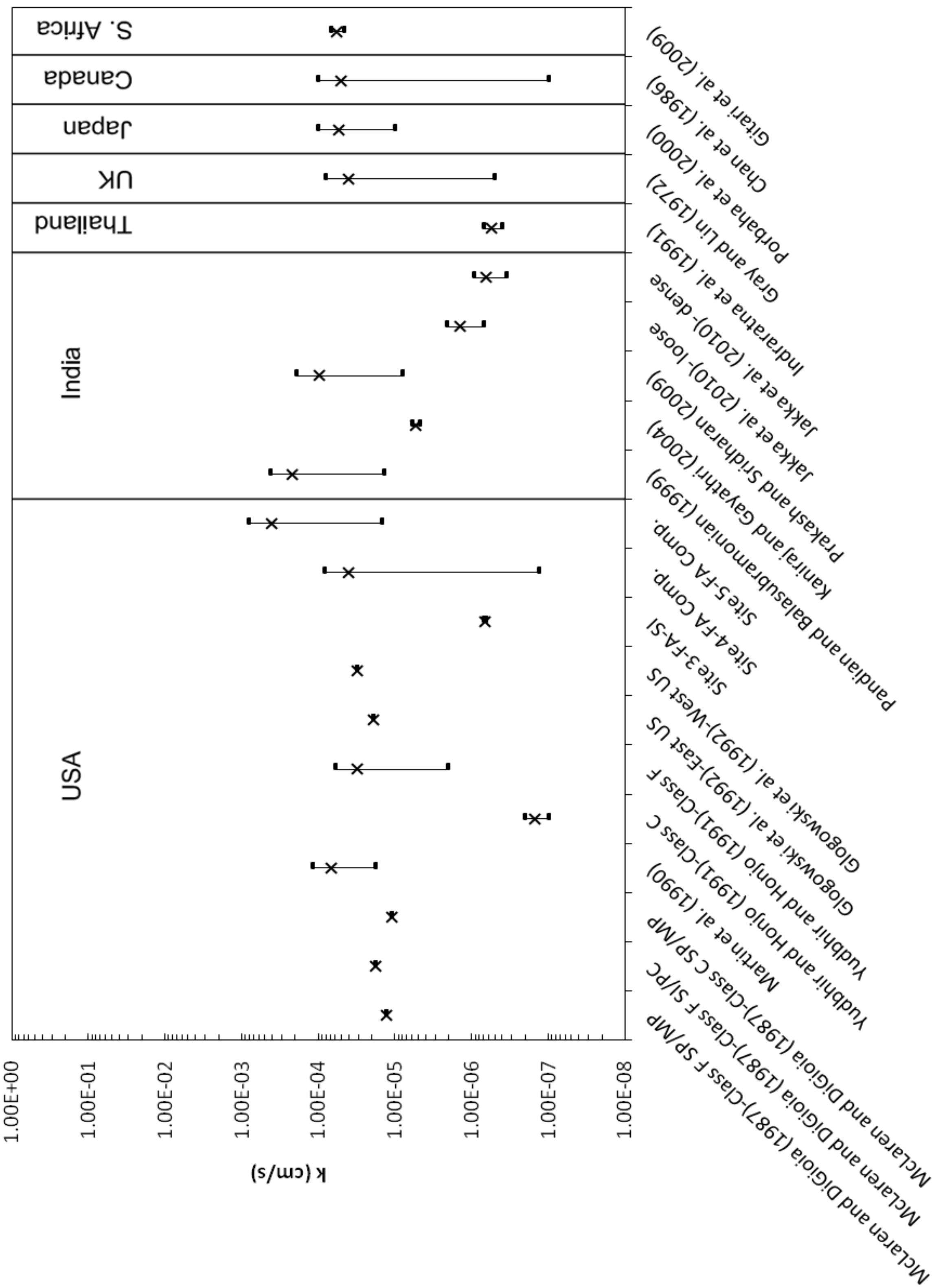


Figure 7: Variability plot of the hydraulic conductivity of fly ashes from different countries, as determined by different researchers.

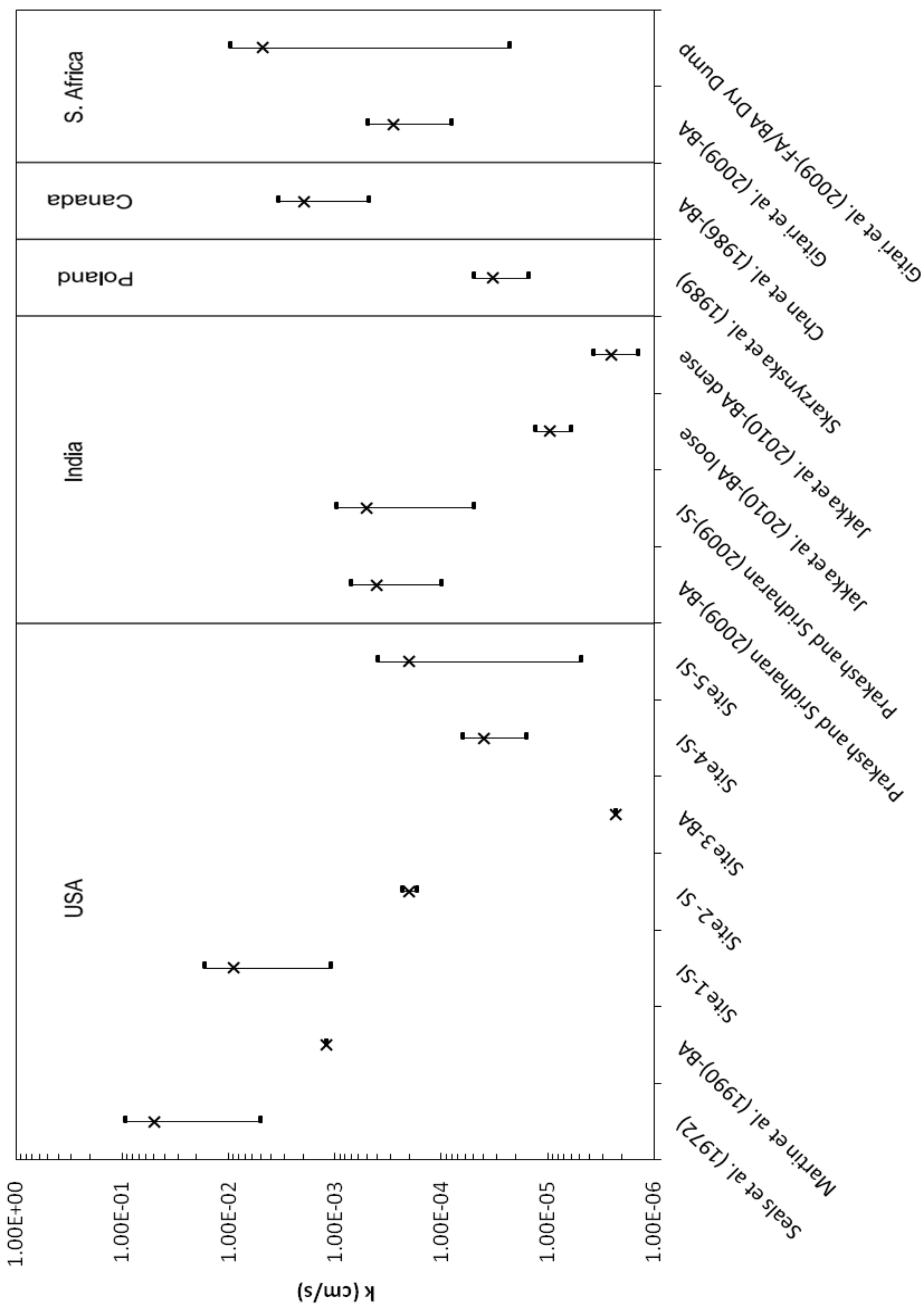


Figure 8: Variability plot of the hydraulic conductivity of surface impounded ashes and bottom ashes from different countries, as determined by different researchers.

2.4 Shear Strength

X-ray diffraction studies indicate that CCRs do not contain any of the clay minerals responsible for the cohesive portion of shear strength in soils (Trivedi and Singh 2004a, Trivedi and Singh 2004b, Ward and French 2005), which means that CCRs must derive their strength entirely from the frictional interaction between ash particles. Through the use of a scanning electron microscope (SEM), it is possible to study the morphological characteristics of coal ash particles and get an idea of their angularity, which would in turn offer clues as to the source of their frictional strength. As shown in Figures 9 and 10, bottom ash is much more angular than fly ash. In general, this can be associated with higher friction angles than fly ash at low confining stresses, which is usually the case. At high confining stresses, the higher angularity could lead to more particle breakage for bottom ash, and consequently to a larger degradation of their frictional resistance.

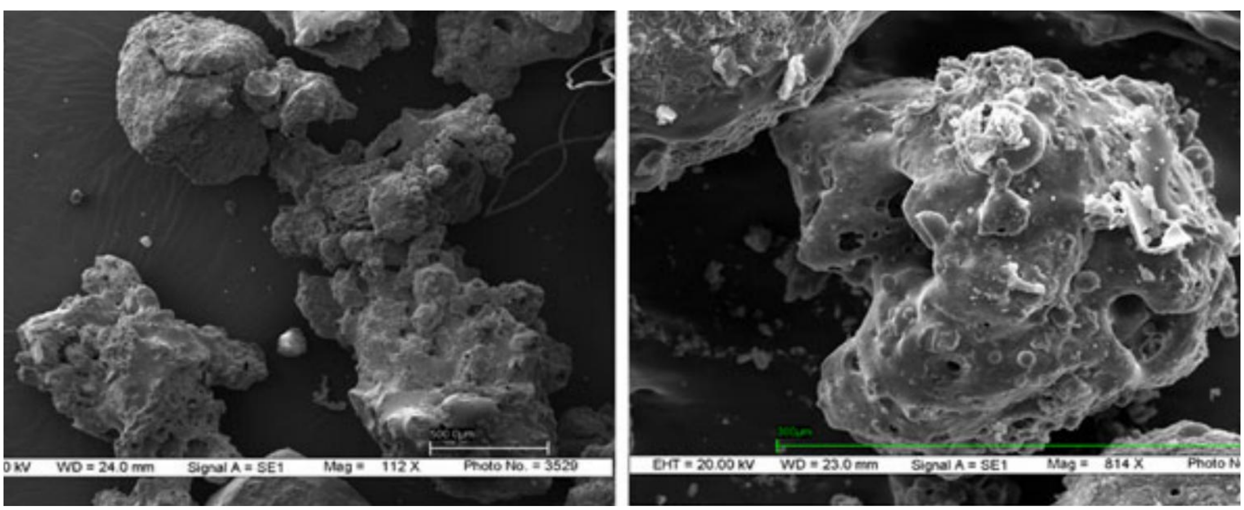


Figure 9: Micrographs of bottom ash particles magnified 112 and 373 times (Jakka et al. 2010)

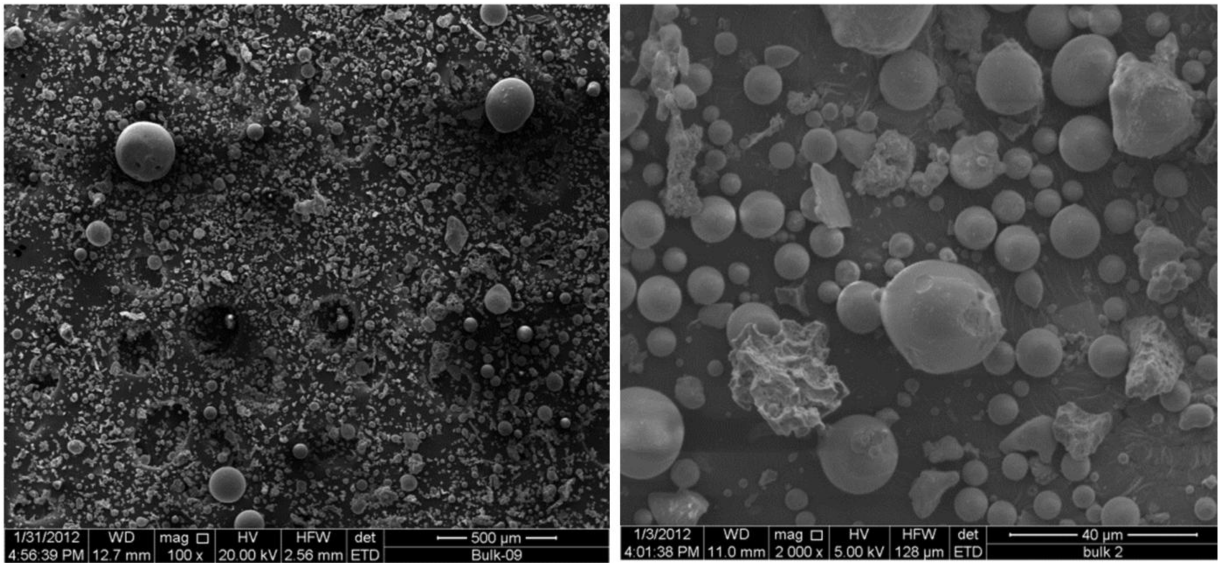


Figure 10: Micrographs of fly ash magnified 100 and 2,000 times (courtesy of Kevin Foster).

Shear strength parameters can be determined using several different laboratory test procedures. For CCRs, the most commonly performed tests are the direct shear test, consolidated drained triaxial test, and the consolidated undrained triaxial test. While the consolidated undrained triaxial test provides both effective and total stess strength parameters, most researchers only report effective strength parameters. This is undoubtedly because the rate of loading because of disposal is usually small enough that pore pressure dissipations are able to complete prior to the next disposal cycle; additionally, total strength parameters from CU tests can be misleading because of their dependence on the value of backpressure at which the specimen is sheared. Tables 6 through 8 report shear strength parameters of different CCRs from direct shear, consolidated drained, and consolidated undrained tests, respectively, reported in different studies. Figures 11 through 13 provide variability plots for the effective stress friction angles determined by various studies, compared on the basis of test type. Figures 14 through 16 provide variability plots on the basis of CCR type, while Figure 17 is a variability plot for the total stress parameters for all types of CCRs, since these parameters are not always reported. Variability plots were not made for values of cohesion since CCRs are usually reported to be non-plastic and the cohesions reported were either apparent cohesions of compacted, unsaturated samples or of samples that may have had self-cementing properties that would not be common to all disposed CCR materials. All acronymns used with the variability plots are consistent with those used in the Tables; for the Figures 14 through 16, DS, CD, and CU designate "direct shear test," "consolidated drained triaxial test," and "consolidated undrained triaxial test," respectively.

Table 6: Shear strength parameters determined by different researchers using the direct shear test.

Reference	Country	CCR Type	Condition	ϕ'_p (°)	c'_p (psf)
Kim & Prezzi (2008)	USA	FA	Comp. DoO	32.9-35.8	100-403
		FA	Comp. WoO	31.7-34.4	104-380
		FA	Comp. Sat.	30.2-34.5	58-276
Site 5		SI	Comp. Sat.	26.8-42.2	0
		SI	Undisturbed	23.4-35.4	0
Pandian (2004)	India	FA	Loose Dry	29.0-36.0	-
		SI	Loose Dry	29.0-34.0	-
		BA	Loose Dry	32.0-34.0	-
		FA	Loose Sat.	27.0-37.0	-
		SI	Loose Sat.	25.0-40.0	-
		BA	Loose Sat.	30.0-37.0	-
		FA	Comp.	28.0-42.0	205-819
		SI	Comp.	29.0-38.0	328-1024
		BA	Comp.	30.0-37.0	205-410
		FA	Comp. Sat.	28.0-41.0	-
		SI	Comp. Sat.	29.0-36.0	-
		BA	Comp. Sat.	30.0-37.0	-
Prakash &Sridharan (2009)		FA	Loose	29.0-33.0	-
		SI	Loose	30.0-33.0	-
		BA	Loose	31.0-34.0	-
		FA	Comp.	32.0-37.0	334-543
		SI	Comp.	30.0-33.0	272-334
		BA	Comp.	31.0-34.0	209-397
		FA	Comp. Sat.	32.0-35.0	0
		SI	Comp. Sat.	29.0-32.0	0
		BA	Comp. Sat.	30.0-33.0	0
Kolay & Kismoor (2009)	Malaysia	FA	Comp. Sat.	30.6-34.9	162-168
		SI	Comp. Sat.	26.2	70
		BA	Comp. Sat.	26.6	3.0-14
Muhardi et al. (2010)		FA	Comp.	23.0	251
		FA	Comp. Sat.	26.0	63
		BA	Comp.	32.0	79
		BA	Comp. Sat.	31.0	0

Note: ϕ'_p = peak effective friction angle; c'_p = peak effective cohesion; Comp. = compacted; Sat. = saturated; DoO = Dry of Optimum; WoO = Wet of Optimum

Table 7: Shear strength parameters determined by different researchers using the consolidated drained triaxial test.

Reference	Country	CCR Type	Condition	RC (%)	ϕ' (°)	c' (psf)
Kim & Prezzi (2008)	USA	FA	Reconst.	95	33.5-47.1	0
		FA	Reconst.	90	27.9-37.9	0
Site 5		SI	Reconst.	-	27.1-31.0	0
Pandian (2004)	India	FA	Reconst.	100	33.0-37.0	418-1942
		FA	Reconst.	100	33.0-43.0	0
Prakash &Sridharan (2009)		FA	Reconst.	95	33.0-43.0	0
Jakka et al. (2010)		FA	Reconst.	-	32.9-37.0	0
		BA	Reconst.	-	33.7-41.7	0
Muhardi et al. (2010)	Malaysia	FA	Reconst.	-	41.0	522
		BA	Reconst.	-	46.0	0
Indraratna et al. (1991)	Thailand	FA	Reconst.	-	26.0	731
		FA	Reconst. Pozz.	-	36.0	37594

Note: Reconst. = reconstituted; Pozz. = pozzolanic curing allowed to occur

Table 8: Shear strength parameters determined by different researchers using the consolidated undrained triaxial test.

Reference	Country	CCR Type	Condition	RC (%)	ϕ (°)	c (psf)	ϕ' (°)	c' (psf)
Site 1	USA	SI	Undist.	-	11.1-19.5	0-950	25.2-33.0	90-190
Site 2		SI	Undist.	-	12.0-45.5	640-2580	31.8-32.1	0-140
Site 3		FA	Reconst.		-	-	36.0	14.3
		SI	Undist.	-	-	-	39.6	0
		BA	Reconst.		-	-	41.0-44.0	0-261
Site 4		FA	DS, Undist.	-	3.4-37.7	200-1900	28.7-36.7	0-400
		SI	Undist.	-	18.3-27.4	400-1600	29.5-38.6	0-740
Prakash &Sridharan (2009)	India	FA	Reconst.	95	20.0-41.0	0	26.0-39.0	334-2005
		SI	Reconst.	95	25.0-34.0	0-1170	28.0-36.0	585-2109
		BA	Reconst.	95	24.0-35.0	0-564	24.0-35.0	585-1149
Jakka et al. (2010)		FA	Reconst.	-	-	-	22.3-38.5	0
		BA	Reconst.	-	-	-	32.2-42.6	0
Muhardi et al. (2010)	Malaysia	FA	Reconst.	-	41.0	710	-	-
		BA	Reconst.	-	44.0	0	-	-
Indraratna et al. (1991)	Thailand	FA	Reconst.	-	20.0	0	26.0	0

Note: Undist. = undisturbed; Reconst. = reconstituted; DS = dry-stacked in field

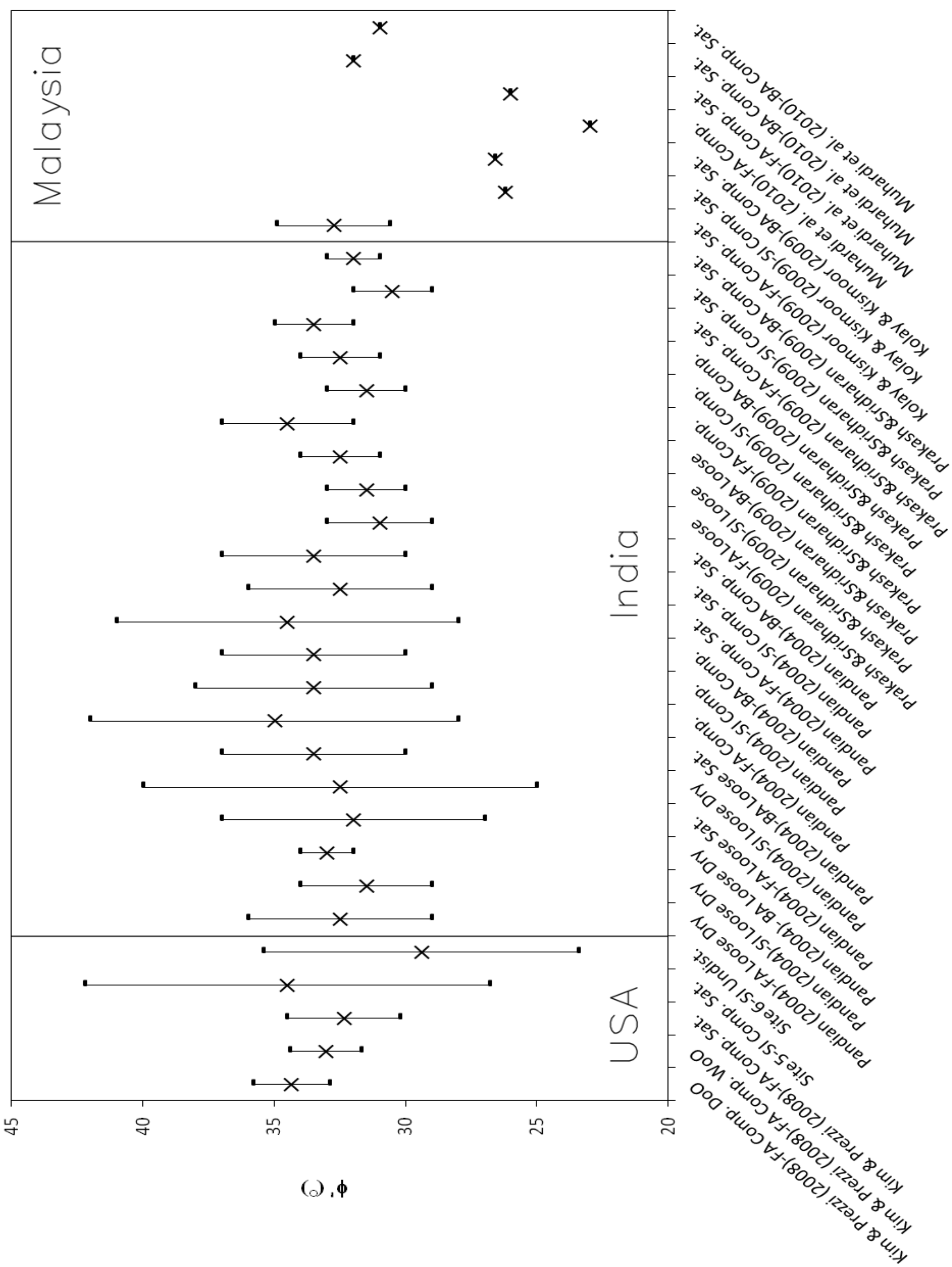


Figure 11: Variability plot of effective stress friction angle of various CCRs as determined by different researchers using the direct shear test.

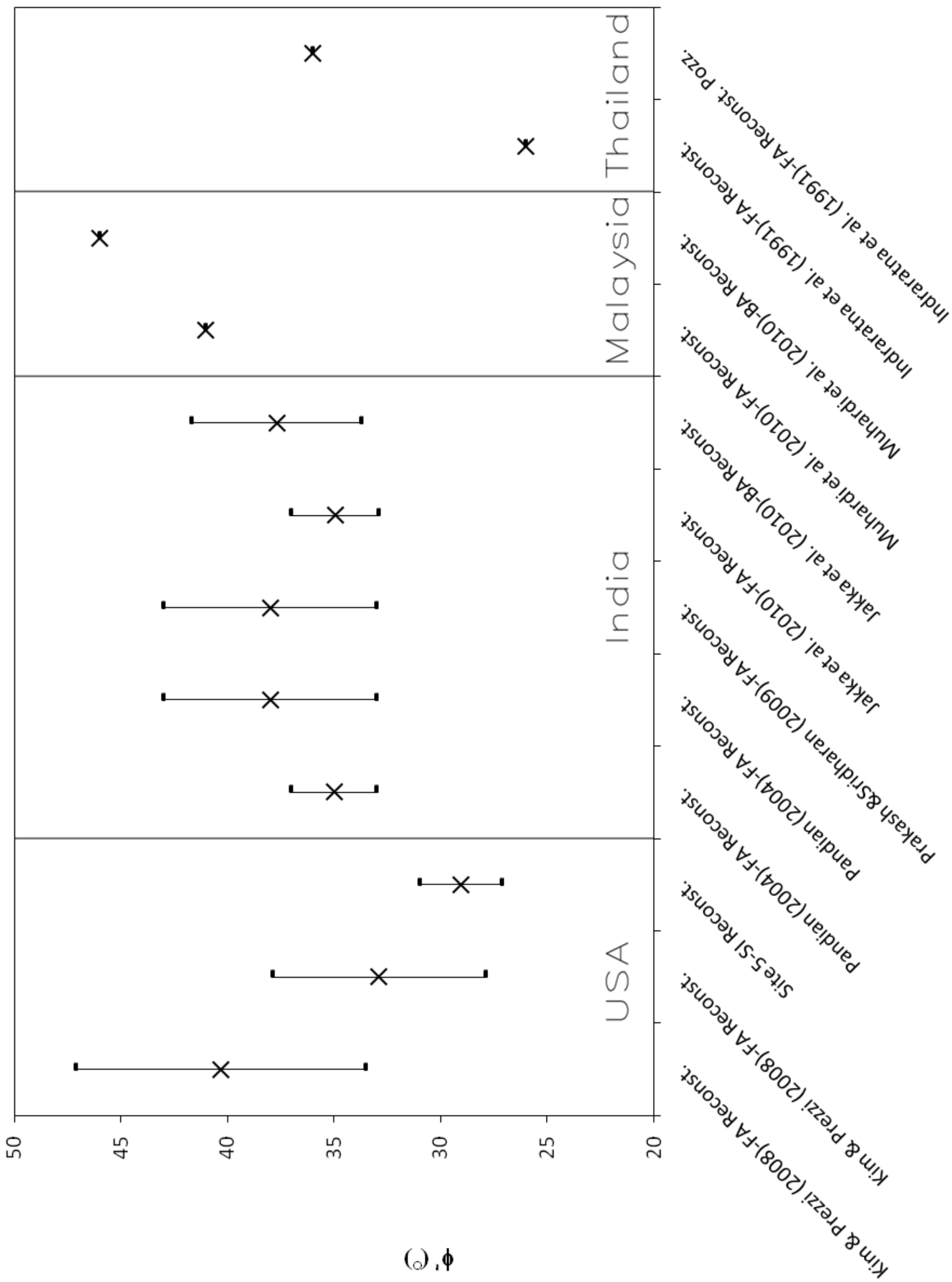


Figure 12: Variability plot of the effective stress friction angle of various CCRs as determined by different researchers using the consolidated drained triaxial test.

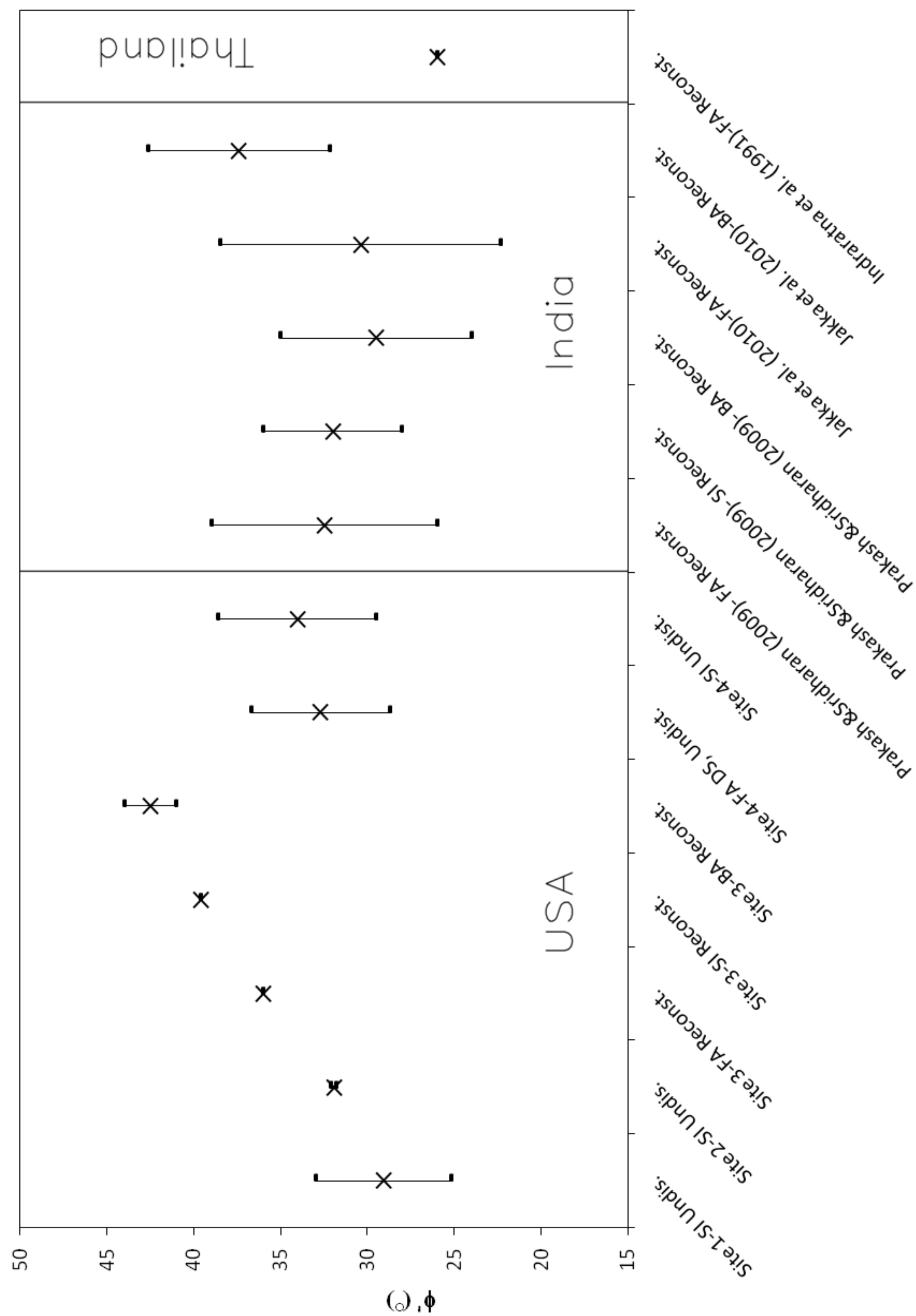


Figure 13: Variability plot of the effective stress friction angle of various CCRs as determined by different researchers using the consolidated undrained triaxial test.

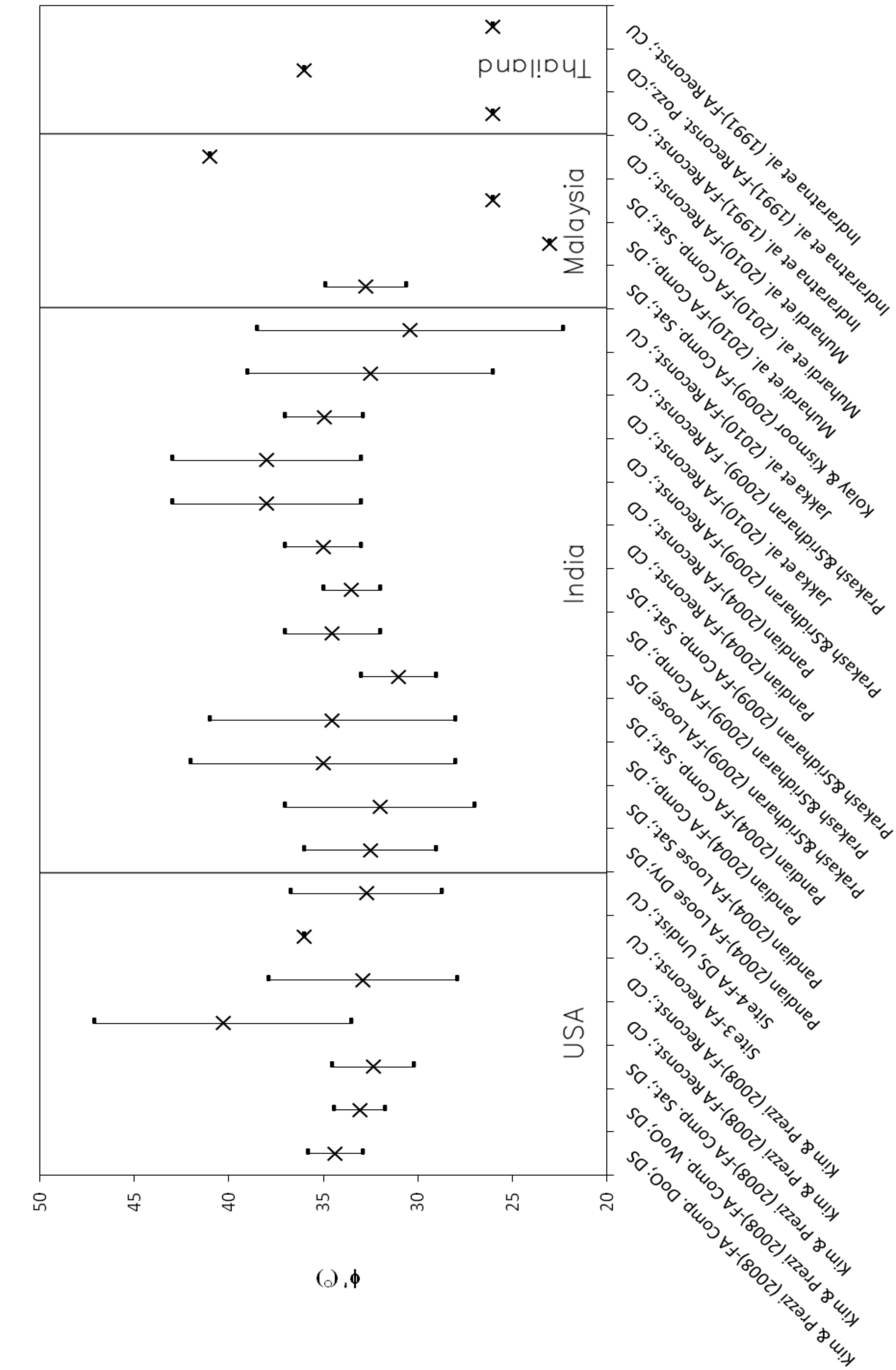


Figure 14: Variability plot of the effective stress friction angle of fly ashes for all shear strength tests performed by various researchers.

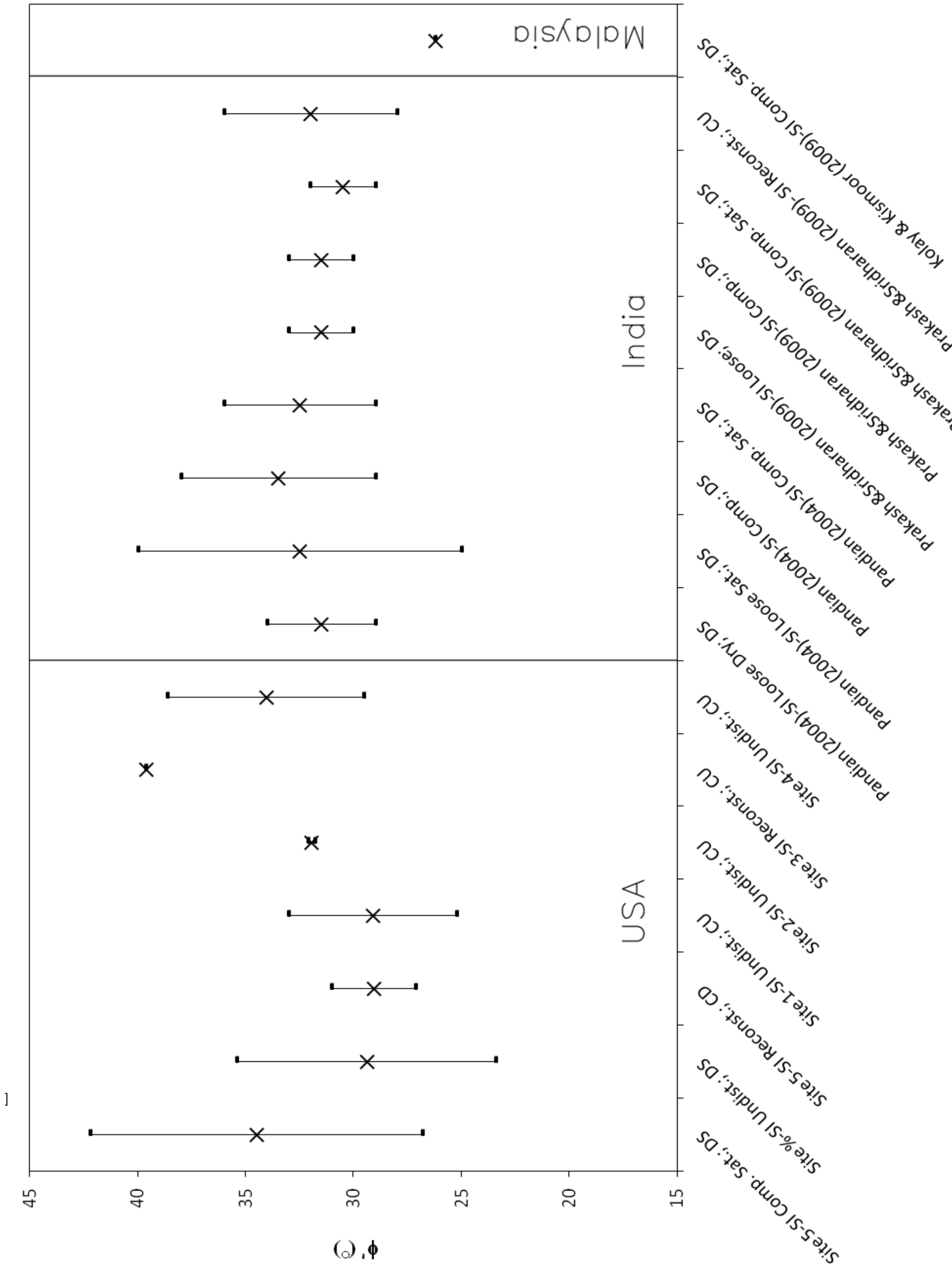


Figure 15: Variability plot of the effective stress friction angle of surface impounded ashes for all shear strength tests performed by various researchers.

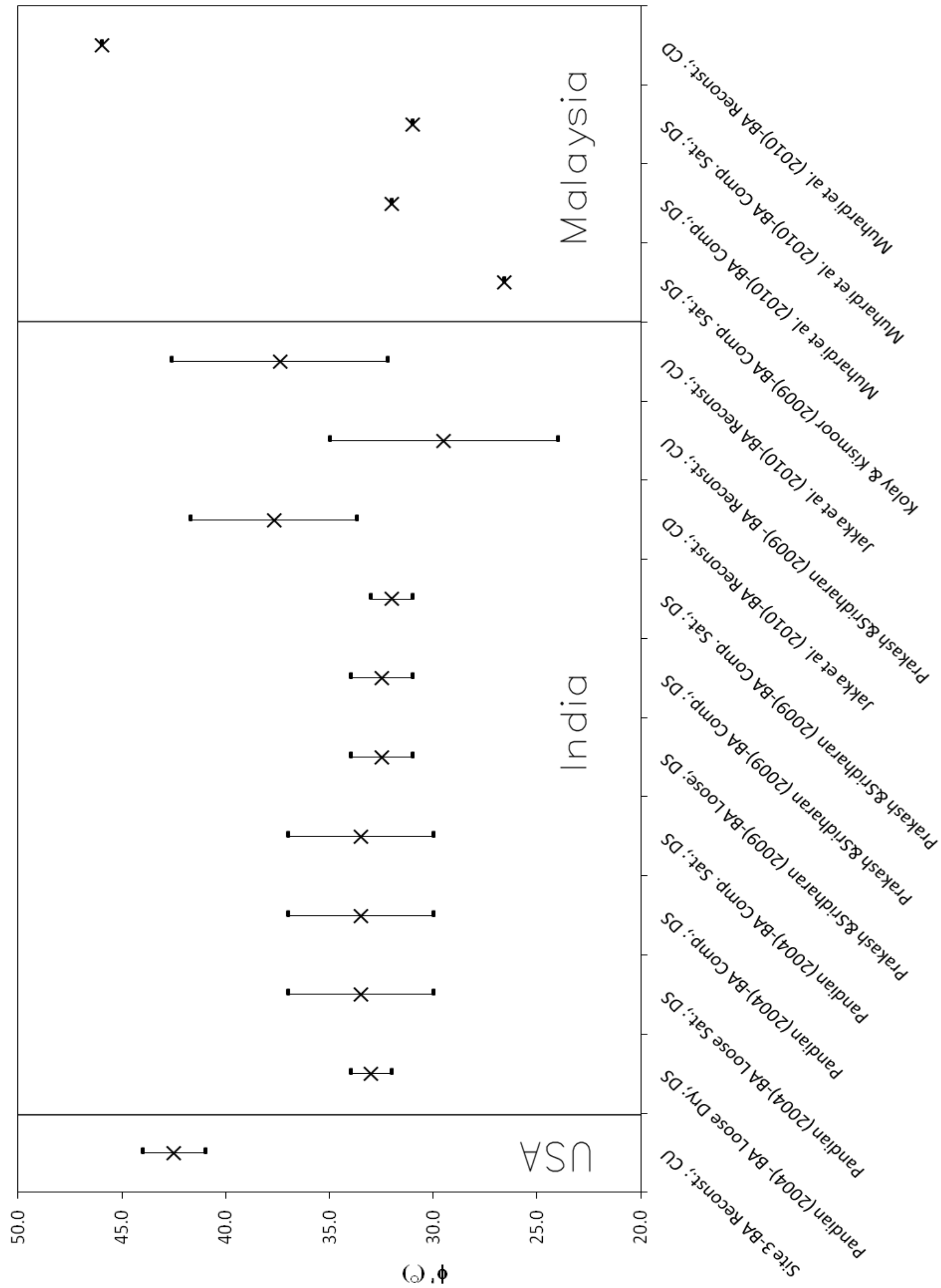


Figure 16: Variability plot of the effective stress friction angle of bottom ashes for all shear strength tests performed by various researchers.

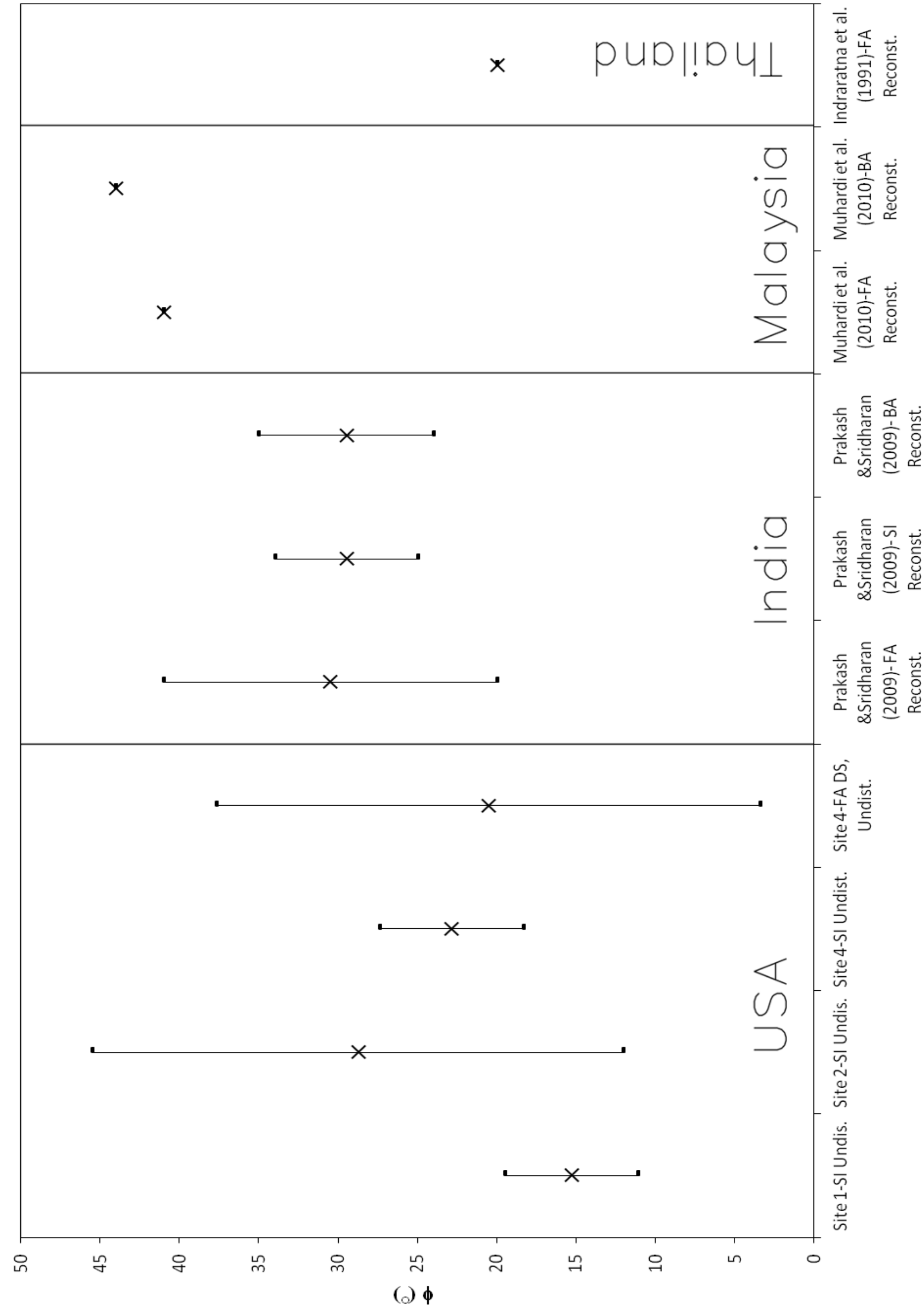


Figure 17: Variability plot of the total stress friction angle of all CCRs as determined by consolidated undrained triaxial tests performed by various researchers.

2.5 Compaction Characteristics

Since CCRs are often used in the construction of embankments for CCR disposal areas, an understanding of their compaction characteristics is necessary to control stability and seepage of the CCR disposal areas. A unique consideration when studying the compaction characteristics of CCRs is their generally low specific gravity. Since CCRs tend to have lower specific gravities and higher air voids than natural soils, their maximum dry density tends to be lower and their optimum moisture content higher than most natural soils (Bera et al. 2007, Prashanth et al. 1999, Trivedi and Singh 2004a). Trivedi and Singh (2004a) associate the high optimum water content of CCRs with the porous nature of the particles; most of the water is absorbed by the particles at lower water contents such that the particles are not workable until higher moisture contents. The lower dry density and higher corresponding water contents of CCRs results in a compaction curve that appears “flatter” than those of most natural fine-grained soils, as shown in Figure 18. The "A-Z soils" included in the plots for comparison are for natural soils from Ohio, as published by J. G. Joslin in the proceedings of the 1958 ASTM Symposium on Soil Testing in Highway Design and Construction.

Bera et al. (2007) also developed empirical models to predict the maximum dry density and optimum moisture content of a specific surface impounded ash, as long as both of these values are known for the standard proctor test:

$$MDD_E = 1.60783 \cdot MDD_{proc} + 1.85727\left(\frac{E}{E_{proc}}\right) - 6.89047 \qquad (7)$$

$$OMC_E = 1.73090 \cdot OMC_{proc} - 9.01750\left(\frac{E}{E_{proc}}\right) - 25.33520 \qquad (8)$$

where
MDD_E = maximum dry density at a given applied energy
MDD_E = maximum dry density for a proctor test
E = amount of energy input for given condition
E_{proc} = amount of energy input for a proctor test
OMC_E = optimum moisture content for a given applied energy
OMC_{proc} = optimum moisture content for a proctor test

It should be noted, however, that these relationships were developed using test data from Indian CCRs. Therefore, before using these relationships, it should be verified that they apply to the specific CCRs in question.

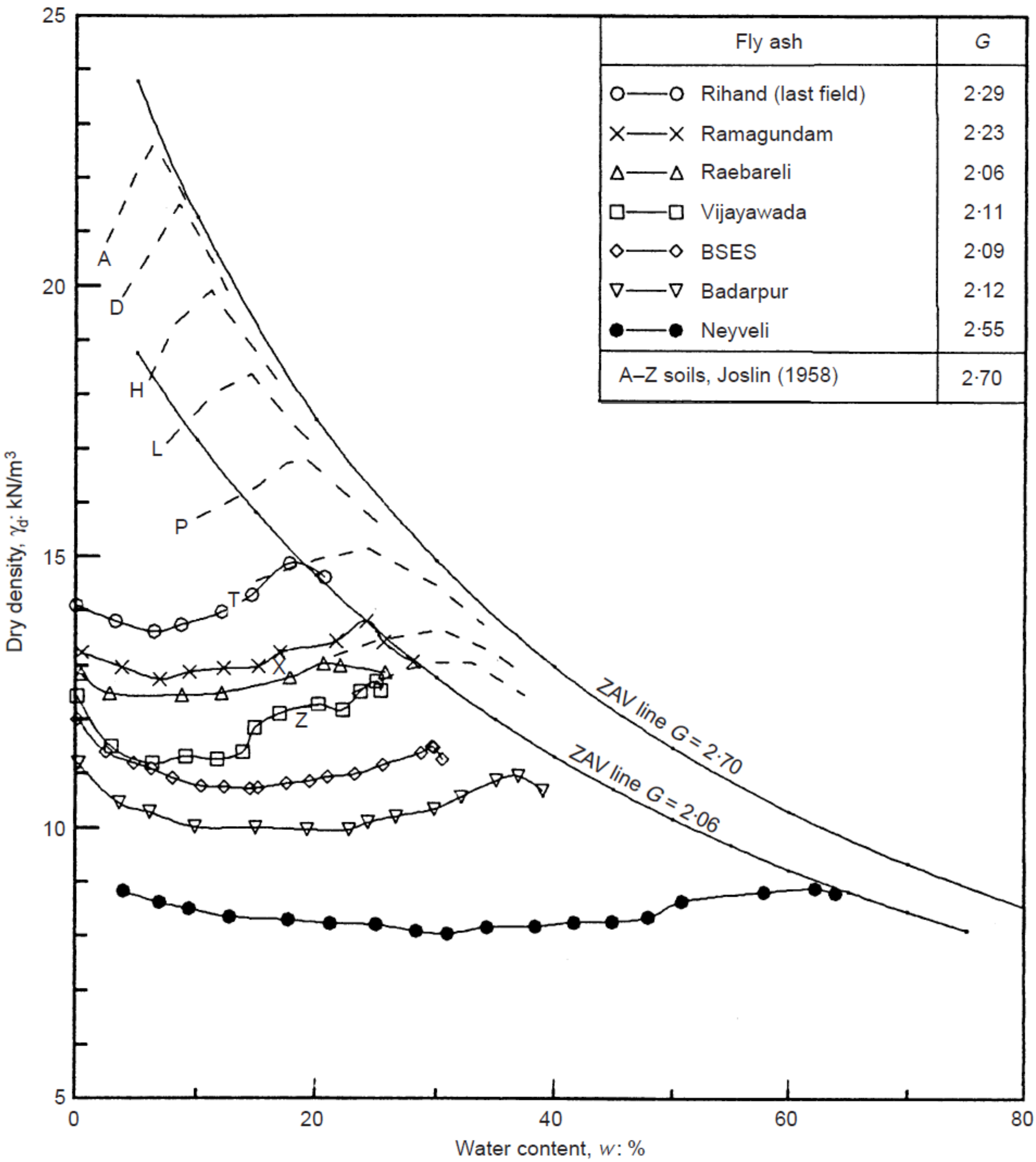


Figure 18(a): Compaction curves for different Indian fly ashes compared to those for several natural soils (Sridharan et al. 2001)

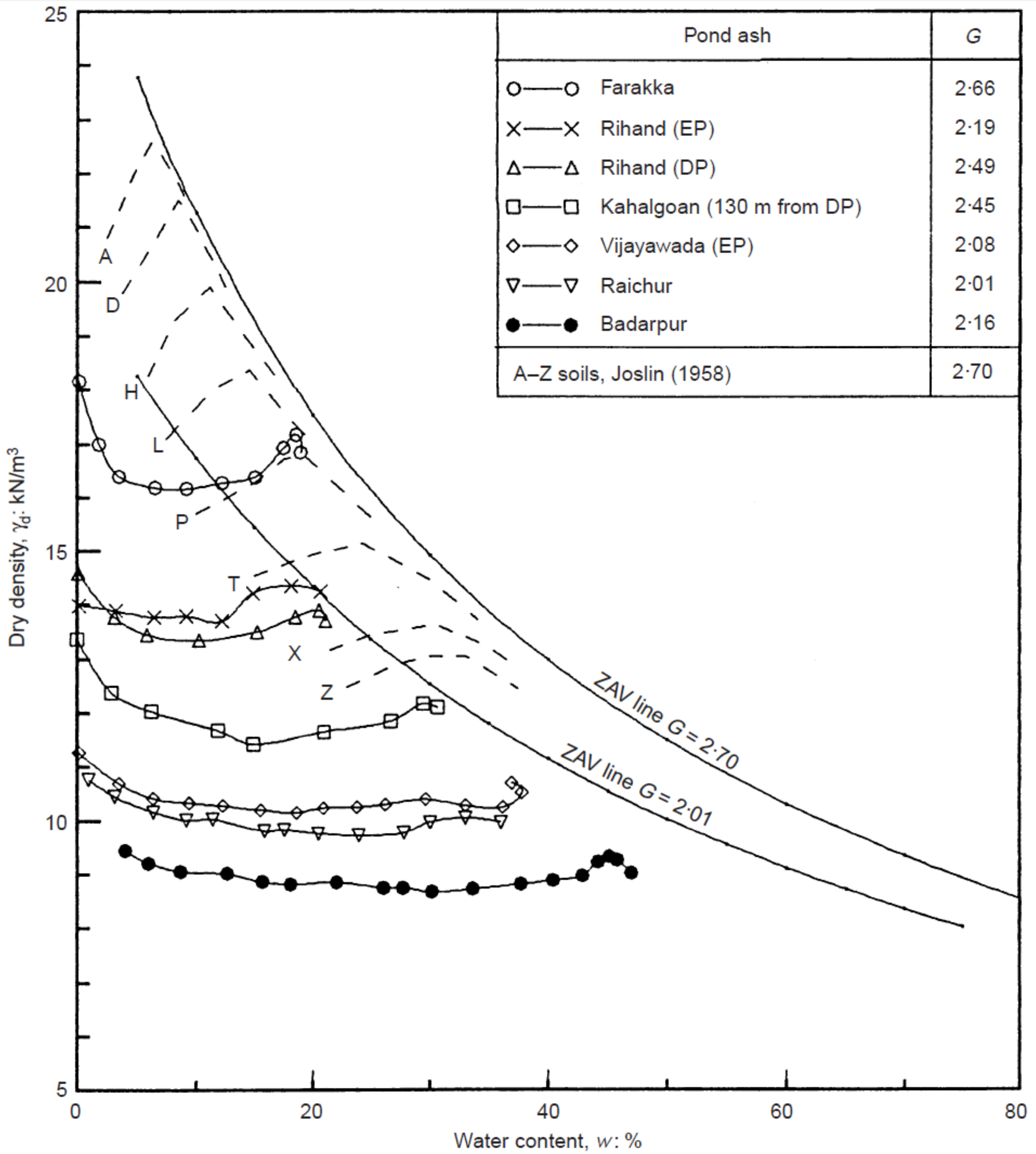


Figure 18(b): Compaction curves for different Indian surface impoundment ashes compared to those for several natural soils (Sridharan et al. 2001)

In Figures 17(a) and 17(b), the CCRs sometimes have a higher dry density at a dry condition (w = 0%). This is not a practical condition to use in construction or disposal situations, however, as there would be considerable dust pollution during placement (Sridharan et al. 2001).

Chapter 3

Dynamic Properties of CCRs

Regardless of the fact that CCRs are often composed of mostly fine-grained particles, they are still granular, non-plastic particles that exhibit no cohesion other than apparent cohesion in the moist state (Kaniraj and Gayathri 2004, Prakash and Sridharan 2009). Based on their grain-size, many CCRs could be classified as fine-grained soils, (which are commonly considered to have a lower liquefaction potential), but since these CCRs are also generally non-plastic, they have the potential of being liquefaction-prone. Liquefaction potential of CCRs is higher in the case of impounded CCRs, since these tend to exist at a saturated or nearly saturated state in-situ (and saturation is a necessary condition for liquefaction). In addition, the high moisture contents imply that impounded CCRs will have no negative pore pressures to help stabilize the soil mass under dynamic loading. Furthermore, the generally metastable structure of impounded CCRs makes their dynamic properties of great importance, even at low intensities of shaking. There have been a limited number of publications on the dynamic properties of CCRs; while this section presents and discusses currently published information on the dynamic properties of CCRs, there is still a need for further research in this area.

3.1 Cyclic Shear Strength Properties of CCRs

The most common laboratory test used to assess the dynamic properties of soils is the cyclic triaxial shear test. Cyclic triaxial testing apparatuses are expensive and provide very specific results, so very few commercial consultant firms own or even have access to them. Therefore, cyclic triaxial testing has traditionally been done at the academic level and has seen little use in commercial consulting. Given the specialized nature of the cyclic triaxial test, there is limited research published on the cyclic triaxial properties of CCRs. Since the cyclic shear strength properties of CCRs is a very specific topic, the research available on this topic is from academics of varied nationalities, all of whom have slightly different methods of analyzing the raw data; as a result, comparing results can be difficult.

Despite differences in how to analyze and present cyclic triaxial test results between researchers, it is useful to compare results using fundamental parameters of cyclic response, such as plots of excess pore pressure (usually excess pore pressure ratio) versus number of loading cycles, or plots of the cyclic stress ratio ($CSR=\sigma_d/2\sigma_{3c}$') versus number of loading cycles, which represents a measure of how the shear strength of the material in question degrades with cyclic loading. Figures 19 and 20 present some typical plots comparing excess pore pressures to the number of cycles to initial liquefaction, and Figures 21 through 23 present plots of CSR versus number of loading cycles to liquefaction (generally defined as 5% double-amplitude axial strain) for different surface impounded CCRs at different confining stresses and relative densities.

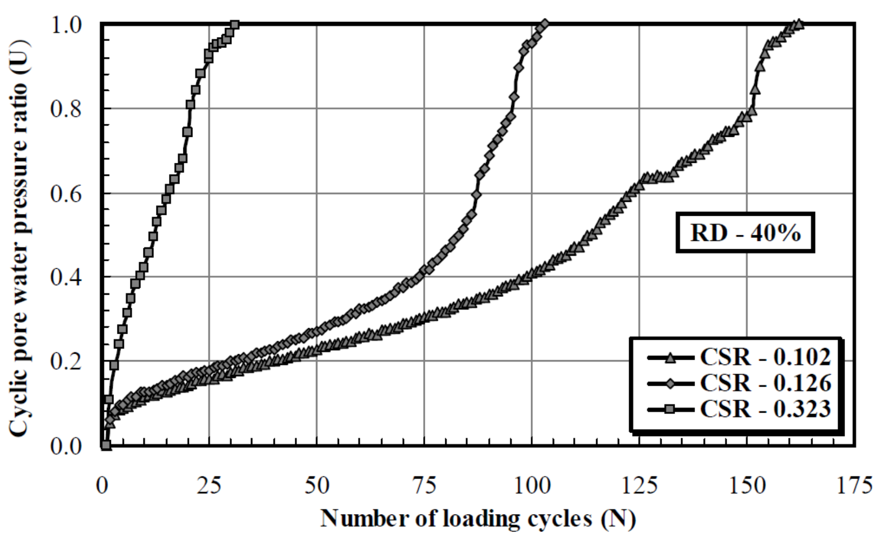


Figure 19: Plot of excess pore pressure ratio versus number of loading cycles for compacted Indian surface impoundment ash at different cyclic stress ratios and 1 Hz loading frequency (Mohanty et al. 2010).

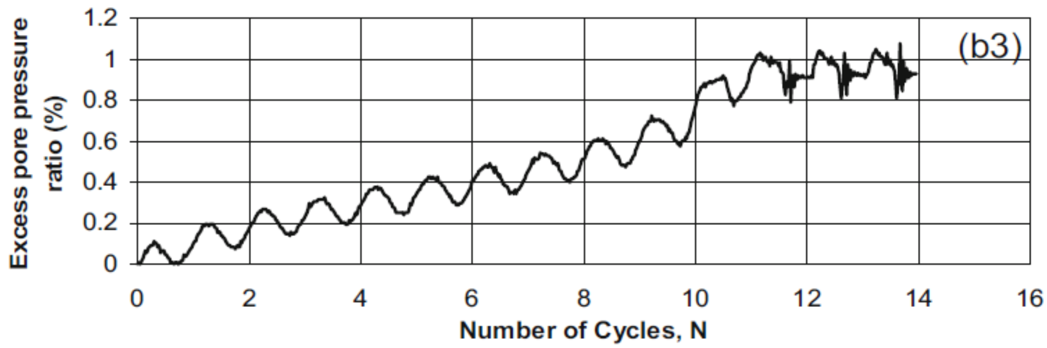


Figure 20: Plot of excess pore pressure ratio versus number of loading cycles for compacted Indian surface impoundment ash at a cyclic stress ratio of 0.10 and confining pressure of 2214 psf and 0.1 Hz loading frequency (Jakka et al. 2010)

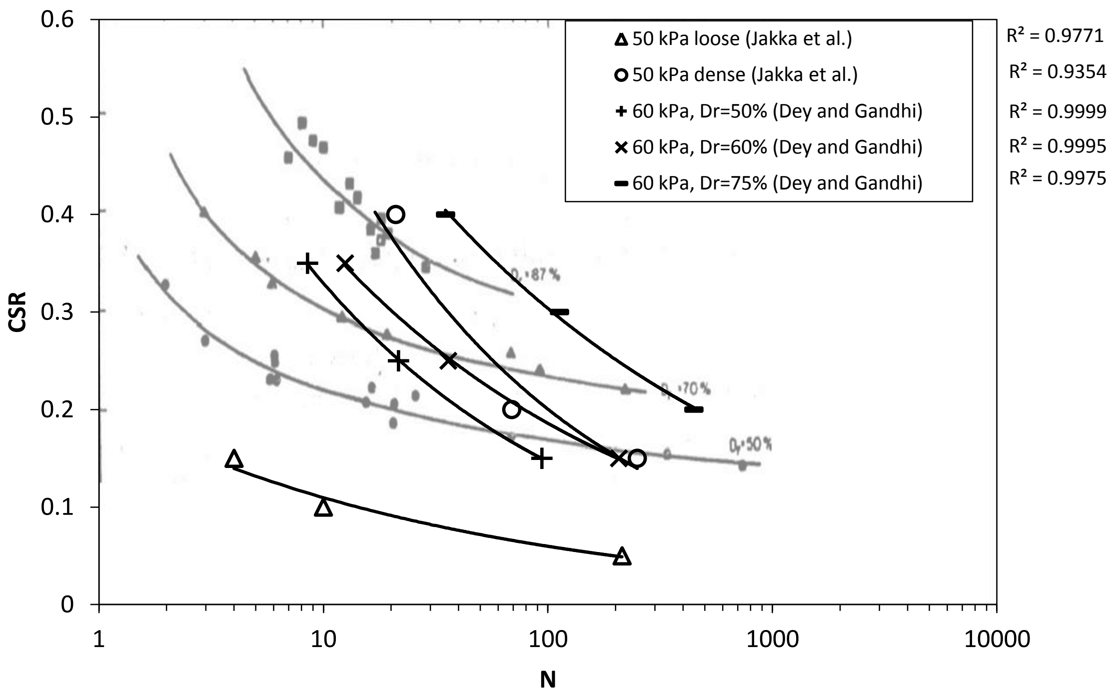


Figure 21: Plot of CSR versus number of loading cycles to liquefaction for different surface impounded CCRs tested by different researchers at confining stresses close to 50 kPa. Jakka et al. loaded specimens at 0.1 Hz to 1 Hz and Dey and Gandhi loaded specimens at 1 Hz. For comparison, curves for sands tested at the same confining pressure are superimposed (Mulilis et al 1976).

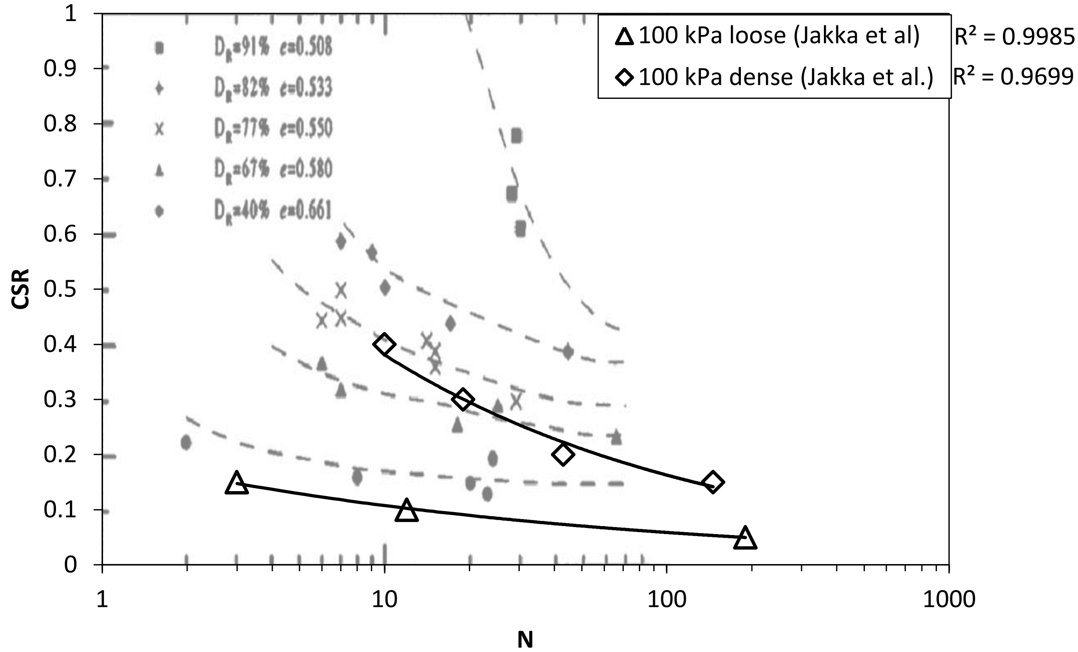


Figure 22: Plot of CSR versus number of loading cycles to liquefaction for surface impounded CCRs tested by Jakka et al (2010) at a confining pressure of 100 kPa. For comparison, curves for C778 sand at the same confining pressure are superimposed (Carraro et al 2003).

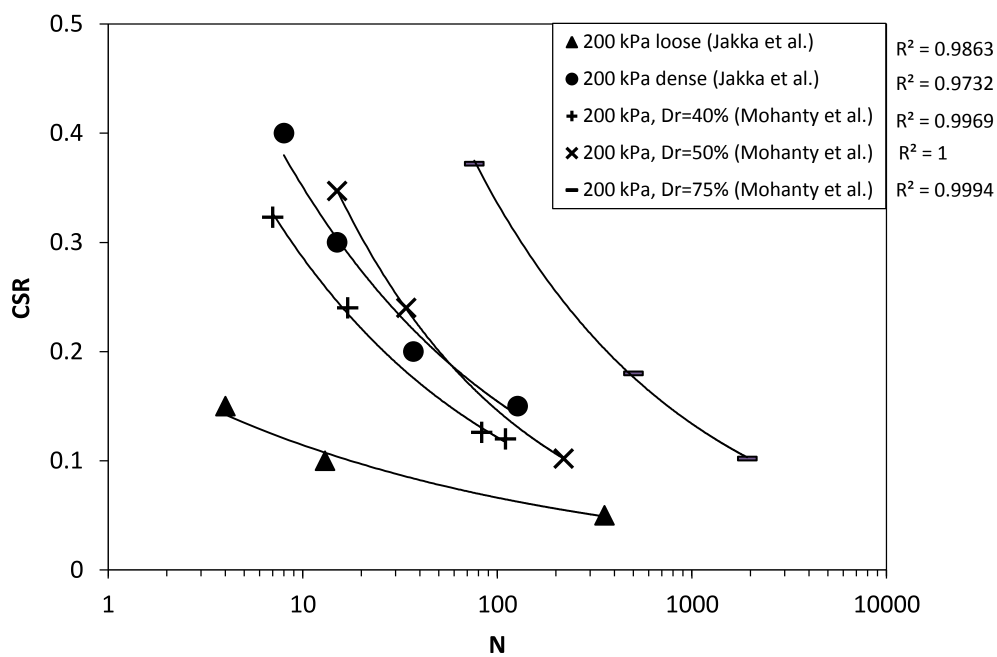


Figure 23: Plot of CSR versus number of loading cycles to liquefaction for different surface impounded CCRs tested by different researchers at 200 kPa confining stress. Jakka et al. loaded specimens at 0.1 Hz to 1 Hz and Mohanty et al. loaded specimens at 1 Hz.

For the two plots of CSR versus number of cycles to initial liquefaction where results for surface impounded CCRs are compared to tests done on sands, it is apparent that the CCRs tested tend to be more resistant to liquefaction than natural sands at higher CSRs, but less resistant to liquefaction at lower CSRs. As more cyclic triaxial tests are run on surface impounded CCRs, it will be more apparent as to whether this is an actual trend, or just an apparent trend in these three studies.

Lastly, many researchers include a plot of the hysteresis loops for a cyclically-tested triaxial sample. This is simply a plot of the deviator stress versus the axial strain through a single load cycle, at which point the plot begins again, creating a nearly-symmetrical shape about the origin of the plot. The area contained within all of these loops represents the cumulative energy dissipated by the soil being tested (Yoshimoto et al. 2006). The cumulative dissipated energy method was used by Towhata and Ishihara (1985) in order to analyze cyclic shear behavior and liquefaction strength of soils. Figure 24 shows a diagram illustrating the dissipation energy contained within a hysteresis loop.

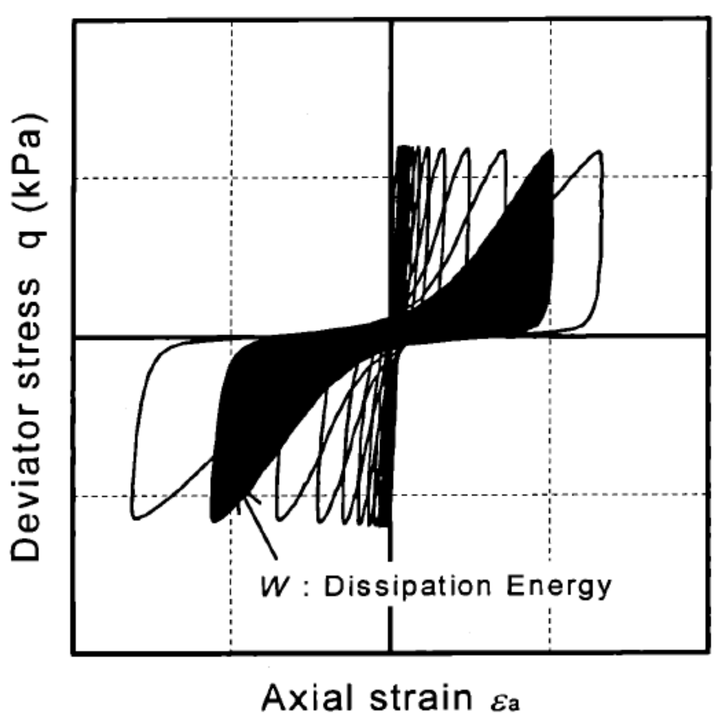


Figure 24: Example of how to determine the energy dissipated by a soil throughout a single loading cycle (Yoshimoto et al. 2006).

Chapter 4

CCR Failure Modes and Monitoring Practices

The critical failure mode for a CCR impoundment is not necessarily the same as for a CCR landfill, since differences in placement techniques for each have a significant effect on the fabric and shear strength properties of the CCRs. Determining the failure modes and developing monitoring practices for CCR impoundments can be done using the same methods as for mine tailings dams because of their similar structure. CCR landfills can be monitored much like any other earthen embankment (with material properties being the major difference), except that unlike most embankments, there is no end of construction until the landfill is retired.

4.1 Surface Impoundments

The observational method is a method of risk management outlined by Dr. Ralph Peck as the process of making design adjustments based on observed behavior in a given structure. The design can be adjusted to be either more or less conservative in order to optimize design (Martin and Davies 2000). This method of risk management is ideal for use with tailings dams since tailings dams are continuously constructed until they are retired; the same is true of CCR surface impoundments, which indicates that such methods could easily be applied to CCR surface impoundment monitoring programs. Figure 25 is a flow chart illustrating the risk management process utilizing the observational method, as applied to tailings dam design; however, the process is general enough that the same or a slightly modified flow chart could be used for surface impounding ash structures.

Another important consideration when developing a monitoring plan for surface impoundments is whether the dikes were constructed using the upstream or downstream methods, since use of the upstream method can lead to weaker dike foundations and an increased probability of sudden or catastrophic failure (Martin and Davies 2000). The upstream construction method consists of constructing the dike of a new phase of a disposal area partly on the top of the previous phase dike and partly on the upstream disposed material; contrarily, the downstream construction method consists of constructing the new phase dike partially on the previous phase dike and partially on land downstream of the disposal area. Figure 26 illustrates that the weaker foundations of mine tailings constructed using the upstream method is evident based on the prevalence of certain failure modes for upstream tailings dams as compared to other types of tailings dams (slope failure and earthquake failure constitute 59% of failure modes for upstream tailings dams, compared to 24% for other types of tailings dams).

Taking all of these factors into consideration, a sample surveillance plan schedule for a mine tailings impoundment is provided in Figure 27. As with the risk management chart presented in Figure 25, this flowchart is general enough that it could be used in its current form, or slightly modified in developing a surveillance plan for CCR surface impoundments.

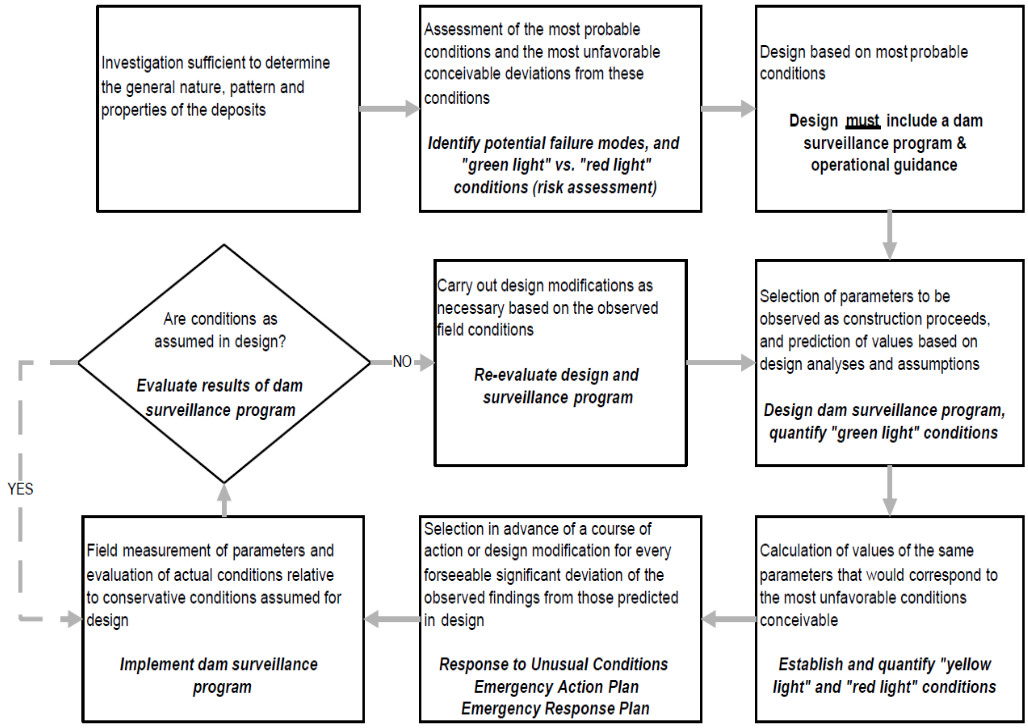


Figure 25: Flow chart illustrating risk management utilizing the observational method (after Martin and Davies 2000)

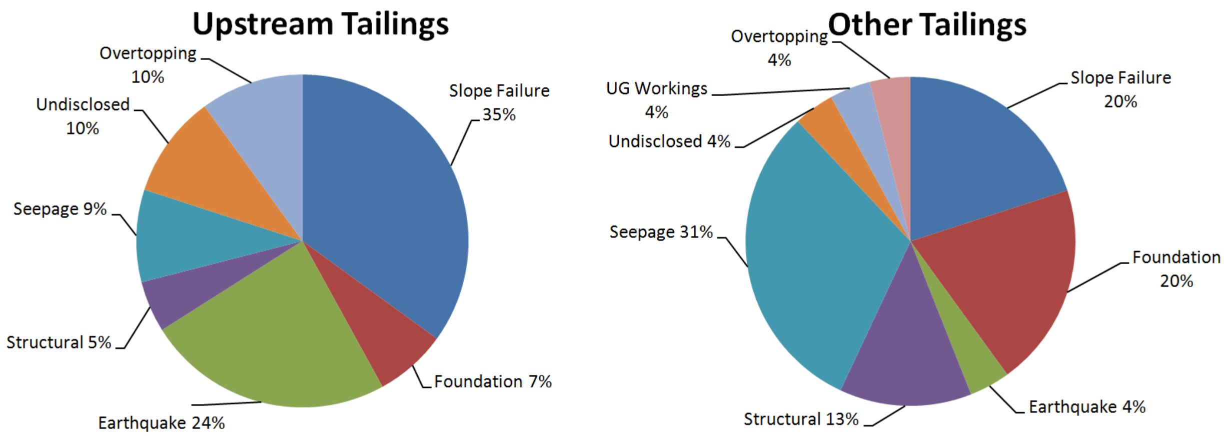


Figure 26: Comparison of failure modes of upstream mine tailings dams as compared to other types of mine tailings dams (modified from Martin and Davies 2000)

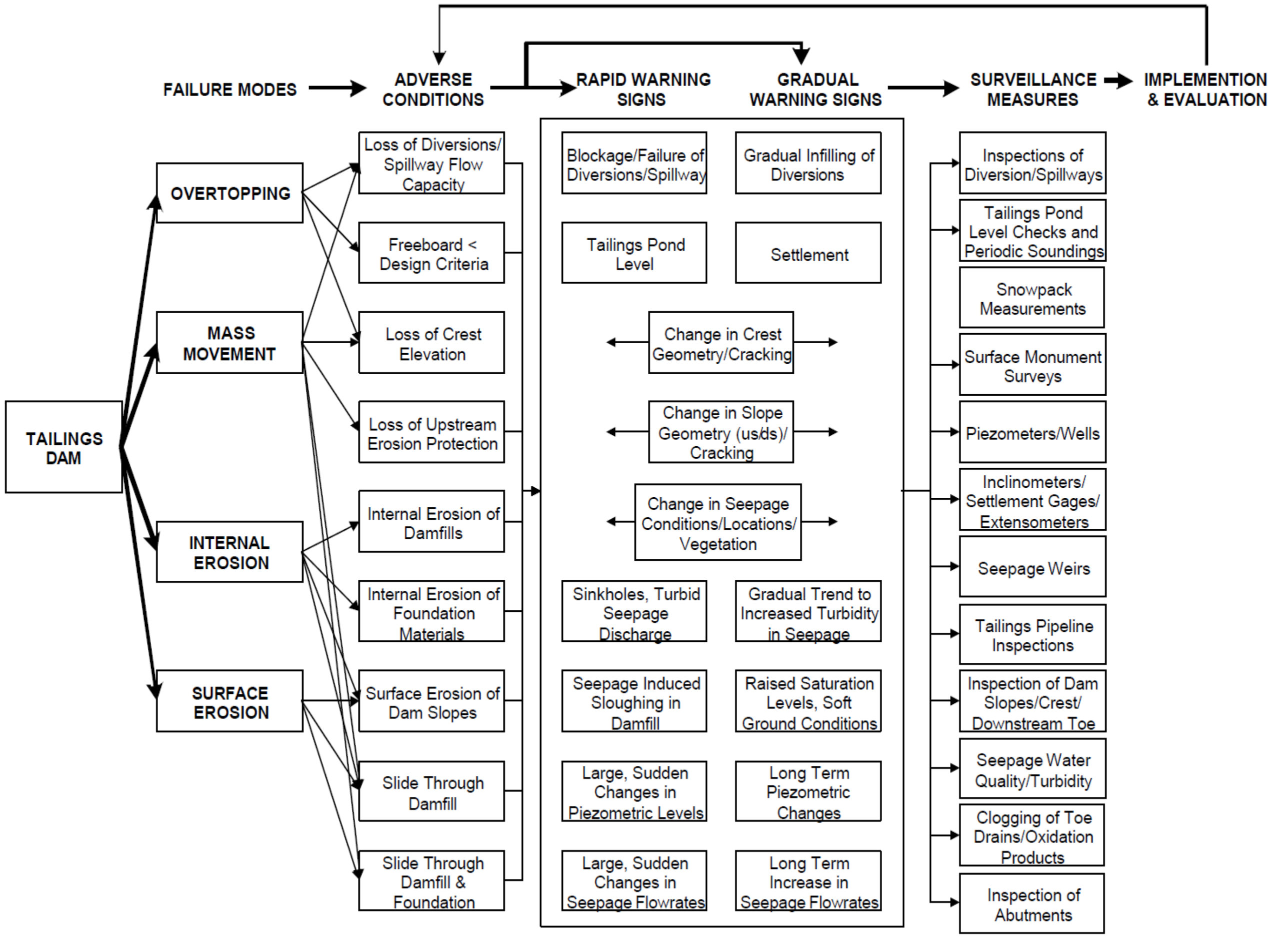


Figure 27: Sample surveillance plan schedule for a mine tailings impoundment (after Martin and Davies 2000)

Since CCR surface impoundments can have containment dikes constructed out of CCR material, natural soils, or a combination of both and these landfills have the potential to collect precipitation. An analysis procedure that can be used alongside the observational method is to treat them as earthen dams according to recommendations of the Bureau of Reclamation and the Army Corps of Engineers.

The Bureau of Reclamation's *Dam Safety Risk Analysis Best Practices Training Manual* (Scott et al. 2010) provides an overview in Chapter 1 of their recommended method for determining potential failure modes of dams for use in conducting risk analyses of dams. In Chapter 1, the authors identify determination of potential failure modes of dams as the basis for risk evaluations, making it one of the most important steps in risk analysis of a dam. They recommend a comprehensive and thorough review of all relevant background information such as, but not limited to, geology, design, analysis and construction documentation, flood and seismic loadings, operations, dam safety evaluations, and performance and monitoring documentation. Additionally, they recommend a site examination, including questioning of the operations personnel as to how unusual events are handled and what they consider to be the vulnerabilities of the structure. The data review process should include several qualified professionals from different disciplines to ensure a thorough investigation. Lastly, the authors outline three major parts in describing a potential failure mode:

- **The initiator**, or what causes the initiation or onset of the failure mode
- **Failure progression**, a step-by-step outline of mechanisms that lead to failure
- **The resulting impacts**, a description of the expected method and magnitude of a failure if it were to occur

For more in-depth guidance on determining failure modes and developing a risk analysis program for a specific structure, the U.S. Bureau of Reclamation's *Dam Safety Risk Analysis Best Practices Training Manual* can be accessed online at http://www.usbr.gov/ssle/damsafety/Risk/methodology.html, entitled "Complete Best Practices Document."

4.2 CCR Landfills

CCR landfills are generally placed at a moist state and compacted to some degree, being constructed in a similar manner to regular earthen embankments. As a result, they can be analyzed like any other earthen embankment, with special attention paid to the engineering properties and placement conditions of the CCR materials used in the embankment. The placement method for CCR materials in CCR landfills results in less uncertainty in their fabric and relative density, generally resulting in an overall more stable structure than with surface impoundments.

Ideally these compacted CCR embankments would remain well-drained, but depending on the geology of the site and variability in the hydraulic conductivity of the CCR materials, monitoring the groundwater table within these areas and how it is affected by rainfall patterns is good practice, unless it is clearly apparent that such monitoring is unnecessary. An additional consideration with CCR landfills is the need to continually condition the landfill surface with water in order to cut down on dust pollution and surface erosion. Ideally, slopes of CCR landfills should be seeded as soon as is feasible, in order to manage surface erosion and eliminate the need to continually condition the moisture of the slopes.

One unique case would be for sites where a CCR landfill is constructed over a retired surface impoundment. This is an appealing option to most CCR disposers, since land area can be reused, negating or delaying the need to purchase new land to construct a disposal area. Since the foundation material cannot be as well-characterized as the material being placed, a more rigorous design and monitoring procedure would be necessary, perhaps the same as or similar to those discussed in section 4.1.

4.3 Failure Modes

Failure modes for CCR surface impoundments and landfills include all of the usual failure modes for a dam or embankment. However, since disposal operations continue for years or decades, the need to continually monitor disposal areas for signs indicating the initiation of a particular failure mode is very important. Since surface impounded CCRs generally have a less stable structure than CCR landfills, they will generally tend to require more vigorous monitoring. Because of the differences in disposal methods between CCR surface impoundments and CCR landfills, the most likely failure modes will not be the same for each structure.

The most common failure modes for earthen dams and embankments include internal erosion or piping (of embankment or foundation materials), surface erosion leading to global instability, excessive seepage leading to an embankment breach, overtopping during a storm event, loss of freeboard due to excessive embankment settlements or subsidence, lateral movement of the embankment, and failure as a result of a seismic event (MSHA 2009; Martin and Davies 2000). Many of these failure modes are included in Figure 27, with common warning signs indicating the initiation of these failure modes.

The majority of these failure modes can be recognized with good monitoring practices, with the exception of failures due to seismic events, for obvious reasons. There is little data on the performance of CCR disposal areas during seismic events and also very little data on the dynamic properties of CCR materials. As a result, dynamic properties of CCRs is an area where further research and laboratory testing is required.

The overall uncertainty in the engineering properties of CCR materials make it necessary to be more vigilant with monitoring practices in order to recognize when different failure modes are initiated so that remedial actions can be taken to prevent costly failures, both on an economic and life scale. Since surface impoundments often most closely resemble tailings dams in their design, a good reference for monitoring practices and identifying failure modes for surface impoundments is the MSHA 2009 "Engineering and Design Manual: Coal Refuse Facilities," which can be accessed at:

http://www.msha.gov/Impoundments/DesignManual/ImpoundmentDesignManual.asp.

Chapter 5

Slope Stability of CCRs

The basic principles of slope stability and methods of assessing slope stability of CCR surface impoundments and landfills are the same as for naturally occurring soils; however, the results of these analyses can be very different based on the unique properties of CCR materials. For example, while an ash might have a high percentage of clay-sized particles, they rarely have any cohesion at all and may be very prone to erosion; many naturally occurring soils with clay-sized particles have a cohesive component of strength and are usually considered erosion resistant. In most instances, CCR disposal areas will not be loaded enough to incur excess pore pressures that will not be fully dissipated by the next loading cycle (the next workday). For this reason, it is generally only necessary to perform effective-stress steady-state shear strength slope stability analyses for CCR disposal areas. Special analyses, such as rapid draw-down analyses may be necessary as dictated by site geometry and design rainfall events.

5.1 Limit Equilibrium and Finite Element Analyses

The majority of slope stability analyses today are performed using commercial software programs that utilize limiting equilibrium analyses and/or finite element analyses of slope stability and seepage through slopes. It is good practice and the recommendation of the United

States Army Corps of Engineers (USACE) that some sort of check be done on the results of these software programs. In their Slope Stability Manual (EM 1110-2-1902), the USACE states that, "verification should be commensurate with the level of risk associated with the structure," and that one or more of the following methods should be used in verification of the initial analyses:

- Graphical (force polygon) method
- Spreadsheet calculations
- A second slope stability program
- Slope stability charts

The following example is of a slope stability analysis of a CCR surface impoundment using a limit equilibrium-based software program that also has a built-in finite element groundwater seepage option. The premise of this example is that a client wants to construct a dry-stacked CCR landfill on top of a retired surface impoundment. A thin layer with increased cohesion was included at the surface of all slopes in order to eliminate infinite slope failures that are solved with vegetation; this layer is not included in the table of strata properties, presented in Table 9.

Table 9: Summary of shear strength and hydraulic parameters used in CCR surface impoundment slope stability example.

Strata	γ (pcf)	N	σ_0' (tsf)	ϕ' (°)	c' (psf)	k (ft/s)	Sources
SI CCRs	92.0	N/A	N/A	25.2	0	2.55×10^{-6}	LT
Compacted CCRs	103.5	N/A	N/A	33.0	0	3.61×10^{-7}	Tables 6-8, Table 5
Embankment Fill	112.7	N/A	N/A	33.8	0	1.79×10^{-8}	LT
RR Embankment Fill	122.0	4.0	0.34	33.7	0	3.00×10^{-8}	Kulhawy and Mayne (1990)/LT
Alluvium	110.0	11.0	0.88	40.6	100	3.28×10^{-8}	Kulhawy and Mayne (1990)/LT
Saprolite	110.0	35.0	1.2	29.6	420	9.35×10^{-7}	LT
Partially Weathered Rock	120.0	N/A	N/A	30.0	500	3.28×10^{-9}	Assumed based on parent material
Bedrock	170.0	N/A	N/A	30.0	1.4×10^{5}	3.28×10^{-10}	Barton and Choubey (1977)

Note: LT = laboratory testing

Analyses were performed for six different conditions: three geometries, each with an in-situ water table and a hypothetical high water table. Figure 28 shows the in-situ subsurface conditions, while Figures 29 through 31 provide the output results with slip surfaces below specified factors of safety shown for the six geometries considered. All slip surfaces shown with a factor of safety value are the lowest factor of safety for that slope geometry.

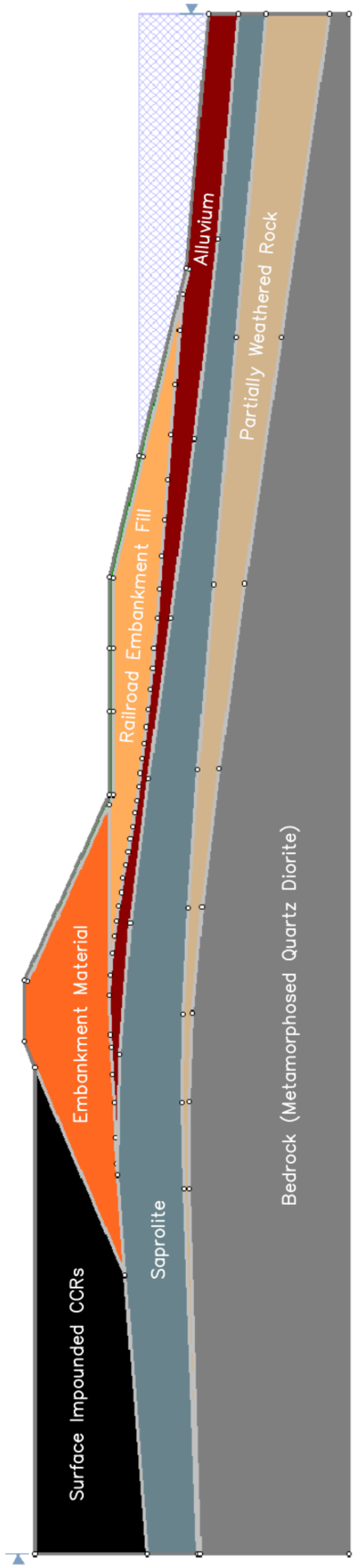


Figure 28: Subsurface profile of a slope stability example for an SI CCR embankment.

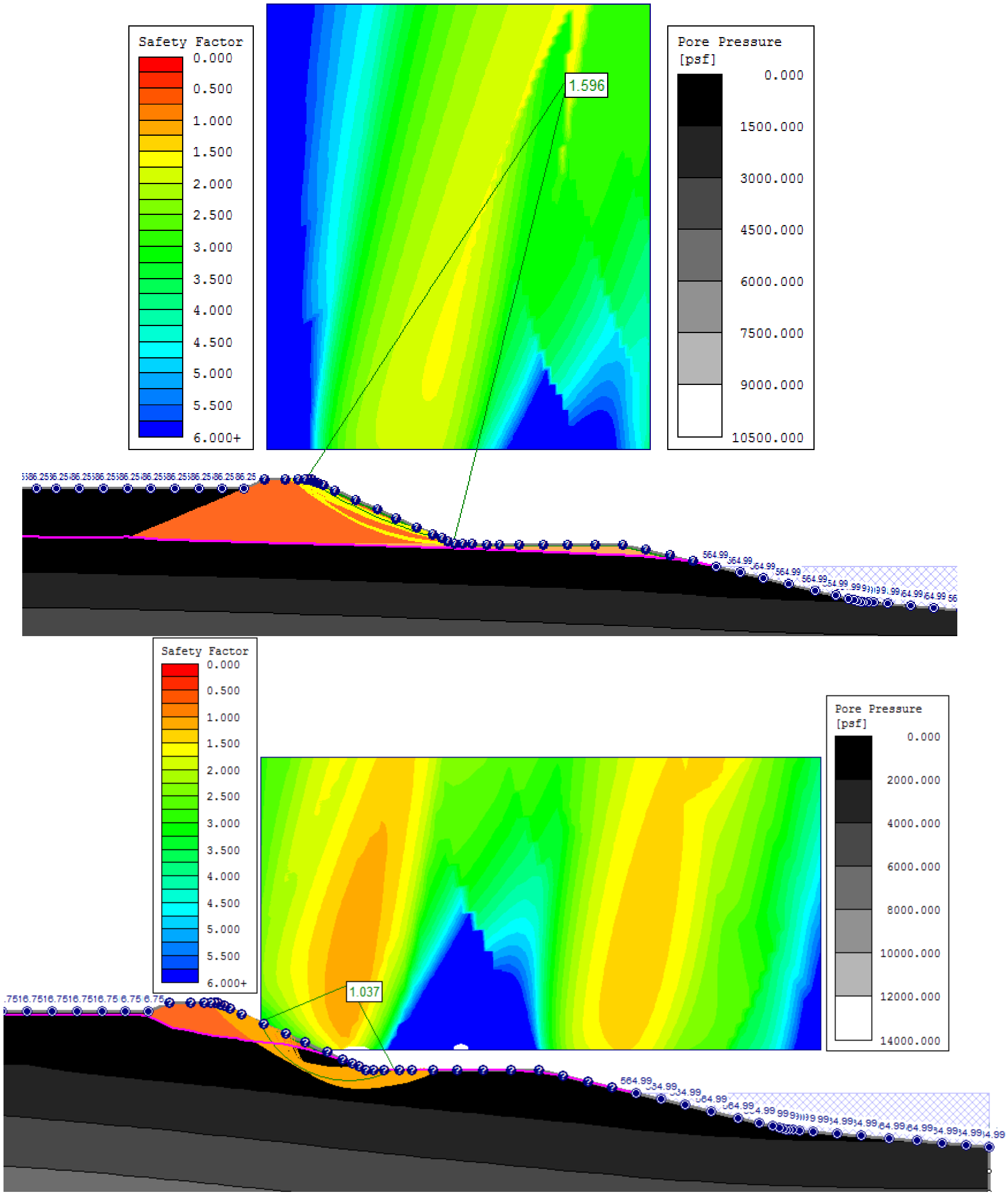


Figure 29: Analyses for the in-situ condition, first with the in-situ measured water table (above) and then with a hypothetical higher water table (below). Slip surfaces are shown for factors of safety below 1.7 for the above case and between 1.0 and 1.2 for the below case.

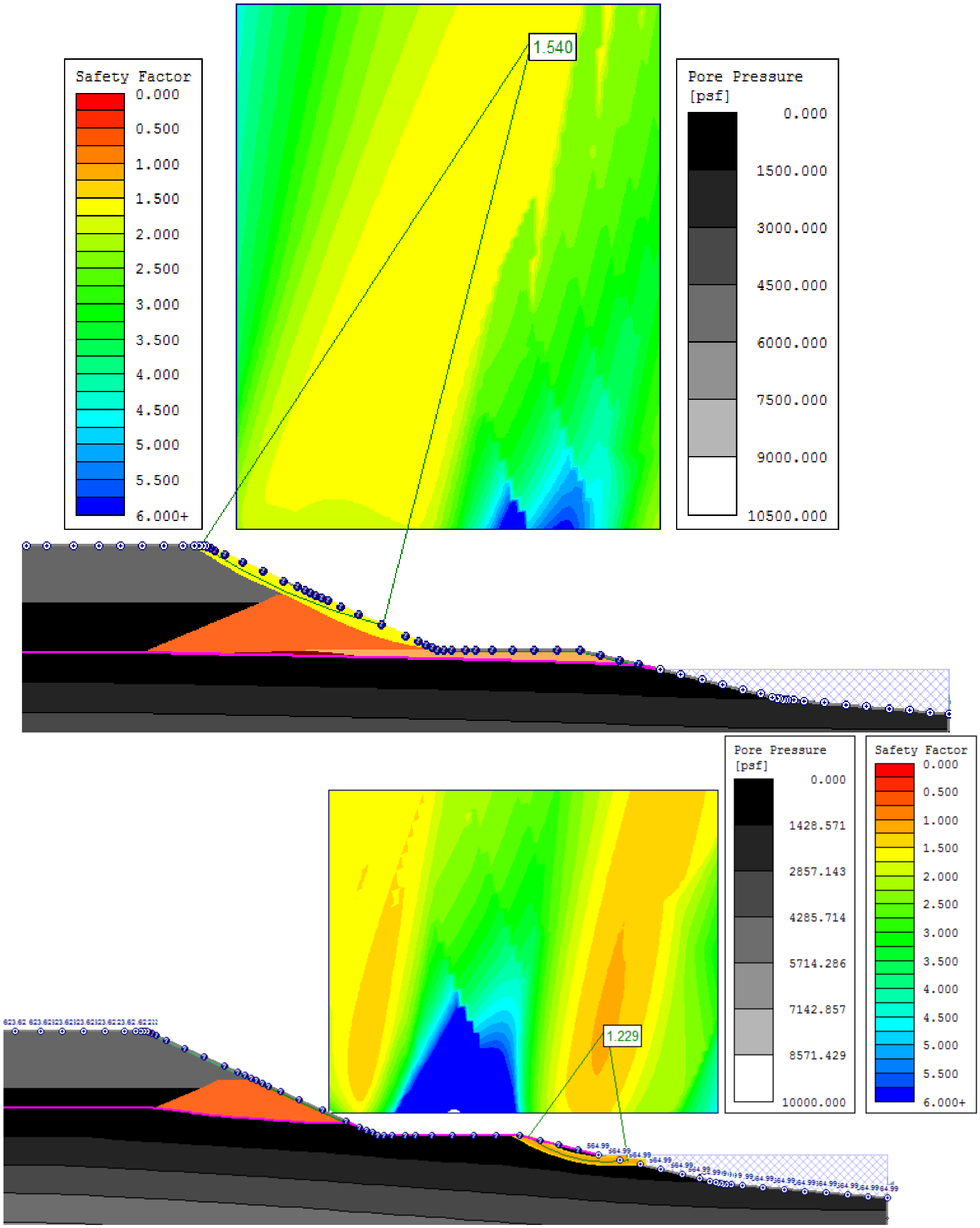


Figure 30: Analyses for an added upstream dry-disposed cell over the surface impoundment, for the in-situ water table (above) and for a hypothetical higher groundwater table (below). Slip surfaces with factors of safety between 1.5 and 1.6 are shown in the above case and between 1.2 and 1.3 for the below case.

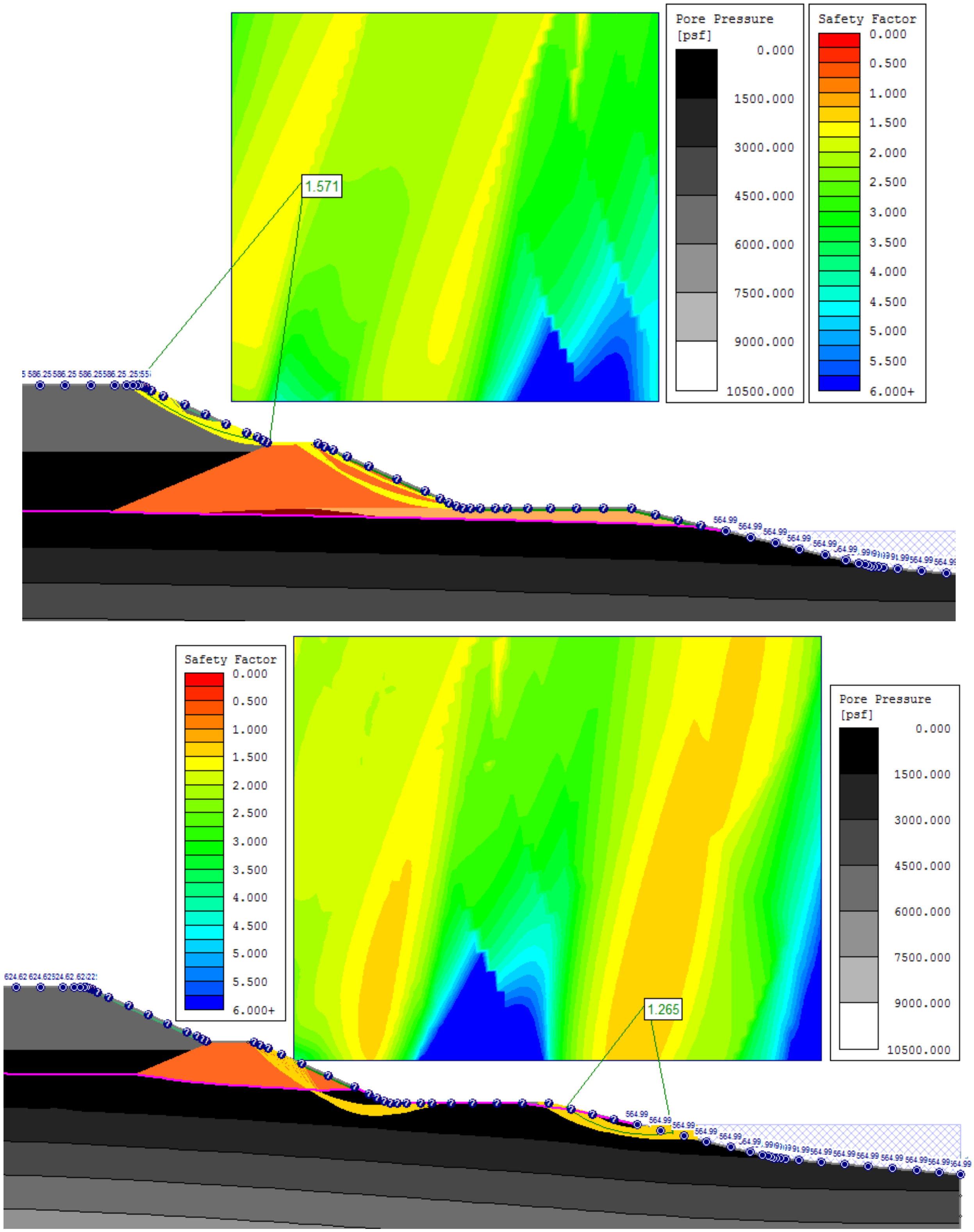


Figure 31: Analyses for an added upstream dry-disposed cell above the surface-impoundment for the in-situ groundwater table (above) and for a hypothetical higher groundwater table (below). Slip surfaces with factors of safety between 1.5 and 1.7 are shown for the above case and between 1.2 and 1.4 for the below case.

In all of the geometries considered in these analyses, a thin layer with a low cohesion was included in order to eliminate infinite slope failures that are easily remediated by keeping the slopes moist or vegetated. In addition, all of the geometries analyzed for the in-situ phreatic surface resulted in acceptable factors of safety, since the in-situ water table is so low compared to the site geometry. However, with a slight rise in the water level (perhaps as the result of a 100-year storm event), the factors of safety drop dramatically. This is the result of the fact that the embankment is constructed out of nonplastic soils that completely derive their strength from the frictional component of shear strength. As the water table rises, buoyancy effects decrease the effective overburden pressures in the geometry, thereby decreasing the slope shear strength and decreasing the factors of safety of all surfaces considered. Furthermore, the very low permeability of the embankment material makes this water table condition a real possibility, if no form of drainage through the slope is provided.

Chapter 6

Settlement Calculations for CCRs

It is common to see consolidation data reported for CCRs in research publications. However, given that CCRs often tend to be fairly free-draining, it would seem odd to use these values to determine settlement of CCRs, given that a structure or embankment were constructed over previously disposed CCRs. However, any methods developed to calculate settlements in sands are not necessarily applicable to CCRs or to silt-sized materials either. In this chapter, a comparison of common methods of calculating settlements will be made for CCRs at a specific site where a test fill was performed and actual CCR settlements monitored.

6.1 Test Fill Results

The results of a test fill of compacted, dry-placed fly ash performed over an approximately uniform 50 ft deep deposit of surface impounded ash was provided by S&ME. The test fill was 20 ft high and had lateral dimensions of 250 ft by 250 ft. The side-slopes all-around were 3H to 1V, making the entire footprint of the fill about 370 ft by 370 ft, or 136,900 ft^2. For the purposes of these analyses and the sake of simplicity this load will be characterized as a constant 20 ft load over the 250 ft square footprint of the test fill. The recorded settlements at the center of the test fill area were between 18.0 and 19.5 inches.

6.2 Settlement Calculation by Consolidation Theory

For increased accuracy, the surface impounded layer is divided into sub-layers and the settlements calculated for each layer and added together for the overall settlement. It is assumed that since the CCR material has not been loaded in the past that it is in the normally consolidated condition and that they unit weights of the surface impounded CCRs and dry-placed CCRs are 95 pcf and 100 pcf, respectively. Four sets of consolidation tests were performed on the impounded CCR material that made up the foundation for the test fill; the compression ratio for the test closest to the depth of the layer being considered is used in calculating the settlement in that layer. The water table is located 8 ft below the ground surface:

Table 10: Consolidation settlements calculated for test fill placed over a CCR surface impoundment.

Layer	T_L (ft)	D_{CL} (ft)	P_0 (psf)	ΔP (psf)	P_f (psf)	c_{ec}	S_i (in)
1	5	2.5	237.5	2000	2237.5	0.20225	11.82
2	10	10	587.7	2000	2587.7	0.20225	15.62
3	15	22.5	832.2	2000	2832.2	0.07299	6.99
4	20	40	1158.2	2000	3158.2	0.07299	7.63
						Σ	42.07

Note: T_L = layer thickness, D_{CL} = depth to center of layer, P_0 = initial stress condition, D_P = change in stress, P_f = final stress condition, and S_i = settlement for a specific layer

As displayed in Table 10, the settlements estimated using consolidation theory are just over twice the amount observed in the test fill. This is not really surprising since CCR materials do not tend to behave like soils where consolidation theory is used to calculate settlements; generally, plots of volumetric strain vs. normal stress from consolidation tests performed on CCRs do not have clearly log-linear portions corresponding to a recompression and compression ratio. As a result, depending on what values are assumed for $c_{\varepsilon c}$ and $c_{\varepsilon c}$, the settlement could either be greatly overestimated or underestimated, depending on different individuals' interpretations of the plot.

6.3 Settlement Calculation by D'Appolonia Method

The D'Appolonia (D'Appolonia et al. 1970) method of calculating settlements in sand is based on elasticity theory and can be applied to this sort of example with some moderate assumptions. Equation 8 is the equation developed by D'Appalonia et al. (1970):

$$\rho = \mu_0 \mu_1 \frac{qB}{M} \tag{9}$$

where ρ = settlement
μ_0, μ_1 = geometry factors from Figure 36
q = applied bearing pressure
B = footing width
M = 1-dimensional compression modulus

Figure 32 provides plots used to determine the geometry factors, while the applied bearing pressure and footing width are the same as determined in section 6.2. From logs of CPT tests performed at the test fill location, the average M measured over the depth of the CCR deposit was about 45 tsf (based on CPT correlations).

Given the dimensions of the test fill given in section 6.1 and Figure 32, μ_0 is estimated as 1.0 (since the fill is at the ground surface) and μ_1 would likely be around 0.14. The settlement can now be calculated as:

$$\rho = 1.0 \cdot 0.14 \cdot \frac{1\text{ tsf} \cdot 250\text{ ft}}{45\text{ tsf}} = 0.777\text{ ft} = 9.33\text{ in}$$

The most obvious problems with applying this method to placement of a fill is that it was developed for shallow foundations, which are a rigid structure and it was developed for sands, while CCRs are usually classified as silts according to the USCS. Tan and Duncan (1991) cite that this method tends to underestimate settlements around 50% of the time, as it certainly does in this case.

Since this method underestimates the settlements observed at this site by about 50 percent, it may be useful to determine what value of compressibility modulus actually give an accurate settlement:

$$M = \mu_0 \mu_1 \frac{qB}{\rho} = 1.0 \cdot 0.14 \cdot \frac{1 \text{ tsf} \cdot 250 \text{ ft}}{1.5833 \text{ ft}} = 22.1 \text{ tsf}$$

This value for the compressibility modulus is equivalent to an average modulus calibrated to the observed settlements. While one data point is not sufficient to develop a correlation, if enough settlement tests were conducted for CCR materials, it would be possible to develop a CPT-*M* correlation that better predicts settlements than the one used in this investigation.

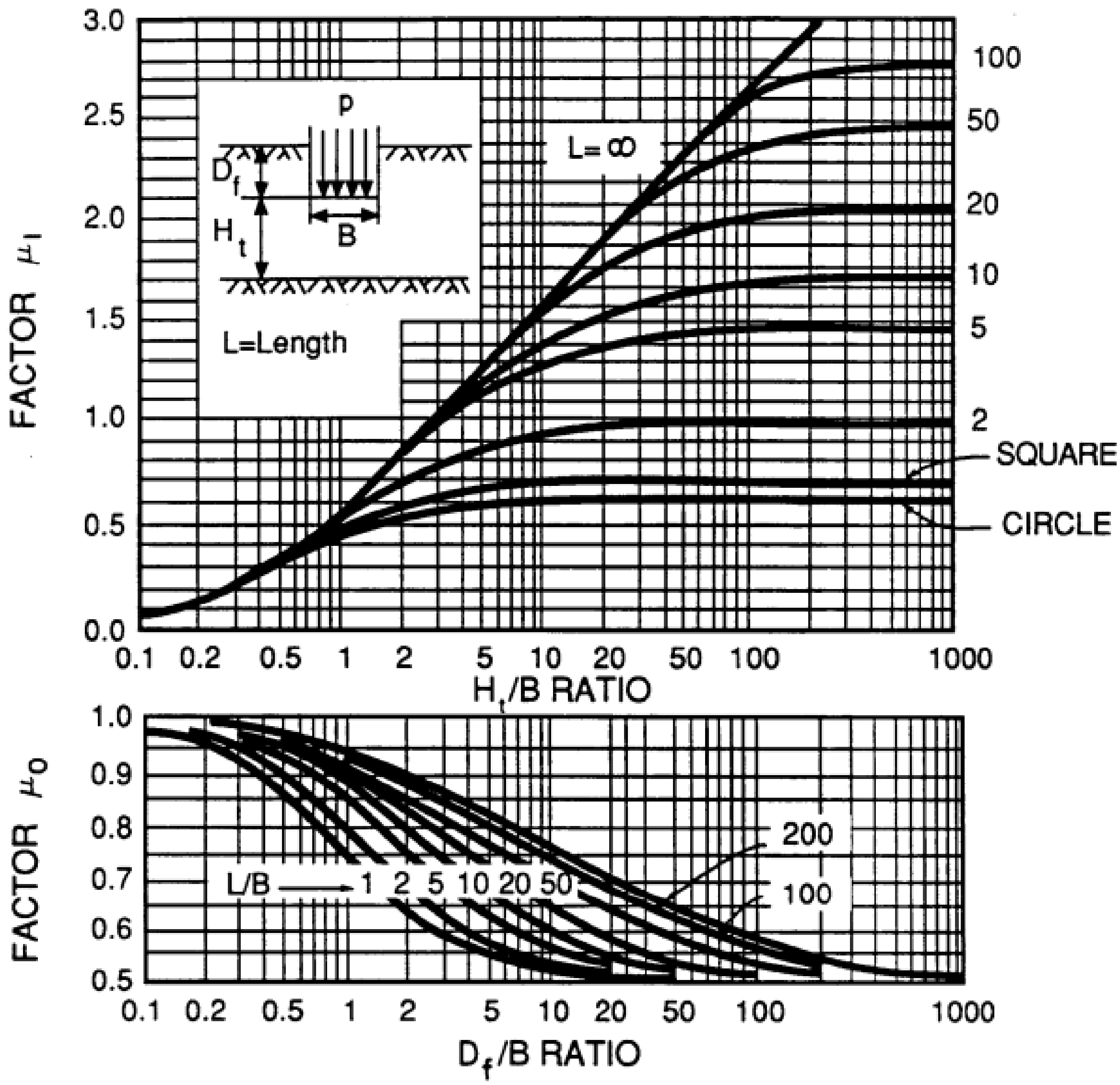


Figure 32: Plots published by D'Appolonia et al. (1970) to determine the values of the geometry factors to be used in footing settlement analyses.

6.4 Other Observations

As an alternative to specific methods of settlement calculations, if it is assumed that the fill is of large lateral extent, a basic calculation of settlement can be made using *M*, the pressure applied by the fill, and the depth of the soil strata being filled:

$$S = \frac{PZ}{M} \tag{10}$$

where *P* = the pressure applied as a result of the fill
Z = the depth of the soil where settlements are being considered

Again using a value of *M* = 45 tsf, the settlement is calculated as 13.33 inches. This is still an under-estimate of settlement for this test fill, but given that a CPT correlation for *M* in CCR materials was developed, it may be possible to calculate more precise estimates of settlement. Reduction factors could then be applied to equation 10 in order to attain an acceptable level of reliability.

A comparison of Young's modulus of soil (E_s) can also be made using Hooke's Law and the observed settlement:

$$E_s = \frac{PZ}{S} \tag{10}$$

where *P* = the pressure applied as a result of the fill
Z = the depth of the soil where settlements are being considered
S = the observed settlements after fill placement

versus the correlation of CPT tip resistance (q_t) to E_s used in Schmertmann's CPT settlement calculation method:

$$E_s \approx 2.5 \cdot q_t \tag{11}$$

Using Hooke's Law with a settlement of 19 inches and an applied fill pressure of 1 tsf, the E_s calculated is 31.6 tsf. Using the CPT correlation given in equation 11, the average CPT tip resistance over the depth of the CCR deposit below the test fill was about 17 tsf, which would return an E_s value of 42.5 tsf.

The accuracy of these values of E_s are questionable, however, Hooke's law assumes a linear-elastic stress-strain condition and the CPT correlation was developed for use with sandy soils. Ideally, CPT correlations should be developed specifically for CCR materials and E_s, which would require a large volume of CPT tests and data analysis.

Chapter 7

Reconstitution Technique for Surface Impounded CCRs

Sample reconstitution techniques try to balance process simplicity with matching the in-situ fabric of the soil as closely as possible. Some reconstitution techniques commonly used on sand and non-plastic silt materials include moist tamping methods, air and water-pluviated methods, and slurry deposited methods. In this chapter, a brief overview of these various methods is given and a technique not yet applied to coal ash materials is analyzed when used with surface impounded CCR materials (will be referred to as SI CCRs throughout this chapter).

7.1 Moist Tamping

The first moist tamping method was proposed by Ladd (1978) in a paper entitled "Preparing Test Specimens Using Undercompaction." In this method, specimens are formed by hand-tamping of moist soil (w% = 20% to 70%) in equal lifts within a triaxial sample split mold, while increasing the dry mass of soil in each subsequent lift. The soil samples should be mixed with water at least 16 hours prior to use and the lift thickness should not exceed 1 inch for specimens with a diameter of less than 4 inches. Ladd provided an equation to calculate the percent under-compaction for each layer placed:

$$U_n = U_{ni} - \left[\frac{(U_{ni} - U_{nt})}{n_t - 1} \times (n - 1)\right] \tag{11}$$

where U_{ni} = percent under-compaction selected for first layer
U_{nt} = percent under-compaction selected for final layer (normally zero)
n = number of layer being considered
n_i = first (initial) layer
n_t = total number of layers (final layer)

The U_{ni} of the first layer is usually between 0% for very dense specimens and 15% for very loose specimens. In order to determine the correct U_{ni}, a series of cyclic triaxial tests must be run with the same effective consolidation stresses and CSR, but with different values of U_{ni}. The specimen then observed during testing and the following observations indicate an inappropriate value of U_{ni}:

- Excessive necking or bulging in any part of the specimen during cyclic loading.
- Non-uniform vertical strains during unconsolidated-undrained loading.
- A honeycomb soil fabric structure at either end of the specimen.
- A non-uniform dry unit weight along the height of the specimen.

Other moist tamping techniques modify this method slightly, usually by either changing the method in which under-compaction is addressed or by defining a specific compaction energy to be used in compacting the sample. This method can be laborious if the correct value of U_{ni} must be determined, since a whole test regime must be completed. Additionally, with regards to hydraulically-placed soils, the fabric of the sample does not match in-situ conditions well.

7.2 Air/Water Pluviation

"Pluviation" or "raining" of soil is a technique first published by Kolbuszweski in 1948. In this technique, the soil is pluviated from a separate apparatus into the soil mold, either in a dry state, or in water. These apparatuses vary in complexity and have various opening sizes and diffuser designs. By controlling the flow rate of the soil through the diffuser and the fall height of the sand, it is possible to place the soil at varying relative densities (Rad and Tumay 1987).

While air-pluviated samples can provide relatively uniform specimens and is a good technique for modeling Aeolian deposits of poorly graded sands and silts, well-graded sands or sands with high fines content have a tendency to segregate. Furthermore, the fabric of the sample can be disturbed during the saturation phase of triaxial testing due to fines washing out of their original placement (Keurbis and Vaid 1988). Air-pluviation would not likely model the fabric of surface-impounded CCRs well, since these CCRs are deposited in a hydraulic environment. Furthermore, the high content of non-plastic fines in CCRs would make loss of soil due to dust very high.

Similarly, water-pluviated specimens form uniform samples of poorly graded soils, though usually at lower relative densities than air-pluviated specimens, since soils fall at a slower velocity through water than through air. However, with well-graded soils, or soils with high fines contents, particle segregation can be a problem with this technique (Keurbis and Vaid 1988). Particle segregation would also be an issue with surface impounded CCRs, since these tend to be a mixture of bottom ash and fly ash.

7.3 Slurry Deposition Techniques

Like the previous two methods, there are several different slurry deposition methods. The first slurry deposition method was first developed by Keurbis and Vaid (1988), which is the technique that is being assessed for use on surface impounded CCRs in this thesis, with some slight modifications. For the sake of avoiding any redundancy, the procedure for this technique will be outlined with specific reference to its use on SI CCRs, with departures from the original procedure of Keurbis and Vaid noted.

7.4 Slurry Deposition Technique Applied to SI CCRs

The basic premise of the slurry deposition technique is to form a lean (just enough water to allow for effective soil mixing), saturated slurry of soil that can then be deposited directly from a mixing tube into a triaxial split-mold, with minimal disturbance to the mixture. The slurry should be lean enough to avoid the development of sedimentation currents during the transfer from the mixing tube to the split-mold, but not so lean that mixing becomes difficult. In addition, the procedure ensures that the sample will be fully or very close to fully saturated upon completion. The samples are deposited very loosely initially and can be densified to higher relative densities by vibration. In their original slurry deposition method, Keurbis and Vaid recommend de-airing the soil-water mixture and then pluviating it into the mixing tube in order to better ensure saturation. However, CCRs can be fine enough that a considerable amount of the sample (of a specific grain-size) can be lost in the pluviation process. Therefore, the CCR samples prepared using this method are simply added to de-aired water directly into the mixing tube in order to minimize sample loss during the preparation process; if saturation ratios using this method are unacceptable, a soil-water mixture can de-aired under a vacuum or by boiling and then transferred directly to the mixing tube. The apparatus required for the CCR slurry deposition technique are as follows:

- Acrylic mixing tube, with an outer diameter slightly smaller than the target diameter of the sample being formed and a plug to seal off one end. The end opposite of the mixing tube will have rubber gasket seal glued around the rim. The other dimensions of this tube will be discussed later.

Figure 33: Acrylic mixing tube with a rubber stopper on one end and rubber gasket seal glued to the opposite end.

- A thin metal disk approximately the same diameter as the bottom porous disk used in testing.

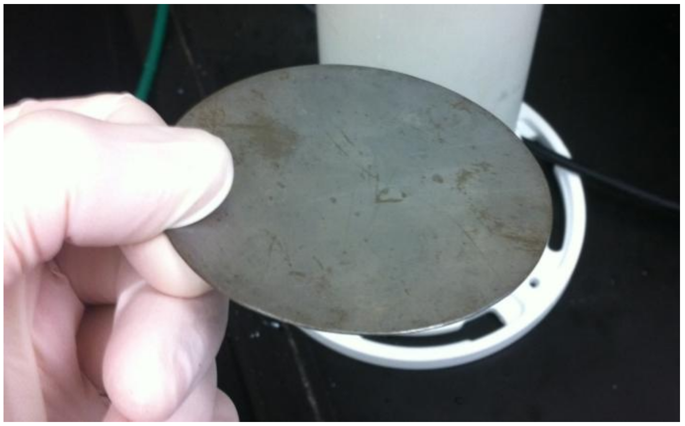


Figure 34: Thin metal disk approximately the same diameter of the bottom porous disk.

- A rubber or latex membrane with a smaller diameter than the mixing tube. Standard store-bought balloons can be cut to fit and are a cheap, readily available alternative.
- Water bath container for the acrylic mixing tube, large enough to completely submerge the mixing tube.

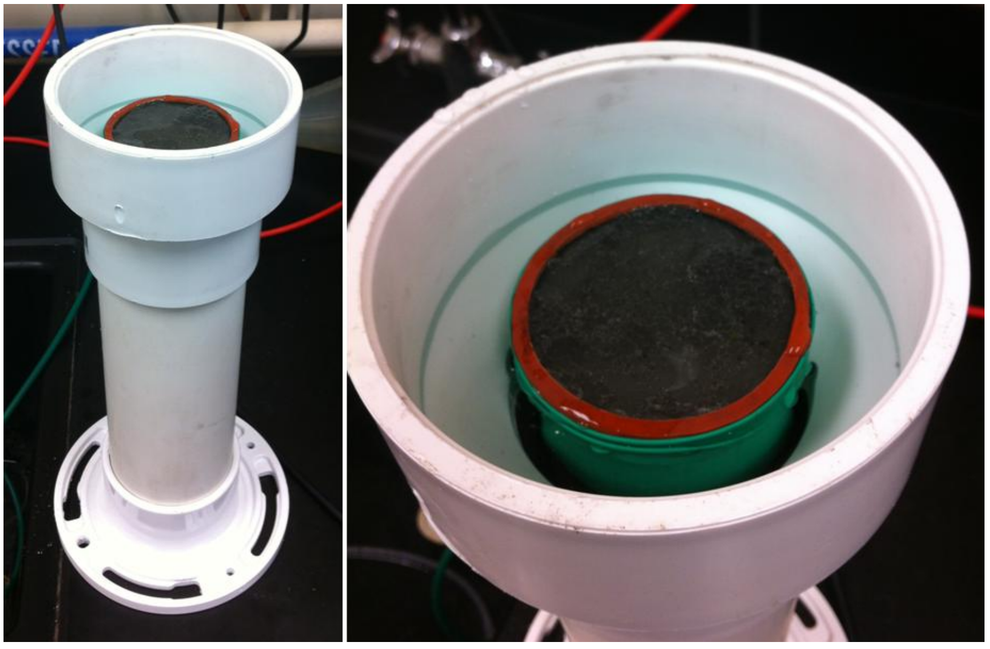


Figure 35: Water bath large enough to completely submerge the mixing tube and allow for easy placement of the porous disk and metal plate. The rubber membrane can also be seen rolled down around the mixing tube.

- Water bath container for the triaxial cell base-platen that can at least submerge the bottom drainage line and the porous disk when the mixing tube is placed on it.

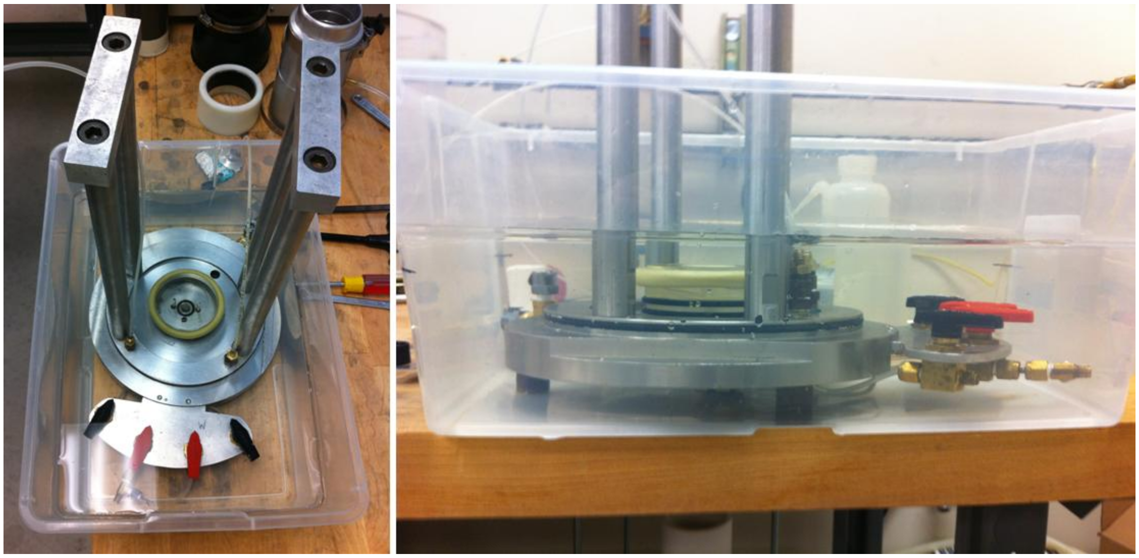


Figure 36: Water bath large enough to accommodate the bottom of the triaxial cell and submerge the bottom platen.

- A split-mold triaxial sample former.
- A collar that fits over the split-mold to accommodate the temporary increased volume of the sample when it is first placed.

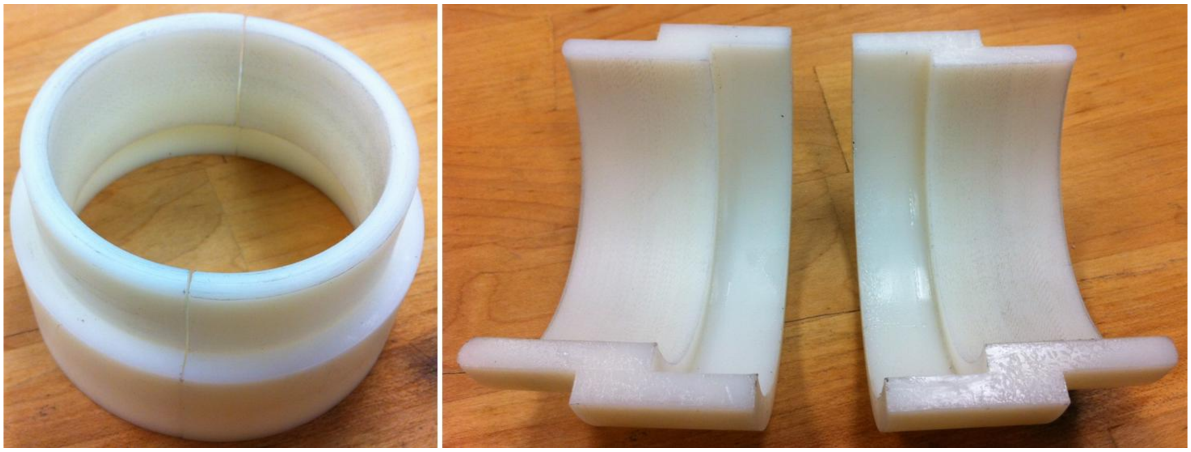


Figure 37: A custom-made split-collar to accommodate the additional volume of soil when the slurry is first placed in the specimen split-mold. This collar was machined out of nylon to fit the dimensions of the split-mold being used and the flexible collar used to accommodate the extra water volume when the slurry was placed.

- A small mechanical shaker or mallet to densify the sample once it is placed. If a mallet is used, a heavier mallet is best, as it transfers more energy than a standard rubber mallet.

In their original slurry-deposition method, Keurbis and Vaid made their soil-water mixtures using dried soil; for SI CCRs, this would be impractical because of the dust that would be lost in handling it in a dry state. Thus, it is recommended that the SI CCRs be mixed at a target water content in order to make it more workable. Once the soil is well-mixed, several small samples should be oven-dried to verify that the moisture content of the soil is homogenous.

The mixing tube should have the thin rubber membrane rolled down over the end with the rubber gasket seal and the other end plugged with the stopper. The moist CCR specimen is placed in the mixing tube, which should then be filled with de-aired water (some water can be in the tube prior to adding the moist soil in order to help collapse the structure of the moist CCRs and decrease their volume during placement in the tube). The mixing tube is now placed into the de-aired-water bath. Once the mixing tube is in the water-bath, a saturated, de-aired porous disk with a filter paper attached is placed on the open end, such that it is completely submerged in the water bath; some fines will escape the mixing tube while it is submerged and before the porous disk is placed over the opening (see Figure 38), so these fines should be put into a container to be oven-dried and weighed in order to adjust the dry mass of the sample.

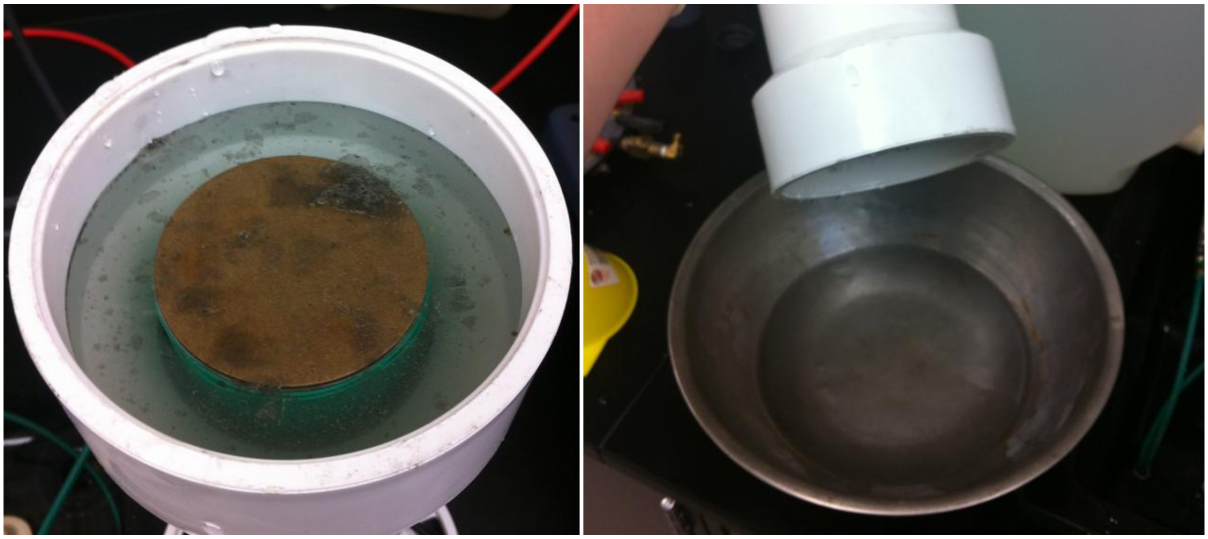


Figure 38: Placement of the porous disk and transferring of the fines lost in the water bath to a container to be oven-dried and weighed.

At this point, the thin rubber membrane is rolled over the porous disk, such that a small portion of the center of the disk is exposed. The thin, metal disk is now placed over the porous disk and membrane and the mixing tube is withdrawn from the water bath, while keeping firm pressure on the metal disk. The securing of the porous disk with the thin rubber membrane and placement of the metal disk are shown in Figure 39.

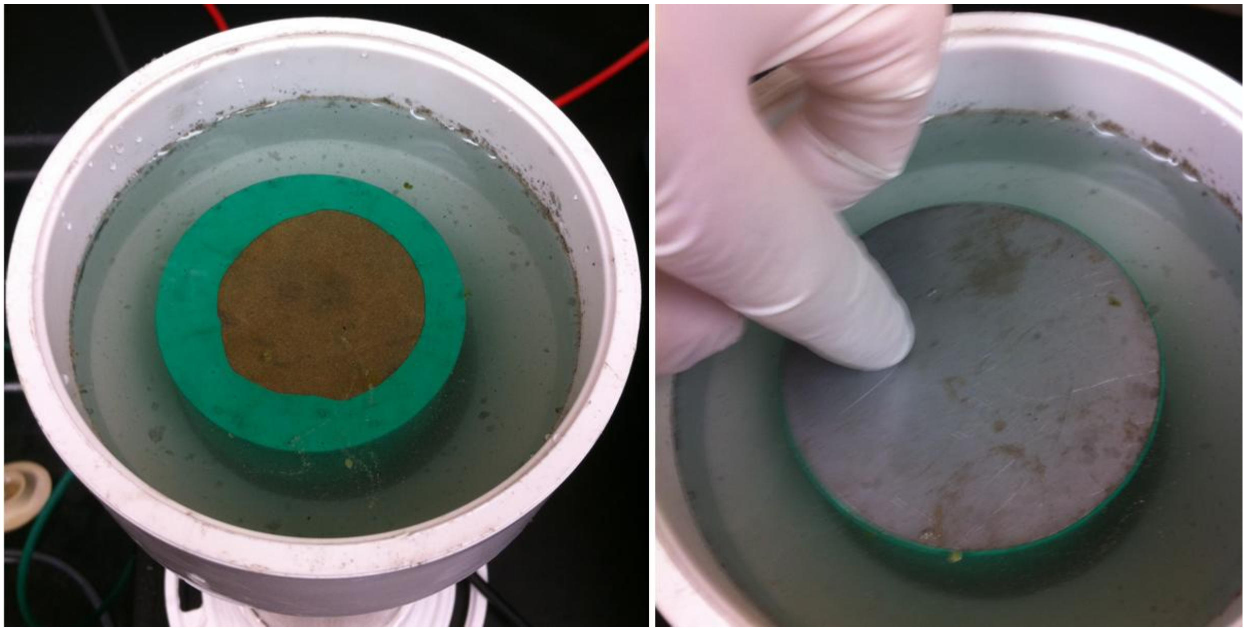


Figure 39: Securing of the porous disk with the thin rubber membrane and placement of the thin metal disk over the opening in the membrane.

Now the mixing tube is removed from the water bath while maintaining firm pressure on the thin metal disk and the soil slurry mixed vigorously, end-over-end for the next twenty minutes, to ensure homogeneity of the slurry. After twenty minutes has passed, the mixing tube is placed disk-end down and the mixture is allowed to settle to its loosest stable state. When the mixture has stabilized, the metal disk is removed (it should be held in place by suction when the mixing tube is lifted), the membrane rolled back to the edges of the porous stone, and the entire apparatus placed porous-disk-down onto the base platen, which is submerged in another de-aired water-bath. The rubber membrane around the mixing tube is now rolled up and off of the mixing tube. The sample membrane has been rolled down around and attached to the bottom platen with two o-rings prior to submerging the base platen in the de-aired water-bath and it is now rolled up and over the outside of the mixing tube. The entire bottom platen can now be removed from the water bath and the split mold formed around the mixing tube and sample membrane. Rolling of the membrane over the mixing tube and placement of the split mold and collars after removal of the triaxial cell base from the water bath is illustrated in Figure 40.

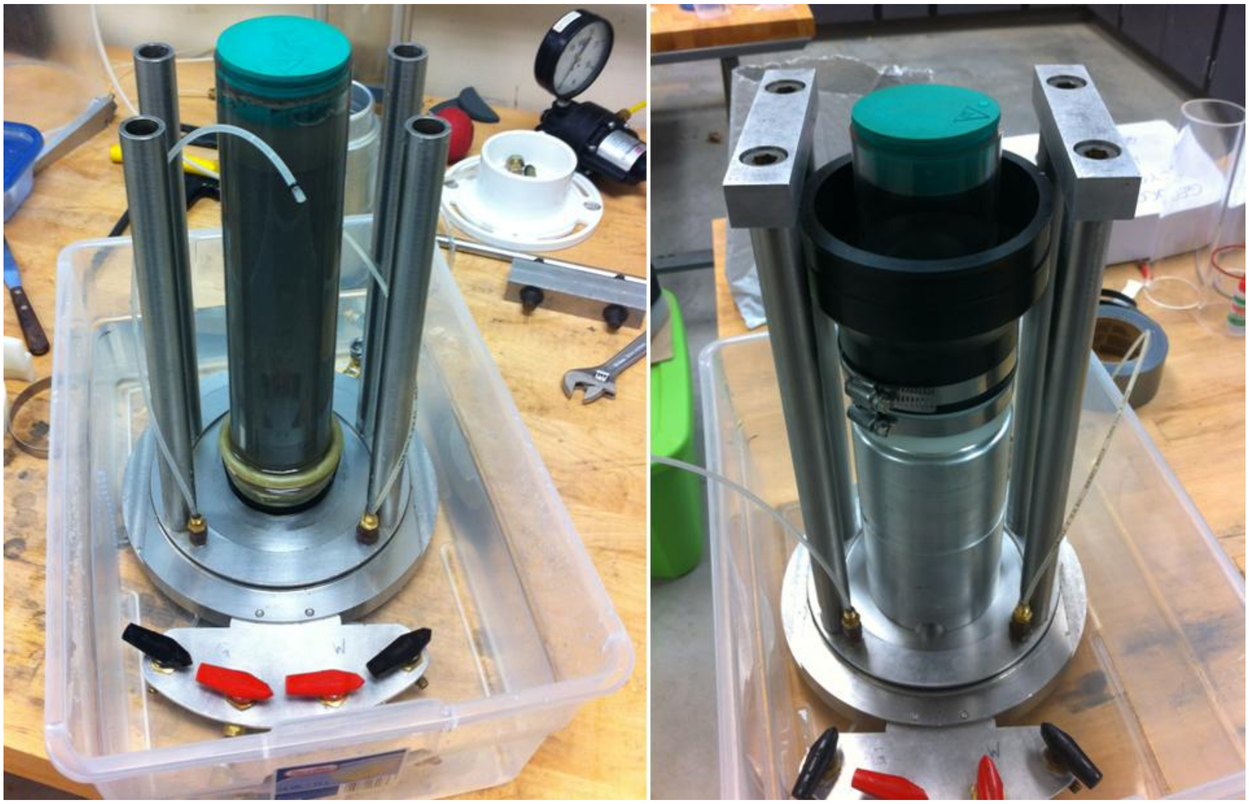


Figure 40: Rolling up the membrane around the mixing tube and placement of the specimen split-mold, the slurry extension collar, and the water extension collar after removal of the triaxial cell base from the water bath.

Once the extension collars for the split-mold is attached, a vacuum is applied between the split mold and the membrane; then, if additional volume is required to accommodate water volume, either a larger membrane can be secured using a hose clamp, or a flexible rubber PVC connection can be used (the flexible PVC connection was used in this experiment, as shown in the right-hand photograph in Figure 40). The last step before transferring the slurry to the split mold is to add a de-aired water bath to the split mold, outside of the mixing tube; this ensures minimal disturbance of the CCR material as it is transferred from the mixing tube to the split-mold. The rubber plug on the mixing tube can now be removed and the mixing tube slowly extruded, such that disturbance to the slurry is minimized as it is deposited in the split-mold. When the mixing tube has been fully extruded, the water level can be adjusted by allowing drainage through the drainage lines on the bottom platen (alternatively, some of the water and fines mixture at the top can be basted off and put into the same container as the fines from the mixing tube water bath and oven-dried and later weighed to save time). Once the water level has dropped enough to allow removal of the extra membrane or flexible PVC connection, the slurry can be densified by attaching the top platen (which also has a filter-paper applied), applying a small pressure, and vibrating the sample if necessary, while allowing excess pore pressures to dissipate through top and bottom drainage lines, as shown in Figure 41. This should be done such that the piezometric pressure is the same across the sample, which was postulated to form specimens of sand at uniform densities with height by Vaid and Negussey (1988).

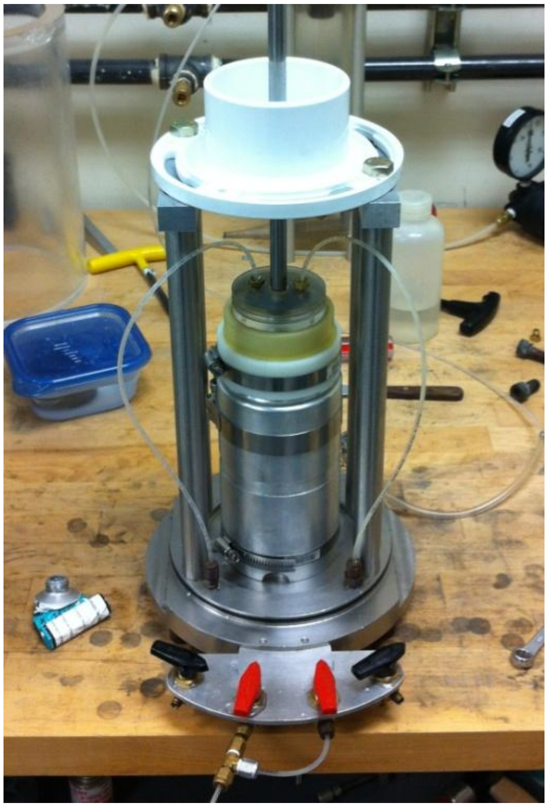


Figure 41: Setup used to densify SI CCR slurry-deposition samples. Notice that the short-circuit between the top and bottom drainage is being used to drain the sample as it is densified with the top platen applied. The top platen fits snugly enough into the extension collar to keep a water-proof seal. The white piece on the top of the triaxial base is simply a part to keep the piston plumb as the slight pressure is applied to the top of the sample during densification.

This vibrating can be accomplished with either a mechanical shaker or by tapping the side of the split mold gently with a mallet. However compaction of specimens to high relative densities can take quite a long time using a mallet, so a mechanical shaker would be preferable for SI CCR specimens. Once the target sample height is reached (and thereby the target sample volume reached), the extension collar is removed, the membrane is secured to the top platen with two o-rings, and a small vacuum pressure is applied to the sample to allow removal of the split mold. The dimensions of the sample are then measured and the sample is placed into the triaxial testing apparatus.

The dimensions of the acrylic mixing tube are determined based on the minimum density of the largest volume of soil that will be used in making a sample. That is, the length of the tube is determined based on the amount of soil required in forming the densest sample to be tested, placed at a zero percent relative density. Keurbis and Vaid found that this volume, increased by five to ten percent is sufficient to allow for adequate slurry mixing, while avoiding large particle sedimentation distances. A sample calculation determining the appropriate length for a mixing tube is included in the appendix.

7.5 Analysis of Slurry Deposition Technique with SI CCRs

In order to assess the slurry deposition technique as applied to SI CCRs, relative density and gradation were determined for the top, middle, and bottom portions of the sample. Since CCRs tend to be non-plastic and negative pore water pressures in a moist sample are not high enough to ensure no disturbance of fabric during the verification process, a gelatin solidification technique developed by Emery et al. (1973) for use with sand specimens was modified for use in this experiment. Gelatin was chosen as the solidifying agent because it is easily dissolved using heat after the volume of each individual slice of the specimen is determined. Then, by adding bromelain, a proteolytic enzyme, the gelatin is broken down, leaving a brittle crystal that can then be avoided when selecting a sample to run a hydrometer test on, and that can be washed out when the gradation is analyzed above the #200 sieve.

SI CCRs have a wide range of hydraulic conductivities (a result of how they are generated and placed), sometimes being similar to sands and other times being more similar to silts. For this reason, the time required to permeate these samples with a gelatin solution is much longer than for clean sand samples. As a result, it was determined that a lower concentration should be used than recommended by Emery et al., such that the solution remains a liquid at room temperature, but is solidified by surrounding the sample in the split mold with an ice-bath; this is explained in more detail in the following paragraphs.

Once the compaction of the slurry deposited sample was complete, height measurements were made at four locations (front, back, right, and left sides of the top platen) using the frame of the triaxial cell and a Mitutoyo micrometer. The height of the sample was determined by subtracting the thicknesses of all the component parts that are not soil from the heights measured from the bottom platen to the triaxial cell frame at four points (front, back, right, and left sides). This was done as a quality-control measure to ensure that the overall relative density across the sample was close to the target relative density. A 0.75% by-mass gelatin solution is then permeated through the specimen by applying an elevation head between the gelatin reservoir and bottom drainage lines of the specimen and allowing drainage through the top drainage lines (not more than 18 inches). About two specimen pore volumes were permeated through the specimen to ensure complete replacement of the pore fluid. After the gelatin flushing of the specimen was complete, the drainage lines were all closed and an ice-bath was packed around the specimen, as shown in Figure 42. For this experiment, the ice bath was maintained over the height of the sample for a period of four hours, which was found to be adequate to solidify the specimen.

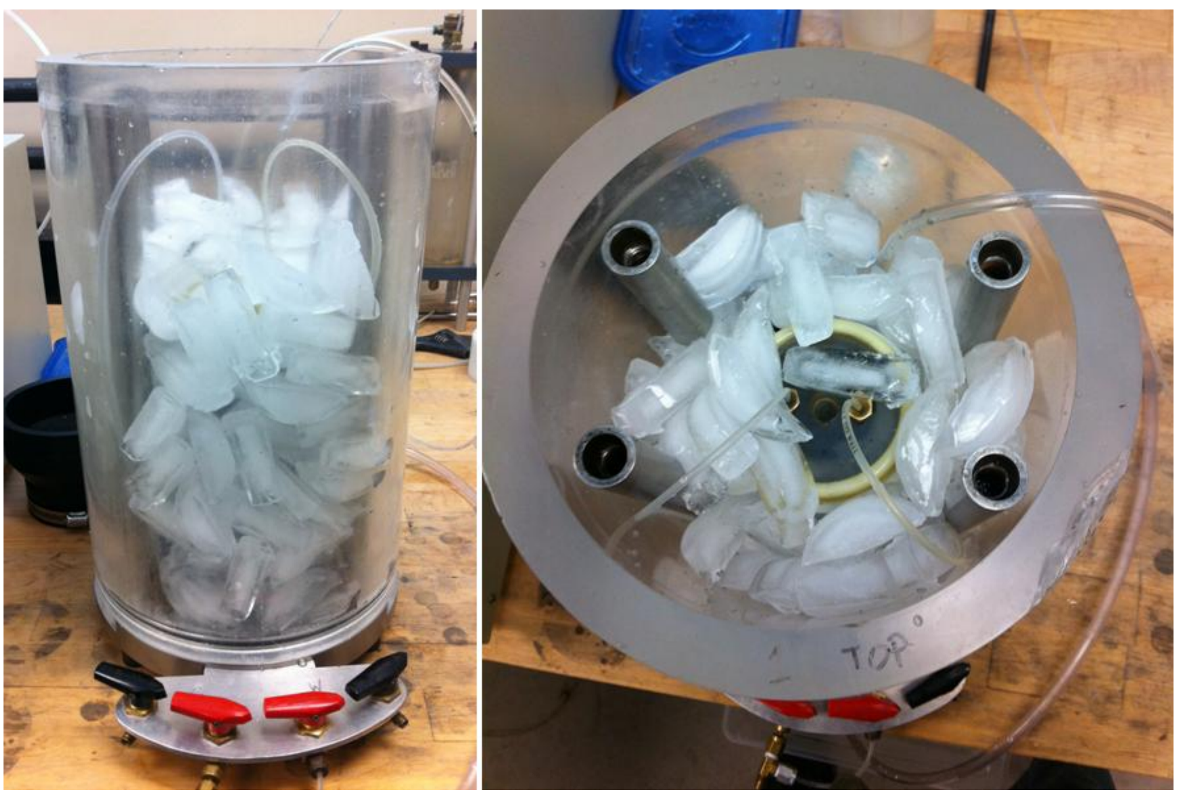


Figure 42: Ice bath placed around the compacted specimen for a period of four hours to set the gelatin.

After the four hours, the ice bath was removed and the specimen was removed from the split mold and taken out of the membrane, as shown in Figure 43, and cut into three approximately even-sized portions.

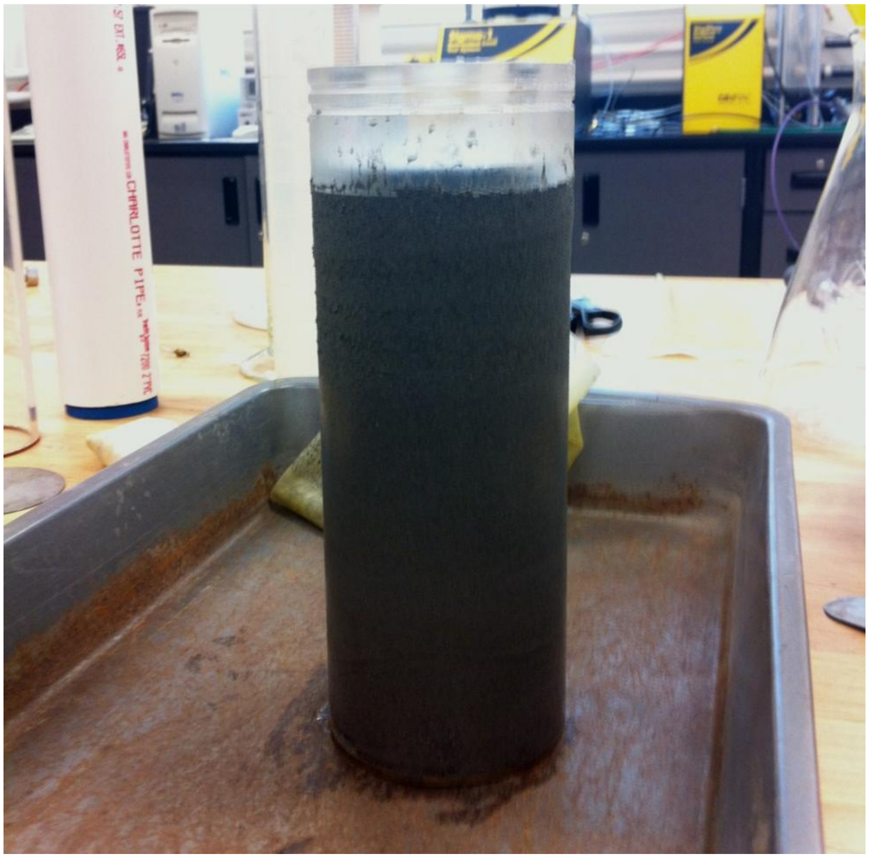


Figure 43: Specimen removed from the split mold and membrane following gelatin curing period.

The mass of these portions was taken and the volume determined using water displacement, as shown in Figure 44. These two measurements allow for the calculation of the density of each slice. It can be assumed that each of the slices is composed only of a mixture of gelatin and CCR material for the purposes of determining the relative density of each slice. The specific gravity of the gelatin solution was determined by permeating a portion of the solution through a piece of filter paper into a graduated cylinder and also placing this in an ice-bath for four hours, after which the mass and volume of the gelatin were measured and used to calculate the specific gravity at that temperature (ranged from 1.000 to 1.008). The specific gravity of the CCR material was determined according to ASTM D854, courtesy of Kevin Foster. Since the overall density of each slice is known, and the density of both component materials is known, it is possible to calculate the volume of each component according to equations 12 and 13.

$$V_{s\_slice} = \frac{\rho_{slice} \cdot V_{Slice} \frac{G_G M_{slice}}{\rho_{slice}}}{G_S - G_G} \tag{12}$$

where V_{s_slice} = volume of solids of the specimen slice
ρ_{slice} = density of the specimen slice
V_{slice} = volume of the specimen slice
G_G = specific gravity of the gelatin solution after ice-bath
M_{slice} = mass of the specimen slice
G_S = specific gravity of the CCR material

$$V_{g\_slice} = \frac{M_{slice}}{\rho_{slice}} - V_{s\_slice} \tag{13}$$

where V_{g_slice} = volume of gelatin of the specimen slice

Since it is assumed that the gelatin completely permeated the pore space of the sample, the volume of the gelatin is equal to the volume of voids in the slice and the void ratio can be calculated, which can then be used to calculate the relative density.

Once the densities of the slices has been determined, each slice is placed in its own container and allowed to dissolve (which will occur at room temperature), after which the Bromelain is added (a mass ratio of 1:10 of Bromelain to gelatin was found to be sufficient) and allowed to sit for two hours before placing it in an oven maintained at 110° C until it dried completely. ASTM D422-63 was followed in the particle-size analyses performed on each of the three slices for each sample, except for a few changes based on the properties of the CCR materials:

- The soil was not separated at the #10 sieve, since the material retained on the #10 sieve represented such a small portion of the sample. Additionally, in separating the samples at this sieve, there was the potential to lose specific particle sizes due to dust losses. Each of the hydrometer tests were separated on the #10 sieve following the test and the mass was adjusted accordingly for the hydrometer analysis calculations. This also eliminates the need to perform the calculation given in section 16 of the ASTM specification.

- A dry sample was used in each hydrometer test, since there would have been considerable time delays waiting for the specimen to dry at room-temperature (especially considering the presence of gelatin and bromelain in the specimens.

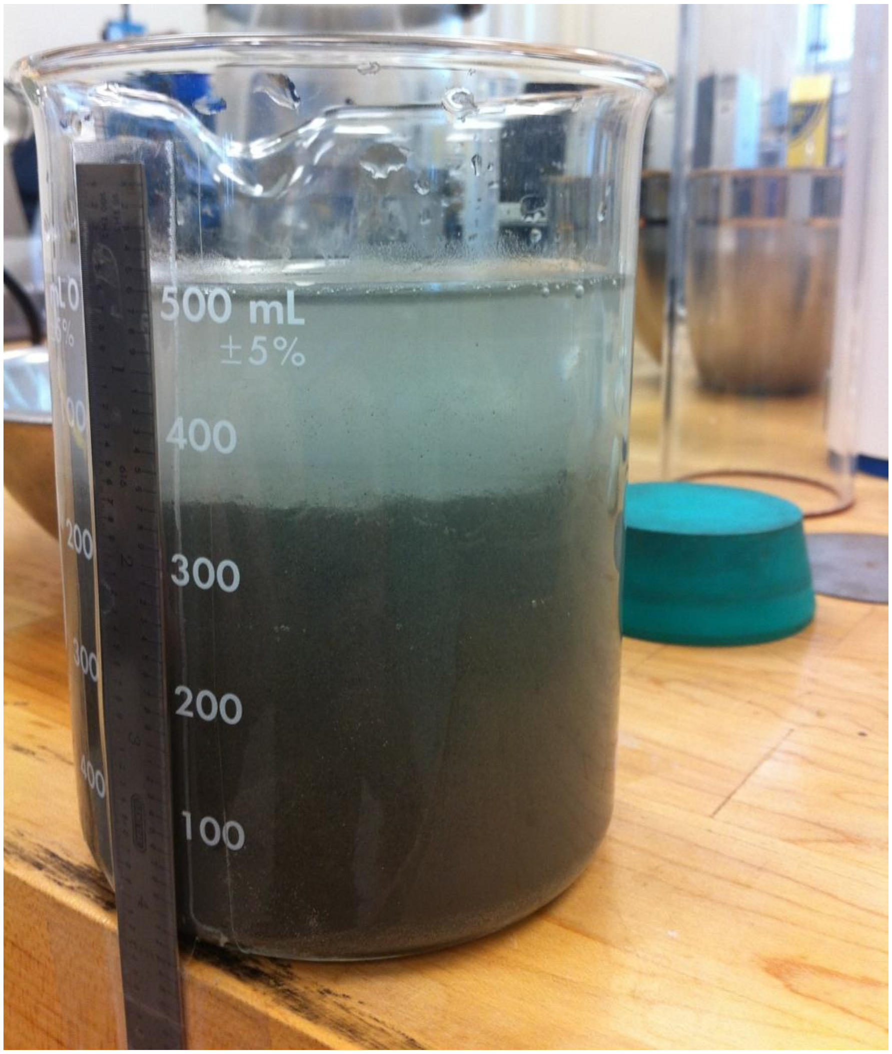


Figure 44: Each specimen slice volume was determined using water displacement. A 500 mL capacity beaker and a ruler incremented at 1/100" were used to do this. The vertical distance between a 100 mL addition of water to the beaker and the equation for the volume of a cylinder was used to calculate the diameter of the beaker; with the diameter known, it was determined that volumes could be measured accurately to ± 1.4 cm^3.

A dry sample of each of the slices could then be chosen to use in a hydrometer test (Bromelain-gelatin crystals were avoided in order to ensure they did not affect the results) to determine the grain size distribution for soil passing the #200 sieve. This soil was then added back to the rest of the dried specimen slice and washed on a #200 sieve to be included in a grain-size analysis for the particles with diameters greater than 75 μm.

Three different specimens were prepared, all at a target relative density of 70%. The first two specimens were deposited without a water bath within the split mold, while the last one was deposited with a water bath within the split mold. Table 11 makes a comparison of overall specimen slice densities and relative densities for the three specimens showing that, with or without a water bath inside the split mold, all three specimens had an increase in relative density down the height of the specimen. The top slice on the last specimen had not fully cured and as a result deformed some during the mass and volume measurements, undoubtedly resulting in the negative value of relative density. However, the bottom two slices of all three specimens are very consistent and the overall increase in relative density down the height of the specimen indicates that the densification technique that Vaid and Negussey (1988) cite as producing specimens of uniform density does not apply to SI CCR materials. Additionally, the very high values of relative density for all of the bottom slices indicate that the maximum and minimum void ratios determined for the material do not necessarily reflect the actual minimum and maximum void ratios; this could be the result of an inaccurate calculation of the specific gravity of the material, since that is a direct parameter for determining void ratio or an indication that the standards ASTM D4253 and D4254 are not appropriate methods for determining the minimum and maximum densities of CCR materials.

Table 11: Specimen relative density and density summary. The bottom two rows summarize relative density and density data for the entire specimen.

	Specimen 1		Specimen 2		Specimen 3	
	D_r	ρ (g/cm^3)	D_r	ρ (g/cm^3)	D_r	ρ (g/cm^3)
Top Slice	45%	1.63	27%	1.60	-13%	1.54
Middle Slice	93%	1.72	79%	1.69	76%	1.69
Bottom Slice	117%	1.78	113%	1.77	112%	1.77
Average	85%	1.71	73%	1.69	58%	1.67
From Dimensions	73%	-	70%	-	70%	-

The gradation curves presented for each specimen in Figures 45 through 47 show little segregation of particle size, with the most notable trend being that the bottom slice did tend to have a higher percentage of coarser particles within it; whether this phenomenon is solely the result of the placement method or the densification technique or whether both factors contribute is unclear and would require further study to determine. A comparison of the different slice gradations across specimens, presented in Figures 48 through 50, shows a very consistent gradation across the height of the sample between trials, indicating that this slight gradation difference is caused by a either the placement technique or the densification technique, though which of the one responsible cannot be stated with any certainty at this time. However, the effect of the placement technique and densification technique could be investigated easily through further testing. It is also interesting to note for specimen three, where a water-bath was used in the split-mold during slurry placement, that the gradations vary slightly more than for the two specimens, where a water-bath was not included. This may indicate that a water-bath allows sedimentation currents to form, while direct transfer without a water-bath minimizes the development of such currents. More reconstitutions would need to be made in order to perform meaningful statistical analyses on variation in gradation between samples made with and without water-baths to verify this claim. Lastly, Figure 51 plots all gradations on a single plot to make the extent of variation in the grain size distributions of the three specimens clear.

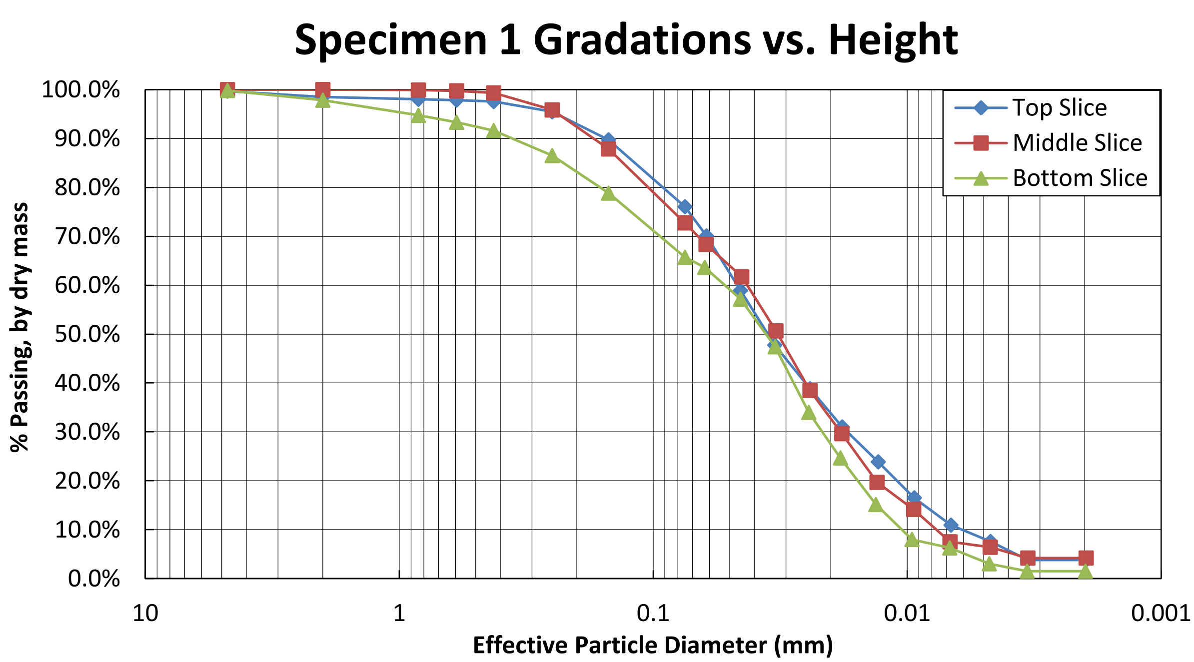


Figure 45: Plot comparing grain-size distributions across the height of specimen one.

While the results of the three reconstitutions performed for this thesis provide some insight, a statement cannot be made about the suitability of the slurry deposition method for use with SI CCRs at this time. However, it can be said that the densification technique used in this investigation is unsuitable for SI CCR materials; if an alternative densification method could be developed, a simple investigation could be undertaken to determine if the slight particle segregation observed in this investigation was due to the vibratory compaction technique used, or if it was the result of the slurry deposition technique itself.

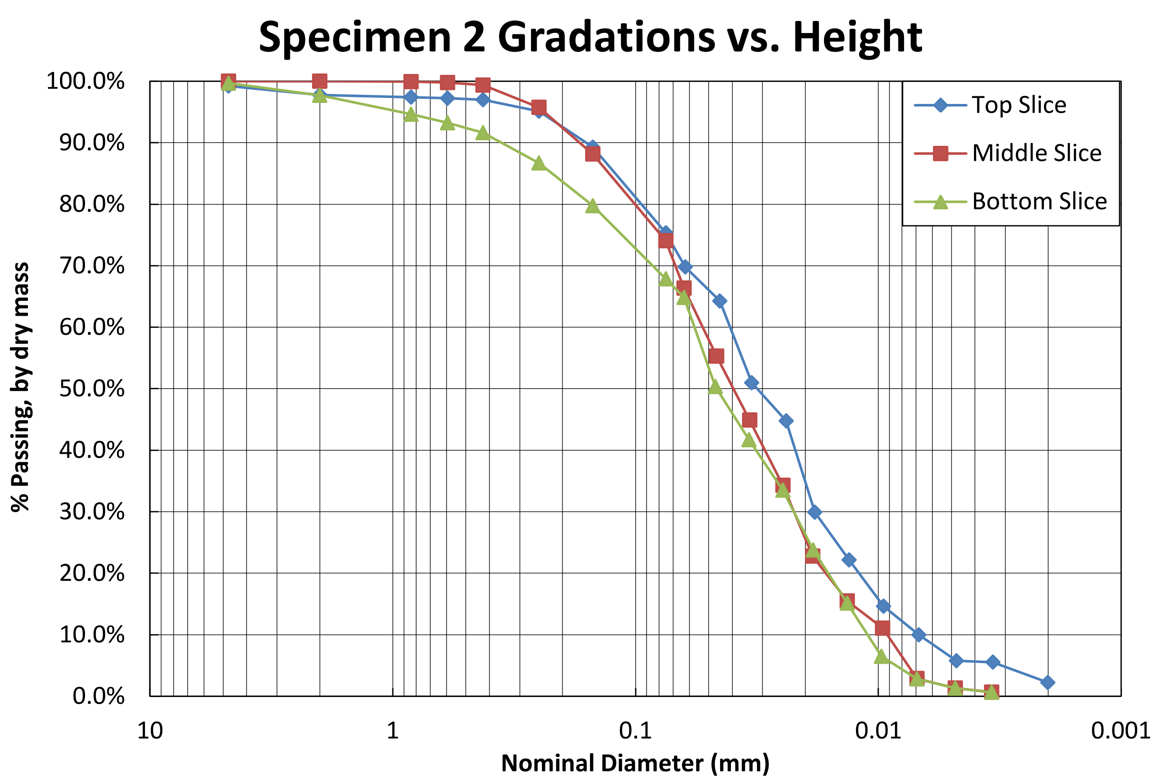


Figure 46: Plot comparing grain-size distribution across the height of specimen two.

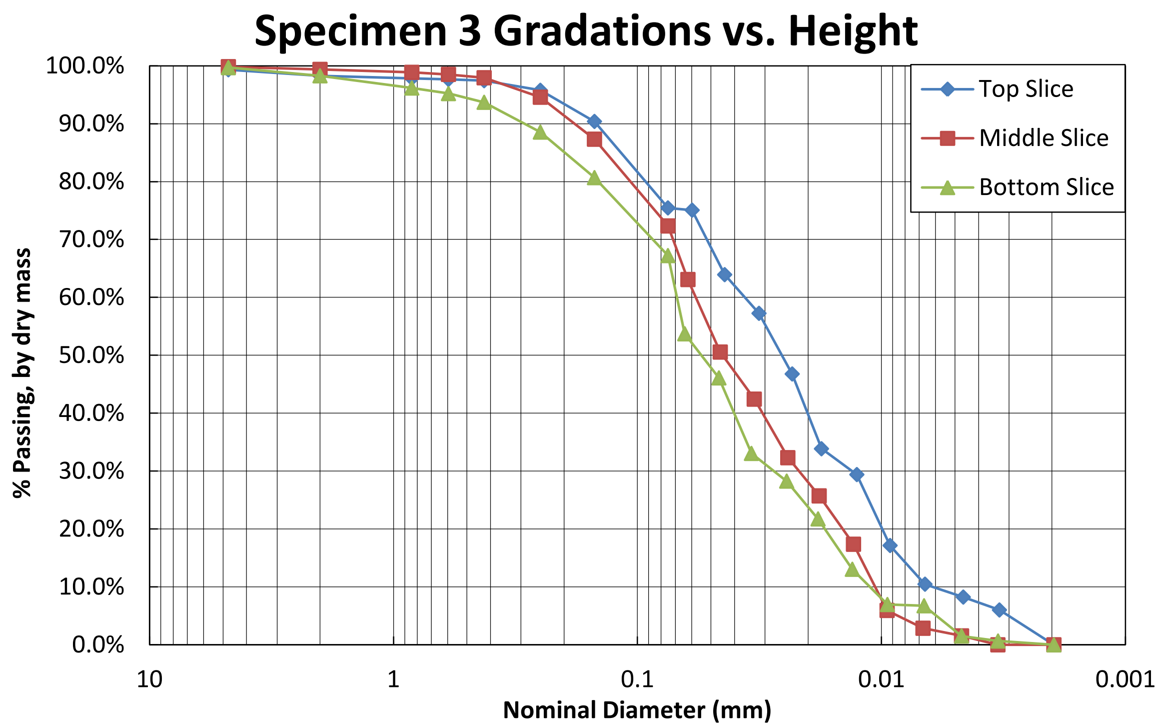


Figure 47: Plot comparing grain-size distribution across the height of specimen three.

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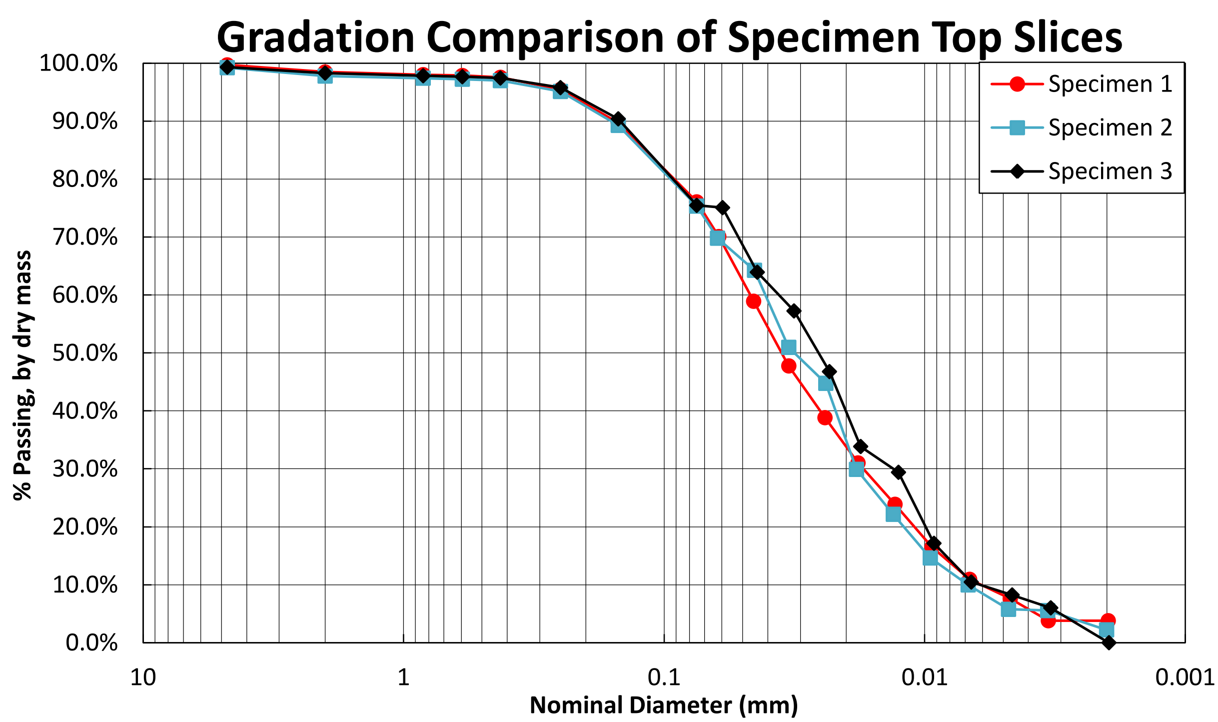

Figure 48: Plot comparing grain-size distributions of the top slices of all three specimens.

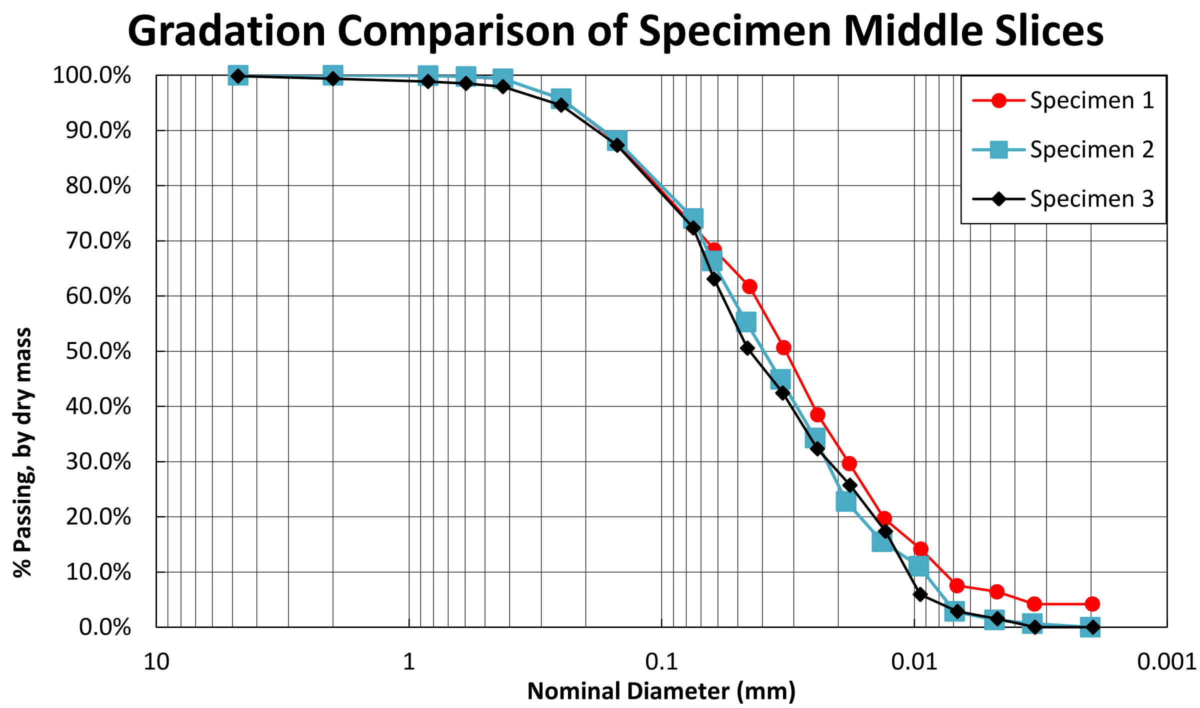

Figure 49: Plot comparing grain-size distribution of the middle slices of all three specimens.

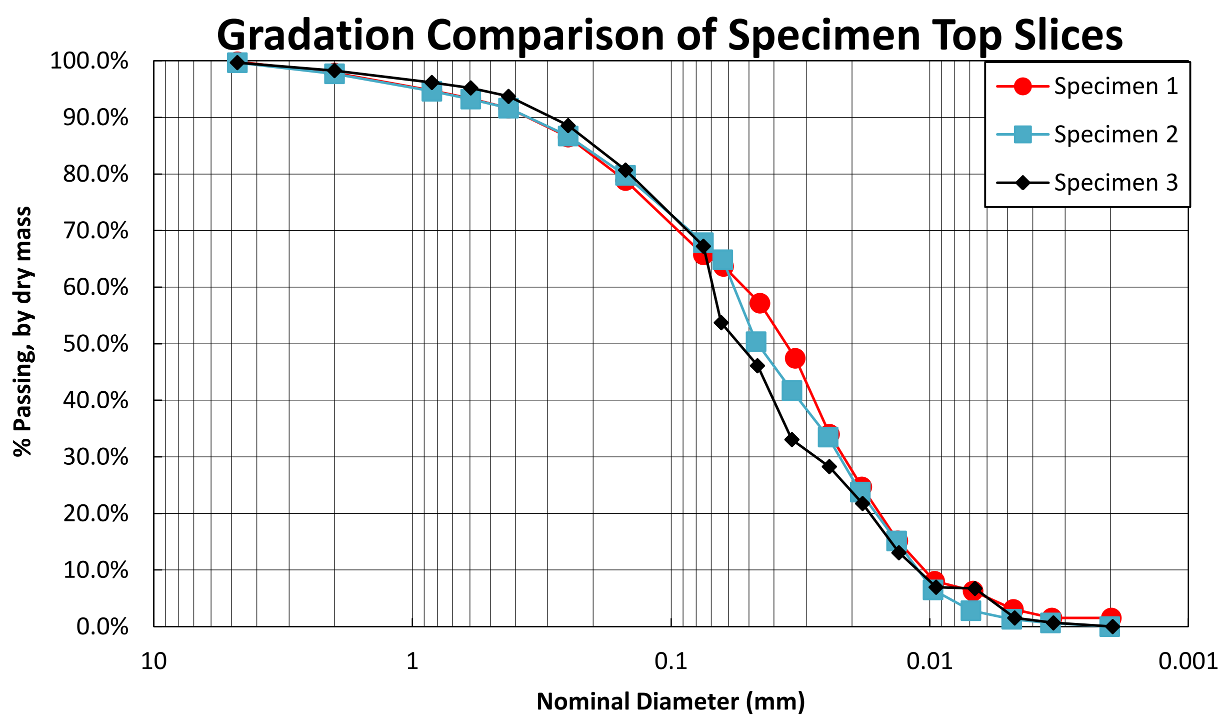

Figure 50: Plot comparing grain-size distribution for the bottom slices of all three specimens.

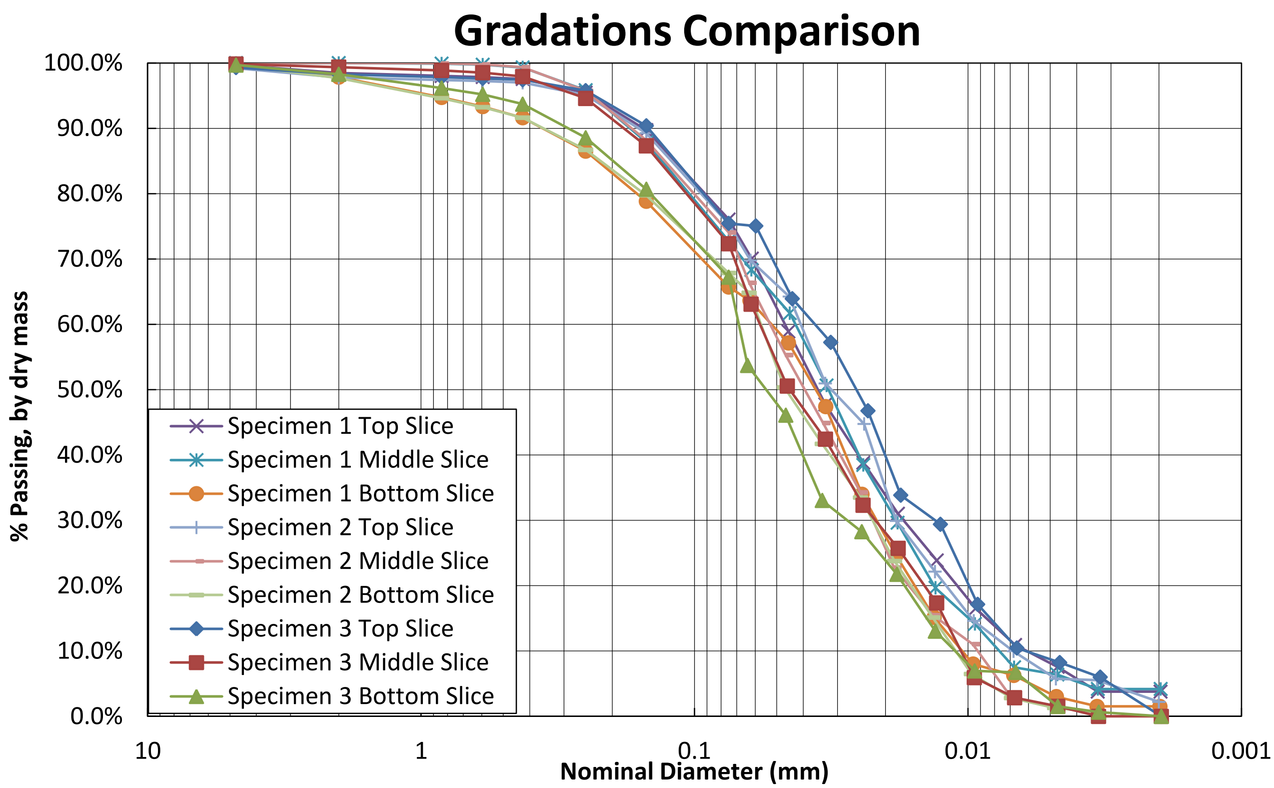

Figure 51: Comparison of all gradations for all three samples.

Examining Figure 51, it is obvious that a considerable amount of variability entered into gradation data with the portion of the graph that was determined using the hydrometer test. This may be the result of slight variations in temperature over the course of the test, regardless of the fact that the room temperature was thermostat-regulated. If temperature readings of the soil suspension had been take at each reading and used in calculating the values derived from Stokes' Law, this variability may have been reduced considerably. The maximum variability in the sieve analysis data for a given nominal diameter was about 10% by mass, while the maximum variability in the hydrometer analysis data for a given nominal diameter was about 25%.

Chapter 8

Conclusions

8.1 Engineering Characterization of CCRs

Geotechnical designs and analyses when working with CCRs are similar to those for natural soils in many respects. The physical and engineering properties of CCRs are what differentiate them from natural soils of similar grain size. Consequently, the single most important aspect of working with CCRs is determining their physical and engineering characteristics. As a result of current and past CCR disposal methods, determining variability in their properties across a given site is also important. As evidenced by the variability plots of the different engineering properties of CCRs, variability can vary greatly to very little within a specific site. However, since the coal source for a given site will inevitable vary, so will the engineering properties of the resulting ash. Because of the differences in properties of CCRs between given sites and from that of natural soils of similar grain size, a more thorough site investigation and laboratory testing schedule will almost always be necessary than for natural soils.

8.2 Dynamic Properties of CCRs

Being a mostly granular and non-plastic material, the characterization of the dynamic properties of CCRs is important to ensure that current and future CCR disposal areas are designed in order to withstand seismic events. Currently there is very little data on the dynamic properties of CCRs and the data that is available is usually from different countries, whose CCRs may not be similar enough in makeup to merit comparison with CCRs in the U. S.; more dynamic laboratory testing is required before such a conclusion can be made.

8.3 CCR Failure Modes and Monitoring Practices

The two main types of CCR disposal areas, surface impoundments and landfills, are very different in their construction and therefore are prone to different failure modes. As a result, monitoring practices should be tailored to the type of disposal area it applies to. Despite the fact that there is a lack of literature and precedence regarding monitoring of CCR disposal areas, their design tends to be similar enough to mine tailings dams that monitoring practices for tailings dams could easily be adapted and applied to CCR disposal areas. The flowcharts developed by Martin and Davies (2000) provide an excellent template that could be adapted to develop a site monitoring program for CCR disposal areas, especially for surface impoundments.

8.4 Slope Stability of CCRs

Slope stability analyses with CCRs are basically the same as for natural soils, except that there is usually an inherently higher degree of uncertainty in the CCR material. For that reason, analyses involving CCRs should have a degree of conservatism built into every step, unless there is evidence to indicate that such a measure is unnecessary. If the dikes containing surface impounded CCRs are built CCR materials, or other non-plastic soils that have the potential to have low hydraulic conductivity, then a sudden rise in the water table has a deleterious effect on the impoundment's performance. For this reason, if such conditions do exist, it is good practice to install drainage (if not already installed) to ensure a steady-state water table can be maintained.

8.5 Settlement Calculations for CCRs

Many researchers report compression and recompression indices for CCR materials. However, since CCRs generally do not have clearly log-linear values of compression and recompression indices, calculating settlements using consolidation theory can yield variable settlements, depending on different individuals' interpretation of standard consolidation tests.

The two methods for settlement of foundations in sand provide very similar results, underestimating settlement considerably. This is possibly the result of scale effects and differences in the mechanics of the materials (silt-sized particles that are the result of an industrial process rather than natural sands). In order to accurately say that none of these settlement calculation methods works well in CCR surface impounded materials, however, more test fills would need to be performed and analyzed in a similar fashion.

8.6 Slurry Deposition Technique Applied to SI CCRs

While it was not verified that the slurry deposition technique can be applied to SI CCR materials, the method shows promise based on the low variability of grain-size distribution across specimen height for the three specimens tested. However, a major drawback to this method is that the original densification method suggested by Keurbis and Vaid (1988), which was for sands and silty sands, does not appear to work for SI CCR material. Furthermore, more investigations would be required to determine whether the gradation differences observed in these three samples are due to particle migration during vibratory densification or to the actual deposition technique; if it is due to the former, a different densification method may make the slurry deposition method a very attractive reconstitution technique because it is relatively easy and has excellent repeatability, as evidenced in the results presented in Chapter 7. All spreadsheets used in specimen preparation and specimen analysis are provided in the appendix.

8.7 Recommendations for Further Study

As discussed in Chapter two, since CCR materials are the result of an industrial process and not a naturally occurring soil, there is a variety of factors that can affect their engineering properties. Not being a naturally occurring soil, there is a comparatively small body of literature available that reports engineering properties of CCRs. Furthermore, these properties will not necessarily be comparable between different regions. It is therefore necessary to continue research in CCRs, especially with regards to the following:

- Effects of placement condition on the engineering properties of CCRs (i.e. surface impounded vs. moist-compacted).
- Variability in engineering properties of CCRs between disposal sites and within disposal sites (and how to best quantify variability for different properties).
- Dynamic properties of CCRs, to ensure that seismic design of CCR disposal areas is adequate and determine if some disposal areas are higher risk in the event of an earthquake.
- CPT correlations to determine engineering characteristics of CCR materials in-situ.
- The effect of time on the engineering properties of CCRs.
- Determining the most appropriate method to determine c_v of CCR materials, in order to determine if disposal loading rates may be cause for engineering concern.
- "Smarter" technologies that can be adapted to aid in monitoring CCR disposal areas that would better identify gradual changes that may not be readily apparent to daily inspectors.
- Further testing on slurry deposition reconstituted SI CCR samples to analyze soil fabric (a large enough body of tests to analyze statistically). The same method as used in this thesis could be used or methods to determine shear wave velocity across the height of the sample could be used.

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Appendix A

Sample Preparation and Fabric Analysis Spreadsheets

Sample Dimensions:

Note: Sample mold has bevelled top portion, so volume is calculated as two separate cylinders added together

H_{TC} =	0.72	inches	D_{TC} =	2.851	inches
H_{BC} =	5.465	inches	D_{BC} =	2.826	inches
T_{BS} =	0.112	inches	T_M =	0.012	inches
T_{TP} =	1.229	inches	T_{FP} =	0.007	inches

Where
- H_{TC} = height of top cylinder
- H_{BC} = height of bottom cylinder
- D_{TC} = diameter of top cylinder
- D_{BC} = diameter of bottom cylinder
- T_M = latex membrane thickness
- T_{BS} = thickness of bottom porous stone
- T_{TP} = thickness of top platen
- T_{FP} = thickness of filter paper

Measurements of Sample Height (Datum: cell frame):

Reading Loc.	Bottom Platen (in)	Top of Top Platen (in)	Sample Height (in)
Front	**12.247**	4.724	6.182
Back	**12.253**	4.724	6.188
Right	**12.249**	4.724	6.184
Left	**12.251**	4.724	6.186
		AVG:	6.185

So target volume, V_{TAR}, is:

V_{TAR} = 38.13 in^3
624.9 cm^3

Minimum and maximum void ratios and specific gravity of solids are:

e_{min} = 0.65
e_{max} = 1.2
G_S = 2.22

Mixing Tube Dimensions Calculation Sheet:

D_r =	100%	
e =	0.65	
% V_T Voids =	39%	
% V_T Solids =	61%	
Mass solids =	840.72	g
$V_{S\_100\%Dr}$ =	378.70	cm^3
$V_{V\_0\%Dr}$ =	454.44	cm^3
V_{TOT} =	833.14	cm^3
V_{TUBE} =	874.80	cm^3
	53.384	in^3
D_{TUBE} =	2.5	inches
H_{TUBE_req} =	10.88	inches

Where

% V_T Voids =	percent of sample volume occupied by void space
% V_T Solids =	percent of sample volume occupied by solids
$V_{S\_100\%Dr}$ =	Volume of solids to prepare a sample at 100% relative density
$V_{V\_0\%Dr}$ =	Volume of voids at a placement relative density of 0%
V_{TOT} =	Volume of soil to prepare a sample with a target relative density of 100% at an initial relative density of 0%
V_{TUBE} =	Volume of specimen mixing tube
D_{TUBE} =	Inner diameter of mixing tube
H_{TUBE_req} =	Height of mixing tube of specified diameter

Specimen 1 Preparation Sheet:

D_{rTAR} =	70%	
M_{ash} =	764.3	g
w (%) =	29.2%	
M_{moist} =	987.9	g

Location	Target H_{TP} (in)	H_{BP} (in)	H_S (in)
Front	4.724	**12.247**	6.168
Back	4.724	**12.253**	6.174
Right	4.724	**12.249**	6.170
Left	4.724	**12.251**	6.172

Location	Initial H_{TP} (in)	Final H_{TP} (in)	H_{BP} (in)	H_{SI} (in)	H_{SF} (in)
Front	N/A	4.732	**12.247**	N/A	6.160
Back	N/A	4.7265	**12.253**	N/A	6.171
Right	N/A	4.728	**12.249**	N/A	6.166
Left	N/A	4.728	**12.251**	N/A	6.168

Fines Lost:		
Tare Name:	Cindy	
Tare:	475.0	g
Gross:	477.24	g
Net:	2.2	g
% Loss:	0.23%	

$G_{gelatin}$:		
Concentration :	0.75 % by mass	
Tare:	126.8	g
Gross:	224.5	g
Net:	97.7	g
Volume:	97.7	cm^3
$G_{gelatin}$:	1.000	

Approximate Placement D_r:		
D_{COLLAR} =	2.822	in
H_{SI_AVG} =	N/A	in
V_{CYL1} =	33.32	in^3
V_{CYL2} =	4.47	in^3
V_{CYL3} =	N/A	in^3
V_{TOT} =	N/A	in^3
V_{SOLIDS} =	N/A	in^3
V_{VOIDS} =	N/A	in^3
e =	N/A	
D_r =	N/A	

Approximate Densified D_r:		
V_{CYL2} =	4.315	in^3
V_{TOT} =	37.64	in^3
	616.74	cm^3
V_{SOLIDS} =	20.95	in^3
	343.29	cm^3
V_{VOIDS} =	16.69	in^3
	273.45	cm^3
e =	0.80	
D_r =	73.35%	

Specimen 1 Fabric Testing Sheet:

Volume Calculation Information:

D_{beaker} =	3.33162	in
$V_{1/100"}$ =	0.0872	in^3
	1.43	cm^3

Top Slice

					Sieve No.	Nominal diameter, mm	wt. retained (g)	% retained	% passing
Mass =	278.67	g	Sieve Analysis		#4	4.75	0.6	0.3%	99.7%
Weight =	0.614	lb			#10	2	2.4	1.5%	98.5%
Volume =	10.46	in^3	Tare Name:	Tare 1	#20	0.841	0.9	2.0%	98.0%
	171.43	cm^3	Tare Mass (g):	329.2	#30	0.595	0.3	2.1%	97.9%
Density =	0.059	lb/in^3	Tare + Dry Soil Mass (g):	525.1	#40	0.425	0.6	2.5%	97.5%
	1.63	g/cm^3	Tare + Dry Soil Mass After Washing (g):	360.3	#60	0.25	4.1	4.5%	95.5%
					#100	0.15	11.2	10.3%	89.7%
$Mass_{Ovendry}$ =	195.87	g			#200	0.075	26.8	23.9%	76.1%
$Mass_{Ovenwash}$ =	46.9	g		Subtract this from $Mass_{Ovenwash}$ =>	Pan		1.9	100.0%	0.0%
$\%Pass_{\#200}$ =	76%								
						% lost:	0.00%		

		Elapsed time (min)	Reading	Comp. Reading	L (cm) (ASTM table 2)	P (ASTM eqn. 2)	D (mm) (ASTM eqn. 4)
Hydrometer Analysis		1	37	31.4	10.2	70%	0.0617
Time readings begin:	6/14/2012 8:23	2	32	26.4	11.0	59%	0.0453
Hydrometer Type:	152H	4	27	21.4	11.9	48%	0.0332
Composite Correction:	5.6	8	23	17.4	12.5	39%	0.0241
Dry mass of soil tested (g):	50.0	15	19.5	13.9	13.1	31%	0.0180
$M_{retained\ on\ \#10\ seive}$ (g):	1.2	30	16.3	10.7	13.6	24%	0.0130
Dry mass of soil past #10 (g):	48.8	60	13	7.4	14.2	17%	0.0094
W (dry mass of soil represented) (g):	49.6	120	10.5	4.9	14.6	11%	0.0067
Temperature (° F):	69	250	9	3.4	14.8	8%	0.0047
G_s correction factor (ASTM D 422, Table 1); Interpolated!:	1.11	500	7.3	1.7	15.1	4%	0.0034
K (ASTM eq. 4, based on temp and G_s):	0.0193	1440	7.3	1.7	15.1	4%	0.0020
% Passing #10 Sieve:	98.5%						

Middle Slice											
						Sieve No.	Nominal diameter, mm	wt. retained (g)	% retained	% passing	
Mass =	327.5	g	Sieve Analysis			#4	4.75	0	0.0%	100.0%	
Weight =	0.722	lb				#10	2	0	0.0%	100.0%	
Volume =	11.59	in^3	Tare Name:	Tare 2		#20	0.841	0.2	0.1%	99.9%	
	190.00	cm^3	Tare Mass (g):	332.6		#30	0.595	0.4	0.3%	99.7%	
Density =	0.062	lb/in^3	Tare + Dry Soil Mass (g):	570.7		#40	0.425	1	0.7%	99.3%	
	1.72	g/cm^3	Tare + Dry Soil Mass After Washing (g):	386.6		#60	0.25	8.3	4.2%	95.8%	
						#100	0.15	19	12.1%	87.9%	
$Mass_{Ovendry}$ =	238.12	g				#200	0.075	36	27.3%	72.7%	
$Mass_{Ovenwash}$ =	64.9	g		Subtract this from $Mass_{Ovenwash}$ =>		Pan		2.5	100.0%	0.0%	
$\%Pass_{\#200}$ =	73%										
							% lost:	0.00%			
						Elapsed time (min)	Reading	Comp. Reading	L (cm) (ASTM table 2)	P (ASTM eqn. 2)	D (mm) (ASTM eqn. 4)
			Hydrometer Analysis			1	36.5	30.9	10.3	68%	0.0619
			Time readings begin:	152H		2	33.5	27.9	10.8	62%	0.0448
			Hydrometer Type:	6/14/2012 10:05		4	28.5	22.9	11.6	51%	0.0329
			Composite Correction:	5.6		8	23	17.4	12.5	38%	0.0241
			Dry mass of soil tested (g):	50		15	19	13.4	13.2	30%	0.0181
			$M_{retained\ on\ \#10\ seive}$ (g):	0		30	14.5	8.9	13.9	20%	0.0131
			Dry mass of soil past #10 (g):	50		60	12	6.4	14.3	14%	0.0094
			W (dry mass of soil represented) (g):	50		120	9	3.4	14.8	8%	0.0068
			Temperature (° F):	69		250	8.5	2.9	14.9	6%	0.0047
			G_s correction factor (ASTM D 422, Table 1); Interpolated!:	1.11		500	7.5	1.9	15.1	4%	0.0033
			K (ASTM eq. 4, based on temp and G_s):	0.0193		1440	7.5	1.9	15.1	4%	0.0020
			% Passing #10 Sieve:	100.0%							

Bottom Slice

Mass =	428.1	g
Weight =	0.944	lb
Volume =	14.65	in^3
	240.00	cm^3
Density =	0.064	lb/in^3
	1.78	g/cm^3
$Mass_{Ovendry}$ =	328.44	g
$Mass_{Ovenwash}$ =	113.6	g
$\%Pass_{\#200}$ =	65%	

Sieve Analysis

Tare Name:	Tare 3
Tare Mass (g):	333.7
Tare + Dry Soil Mass (g):	662.1
Tare + Dry Soil Mass After Washing (g):	436.2

Sieve No.	Nominal diameter, mm	wt. retained (g)	% retained	% passing
#4	4.75	0.6	0.2%	99.8%
#10	2	6.5	2.2%	97.8%
#20	0.841	10.2	5.3%	94.7%
#30	0.595	4.6	6.7%	93.3%
#40	0.425	5.6	8.4%	91.6%
#60	0.25	16.8	13.5%	86.5%
#100	0.15	25.2	21.2%	78.8%
#200	0.075	43.1	34.3%	65.7%
Subtract this from $Mass_{Ovenwash}$ => Pan		4.5	35.7%	64.3%
	% lost:	0.30%		

Hydrometer Analysis

Time readings begin:	152H
Hydrometer Type:	6/14/2012 11:43
Composite Correction:	5.6
Dry mass of soil tested (g):	50
$M_{retained\ on\ \#10\ seive}$ (g):	0.02
Dry mass of soil past #10 (g):	49.98
W (dry mass of soil represented) (g):	51.1
Temperature (° F):	69
G_s correction factor (ASTM D 422, Table 1); Interpolated!:	1.11
K (ASTM eq. 4, based on temp and G_s):	0.0193
% Passing #10 Sieve:	97.8%

Elapsed time (min)	Reading	Comp. Reading	L (cm) (ASTM table 2)	P (ASTM eqn. 2)	D (mm) (ASTM eqn. 4)
1	35	29.4	10.6	64%	0.0627
2	32	26.4	11.0	57%	0.0453
4	27.5	21.9	11.8	47%	0.0331
8	21.3	15.7	12.8	34%	0.0244
15	17	11.4	13.5	25%	0.0183
30	12.6	7	14.2	15%	0.0133
60	9.3	3.7	14.8	8%	0.0096
120	8.5	2.9	14.9	6%	0.0068
250	7	1.4	15.1	3%	0.0047
500	6.3	0.7	15.3	2%	0.0034
1440	6.3	0.7	15.3	2%	0.0020

Summary										
$\Sigma Mass_{Ovendry}$ =	762.43	g								
			Checks on Relative Density of Individual Slices:							
Mass =	1034.3	g								
Weight =	2.280	lb	Knowns:							
Volume =	36.70	in^3	V_{s1} =	171.43	cm^3	Slice 1:				
	601.43	cm^3	V_{s2} =	190.00	cm^3	V_{S_S1} =	87.90	cm^3	e_{S1} =	0.95
Density =	0.062	lb/in^3	V_{s3} =	240.00	cm^3	V_{G_S1} =	83.53	cm^3	D_{rS1} =	45%
	1.72	g/cm^3	m_{s1} =	278.7	g					
			m_{s2} =	327.5	g	Slice 2:				
M_{DRIED_FINES} =	2.24	g	m_{s3} =	428.1	g	V_{S_S2} =	112.71	cm^3	e_{S2} =	0.69
M_{DRY_SAMPLE} =	762.1	g	ρ_{S1} =	1.63	g/cm^3	V_{G_S2} =	77.29	cm^3	D_{rS2} =	93%
V_{SOLIDS} =	343.29	cm^3	ρ_{S2} =	1.72	g/cm^3					
	20.95	in^3	ρ_{S3} =	1.78	g/cm^3	Slice 3:				
V_{VOIDS} =	258.14	cm^3	G_s =	2.22		V_{S_S3} =	154.17	cm^3	e_{S3} =	0.56
	15.75	in^3	G_{gel} =	1.000		V_{G_S3} =	85.83	cm^3	D_{rS3} =	117%
e =	0.75								e_{avg} =	0.73
			M_{DRY_SAMPLE} =	787.6017474		V_{TOT} =	601.43	cm^3	D_{r_avg} =	85%
D_r =	81.5%									

Specimen 2 Preparation Sheet:

D_{rTAR} =	70%	
M_{ash} =	764.3	g
w (%) =	29.2%	
M_{moist} =	987.8	g

Location	Target H_{TP} (in)	H_{BP} (in)	H_S (in)
Front	4.724	**12.247**	6.168
Back	4.724	**12.253**	6.174
Right	4.724	**12.249**	6.170
Left	4.724	**12.251**	6.172

Location	Initial H_{TP} (in)	Final H_{TP} (in)	H_{BP} (in)	H_{SI} (in)	H_{SF} (in)
Front	4.245	4.729	**12.247**	6.648	6.163
Back	4.245	4.728	**12.253**	6.653	6.170
Right	4.245	4.731	**12.249**	6.649	6.163
Left	4.246	4.725	**12.251**	6.650	6.171

Fines Lost:

Tare Name:	Cindy	
Tare:	475.0	g
Gross:	476.3	g
Net:	1.3	g
% Loss:	0.13%	

$G_{gelatin}$:

Concentration :	0.75 % by mass	
Tare:	126.8	g
Gross:	224.8	g
Net:	98	g
Volume:	98	cm^3
$G_{gelatin}$:	1.000	

Approximate Placement D_r:

D_{COLLAR} =	2.825	
H_{IS_AVG} =	0.465	
V_{CYL1} =	33.66	in^3
V_{CYL2} =	4.52	in^3
V_{CYL3} =	2.86	in^3
V_{TOT} =	41.04	in^3
V_{SOLIDS} =	20.97	in^3
V_{VOIDS} =	20.07	in^3
e =	0.96	
D_r =	44%	

Approximate Densified D_r:

V_{CYL2} =	4.36	in^3
V_{TOT} =	38.02	in^3
	622.98	cm^3
V_{SOLIDS} =	20.97	in^3
	343.69	cm^3
V_{VOIDS} =	17.04	in^3
	279.29	cm^3
e =	0.81	
D_r =	70.43%	

Specimen 2 Fabric Testing Sheet:

Volume Calculation Information:

D_{beaker} =	3.33162	in
$V_{1/100"}$ =	0.087	in^3
	1.43	cm^3

Top Slice

Mass =	237	g
Weight =	0.522	lb
Volume =	9.07	in^3
	148.57	cm^3
Density =	0.058	lb/in^3
	1.60	g/cm^3
$Mass_{Ovendry}$ =	165.8	g
$Mass_{Ovenwash}$ =	41.1	g
$\%Pass_{\#200}$ =	75%	

Sieve Analysis

		Sieve No.	Nominal diameter, mm	wt. retained (g)	% retained	% passing
		#4	4.75	1.3	0.8%	99.2%
		#10	2	2.4	2.2%	97.8%
Tare Name:	Tare 4	#20	0.841	0.6	2.6%	97.4%
Tare Mass (g):	329.8	#30	0.595	0.3	2.8%	97.2%
Tare + Dry Soil Mass (g):	495.6	#40	0.425	0.4	3.0%	97.0%
Tare + Dry Soil Mass After Washing (g):	371.9	#60	0.25	3.1	4.9%	95.1%
		#100	0.15	9.7	10.7%	89.3%
		#200	0.075	23.1	24.7%	75.3%
	Subtract this from $Mass_{Ovenwash}$ =>	Pan		1	100.0%	0.0%
			% lost:	0.12%		

Hydrometer Analysis

		Elapsed time (min)	Reading	Comp. Reading	L (cm) (ASTM table	P (ASTM eqn. 2)	D (mm) (ASTM eqn. 4)
		1	36.5	31.5	10.3	70%	0.0624
Time readings begin:	6/15/2012 17:13	2	34	29	10.7	64%	0.0450
Hydrometer Type:	152H	4	28	23	11.7	51%	0.0332
Composite Correction:	5	8	25.2	20.2	12.2	45%	0.0240
Dry mass of soil tested (g):	50.0	15	18.5	13.5	13.3	30%	0.0183
$M_{retained\ on\ \#10\ seive}$ (g):	1.2	30	15	10	13.8	22%	0.0132
Dry mass of soil past #10 (g):	48.8	60	11.6	6.6	14.4	15%	0.0095
W (dry mass of soil represented) (g):	49.9	120	9.5	4.5	14.7	10%	0.0068
Temperature (° F):	68	250	7.6	2.6	15.0	6%	0.0048
G_s correction factor (ASTM D 422, Table 1); Interpolated!:	1.11	500	7.5	2.5	15.1	6%	0.0034
K (ASTM eq. 4, based on temp and G_s):	0.0194	1440	6	1	15.3	2%	0.0020
% Passing #10 Sieve:	97.8%						

Middle Slice

Mass =	367.1	g
Weight =	0.809	lb
Volume =	13.25	in^3
	217.14	cm^3
Density =	0.061	lb/in^3
	1.69	g/cm^3
$Mass_{Ovendry}$ =	265.97	g
$Mass_{Ovenwash}$ =	69	g
$\%Pass_{\#200}$ =	74%	

Sieve Analysis

		Sieve No.	Nominal diameter, mm	wt. retained (g)	% retained	% passing
		#4	4.75	0	0.0%	100.0%
		#10	2	0	0.0%	100.0%
Tare Name:	Tare 6	#20	0.841	0.2	0.1%	99.9%
Tare Mass (g):	329.8	#30	0.595	0.4	0.2%	99.8%
Tare + Dry Soil Mass (g):	595.8	#40	0.425	1.1	0.6%	99.4%
Tare + Dry Soil Mass After Washing (g):	400.0	#60	0.25	9.6	4.2%	95.8%
		#100	0.15	20.2	11.8%	88.2%
		#200	0.075	37.5	25.9%	74.1%
Subtract this from $Mass_{Ovenwash}$ =>		Pan		1.7	100.0%	0.0%
			% lost:	0.00%		

Hydrometer Analysis

		Elapsed time (min)	Reading	Comp. Reading	L (cm) (ASTM table	P (ASTM eqn. 2)	D (mm) (ASTM eqn. 4)
		1	35	30	10.6	66%	0.0631
Time readings begin:	152H	2	30	25	11.4	55%	0.0463
Hydrometer Type:	6/15/2012 14:54	4	25.3	20.3	12.1	45%	0.0339
Composite Correction:	5	8	20.5	15.5	12.9	34%	0.0247
Dry mass of soil tested (g):	50	15	15.3	10.3	13.8	23%	0.0186
$M_{retained\ on\ \#10\ seive}$ (g):	0	30	12	7	14.3	15%	0.0134
Dry mass of soil past #10 (g):	50	60	10	5	14.7	11%	0.0096
W (dry mass of soil represented) (g):	50	120	6.3	1.3	15.3	3%	0.0069
Temperature (° F):	68	250	5.6	0.6	15.4	1%	0.0048
G_s correction factor (ASTM D 422, Table 1); Interpolated!:	1.11	500	5.3	0.3	15.4	1%	0.0034
K (ASTM eq. 4, based on temp and G_s):	0.0194	1440	5	0	15.5	0%	0.0020
% Passing #10 Sieve:	100.0%						

Bottom Slice											
						Sieve No.	Nominal diameter, mm	wt. retained (g)	% retained	% passing	
Mass =	435.44	g	Sieve Analysis			#4	4.75	1.1	0.3%	99.7%	
Weight =	0.960	lb				#10	2	6.5	2.3%	97.7%	
Volume =	14.99	in^3	Tare Name:	Tare 5		#20	0.841	10.2	5.4%	94.6%	
	245.71	cm^3	Tare Mass (g):	335.8		#30	0.595	4.6	6.8%	93.2%	
Density =	0.064	lb/in^3	Tare + Dry Soil Mass (g):	666.8		#40	0.425	5.3	8.4%	91.6%	
	1.77	g/cm^3	Tare + Dry Soil Mass After Washing (g):	444.1		#60	0.25	16.3	13.3%	86.7%	
						#100	0.15	23	20.2%	79.8%	
$Mass_{Ovendry}$ =	331	g				#200	0.075	39.4	32.1%	67.9%	
$Mass_{Ovenwash}$ =	106.2	g		Subtract this from $Mass_{Ovenwash}$ =>		Pan		2.7	100.0%	0.0%	
$\%Pass_{\#200}$ =	68%										
							% lost:	-0.06%			
						Elapsed time (min)	Reading	Comp. Reading	L (cm) (ASTM table	P (ASTM eqn. 2)	D (mm) (ASTM eqn. 4)
			Hydrometer Analysis			1	35	30	10.6	65%	0.0631
			Time readings begin:	152H		2	28.3	23.3	11.7	50%	0.0469
			Hydrometer Type:	6/15/2012 15:19		4	24.3	19.3	12.3	42%	0.0341
			Composite Correction:	5		8	20.5	15.5	12.9	33%	0.0247
			Dry mass of soil tested (g):	50		15	16	11	13.7	24%	0.0186
			$M_{retained\ on\ \#10\ seive}$ (g):	0		30	12	7	14.3	15%	0.0134
			Dry mass of soil past #10 (g):	50		60	8	3	15.0	6%	0.0097
			W (dry mass of soil represented) (g):	51.2		120	6.3	1.3	15.3	3%	0.0069
			Temperature (° F):	68		250	5.6	0.6	15.4	1%	0.0048
			G_s correction factor (ASTM D 422, Table 1); Interpolated!:	1.11		500	5.3	0.3	15.4	1%	0.0034
			K (ASTM eq. 4, based on temp and G_s):	0.0194		1440	5	0	15.5	0%	0.0020
			% Passing #10 Sieve:	97.7%							

Summary										
$\Sigma Mass_{Ovendry}$ =	762.77	g								
			Checks on Relative Density of Individual Slices:							
Mass =	1039.5	g								
Weight =	2.292	lb	Knowns:							
Volume =	37.31	in^3	V_{s1} =	148.57	cm^3	Slice 1:				
	611.43	cm^3	V_{s2} =	217.14	cm^3	V_{S_S1} =	72.48	cm^3	e_{S1} =	1.05
Density =	0.061	lb/in^3	V_{s3} =	245.71	cm^3	V_{G_S1} =	76.09	cm^3	D_{rS1} =	27%
	1.70	g/cm^3	m_{s1} =	237.0	g					
			m_{s2} =	367.1	g	Slice 2:				
M_{DRIED_FINES} =	1.3	g	m_{s3} =	435.4	g	V_{S_S2} =	122.88	cm^3	e_{S2} =	0.77
M_{DRY_SAMPLE} =	763.0	g	ρ_{S1} =	1.60	g/cm^3	V_{G_S2} =	94.26	cm^3	D_{rS2} =	79%
V_{SOLIDS} =	343.69	cm^3	ρ_{S2} =	1.69	g/cm^3					
	20.97	in^3	ρ_{S3} =	1.77	g/cm^3	Slice 3:				
V_{VOIDS} =	267.74	cm^3	G_s =	2.22		V_{S_S3} =	155.51	cm^3	e_{S3} =	0.58
	16.34	in^3	G_{gel} =	1.000		V_{G_S3} =	90.20	cm^3	D_{rS3} =	113%
e =	0.78								e_{avg} =	0.80
			M_{DRY_SAMPLE} =	778.9496685		V_{TOT} =	611.43	cm^3	D_{r_avg} =	73%
D_r =	76.5%									

Specimen 3 Preparation Sheet:

D_{rTAR} =	70%	
M_{ash} =	764.3	g
w (%) =	29.2%	
M_{moist} =	987.8	g

Location	Target H_{TP} (in)	H_{BP} (in)	H_S (in)
Front	4.724	**12.247**	6.168
Back	4.724	**12.253**	6.174
Right	4.724	**12.249**	6.170
Left	4.724	**12.251**	6.172

Location	Initial H_{TP} (in)	Final H_{TP} (in)	H_{BP} (in)	H_{SI} (in)	H_{SF} (in)
Front	4.447	4.735	**12.247**	6.446	6.157
Back	4.449	4.734	**12.253**	6.449	6.164
Right	4.451	4.734	**12.249**	6.443	6.160
Left	4.446	4.735	**12.251**	6.450	6.161

Fines Lost:		
Tare Name:	Cindy	
Tare:	475.0	g
Gross:	477.3	g
Net:	2.3	g
% Loss:	0.23%	

$G_{gelatin}$:		
Concentration:	0.75% by mass	
Tare:	126.8	g
Gross:	225.55	g
Net:	98.75	g
Volume:	98	cm^3
$G_{gelatin}$:	1.008	

Approximate Placement D_r:		
D_{COLLAR} =	2.825	
H_{IS_AVG} =	0.262	in
V_{CYL1} =	33.66	in^3
V_{CYL2} =	4.52	in^3
V_{CYL3} =	1.61	in^3
V_{TOT} =	39.79	in^3
V_{SOLIDS} =	20.95	in^3
V_{VOIDS} =	18.84	in^3
e =	0.90	
D_r =	55%	

Approximate Densified D_r:		
V_{CYL2} =	4.32	in^3
V_{TOT} =	37.98	in^3
	622.34	cm^3
V_{SOLIDS} =	20.95	in^3
	343.24	cm^3
V_{VOIDS} =	17.03	in^3
	279.10	cm^3
e =	0.81	
D_r =	70.34%	

Specimen 3 Fabric Testing Sheet:

Volume Calculation Information:

D_{beaker} =	3.33162	in
$V_{1/100"}$ =	0.087	in^3
	1.43	cm^3

Top Slice

Mass =	257.6	g
Weight =	0.568	lb
Volume =	10.20	in^3
	167.14	cm^3
Density =	0.056	lb/in^3
	1.54	g/cm^3
$Mass_{Ovendry}$ =	174.8	g
$Mass_{Ovenwash}$ =	42.7	g
$\%Pass_{\#200}$ =	76%	

Sieve Analysis

Tare Name:	Tare 1
Tare Mass (g):	329.2
Tare + Dry Soil Mass (g):	504.0
Tare + Dry Soil Mass After Washing (g):	374.0

Sieve No.	Nominal diameter, mm	wt. retained (g)	% retained	% passing
#4	4.75	1.2	0.7%	99.3%
#10	2	1.8	1.7%	98.3%
#20	0.841	0.8	2.2%	97.8%
#30	0.595	0.3	2.3%	97.7%
#40	0.425	0.4	2.6%	97.4%
#60	0.25	2.9	4.2%	95.8%
#100	0.15	9.4	9.6%	90.4%
#200	0.075	26.1	24.5%	75.5%
Subtract this from $Mass_{Ovenwash}$ => Pan		2.6	100.0%	0.0%
	% lost:	-0.11%		

Hydrometer Analysis

Time readings begin:	6/16/2012 12:57
Hydrometer Type:	152H
Composite Correction:	5.3
Dry mass of soil tested (g):	50.0
$M_{retained\ on\ \#10\ seive}$ (g):	1.2
Dry mass of soil past #10 (g):	48.8
W (dry mass of soil represented) (g):	49.7
Temperature (° F):	71.6
G_s correction factor (ASTM D 422, Table 1); Interpolated!:	1.11
K (ASTM eq. 4, based on temp and G_s):	0.0190
% Passing #10 Sieve:	98.3%

Elapsed time (min)	Reading	Comp. Reading	L (cm) (ASTM table 2)	P (ASTM eqn. 2)	D (mm) (ASTM eqn. 4)
1	39	33.7	9.9	75%	0.0597
2	34	28.7	10.7	64%	0.0439
4	31	25.7	11.2	57%	0.0317
8	26.3	21	12.0	47%	0.0232
15	20.5	15.2	12.9	34%	0.0176
30	18.5	13.2	13.3	29%	0.0126
60	13	7.7	14.2	17%	0.0092
120	10	4.7	14.7	10%	0.0066
250	9	3.7	14.8	8%	0.0046
500	8	2.7	15.0	6%	0.0033
1440	5.3	0	15.4	0%	0.0020

Middle Slice

Mass =	349.9	g
Weight =	0.771	lb
Volume =	12.64	in^3
	207.14	cm^3
Density =	0.061	lb/in^3
	1.69	g/cm^3
$Mass_{Ovendry}$ =	256.3	g
$Mass_{Ovenwash}$ =	71.3	g
$\%Pass_{\#200}$ =	72%	

		Sieve No.	Nominal diameter, mm	wt. retained (g)	% retained	% passing
Sieve Analysis		#4	4.75	0.4	0.2%	99.8%
		#10	2	1.2	0.6%	99.4%
Tare Name:	Tare 2	#20	0.841	1.3	1.1%	98.9%
Tare Mass (g):	332.5	#30	0.595	0.9	1.5%	98.5%
Tare + Dry Soil Mass (g):	588.8	#40	0.425	1.5	2.1%	97.9%
Tare + Dry Soil Mass After Washing (g):	406.4	#60	0.25	8.6	5.4%	94.6%
		#100	0.15	18.6	12.7%	87.3%
		#200	0.075	38.4	27.7%	72.3%
	Subtract this from $Mass_{Ovenwash}$ =>	Pan		2.9	100.0%	0.0%
			% lost:	0.16%		

		Elapsed time (min)	Reading	Comp. Reading	L (cm) (ASTM table 2)	P (ASTM eqn. 2)	D (mm) (ASTM eqn. 4)
Hydrometer Analysis		1	34	28.7	10.7	63%	0.0621
Time readings begin:	152H	2	28.3	23	11.7	51%	0.0458
Hydrometer Type:	6/16/2012 13:30	4	24.6	19.3	12.3	42%	0.0332
Composite Correction:	5.3	8	20	14.7	13.0	32%	0.0242
Dry mass of soil tested (g):	50	15	17	11.7	13.5	26%	0.0180
$M_{retained\ on\ \#10\ seive}$ (g):	0	30	13.2	7.9	14.1	17%	0.0130
Dry mass of soil past #10 (g):	50	60	8	2.7	15.0	6%	0.0095
W (dry mass of soil represented) (g):	50.31409501	120	6.6	1.3	15.2	3%	0.0068
Temperature (° F):	71.6	250	6	0.7	15.3	2%	0.0047
G_s correction factor (ASTM D 422, Table 1); Interpolated!:	1.11	500	5.3	0	15.4	0%	0.0033
K (ASTM eq. 4, based on temp and G_s):	0.0190	1440	5.3	0	15.4	0%	0.0020
% Passing #10 Sieve:	99.4%						

Bottom Slice

						Sieve No.	Nominal diameter, mm	wt. retained (g)	% retained	% passing	
Mass =	410.1	g	Sieve Analysis			#4	4.75	1	0.3%	99.7%	
Weight =	0.904	lb				#10	2	4.4	1.7%	98.3%	
Volume =	14.12	in^3	Tare Name:	Tare 3		#20	0.841	6.6	3.8%	96.2%	
	231.43	cm^3	Tare Mass (g):	333.6		#30	0.595	3	4.8%	95.2%	
Density =	0.064	lb/in^3	Tare + Dry Soil Mass (g):	646.3		#40	0.425	4.7	6.3%	93.7%	
	1.77	g/cm^3	Tare + Dry Soil Mass After Washing (g):	441.7		#60	0.25	16.1	11.4%	88.6%	
						#100	0.15	24.6	19.3%	80.7%	
$Mass_{Ovendry}$ =	312.7	g				#200	0.075	42.1	32.8%	67.2%	
$Mass_{Ovenwash}$ =	103.1	g		Subtract this from $Mass_{Ovenwash}$ =>		Pan		5.4	100.0%	0.0%	
$\%Pass_{\#200}$ =	67%										
							% lost:	0.19%			
						Elapsed time (mi	Reading	Comp. Reading	L (cm) (ASTM table 2)	P (ASTM eqn. 2)	D (mm) (ASTM eqn. 4)
			Hydrometer Analysis			1	30	24.7	11.4	54%	0.0640
			Time readings begin:	152H		2	26.5	21.2	11.9	46%	0.0463
			Hydrometer Type:	6/16/2012 14:03		4	20.5	15.2	12.9	33%	0.0341
			Composite Correction:	5.3		8	18.3	13	13.3	28%	0.0244
			Dry mass of soil tested (g):	50		15	15.3	10	13.8	22%	0.0182
			$M_{retained\ on\ \#10\ seive}$ (g):	0.02		30	11.3	6	14.4	13%	0.0132
			Dry mass of soil past #10 (g):	49.98		60	8.5	3.2	14.9	7%	0.0094
			W (dry mass of soil represented) (g):	50.9		120	8.4	3.1	14.9	7%	0.0067
			Temperature (° F):	71.6		250	6	0.7	15.3	2%	0.0047
			G_s correction factor (ASTM D 422, Table 1); Interpolated!:	1.11		500	5.6	0.3	15.4	1%	0.0033
						1440	5.3	0	15.4	0%	0.0020
			K (ASTM eq. 4, based on temp and G_s):	0.0190							
			% Passing #10 Sieve:	98.3%							

Summary											
$\Sigma Mass_{Ovendry}$ =	743.8	g									
			Checks on Relative Density of Individual Slices:								
Mass =	1017.6	g									
Weight =	2.243	lb	Knowns:								
Volume =	36.96	in^3	V_{s1} =	167.14	cm^3	Slice 1:					
	605.71	cm^3	V_{s2} =	207.14	cm^3		V_{S_S1} =	73.56	cm^3	e_{S1} =	1.27
Density =	0.061	lb/in^3	V_{s3} =	231.43	cm^3		V_{G_S1} =	93.58	cm^3	D_{rS1} =	-13%
	1.68	g/cm^3	m_{s1} =	257.6	g						
			m_{s2} =	349.9	g	Slice 2:					
M_{DRIED_FINES} =	2.3	g	m_{s3} =	410.1	g		V_{S_S2} =	116.40	cm^3	e_{S2} =	0.78
M_{DRY_SAMPLE} =	762.0	g	ρ_{S1} =	1.54	g/cm^3		V_{G_S2} =	90.74	cm^3	D_{rS2} =	76%
V_{SOLIDS} =	343.24	cm^3	ρ_{S2} =	1.69	g/cm^3						
	20.95	in^3	ρ_{S3} =	1.77	g/cm^3	Slice 3:					
V_{VOIDS} =	262.48	cm^3	G_s =	2.22			V_{S_S3} =	145.92	cm^3	e_{S3} =	0.59
	16.02	in^3	G_{gel} =	1.008			V_{G_S3} =	85.51	cm^3	D_{rS3} =	112%
e =	0.76									e_{avg} =	0.88
			M_{DRY_SAMPLE} =	745.65			V_{TOT} =	605.71	cm^3	D_{r_avg} =	58%
D_r =	79.1%										

Note: Top Slice not cured; bottom two slices were

APPENDIX D

Dallman Boring Log and Cross Section

psi *Information To Build On*
Engineering • Consulting • Testing

August 30, 2010

City Water, Light & Power
Environmental Health & Safety
201 East Lake Shore Drive
Springfield, Illinois 62712

Attn: Ms. Sue Corcoran
Tel: 217-757-8610
Fax: 217-757-8615

Re: Piezometer Installation
CWLP Ash Ponds
East Lake Shore Drive
Springfield, Illinois
PSI Report No. 0020522-1 Rev. 1 Page 1 of 22 (including attachments)

Dear Ms. Corcoran:

In general accordance with your instructions, Professional Service Industries, Inc. (PSI) has completed the installation of four (4) temporary piezometers at the periphery of CWLP's ash pond area in Springfield, Illinois. Additionally, certain laboratory analysis was performed, as was in situ hydraulic conductivity (slug) testing. The piezometer locations are identified on the attached location plan. Boring depths and static water levels are shown in the table below.

	AP-1	AP-2	AP-3	AP-4
Date drilled	4/21/2010	4/21/2010	4/21/2010	4/20/2010
Total boring depth (ft)	31.5	20	19.5	60
Piezometer depth from top of first casing above ground surface (ft)	33.15	19.47	19.63	58.93
Piezometer depth from ground surface (ft)	28.34	17.18	17.91	58.31
Well screen length (ft)	10	10	10	10
Static water level from ground surface (5/5/2010)	4.81	3.89	5.16	5.95

The borings were drilled to depths ranging from approximately 17.2 to 58.3 feet below the existing ground surface, respectively. It is PSI's understanding that the purpose for these soil borings is to aid CWLP in assessing the groundwater quality outside the existing CWLP ash ponds. The general boring locations were determined and located in the field by CWLP personnel. With the approval of Ms. Corcoran, AP-2 was offset to the north of the clarifier pond drainage pipe. Depths on the attached boring logs are relative to the ground surface at each boring location.

Water level observations were made during and upon completion of the boring operations and are noted on the boring logs presented herewith. In addition, static water levels were observed at the time of the slug testing. In relatively impervious soils, the accurate determination of the groundwater elevation may not be possible even after several days of observation. Seasonal variations, temperature and recent rainfall conditions may influence the levels of the groundwater table and volumes of water will depend on the permeability of the soils.

Soil samples were visually classification in the field for logging purposes. The limited laboratory testing program included grain size analysis. Where soil tests are reported, they have been performed in accordance with generally acceptable or applicable standards. Sieve analysis worksheets are appended. Soil samples were conveyed to CWLP upon completion of the well installation activities.

A copy of the boring logs are appended. The stratification of the soils on the log represents the soil conditions in the actual boring location. Lines of demarcation represent the approximate boundaries between the soil types, but the transition may be gradual.

On May 5, 2010, in situ rising head hydraulic conductivity (slug) testing was performed on each of the four piezometers. Testing was conducted by rapidly removing one bailer (1 liter) of groundwater from the well while recording the rate of recovery using a Solinst 3001 level logger. Hydraulic conductivity was estimated using the Hvorslev method. Based on this method, the average hydraulic conductivity was estimated at 2.50E-02. Slug test results and hydraulic conductivity calculations are appended.

PSI appreciates the opportunity to perform these services and if we can be of further service, please contact our office at (217) 544-6663.

Respectfully submitted,
PROFESSIONAL SERVICE INDUSTRIES, INC.

James Gerloff, E.I.
Branch Manager

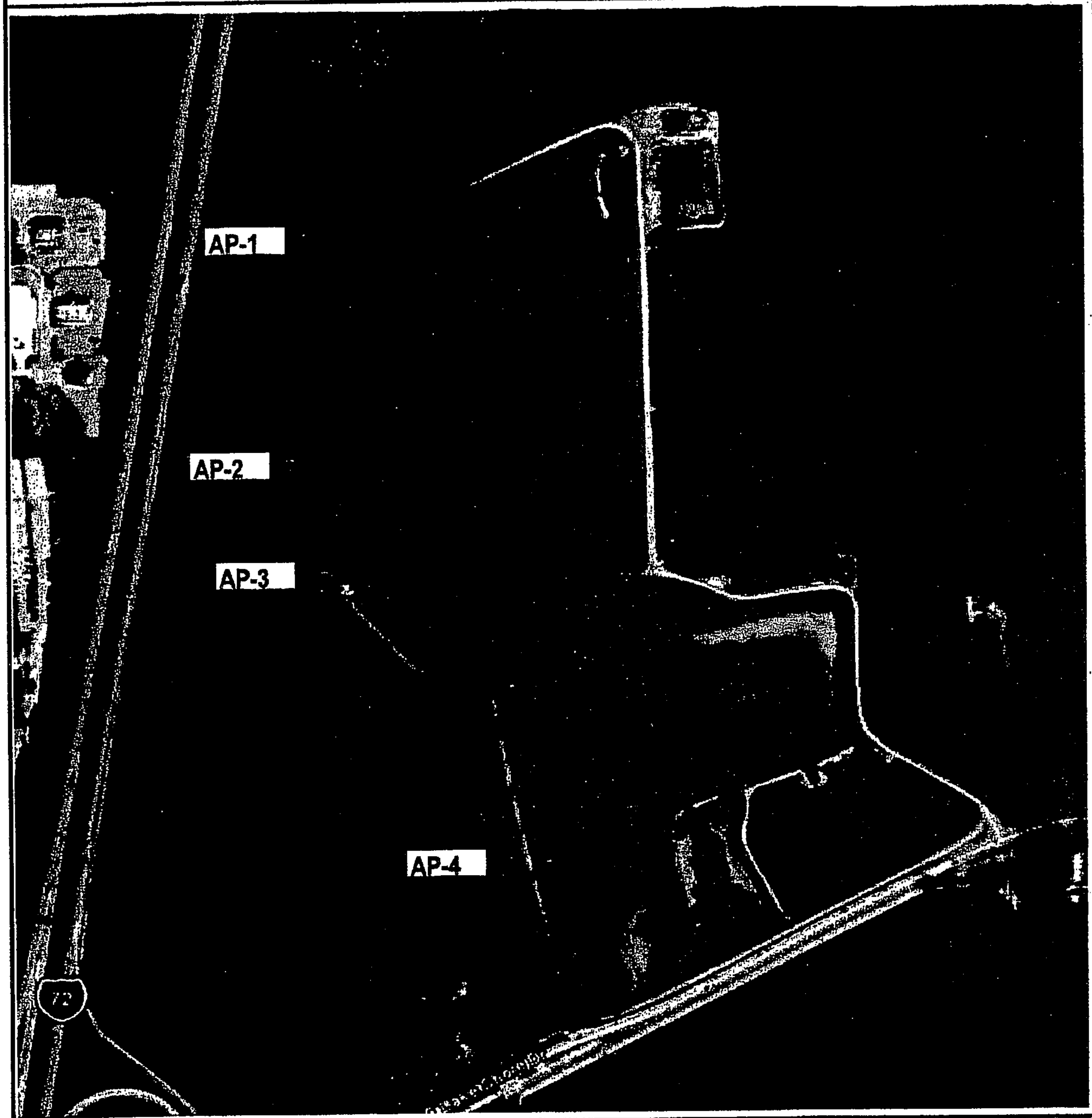
William P. Pongracz, P.E.
Vice President

Attachments:
- Key to Symbols
- Boring Logs (4 pages)
- Piezometer Location Plan
- In-Situ Hydraulic Conductivity Results (6 pages)
- Sieve Analysis Worksheets (8 pages)

Distribution: (1) above

PIEZOMETER LOCATION PLAN

SOURCE:	DATE:	SCALE:	
Google © 2010 / DigitalGlobe © 2010	Nov-05	No Scale	



psi Information To Build On
Engineering • Consulting • Testing
480 North Street, Springfield, Illinois 62704
phone 217/544-6663 fax 217/544-6148

PIEZOMETER LOCATION PLAN

PSI PROJECT No.:	0020522
Project:	Piezometer Installation
Location:	CWLP Ash Pond East Lake Shore Drive Springfield, Illinois

KEY TO SYMBOLS

Symbol	Description
(cross-hatched)	Fill (made ground)
(diagonal hatch)	USCS Low Plasticity Clay
(vertical lines)	USCS Silt
(diagonal hatch)	USCS Low Plasticity Sandy Clay
(hatch and dots)	USCS Clayey Sand
(dots and lines)	USCS Well-graded Sand with Silt
(fine dots)	USCS Poorly-graded Sand
(dots)	USCS Well-graded Sand

HSA = Hollow Stem Auger

CFA = Continuous Flight Auger

SPT = Standard Penetration Test

DCP = Dynamic Cone Penetrometer

SS = Split-spoon Sampler

ST = Shelby Tube Sampler

RC = Rock Core

DD = Dry Density

LL = Liquid Limit

PL = Plastic Limit

Qu = Unconfined Compressive Strength

Qp = Pocket Penetrometer

RQD = Rock Quality Designation

REC'D = Rock Core Recovery Percentage

PID = Photo Ionic Detector (ppm)

MR* = Unable to determine depth of water due to mud rotary drilling methods

The borings were advanced into the ground using hollow stem augers. At regular intervals throughout the boring depths, soil samples were obtained with either a 1.4-inch I.D., 2.0-inch O.D., split-spoon sampler or a 3-inch diameter Shelby tube. The split-spoon sampler was first seated 6-inches to penetrate any loose cuttings and then driven an additional foot where possible with blows of a 140 pound hammer falling 30-inches. The number of hammer blows required to drive the sampler each 6-inch increment is recorded in the field. The penetration resistance "N-value" is redesignated as the number of hammer blows required to drive the sampler the final foot and, when properly evaluated, is an index to cohesion for clays and relative density for sands. The split-spoon sampling procedures used during this exploration are in general accordance with ASTM Designation D 1586.

Relatively undisturbed Shelby tube samples were obtained by forcing a section of 3-inch diameter steel tubing into the soil at the desired sampling levels. This sampling procedure was in general accordance with ASTM Designation D 1587. Each tube, together with the encased soil, was carefully removed from the ground, sealed and transported to the laboratory for testing.

Professional Service Industries, Inc.
480 North Street
Springfield, Illinois 62704
Telephone: 217/544-6663
Fax: 217/544-6143

PSI Job No.: 0020522
Project: Piezometer Installation
Location: CWLP Ash Pond, East Lake Shore Drive, Springfield, Illinois

Professional Service Industries, Inc.
480 North Street
Springfield, Illinois 62704
Telephone: 217/544-6663
Fax: 217/544-6143

LOG OF BORING AP-1

Sheet 1 of 1

PSI Job No.: 0020522
Project: Piezometer Installation
Location: CWLP Ash Pond
East Lake Shore Drive
Springfield, Illinois

Drilling Method: Hollow Stem Auger
Sampling Method: Split Spoon
Hammer Type: CME Automatic; ETR = 86%
Boring Location: See attached boring location plan.

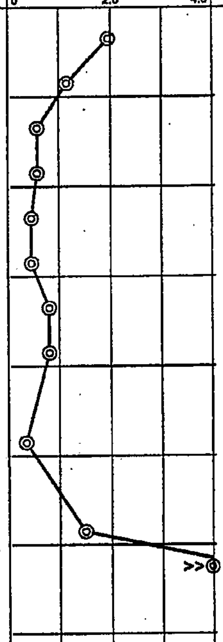
WATER LEVELS

While Drilling	9 feet
Upon Completion	N/A
Delay	N/A

Station: N/A
Offset: N/A

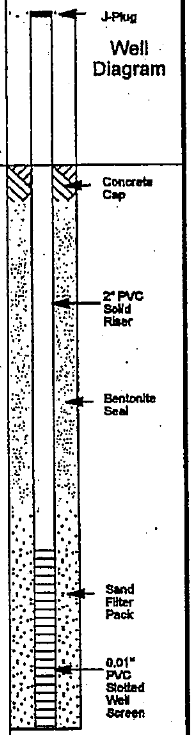
Depth, (feet)	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)
0	Split-Spoon	1	18	Dark brown silty CLAY, very stiff, slightly moist	CL	7-8-9 N_{60}=24
	Split-Spoon	2	18	Dark brown clayey SILT, stiff, slightly moist	ML	5-5-5 N_{60}=14
5	Split-Spoon	3	18	Gray clayey SILT, trace brown, firm, moist	ML	2-2-3 N_{60}=7
	Split-Spoon	4	18			2-2-3 N_{60}=7
10	Split-Spoon	5	18			1-2-2 N_{60}=6
	Split-Spoon	6	18	Gray silty CLAY, few brown sand, firm, saturated	CL	1-2-2 N_{60}=6
15	Split-Spoon	7	18	Gray sandy CLAY, stiff, saturated	CLS	4-3-4 N_{60}=10
	Split-Spoon	8	18	Blue-gray clayey SILT, soft to very stiff, moist to saturated	ML	3-3-4 N_{60}=10
25	Split-Spoon	9	18			1-2-1 N_{60}=4
	Split-Spoon	10	18	Gray SAND with SILT, medium dense/very stiff, saturated	SW-SM	6-7-6 N_{60}=19
30	Split-Spoon	11	6	Gray SHALE, hard, slightly moist	CL	50/6"
				Boring terminated ay -31.5'		

STANDARD PENETRATION TEST DATA
N in blows/ft ◎
× Moisture ◪ PL ✚ LL
0 25 50
STRENGTH, tsf
▲ Qu ✳ Qp
0 2.0 4.0



Additional Remarks

Well Diagram



Completion Depth: 35.0 ft
Date Boring Started: 4/21/10
Date Boring Completed: 4/21/10
Logged By: Rob Preuss
Drilling Contractor: PSI, Inc.

Sample Types:
Auger Cutting
Split-Spoon
Rock Core
Shelby Tube
Hand Auger
Texas Cone

Latitude:
Longitude:
Drill Rig: ATV D50
Remarks: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633. Moistures determined by visual methods

The stratification lines represent approximate boundaries. The transition may be gradual.

Professional Service Industries, Inc.
480 North Street
Springfield, Illinois 62704
Telephone: 217/544-6663
Fax: 217/544-6143

LOG OF BORING AP-2

Sheet 1 of 1

PSI Job No.: 0020522
Project: Piezometer Installation
Location: CWLP Ash Pond, East Lake Shore Drive, Springfield, Illinois

Drilling Method: Hollow Stem Auger
Sampling Method: Split Spoon
Hammer Type: CME Automatic; ETR = 86%
Boring Location: See attached boring location plan.

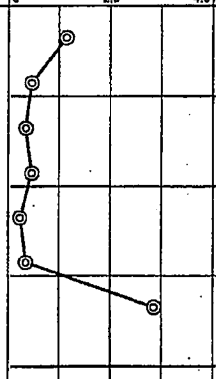
WATER LEVELS

While Drilling	9 feet
Upon Completion	N/A
Delay	N/A

Station: N/A
Offset: N/A

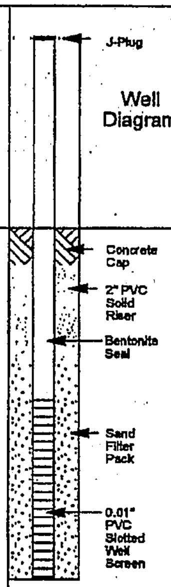
Elevation (feet)	Depth, (feet)	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %
	0	Split-Spoon	1	10	Dark brown silty CLAY, some sand, stiff, slightly moist (FILL)	CL	4-4-6 N_{60}=14	
		Split-Spoon	2	8	Dark brown silty CLAY, soft to firm, moist	CL	2-2-2 N_{60}=6	
	5	Split-Spoon	3	6	Gray silty CLAY, soft to firm, moist	CL	1-1-2 N_{60}=4	
		Split-Spoon	4	18	Gray clayey SILT, soft to firm, saturated	ML	2-2-2 N_{60}=6	
	10	Split-Spoon	5	18			2-1-1 N_{60}=3	
		Split-Spoon	6	18			2-1-2 N_{60}=4	
	15	Split-Spoon	7	18	Light gray SAND, dense, saturated	SP	4-9-16 N_{60}=36	
		Split-Spoon	8	14	Gray SHALE, hard, slightly moist	CL	19-24-50/2"	
	20				Boring terminate at -20'			

STANDARD PENETRATION TEST DATA
N in blows/ft ◎
× Moisture ◪ PL ✚ LL
0 25 50
STRENGTH, tsf
▲ Qu ✳ Qp
0 2.0 4.0



Additional Remarks

Well Diagram



Completion Depth:	20.0 ft
Date Boring Started:	4/21/10
Date Boring Completed:	4/21/10
Logged By:	Rob Preuss
Drilling Contractor:	PSI, Inc.

Sample Types:
Auger Cutting, Split-Spoon, Rock Core, Shelby Tube, Hand Auger, Texas Cone

Latitude:
Longitude:
Drill Rig: ATV D50
Remarks: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633. Moistures determined by visual methods.

The stratification lines represent approximate boundaries. The transition may be gradual.

Professional Service Industries, Inc.
480 North Street
Springfield, Illinois 62704
Telephone: 217/544-6663
Fax: 217/544-6143

LOG OF BORING AP-3

PSI Job No.: 0020522
Project: Piezometer Installation
Location: CWLP Ash Pond
East Lake Shore Drive
Springfield, Illinois

Drilling Method: Hollow Stem Auger
Sampling Method: Split Spoon
Hammer Type: CME Automatic; ETR = 86%
Boring Location: See attached boring location plan.

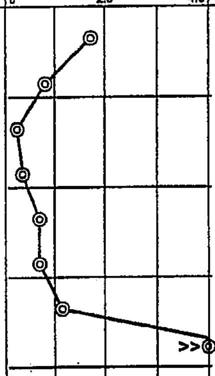
WATER LEVELS

While Drilling	None feet
Upon Completion	N/A
Delay	N/A

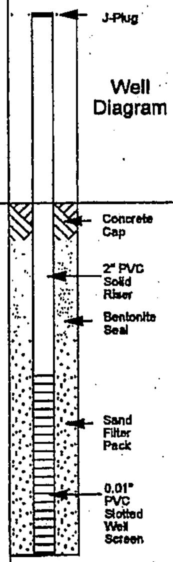
Station: N/A
Offset: N/A

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0		Split-Spoon	1	18	Dark brown silty CLAY, very stiff, slightly moist	CL	6-7-8 N_{60}=21		
	5		Split-Spoon	2	18	Gray/brown clayey SILT, soft to stiff, moist to saturated	ML	3-3-4 N_{60}=10		
			Split-Spoon	3	18			1-1-1 N_{60}=3		
	10		Split-Spoon	4	18	Gray clayey SILT, soft to very stiff, saturated	ML	2-1-2 N_{60}=4		
			Split-Spoon	5	18			2-2-4 N_{60}=9		
	15		Split-Spoon	6	16			2-2-4 N_{60}=9		
			Split-Spoon	7	18			4-4-6 N_{60}=14		
	20		Split-Spoon	8	10	Gray SHALE, hard, slightly moist Boring terminated at -19.5	CL	32-50/3"		

STANDARD PENETRATION TEST DATA
N in blows/ft ⊙
× Moisture ◪ PL ✚ LL
0 25 50
STRENGTH, tsf
▲ Qu ✳ Qp
0 2.0 4.0



Well Diagram



Completion Depth:	20.0 ft
Date Boring Started:	4/21/10
Date Boring Completed:	4/21/10
Logged By:	Rob Preuss
Drilling Contractor:	PSI, Inc.

Sample Types:
Auger Cutting
Split-Spoon
Rock Core
Shelby Tube
Hand Auger
Texas Cone

Latitude:
Longitude:
Drill Rig: ATV D50
Remarks: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633. Moistures determined by visual methods

The stratification lines represent approximate boundaries. The transition may be gradual.

Professional Service Industries, Inc.
480 North Street
Springfield, Illinois 62704
Telephone: 217/544-6663
Fax: 217/544-6143

LOG OF BORING AP-4

Sheet 1 of 1

PSI Job No.: 0020522
Project: Piezometer Installation
Location: CWLP Ash Pond, East Lake Shore Drive, Springfield, Illinois

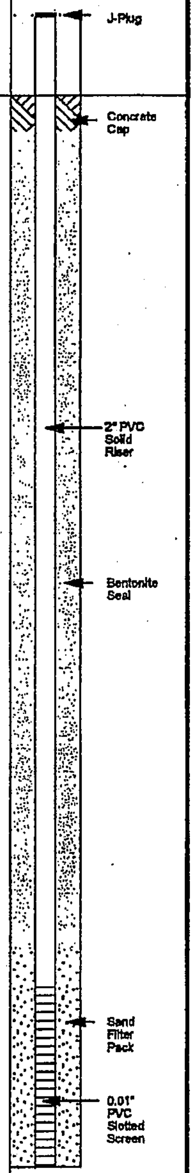
Drilling Method: Hollow Stem Auger
Sampling Method: Split Spoon
Hammer Type: CME Automatic; ETR = 86%
Boring Location: See attached boring location plan.

WATER LEVELS
- While Drilling: 11 feet
- Upon Completion: N/A
- Delay: N/A

Station: N/A
Offset: N/A

STANDARD PENETRATION TEST DATA: N in blows/ft ◎; × Moisture; PL; LL (0 – 25 – 50). STRENGTH, tsf: ▲ Qu; ✳ Qp (0 – 2.0 – 4.0)

Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)
Split-Spoon	1	17	Brown silty CLAY, some brown sand, firm to stiff, slightly moist (FILL)	CL	4-4-3 N_{60}=10
Split-Spoon	2	18	Brown silty CLAY, trace roots, firm to stiff, moist (FILL)	CL	4-3-2 N_{60}=7
Split-Spoon	3	10	Brown SILT, trace gray, firm to stiff, moist (FILL)	ML	6-3-2 N_{60}=7
Split-Spoon	4	12	5" Brown SAND transitioning to Black FLY ASH at 9.4', stiff to very stiff, slightly moist (FILL)	SAND/FLY ASH	2-2-4 N_{60}=9
Split-Spoon	5	18			2-2-2 N_{60}=6
Split-Spoon	6	16			2-1-1 N_{60}=3
Split-Spoon	7	16	Black FLY ASH, some fine sub-round gravel, stiff to very stiff, moist to saturated (FILL)	FLY ASH	6-6-5 N_{60}=16
Split-Spoon	8	18	Gray/green (organic?) CLAY, stiff, trace fine sand, moist to saturated		3-3-3 N_{60}=9
Split-Spoon	9	1		CL	3-3-4 N_{60}=10
Split-Spoon	10	18	Brown/gray silty CLAY, fiorm to stiff, saturated	CL	2-2-3 N_{60}=7
Split-Spoon	11	18	Gray SILT, stiff to very stiff, saturated		3-3-4 N_{60}=10
Split-Spoon	12	18		ML	4-4-4 N_{60}=11
Split-Spoon	13	18			4-4-6 N_{60}=14
Split-Spoon	14	18	Gray fine to coarse SAND, medium dense, saturated		4-5-7 N_{60}=17
Split-Spoon	15	18		SW	5-5-7 N_{60}=17
Split-Spoon	16	1	Gray SHALE, hard, moist	CL	50/1"
			Boring terminated at -60'		



Completion Depth: 60.0 ft
Date Boring Started: 4/20/10
Date Boring Completed: 4/20/10
Logged By: Rob Preuss
Drilling Contractor: PSI, Inc.

Sample Types: Auger Cutting, Split-Spoon, Rock Core, Shelby Tube, Hand Auger, Texas Cone

Latitude:
Longitude:
Drill Rig: ATV D50
Remarks: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633. Moistures determined by visual methods.

The stratification lines represent approximate boundaries. The transition may be gradual.

In-Situ Hydraulic Conductivity Test Analysis
Utlizing the Hvorslev Slug Test Method[1]

GOVERNING EQUATION:
$K = (r^2 * \ln(L_e/R))/(2L_eT_o)$
K is the hydraulic conductivity (cm/sec)
r is the radius of the well casing (cm)
R is the radius of the borehole (cm)
L_e is the length of the well screen (cm)
T_o is the time it takes for the water level to rise or fall 37% of the initial change (sec)

CWLP Ash Ponds, East Lake Shore Drive, Springfield, Illinois In-Situ Hydraulic Conductivity Analysis[2]

Test Number	Test Type	L_e (ft)	L_e (cm)	T_o (min)	T_o (sec)	K (cm/sec)
AP-4	Rising Head	10.0	304.8	0.025	1.500	7.64E-02
AP-3	Rising Head	10.0	304.8	0.083	4.980	2.30E-02
AP-2.1	Rising Head	10.0	304.8	0.150	9.000	1.27E-02
AP-2.2	Rising Head	10.0	304.8	0.167	10.020	1.14E-02
AP-1	Rising Head	10.0	304.8	1.667	100.020	1.15E-03
					AVERAGE:	2.50E-02

CONSTANTS			
r (inch)	r (cm)	R (inch)	R (cm)
2.0	5.08	8.0	20.3

HVORSLEV CALCULATIONS						
Test	L_e/R (-)	$\ln(L_e/R)$ (-)	L_eT_o (cm*sec)	K (cm/sec)		
AP-4	15.00	2.71	4.57E+02	7.64E-02		
AP-3	15.00	2.71	1.52E+03	2.30E-02		
AP-2.1	15.00	2.71	2.74E+03	1.27E-02		
AP-2.2	15.00	2.71	3.05E+03	1.14E-02	AP-2 AVG:	1.21E-02
AP-1	15.00	2.71	3.05E+04	1.15E-03		

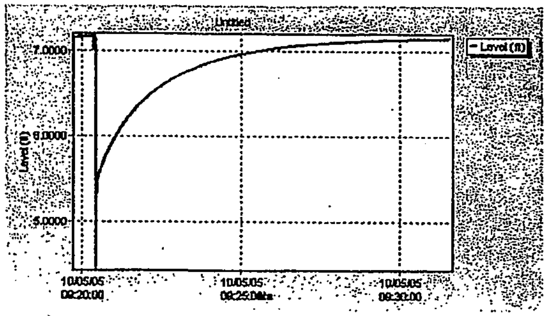
Notes:

[1] Hvorslev slug test method applied as described by C.W. Fetter in Applied Hydrology (Third Edition) published by Prentice-Hall in New Jersey in 1994 on pages 247-251.

[2] In-situ hydraulic conductivity tests conducted on monitoring wells, MW-1 thru MW-4 on May 5, 2010.

Solinst	3001	
Report generated:	5/11/2010	
Report from file:	...\mw-4.csv	
Serial number:	1032308	
Unit name:	Solinst 3001	
Test name:	AP-1	Test 1
Test defined on:	5/5/2010	
Test started on:	5/5/2010	9:20:28
Test stopped on:	5/5/2010	9:21:41
Data gathered using Linear testing		
Time between data points:	1	Seconds
Number of data samples:	75	
TOTAL DATA SAMPLES	75	
Channel number [1]		
Measurement type:	Level	
Unit	feet	
Channel number [2]		
Measurement type:	Temperature	
Unit	Deg C	
Sensor Range:		
Specific gravity:		
Mode:	TOC	
User-defined reference*:	33.15	Feet H2O
Referenced on:	test start	
Pressure head at reference:		Feet H2O

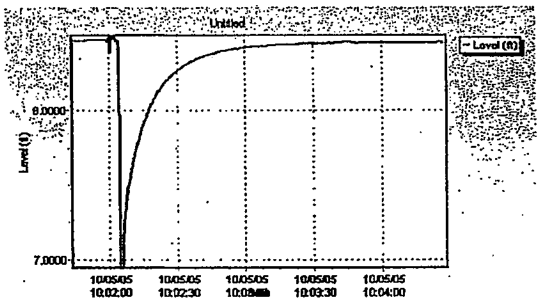
*Well depth to top of first casing terminating above ground. Does not include above ground extensions.



	Date	Time	ET (sec)	Time (min)	Test Time (min)	Temperature	Level	Water Level Bottom of well to TOC* (ft)	Change of Static Water Level (ft)	h/ho	
1	5/5/2010	9:20:27	0	0.000		11.254	7.1703	25.980	0		TEST START
2	5/5/2010	9:20:28	1	0.017	0.000	11.252	5.298	27.852	1.8723	1	SLUG REMOVED
3	5/5/2010	9:20:29	2	0.033	0.017	11.254	5.3982	27.751	1.7711	0.945948833	
4	5/5/2010	9:20:30	3	0.050	0.033	11.254	5.4584	27.692	1.7119	0.914328868	
5	5/5/2010	9:20:31	4	0.067	0.050	11.257	5.4885	27.662	1.6818	0.898253485	
6	5/5/2010	9:20:32	5	0.083	0.067	11.255	5.519	27.631	1.6513	0.881963361	
7	5/5/2010	9:20:33	6	0.100	0.083	11.258	5.5421	27.608	1.6282	0.869625594	
8	5/5/2010	9:20:34	7	0.117	0.100	11.257	5.5658	27.584	1.6045	0.856957368	
9	5/5/2010	9:20:35	8	0.133	0.117	11.258	5.5919	27.558	1.5784	0.843027293	
10	5/5/2010	9:20:36	9	0.150	0.133	11.257	5.6074	27.543	1.5629	0.834748705	
11	5/5/2010	9:20:37	10	0.167	0.150	11.257	5.6237	27.526	1.5466	0.826042836	
12	5/5/2010	9:20:38	11	0.183	0.167	11.258	5.6423	27.508	1.528	0.81610853	
13	5/5/2010	9:20:39	12	0.200	0.183	11.259	5.6595	27.491	1.5108	0.806921968	
14	5/5/2010	9:20:40	13	0.217	0.200	11.258	5.676	27.474	1.4943	0.798108277	
15	5/5/2010	9:20:41	14	0.233	0.217	11.259	5.6922	27.458	1.4781	0.788468618	
16	5/5/2010	9:20:42	15	0.250	0.233	11.261	5.7084	27.442	1.4819	0.774060435	
17	5/5/2010	9:20:43	16	0.267	0.250	11.259	5.7226	27.427	1.4477	0.773220104	
18	5/5/2010	9:20:44	17	0.283	0.267	11.259	5.7383	27.412	1.432	0.764834698	
19	5/5/2010	9:20:45	18	0.300	0.283	11.26	5.7519	27.398	1.4184	0.757570902	
20	5/5/2010	9:20:46	19	0.317	0.300	11.259	5.766	27.384	1.4043	0.750040055	
21	5/5/2010	9:20:47	20	0.333	0.317	11.261	5.7815	27.369	1.3888	0.74176147	
22	5/5/2010	9:20:48	21	0.350	0.333	11.259	5.7955	27.355	1.3748	0.734284036	
23	5/5/2010	9:20:49	22	0.367	0.350	11.259	5.8088	27.341	1.3615	0.727180473	
24	5/5/2010	9:20:50	23	0.383	0.367	11.26	5.8224	27.328	1.3479	0.71991668	
25	5/5/2010	9:20:51	24	0.400	0.383	11.259	5.8355	27.315	1.3348	0.712919938	
26	5/5/2010	9:20:52	25	0.417	0.400	11.26	5.8489	27.301	1.3214	0.705762966	
27	5/5/2010	9:20:53	26	0.433	0.417	11.261	5.8621	27.288	1.3082	0.698712813	
28	5/5/2010	9:20:54	27	0.450	0.433	11.26	5.875	27.275	1.2953	0.691822892	
29	5/5/2010	9:20:55	28	0.467	0.450	11.261	5.8867	27.263	1.2836	0.685573893	
30	5/5/2010	9:20:56	29	0.483	0.467	11.26	5.8996	27.250	1.2707	0.678683972	
31	5/5/2010	9:20:57	30	0.500	0.150	11.259	5.9124	27.238	1.2579	0.67184746	
32	5/5/2010	9:20:58	31	0.517	0.500	11.259	5.9236	27.226	1.2467	0.665865513	
33	5/5/2010	9:20:59	32	0.533	0.517	11.259	5.9351	27.215	1.2352	0.659723335	
34	5/5/2010	9:21:00	33	0.550	0.533	11.26	5.9479	27.202	1.2224	0.652886824	
35	5/5/2010	9:21:01	34	0.567	0.550	11.259	5.9589	27.191	1.2114	0.647011697	
36	5/5/2010	9:21:02	35	0.583	0.567	11.258	5.9699	27.180	1.2004	0.64113657	
37	5/5/2010	9:21:03	36	0.600	0.583	11.259	5.9803	27.170	1.19	0.635581905	
38	5/5/2010	9:21:04	37	0.617	0.600	11.258	5.9928	27.157	1.1775	0.628905624	
39	5/5/2010	9:21:05	38	0.633	0.617	11.26	6.0028	27.147	1.1675	0.6235646	
40	5/5/2010	9:21:06	39	0.650	0.633	11.258	6.0142	27.136	1.1561	0.617476832	
41	5/5/2010	9:21:07	40	0.667	0.650	11.257	6.025	27.125	1.1453	0.611707526	
42	5/5/2010	9:21:08	41	0.683	0.667	11.259	6.0346	27.115	1.1357	0.606580142	
43	5/5/2010	9:21:09	42	0.700	0.683	11.258	6.0448	27.105	1.1255	0.601132297	
44	5/5/2010	9:21:10	43	0.717	0.700	11.259	6.0554	27.095	1.1149	0.595470811	
45	5/5/2010	9:21:11	44	0.733	0.717	11.258	6.0658	27.084	1.1045	0.589916146	
46	5/5/2010	9:21:12	45	0.750	0.733	11.259	6.0765	27.074	1.0938	0.58420126	
47	5/5/2010	9:21:13	46	0.767	0.750	11.257	6.0864	27.064	1.0839	0.578913636	
48	5/5/2010	9:21:14	47	0.783	0.767	11.257	6.096	27.054	1.0743	0.573780262	
49	5/5/2010	9:21:15	48	0.800	0.783	11.257	6.1055	27.045	1.0648	0.568712276	
50	5/5/2010	9:21:16	49	0.817	0.800	11.259	6.1144	27.036	1.0559	0.563958767	
51	5/5/2010	9:21:17	50	0.833	0.817	11.257	6.1235	27.027	1.0468	0.559098435	
52	5/5/2010	9:21:18	51	0.850	0.833	11.259	6.1332	27.017	1.0371	0.553917641	
53	5/5/2010	9:21:19	52	0.867	0.850	11.257	6.1423	27.008	1.028	0.549057309	
54	5/5/2010	9:21:20	53	0.883	0.867	11.258	6.1513	26.999	1.019	0.544260387	
55	5/5/2010	9:21:21	54	0.900	0.883	11.257	6.1613	26.989	1.009	0.538909363	
56	5/5/2010	9:21:22	55	0.917	0.900	11.258	6.1693	26.981	1.001	0.534638543	
57	5/5/2010	9:21:23	56	0.933	0.917	11.257	6.1786	26.971	0.9917	0.529669391	
58	5/5/2010	9:21:24	57	0.950	0.933	11.257	6.1869	26.963	0.9834	0.52526934	
59	5/5/2010	9:21:25	58	0.967	0.950	11.257	6.196	26.954	0.9743	0.520376006	
60	5/5/2010	9:21:26	59	0.983	0.967	11.258	6.2045	26.946	0.9658	0.515836137	
61	5/5/2010	9:21:27	60	1.000	0.983	11.257	6.213	26.937	0.9573	0.511296267	
62	5/5/2010	9:21:28	61	1.017	1.000	11.256	6.2215	26.929	0.9488	0.506756396	
63	5/5/2010	9:21:29	62	1.033	1.017	11.256	6.2287	26.921	0.9416	0.502910068	
64	5/5/2010	9:21:30	63	1.050	1.033	11.255	6.2371	26.913	0.9332	0.498424398	
65	5/5/2010	9:21:31	64	1.067	1.050	11.257	6.2466	26.903	0.9237	0.493350425	
66	5/5/2010	9:21:32	65	1.083	1.067	11.257	6.2524	26.898	0.9179	0.49026263	
67	5/5/2010	9:21:33	66	1.100	1.083	11.255	6.2615	26.889	0.9088	0.485392298	
68	5/5/2010	9:21:34	67	1.117	1.100	11.256	6.268	26.882	0.9023	0.481920632	
69	5/5/2010	9:21:35	68	1.133	1.117	11.255	6.2762	26.874	0.8941	0.477540924	
70	5/5/2010	9:21:36	69	1.150	1.133	11.255	6.2835	26.867	0.8868	0.473642045	
71	5/5/2010	9:21:37	70	1.167	1.150	11.255	6.2923	26.858	0.878	0.468941943	
72	5/5/2010	9:21:38	71	1.183	1.167	11.256	6.2979	26.852	0.8724	0.465950969	
73	5/5/2010	9:21:39	72	1.200	1.183	11.256	6.3053	26.845	0.865	0.461998611	
74	5/5/2010	9:21:40	73	1.217	1.200	11.255	6.3126	26.837	0.8577	0.458099664	
75	5/5/2010	9:21:41	74	1.233	1.217	11.254	6.3208	26.829	0.8495	0.45372007	

Solinst	3001	
Report generated:	5/11/2010	
Report from file:	...\mw-3_1.csv	
Serial number:	1032306	
Unit name:	Solinst 3001	
Test name:	AP-2	Test 1
Test defined on:	5/5/2010	
Test started on:	5/5/2010	10:02:05
Test stopped on:	5/5/2010	10:02:58
Data gathered using Linear testing		
Time between data points:	1	Seconds.
Number of data samples:	55	
TOTAL DATA SAMPLES	55	
Channel number [1]		
Measurement type:	Level	
Unit	feet	
Channel number [2]		
Measurement type:	Temperature	
Unit	Deg C	
Sensor Range:		
Specific gravity:		
Mode:	TOC	
User-defined reference*:	19.47	Feet H2O
Referenced on:	test start	
Pressure head at reference:		Feet H2O

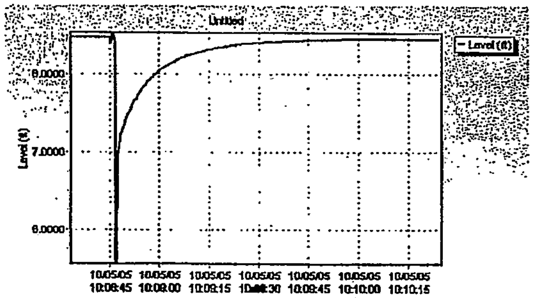
*Well depth to top of first casing terminating above ground. Does not include above ground extensions.



	Date	Time	ET (sec)	Time (min)	Test Time (min)	Temperature	Level	Water Level Bottom of well to TOC* (ft)	Change of Static Water Level (ft)	h/ho	
1	5/5/2010	10:02:04	0	0.000		11.23	8.4182	11.052	0	[illegible]	TEST START
2	5/5/2010	10:02:05	1	0.017	0.000	11.231	6.9143	12.556	1.5039	[illegible]	SLUG REMOVED
3	5/5/2010	10:02:06	2	0.033	0.017	11.231	7.2562	12.214	1.162	0.772257756	
4	5/5/2010	10:02:07	3	0.050	0.033	11.231	7.3727	12.097	1.0465	0.6951925	
5	5/5/2010	10:02:08	4	0.067	0.050	11.231	7.4828	11.987	0.9354	0.621962646	
6	5/5/2010	10:02:09	5	0.083	0.067	11.231	7.5707	11.899	0.8475	0.563534609	
7	5/5/2010	10:02:10	6	0.100	0.083	11.231	7.6472	11.823	0.771	0.512667066	
8	5/5/2010	10:02:11	7	0.117	0.100	11.231	7.715	11.755	0.7032	0.467584281	
9	5/5/2010	10:02:12	8	0.133	0.117	11.232	7.7747	11.695	0.6435	0.427887493	
10	5/5/2010	10:02:13	9	0.150	0.133	11.232	7.8285	11.642	0.5897	0.392113837	
11	5/5/2010	10:02:14	10	0.167	0.150	11.232	7.878	11.592	0.5402	0.359199415	
12	5/5/2010	10:02:15	11	0.183	0.167	11.231	7.9204	11.550	0.4978	0.331006051	
13	5/5/2010	10:02:16	12	0.200	0.183	11.232	7.9625	11.508	0.4557	0.303012168	
14	5/5/2010	10:02:17	13	0.217	0.200	11.232	8.0004	11.470	0.4178	0.277811025	
15	5/5/2010	10:02:18	14	0.233	0.217	11.232	8.0325	11.438	0.3857	0.25646682	
16	5/5/2010	10:02:19	15	0.250	0.233	11.232	8.0633	11.407	0.3549	0.235966435	
17	5/5/2010	10:02:20	16	0.267	0.250	11.231	8.0906	11.379	0.3276	0.217833633	
18	5/5/2010	10:02:21	17	0.283	0.267	11.23	8.1151	11.355	0.3031	0.201542556	
19	5/5/2010	10:02:22	18	0.300	0.283	11.23	8.1395	11.331	0.2787	0.185318173	
20	5/5/2010	10:02:23	19	0.317	0.300	11.23	8.1616	11.308	0.2566	0.170623047	
21	5/5/2010	10:02:24	20	0.333	0.317	11.23	8.1805	11.290	0.2377	0.158056722	
22	5/5/2010	10:02:25	21	0.350	0.333	11.229	8.2001	11.270	0.2181	0.14502294	
23	5/5/2010	10:02:26	22	0.367	0.350	11.229	8.2158	11.254	0.2024	0.134583416	
24	5/5/2010	10:02:27	23	0.383	0.367	11.229	8.2315	11.239	0.1867	0.124143893	
25	5/5/2010	10:02:28	24	0.400	0.383	11.229	8.2454	11.225	0.1728	0.114901257	
26	5/5/2010	10:02:29	25	0.417	0.400	11.228	8.2589	11.211	0.1593	0.105924596	
27	5/5/2010	10:02:30	26	0.433	0.417	11.228	8.2709	11.199	0.1473	0.097946342	
28	5/5/2010	10:02:31	27	0.450	0.433	11.227	8.2821	11.188	0.1361	0.090498038	
29	5/5/2010	10:02:32	28	0.467	0.450	11.228	8.2931	11.177	0.1251	0.083183722	
30	5/5/2010	10:02:33	29	0.483	0.467	11.227	8.3029	11.167	0.1153	0.076667332	
31	5/5/2010	10:02:34	30	0.500	0.150	11.226	8.3123	11.158	0.1059	0.070416916	
32	5/5/2010	10:02:35	31	0.517	0.500	11.226	8.3207	11.149	0.0975	0.064831438	
33	5/5/2010	10:02:36	32	0.533	0.517	11.225	8.3292	11.141	0.089	0.059178487	
34	5/5/2010	10:02:37	33	0.550	0.533	11.225	8.3355	11.135	0.0827	0.054990356	
35	5/5/2010	10:02:38	34	0.567	0.550	11.224	8.3418	11.128	0.0764	0.05080125	
36	5/5/2010	10:02:39	35	0.583	0.567	11.224	8.3491	11.121	0.0691	0.045947204	
37	5/5/2010	10:02:40	36	0.600	0.583	11.223	8.3548	11.115	0.0634	0.042157058	
38	5/5/2010	10:02:41	37	0.617	0.600	11.223	8.3615	11.109	0.0567	0.037701975	
39	5/5/2010	10:02:42	38	0.633	0.617	11.223	8.3654	11.105	0.0528	0.035108717	
40	5/5/2010	10:02:43	39	0.650	0.633	11.222	8.3729	11.097	0.0453	0.030121884	
41	5/5/2010	10:02:44	40	0.667	0.650	11.222	8.3761	11.094	0.0421	0.027993883	
42	5/5/2010	10:02:45	41	0.683	0.667	11.221	8.3803	11.090	0.0379	0.025201144	
43	5/5/2010	10:02:46	42	0.700	0.683	11.221	8.385	11.085	0.0332	0.022075936	
44	5/5/2010	10:02:47	43	0.717	0.700	11.22	8.3888	11.081	0.0294	0.019549172	
45	5/5/2010	10:02:48	44	0.733	0.717	11.22	8.3922	11.078	0.026	0.017288384	
46	5/5/2010	10:02:49	45	0.750	0.733	11.22	8.3959	11.074	0.0223	0.014828114	
47	5/5/2010	10:02:50	46	0.767	0.750	11.219	8.3983	11.072	0.0199	0.013232283	
48	5/5/2010	10:02:51	47	0.783	0.767	11.219	8.4029	11.067	0.0153	0.010173549	
49	5/5/2010	10:02:52	48	0.800	0.783	11.218	8.4042	11.066	0.014	0.00930913	
50	5/5/2010	10:02:53	49	0.817	0.800	11.218	8.4084	11.062	0.0098	0.006516391	
51	5/5/2010	10:02:54	50	0.833	0.817	11.218	8.4099	11.060	0.0083	0.005518984	
52	5/5/2010	10:02:55	51	0.850	0.833	11.218	8.4117	11.058	0.0065	0.004322096	
53	5/5/2010	10:02:56	52	0.867	0.850	11.216	8.4145	11.056	0.0037	0.00246027	
54	5/5/2010	10:02:57	53	0.883	0.867	11.217	8.416	11.054	0.0022	0.001462883	
55	5/5/2010	10:02:58	54	0.900	0.883	11.216	8.4182	11.052	0	0	

Solinst	3001	
Report generated:	5/11/2010	
Report from file:	...\mw-3_2.csv	
Serial number:	1032308	
Unit name:	Solinst 3001	
Test name:	AP-2	Test 2
Test defined on:	5/5/2010	
Test started on:	5/5/2010	10:08:48
Test stopped on:	5/5/2010	10:09:43
Data gathered using Linear testing		
Time between data points:	1	Seconds.
Number of data samples:	57	
TOTAL DATA SAMPLES	57	
Channel number [1]		
Measurement type:	Level	
Unit	feet	
Channel number [2]		
Measurement type:	Temperature	
Unit	Deg C	
Sensor Range:		
Specific gravity:		
Mode:	TOC	
User-defined reference*:	19.47	Feet H2O
Referenced on:	test start	
Pressure head at reference:		Feet H2O

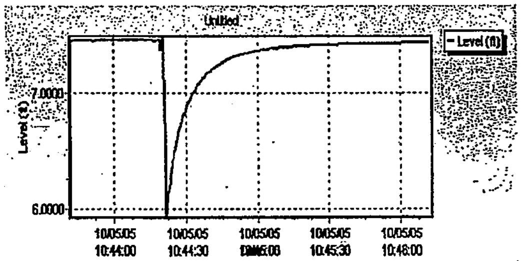
*Well depth to top of first casing terminating above ground. Does not include above ground extensions.



	Date	Time	ET (sec)	Time (min)	Test Time (min)	Temperature	Level	Water Level Bottom of well to TOC* (ft)	Change of Static Water Level (ft)	h/ho	
1	5/5/2010	10:08:47	0	0.000		11.111	8.4246	11.045	0	[illegible]	TEST START
2	5/5/2010	10:08:48	1	0.017	0.000	11.114	6.9757	12.494	1.4489	[illegible]	SLUG REMOVED
3	5/5/2010	10:08:49	2	0.033	0.017	11.114	7.2067	12.263	1.2178	0.840588707	
4	5/5/2010	10:08:50	3	0.050	0.033	11.116	7.3467	12.123	1.0779	0.743943881	
5	5/5/2010	10:08:51	4	0.067	0.050	11.117	7.4619	12.008	0.9627	0.664435089	
6	5/5/2010	10:08:52	5	0.083	0.067	11.117	7.5593	11.911	0.8653	0.597211678	
7	5/5/2010	10:08:53	6	0.100	0.083	11.117	7.6431	11.827	0.7815	0.539374698	
8	5/5/2010	10:08:54	7	0.117	0.100	11.118	7.7197	11.750	0.7049	0.486507005	
9	5/5/2010	10:08:55	8	0.133	0.117	11.121	7.7838	11.686	0.6408	0.442266547	
10	5/5/2010	10:08:56	9	0.150	0.133	11.12	7.8425	11.628	0.5821	0.401753054	
11	5/5/2010	10:08:57	10	0.167	0.150	11.12	7.8942	11.576	0.5304	0.366070812	
12	5/5/2010	10:08:58	11	0.183	0.167	11.123	7.9419	11.528	0.4827	0.333149286	
13	5/5/2010	10:08:59	12	0.200	0.183	11.123	7.9837	11.486	0.4409	0.304299814	
14	5/5/2010	10:09:00	13	0.217	0.200	11.123	8.0214	11.449	0.4032	0.278280075	
15	5/5/2010	10:09:01	14	0.233	0.217	11.124	8.0533	11.417	0.3713	0.256263372	
16	5/5/2010	10:09:02	15	0.250	0.233	11.124	8.0854	11.385	0.3392	0.234108634	
17	5/5/2010	10:09:03	16	0.267	0.250	11.125	8.1137	11.356	0.3109	0.214576575	
18	5/5/2010	10:09:04	17	0.283	0.267	11.125	8.1368	11.333	0.2878	0.198633446	
19	5/5/2010	10:09:05	18	0.300	0.283	11.127	8.1636	11.306	0.261	0.180136855	
20	5/5/2010	10:09:06	19	0.317	0.300	11.126	8.1829	11.287	0.2417	0.166816205	
21	5/5/2010	10:09:07	20	0.333	0.317	11.127	8.2006	11.269	0.224	0.154600041	
22	5/5/2010	10:09:08	21	0.350	0.333	11.127	8.2186	11.251	0.206	0.142176824	
23	5/5/2010	10:09:09	22	0.367	0.350	11.126	8.2347	11.235	0.1899	0.131064946	
24	5/5/2010	10:09:10	23	0.383	0.367	11.127	8.2493	11.221	0.1753	0.120988336	
25	5/5/2010	10:09:11	24	0.400	0.383	11.128	8.2622	11.208	0.1624	0.112085031	
26	5/5/2010	10:09:12	25	0.417	0.400	11.128	8.275	11.195	0.1496	0.103250742	
27	5/5/2010	10:09:13	26	0.433	0.417	11.128	8.2863	11.184	0.1383	0.095451722	
28	5/5/2010	10:09:14	27	0.450	0.433	11.129	8.2973	11.173	0.1273	0.087859756	
29	5/5/2010	10:09:15	28	0.467	0.450	11.13	8.3084	11.162	0.1162	0.080198771	
30	5/5/2010	10:09:16	29	0.483	0.467	11.13	8.3152	11.155	0.1094	0.075505556	
31	5/5/2010	10:09:17	30	0.500	0.150	11.129	8.3253	11.145	0.0993	0.068534751	
32	5/5/2010	10:09:18	31	0.517	0.500	11.13	8.3319	11.138	0.0927	0.063979571	
33	5/5/2010	10:09:19	32	0.533	0.517	11.132	8.3386	11.131	0.086	0.059355373	
34	5/5/2010	10:09:20	33	0.550	0.533	11.132	8.3487	11.121	0.0759	0.052384568	
35	5/5/2010	10:09:21	34	0.567	0.550	11.131	8.3532	11.117	0.0714	0.049278763	
36	5/5/2010	10:09:22	35	0.583	0.567	11.132	8.3595	11.111	0.0651	0.044930637	
37	5/5/2010	10:09:23	36	0.600	0.583	11.132	8.3639	11.106	0.0607	0.041893951	
38	5/5/2010	10:09:24	37	0.617	0.600	11.133	8.3697	11.100	0.0549	0.037890814	
39	5/5/2010	10:09:25	38	0.633	0.617	11.133	8.3747	11.095	0.0499	0.034439882	
40	5/5/2010	10:09:26	39	0.650	0.633	11.133	8.3806	11.089	0.044	0.030367865	
41	5/5/2010	10:09:27	40	0.667	0.650	11.134	8.3842	11.086	0.0404	0.027883222	
42	5/5/2010	10:09:28	41	0.683	0.667	11.134	8.3879	11.082	0.0367	0.02532956	
43	5/5/2010	10:09:29	42	0.700	0.683	11.134	8.3903	11.080	0.0343	0.023673131	
44	5/5/2010	10:09:30	43	0.717	0.700	11.135	8.3943	11.076	0.0303	0.020912416	
45	5/5/2010	10:09:31	44	0.733	0.717	11.134	8.3975	11.073	0.0271	0.018703844	
46	5/5/2010	10:09:32	45	0.750	0.733	11.135	8.3985	11.072	0.0261	0.018013666	
47	5/5/2010	10:09:33	46	0.767	0.750	11.135	8.4027	11.067	0.0219	0.015114916	
48	5/5/2010	10:09:34	47	0.783	0.767	11.136	8.4058	11.064	0.0188	0.012975361	
49	5/5/2010	10:09:35	48	0.800	0.783	11.136	8.4085	11.062	0.0161	0.011111878	
50	5/5/2010	10:09:36	49	0.817	0.800	11.136	8.4115	11.059	0.0131	0.009041342	
51	5/5/2010	10:09:37	50	0.833	0.817	11.136	8.4124	11.058	0.0122	0.008420181	
52	5/5/2010	10:09:38	51	0.850	0.833	11.137	8.4148	11.055	0.0098	0.006763752	
53	5/5/2010	10:09:39	52	0.867	0.850	11.138	8.4159	11.054	0.0087	0.006004555	
54	5/5/2010	10:09:40	53	0.883	0.867	11.138	8.4178	11.052	0.0068	0.004693216	
55	5/5/2010	10:09:41	54	0.900	0.883	11.137	8.4188	11.051	0.0058	0.004003037	
56	5/5/2010	10:09:42	55	0.917	0.900	11.137	8.4221	11.048	0.0025	0.001725447	
57	5/5/2010	10:09:43	56	0.933	0.917	11.138	8.4239	11.046	0.0007	0.000483125	

Solinst	3001	
Report generated:	5/11/2010	
Report from file:	...\mw-2_1.csv	
Serial number:	1032308	
Unit name:	Solinst 3001	
Test name:	AP-3	Test 1
Test defined on:	5/5/2010	
Test started on:	5/5/2010	10:44:21
Test stopped on:	5/5/2010	11:45:28
Data gathered using Linear testing		
Time between data points:	1	Seconds
Number of data samples:	69	
TOTAL DATA SAMPLES	69	
Channel number [1]		
Measurement type:	Level	
Unit:	feet	
Channel number [2]		
Measurement type:	Temperature	
Unit	Deg C	
Sensor Range:		
Specific gravity:		
Mode:	TOC	
User-defined reference*:	19.83	Feet H2O
Referenced on:	test start	
Pressure head at reference:		Feet H2O

*Well depth to top of first casing terminating above ground. Does not include above ground extensions.



	Date	Time	ET (sec)	Time (min)	Test Time (min)	Temperature	Level	Water Level Bottom of well to TOC* (ft)	Change of Static Water Level (ft)	h/ho	
1	5/5/2010	10:44:20	0	0.000		11.841	7.4264	12.204	0		TEST START
2	5/5/2010	10:44:21	1	0.017	0.000	11.841	4.946	14.684	2.4804	1	SLUG REMOVED
3	5/5/2010	10:44:22	2	0.033	0.017	11.841	6.031	13.599	1.3954	0.582570563	
4	5/5/2010	10:44:23	3	0.050	0.033	11.841	6.2314	13.399	1.195	0.481777133	
5	5/5/2010	10:44:24	4	0.067	0.050	11.839	6.374	13.256	1.0524	0.424286405	
6	5/5/2010	10:44:25	5	0.083	0.067	11.841	6.4939	13.136	0.9325	0.375947428	
7	5/5/2010	10:44:26	6	0.100	0.083	11.841	6.5956	13.034	0.8308	0.334946976	
8	5/5/2010	10:44:27	7	0.117	0.100	11.84	6.6811	12.949	0.7453	0.30047573	
9	5/5/2010	10:44:28	8	0.133	0.117	11.841	6.7553	12.875	0.6711	0.27056812	
10	5/5/2010	10:44:29	9	0.150	0.133	11.84	6.8204	12.810	0.606	0.244316433	
11	5/5/2010	10:44:30	10	0.167	0.150	11.837	6.8768	12.753	0.5496	0.221577165	
12	5/5/2010	10:44:31	11	0.183	0.167	11.839	6.9267	12.703	0.4997	0.201459442	
13	5/5/2010	10:44:32	12	0.200	0.183	11.837	6.9731	12.657	0.4533	0.182752782	
14	5/5/2010	10:44:33	13	0.217	0.200	11.837	7.0111	12.619	0.4153	0.167432672	
15	5/5/2010	10:44:34	14	0.233	0.217	11.839	7.0481	12.582	0.3783	0.152515723	
16	5/5/2010	10:44:35	15	0.250	0.233	11.836	7.0792	12.551	0.3472	0.139977423	
17	5/5/2010	10:44:36	16	0.267	0.250	11.837	7.1094	12.521	0.317	0.127801967	
18	5/5/2010	10:44:37	17	0.283	0.267	11.837	7.1355	12.495	0.2909	0.117278471	
19	5/5/2010	10:44:38	18	0.300	0.283	11.837	7.1579	12.472	0.2685	0.108248667	
20	5/5/2010	10:44:39	19	0.317	0.300	11.834	7.1803	12.450	0.2461	0.099217868	
21	5/5/2010	10:44:40	20	0.333	0.317	11.834	7.1981	12.432	0.2283	0.092041606	
22	5/5/2010	10:44:41	21	0.350	0.333	11.836	7.2175	12.413	0.2089	0.084220287	
23	5/5/2010	10:44:42	22	0.367	0.350	11.834	7.2342	12.396	0.1922	0.077487502	
24	5/5/2010	10:44:43	23	0.383	0.367	11.831	7.2477	12.382	0.1787	0.072044831	
25	5/5/2010	10:44:44	24	0.400	0.383	11.833	7.2613	12.369	0.1651	0.066561845	
26	5/5/2010	10:44:45	25	0.417	0.400	11.831	7.2733	12.357	0.1531	0.061723916	
27	5/5/2010	10:44:46	26	0.433	0.417	11.83	7.2842	12.346	0.1422	0.057329463	
28	5/5/2010	10:44:47	27	0.450	0.433	11.829	7.2947	12.335	0.1317	0.053096275	
29	5/5/2010	10:44:48	28	0.467	0.450	11.829	7.3038	12.326	0.1226	0.049427512	
30	5/5/2010	10:44:49	29	0.483	0.467	11.828	7.313	12.317	0.1134	0.045718433	
31	5/5/2010	10:44:50	30	0.500	0.150	11.83	7.3204	12.310	0.106	0.042735043	
32	5/5/2010	10:44:51	31	0.517	0.500	11.83	7.3277	12.302	0.0987	0.039791969	
33	5/5/2010	10:44:52	32	0.533	0.517	11.827	7.3358	12.294	0.0906	0.036526367	
34	5/5/2010	10:44:53	33	0.550	0.533	11.828	7.3408	12.289	0.0856	0.034510563	
35	5/5/2010	10:44:54	34	0.567	0.550	11.827	7.3465	12.284	0.0799	0.032212548	
36	5/5/2010	10:44:55	35	0.583	0.567	11.827	7.3529	12.277	0.0735	0.029632317	
37	5/5/2010	10:44:56	36	0.600	0.583	11.825	7.3567	12.273	0.0697	0.028100306	
38	5/5/2010	10:44:57	37	0.617	0.600	11.826	7.3618	12.268	0.0646	0.026044186	
39	5/5/2010	10:44:58	38	0.633	0.617	11.825	7.3666	12.263	0.0598	0.024108015	
40	5/5/2010	10:44:59	39	0.650	0.633	11.823	7.3705	12.260	0.0559	0.022536688	
41	5/5/2010	10:45:00	40	0.667	0.650	11.824	7.3748	12.255	0.0516	0.020803096	
42	5/5/2010	10:45:01	41	0.683	0.667	11.823	7.3783	12.252	0.0481	0.019392034	
43	5/5/2010	10:45:02	42	0.700	0.683	11.823	7.3814	12.249	0.045	0.018142235	
44	5/5/2010	10:45:03	43	0.717	0.700	11.821	7.3848	12.245	0.0416	0.016771488	
45	5/5/2010	10:45:04	44	0.733	0.717	11.82	7.3878	12.242	0.0386	0.015562006	
46	5/5/2010	10:45:05	45	0.750	0.733	11.82	7.3908	12.239	0.0356	0.014352524	
47	5/5/2010	10:45:06	46	0.767	0.750	11.819	7.3935	12.237	0.0329	0.013263989	
48	5/5/2010	10:45:07	47	0.783	0.767	11.818	7.3943	12.236	0.0321	0.012941461	
49	5/5/2010	10:45:08	48	0.800	0.783	11.817	7.3971	12.233	0.0293	0.011812611	
50	5/5/2010	10:45:09	49	0.817	0.800	11.816	7.3997	12.230	0.0267	0.010764393	
51	5/5/2010	10:45:10	50	0.833	0.817	11.819	7.4032	12.227	0.0232	0.009353333	
52	5/5/2010	10:45:11	51	0.850	0.833	11.815	7.4038	12.226	0.0226	0.009111434	
53	5/5/2010	10:45:12	52	0.867	0.850	11.817	7.4051	12.225	0.0213	0.008587325	
54	5/5/2010	10:45:13	53	0.883	0.867	11.816	7.4083	12.222	0.0181	0.00729721	
55	5/5/2010	10:45:14	54	0.900	0.883	11.815	7.4086	12.221	0.0178	0.007176262	
56	5/5/2010	10:45:15	55	0.917	0.900	11.813	7.411	12.219	0.0154	0.006208676	
57	5/5/2010	10:45:16	56	0.933	0.917	11.815	7.4116	12.218	0.0148	0.005966676	
58	5/5/2010	10:45:17	57	0.950	0.933	11.814	7.4149	12.215	0.0115	0.004636349	
59	5/5/2010	10:45:18	58	0.967	0.950	11.813	7.4155	12.215	0.0109	0.004394453	
60	5/5/2010	10:45:19	59	0.983	0.967	11.811	7.4162	12.214	0.0102	0.00411224	
61	5/5/2010	10:45:20	60	1.000	0.983	11.811	7.4176	12.212	0.0088	0.003547815	
62	5/5/2010	10:45:21	61	1.017	1.000	11.81	7.4187	12.211	0.0077	0.003104339	
63	5/5/2010	10:45:22	62	1.033	1.017	11.81	7.4192	12.211	0.0072	0.002902758	
64	5/5/2010	10:45:23	63	1.050	1.033	11.808	7.4215	12.209	0.0049	0.001975488	
65	5/5/2010	10:45:24	64	1.067	1.050	11.809	7.4218	12.208	0.0046	0.00185454	
66	5/5/2010	10:45:25	65	1.083	1.067	11.811	7.4231	12.207	0.0033	0.001330431	
67	5/5/2010	10:45:26	66	1.100	1.083	11.81	7.4244	12.206	0.002	0.000806322	
68	5/5/2010	10:45:27	67	1.117	1.100	11.809	7.424	12.206	0.0024	0.000967586	
69	5/5/2010	10:45:28	68	1.133	1.117	11.807	7.4257	12.204	0.0007	0.000282213	
70											
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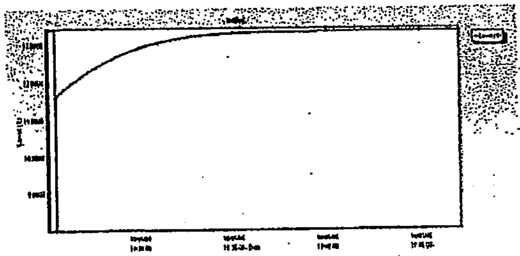
73											
74											

Solinst	3001	
Report generated:	5/11/2010	
Report from file:	...\MW-1.lev	
Serial number:	1032308	
Unit name:	Solinst 3001	
Test name:	AP-4	
Test defined on:	5/5/2010	
Test started on:	5/5/2010	11:25:32
Test stopped on:	5/5/2010	11:25:51
Data gathered using Linear testing		
Time between data points:	0.5	Seconds
Number of data samples:	41	
TOTAL DATA SAMPLES	41	
Channel number [1]		
Measurement type:	Level	
Unit	feet	
Channel number [2]		
Measurement type:	Temperature	
Unit	Deg C	
Sensor Range:		
Specific gravity:		
Mode:	TOC	
User-defined reference*:	59.93	Feet H2O
Referenced on:	test start	
Pressure head at reference:		Feet H2O

*Well depth to top of first casing terminating above ground. Does not include above ground extensions.



	Date	Time	ET (sec)	Time (min)	Test Time (min)	Temperature	Level	Water Level Bottom of well to TOC* (ft)	Change of Static Water Level (ft)	h/ho	
1	5/5/2010	11:25:31	0	0.000		12.799	13.4081	45.522	0	[illegible]	TEST START
2	5/5/2010	11:25:31	0	0.000	0.000	12.789	11.9721	46.958	1.436	[illegible]	SLUG REMOVED
3	5/5/2010	11:25:32	0.5	0.008	0.008	12.794	8.02638	50.904	5.38172	[illegible]	
4	5/5/2010	11:25:32	1	0.017	0.017	12.785	11.2523	47.678	2.1558	0.400578254	
5	5/5/2010	11:25:33	1.5	0.025	0.025	12.79	11.5307	47.399	1.8774	0.34884758	
6	5/5/2010	11:25:33	2	0.033	0.033	12.781	11.5481	47.382	1.86	0.346614413	
7	5/5/2010	11:25:34	2.5	0.042	0.042	12.785	11.5979	47.332	1.8102	0.338380868	
8	5/5/2010	11:25:34	3	0.050	0.050	12.776	11.5927	47.337	1.8154	0.3373271	
9	5/5/2010	11:25:35	3.5	0.058	0.058	12.78	11.6036	47.326	1.8045	0.335301725	
10	5/5/2010	11:25:35	4	0.067	0.067	12.771	11.6202	47.310	1.7879	0.332217209	
11	5/5/2010	11:25:36	4.5	0.075	0.075	12.775	11.6344	47.296	1.7737	0.329578548	
12	5/5/2010	11:25:36	5	0.083	0.083	12.766	11.6361	47.294	1.772	0.328252764	
13	5/5/2010	11:25:37	5.5	0.092	0.092	12.771	11.6445	47.286	1.7636	0.327701924	
14	5/5/2010	11:25:37	6	0.100	0.100	12.763	11.6514	47.279	1.7567	0.326418606	
15	5/5/2010	11:25:38	6.5	0.108	0.108	12.767	11.6587	47.271	1.7494	0.325063363	
16	5/5/2010	11:25:38	7	0.117	0.117	12.768	11.6626	47.267	1.7455	0.324338687	
17	5/5/2010	11:25:39	7.5	0.125	0.125	12.762	11.669	47.261	1.7391	0.323148476	
18	5/5/2010	11:25:39	8	0.133	0.133	12.752	11.6739	47.256	1.7342	0.322238887	
19	5/5/2010	11:25:40	8.5	0.142	0.142	12.758	11.6794	47.251	1.7287	0.321217009	
20	5/5/2010	11:25:40	9	0.150	0.150	12.749	11.6836	47.246	1.7245	0.320436689	
21	5/5/2010	11:25:41	9.5	0.158	0.158	12.753	11.6884	47.242	1.7197	0.319544881	
22	5/5/2010	11:25:41	10	0.167	0.167	12.743	11.6921	47.238	1.716	0.318857168	
23	5/5/2010	11:25:42	10.5	0.175	0.175	12.748	11.6969	47.233	1.7112	0.31796628	
24	5/5/2010	11:25:42	11	0.183	0.183	12.739	11.7013	47.229	1.7068	0.317147678	
25	5/5/2010	11:25:43	11.5	0.192	0.192	12.745	11.7049	47.225	1.7032	0.316476747	
26	5/5/2010	11:25:43	12	0.200	0.200	12.735	11.7092	47.221	1.6989	0.315879748	
27	5/5/2010	11:25:44	12.5	0.208	0.208	12.74	11.7131	47.217	1.695	0.31495607	
28	5/5/2010	11:25:44	13	0.217	0.217	12.731	11.7157	47.214	1.6924	0.314471953	
29	5/5/2010	11:25:45	13.5	0.225	0.225	12.735	11.7212	47.209	1.6869	0.313449975	
30	5/5/2010	11:25:45	14	0.233	0.233	12.726	11.7248	47.205	1.6833	0.312781044	
31	5/5/2010	11:25:46	14.5	0.242	0.075	12.731	11.7288	47.201	1.6793	0.312037787	
32	5/5/2010	11:25:46	15	0.250	0.250	12.722	11.7311	47.199	1.677	0.311610415	
33	5/5/2010	11:25:47	15.5	0.258	0.258	12.727	11.7354	47.195	1.6727	0.310811413	
34	5/5/2010	11:25:47	16	0.267	0.267	12.719	11.7394	47.191	1.6687	0.310068167	
35	5/5/2010	11:25:48	16.5	0.275	0.275	12.723	11.743	47.187	1.6651	0.309389226	
36	5/5/2010	11:25:48	17	0.283	0.283	12.713	11.7467	47.183	1.6614	0.308711713	
37	5/5/2010	11:25:49	17.5	0.292	0.292	12.718	11.75	47.180	1.6581	0.308088628	
38	5/5/2010	11:25:49	18	0.300	0.300	12.709	11.7529	47.177	1.6552	0.307669665	
39	5/5/2010	11:25:50	18.5	0.308	0.308	12.714	11.7568	47.173	1.6513	0.30683499	
40	5/5/2010	11:25:50	19	0.317	0.317	12.705	11.7612	47.169	1.6489	0.306017407	
41	5/5/2010	11:25:51	19.5	0.325	0.325	12.709	11.7641	47.166	1.644	0.305478546	

SIEVE ANALYSIS WORKSHEET

CLIENT: CWLP
Environmental Health & Safety

PROJECT: Piezometer Installation
CWLP Ash Ponds
Springfield, IL

DATE: April 26, 2010

PSI REPORT NO. 0020522-1

GENERAL SAMPLE INFORMATION

SAMPLE TYPE: Clayey SILT, Some Fine to Coarse Sand	SAMPLED BY: PSI DATE SAMPLED: 4/21/2010
SAMPLE SOURCE: AP-1, 3'-7'	TESTED BY: Don Reed DATE TESTED: April 26, 2010
SPECIFICATIONS: ASTM C136	NOTES/OBSERVATIONS NP=Not Provided to PSI

SIEVE ANALYSIS DATA/RESULTS

SIEVE ANALYSIS DATA/RESULTS		TEST METHOD
Original "Wet" Sample Mass (OSM) + Pan:	996.3	ASTM C136
Pan Weight:	93.2	
Original "Wet" Sample Mass (OSM):	903.1	
Total "Dry" Sample Mass (TSM) + Pan:	820.4	
Pan Weight:	93.2	
Total "Dry" Sample Mass (TSM):	727.2	
Total "Dry" Washed Sample Mass (TWM) + Pan Wt.	182.6	
Pan Weight:	93.2	
Total "Dry" Washed Sample Mass (TWM), grams	89.4	

Sieve Size metric (English)	Individual Weight (g)	Cumulative Weight (g)	Percent Retained (%)	Percent Passing (%)	Specification
37.5 (1 1/2)	0.0	0.0	0.0	100.0	NP
25 (1)	0.0	0.0	0.0	100.0	NP
19 (3/4)	0.0	0.0	0.0	100.0	NP
16 (5/8)	0.0	0.0	0.0	100.0	NP
12.5 (1/2)	0.0	0.0	0.0	100.0	NP
9.5 (3/8)	0.0	0.0	0.0	100.0	NP
6.3 (1/4)	0.4	0.4	0.1	99.9	NP
4.75 (4)	1.2	1.6	0.2	99.8	NP
2.36 (8)	3.0	4.6	0.6	99.4	NP
1.18 (16)	2.1	6.7	0.9	99.1	NP
0.6 (30)	5.3	12.0	1.7	98.3	NP
0.425 (40)	0.0	12.0	1.7	98.3	NP
0.3 (50)	7.9	19.9	2.7	97.3	NP
0.15 (100)	27.4	47.3	6.5	93.5	NP
0.075 (200)	39.3	86.6	11.9	88.1	NP
Pan					

SIEVE ANALYSIS WORKSHEET

CLIENT: CWLP
Environmental Health & Safety

PROJECT: Piezometer Installation
CWLP Ash Ponds
Springfield, IL

DATE: April 26, 2010

PSI REPORT NO. 0020522-1

GENERAL SAMPLE INFORMATION

SAMPLE TYPE: Clayey SILT, Some Fine to Coarse Sand	SAMPLED BY: PSI DATE SAMPLED: 4/21/2010
SAMPLE SOURCE: AP-1, 10'-15'	TESTED BY: Don Reed DATE TESTED: April 26, 2010
SPECIFICATIONS: ASTM C136	NOTES/OBSERVATIONS NP=Not Provided to PSI

SIEVE ANALYSIS DATA/RESULTS

SIEVE ANALYSIS DATA/RESULTS		TEST METHOD
Original "Wet" Sample Mass (OSM) + Pan:	1030.6	ASTM C136
Pan Weight:	93.5	
Original "Wet" Sample Mass (OSM):	937.1	
Total "Dry" Sample Mass (TSM) + Pan:	814.4	
Pan Weight:	93.5	
Total "Dry" Sample Mass (TSM):	720.9	
Total "Dry" Washed Sample Mass (TWM) + Pan Wt.	247.0	
Pan Weight:	93.5	
Total "Dry" Washed Sample Mass (TWM), grams	153.5	

Sieve Size metric (English)	Individual Weight (g)	Cumulative Weight (g)	Percent Retained (%)	Percent Passing (%)	Specification
37.5 (1 1/2)	0.0	0.0	0.0	100.0	NP
25 (1)	0.0	0.0	0.0	100.0	NP
19 (3/4)	0.0	0.0	0.0	100.0	NP
16 (5/8)	0.0	0.0	0.0	100.0	NP
12.5 (1/2)	0.0	0.0	0.0	100.0	NP
9.5 (3/8)	0.9	0.9	0.1	99.9	NP
6.3 (1/4)	0.9	1.8	0.2	99.8	NP
4.75 (4)	3.1	4.9	0.7	99.3	NP
2.36 (8)	21.1	26.0	3.6	96.4	NP
1.18 (16)	40.7	66.7	9.3	90.7	NP
0.6 (30)	31.2	97.9	13.6	86.4	NP
0.425 (40)	0.0	97.9	13.6	86.4	NP
0.3 (50)	14.4	112.3	15.6	84.4	NP
0.15 (100)	14.7	127.0	17.6	82.4	NP
0.075 (200)	25.6	152.6	21.2	78.8	NP
Pan					

SIEVE ANALYSIS WORKSHEET

CLIENT:	CWLP Environmental Health & Safety	PROJECT:	Piezometer Installation CWLP Ash Ponds Springfield, IL
DATE:	April 26, 2010	PSI REPORT NO.	0020522-1 Page 3 of 8

GENERAL SAMPLE INFORMATION

SAMPLE TYPE: Clayey SILT, Some Fine to Coarse Sand	SAMPLED BY: PSI DATE SAMPLED: 4/21/2010
SAMPLE SOURCE: AP-2, 3'-7'	TESTED BY: Don Reed DATE TESTED: April 26, 2010
SPECIFICATIONS: ASTM C136	NOTES/OBSERVATIONS NP=Not Provided to PSI

SIEVE ANALYSIS DATA/RESULTS

		TEST METHOD
Original "Wet" Sample Mass (OSM) + Pan:	1706.4	ASTM C136
Pan Weight:	90.7	
Original "Wet" Sample Mass (OSM):	1615.7	
Total "Dry" Sample Mass (TSM) + Pan:	1381.0	
Pan Weight:	90.7	
Total "Dry" Sample Mass (TSM):	1290.3	
Total "Dry" Washed Sample Mass (TWM) + Pan Wt.	420.6	
Pan Weight:	90.7	
Total "Dry" Washed Sample Mass (TWM), grams	329.9	

Sieve Size metric (English)	Individual Weight (g)	Cumulative Weight (g)	Percent Retained (%)	Percent Passing (%)	Specification
37.5 (1 1/2)	0.0	0.0	0.0	100.0	NP
25 (1)	0.0	0.0	0.0	100.0	NP
19 (3/4)	0.0	0.0	0.0	100.0	NP
16 (5/8)	0.0	0.0	0.0	100.0	NP
12.5 (1/2)	0.0	0.0	0.0	100.0	NP
9.5 (3/8)	3.5	3.5	0.3	99.7	NP
6.3 (1/4)	2.3	5.8	0.4	99.6	NP
4.75 (4)	2.7	8.5	0.7	99.3	NP
2.36 (8)	6.6	15.1	1.2	98.8	NP
1.18 (16)	7.0	22.1	1.7	98.3	NP
0.6 (30)	8.0	30.1	2.3	97.7	NP
0.425 (40)	0.0	30.1	2.3	97.7	NP
0.3 (50)	18.1	48.2	3.7	96.3	NP
0.15 (100)	119.7	167.9	13.0	87.0	NP
0.075 (200)	156.2	324.1	25.1	74.9	NP
Pan					

SIEVE ANALYSIS WORKSHEET

CLIENT: CWLP
Environmental Health & Safety

PROJECT: Piezometer Installation
CWLP Ash Ponds
Springfield, IL

DATE: April 26, 2010

PSI REPORT NO. 0020522-1

GENERAL SAMPLE INFORMATION

SAMPLE TYPE: Clayey SILT, Some Fine to Coarse Sand	SAMPLED BY: PSI DATE SAMPLED: 4/21/2010
SAMPLE SOURCE: AP-2, 9'-16'	TESTED BY: Don Reed DATE TESTED: April 26, 2010
SPECIFICATIONS: ASTM C136	NOTES/OBSERVATIONS NP=Not Provided to PSI

SIEVE ANALYSIS DATA/RESULTS

SIEVE ANALYSIS DATA/RESULTS		TEST METHOD
Original "Wet" Sample Mass (OSM) + Pan:	1461.6	ASTM C136
Pan Weight:	173.0	
Original "Wet" Sample Mass (OSM):	1288.6	
Total "Dry" Sample Mass (TSM) + Pan:	1178.1	
Pan Weight:	173.0	
Total "Dry" Sample Mass (TSM):	1005.1	
Total "Dry" Washed Sample Mass (TWM) + Pan Wt.	319.2	
Pan Weight:	173.0	
Total "Dry" Washed Sample Mass (TWM), grams	146.2	

Sieve Size metric (English)	Individual Weight (g)	Cumulative Weight (g)	Percent Retained (%)	Percent Passing (%)	Specification
37.5 (1 1/2)	0.0	0.0	0.0	100.0	NP
25 (1)	0.0	0.0	0.0	100.0	NP
19 (3/4)	0.0	0.0	0.0	100.0	NP
16 (5/8)	0.0	0.0	0.0	100.0	NP
12.5 (1/2)	0.0	0.0	0.0	100.0	NP
9.5 (3/8)	0.0	0.0	0.0	100.0	NP
6.3 (1/4)	0.8	0.8	0.1	99.9	NP
4.75 (4)	1.2	2.0	0.2	99.8	NP
2.36 (8)	1.5	3.5	0.3	99.7	NP
1.18 (16)	2.8	6.3	0.6	99.4	NP
0.6 (30)	5.7	12.0	1.2	98.8	NP
0.425 (40)	0.0	12.0	1.2	98.8	NP
0.3 (50)	7.2	19.2	1.9	98.1	NP
0.15 (100)	42.1	61.3	6.1	93.9	NP
0.075 (200)	82.8	144.1	14.3	85.7	NP
Pan					

SIEVE ANALYSIS WORKSHEET

CLIENT: CWLP
Environmental Health & Safety

PROJECT: Piezometer Installation
CWLP Ash Ponds
Springfield, IL

DATE: April 26, 2010

PSI REPORT NO. 0020522-1

GENERAL SAMPLE INFORMATION

SAMPLE TYPE: Clayey SILT, Some Fine to Coarse Sand, Trace Subround Gravel	SAMPLED BY: PSI DATE SAMPLED: 4/21/2010
SAMPLE SOURCE: AP-3, 3'-6'	TESTED BY: Don Reed DATE TESTED: April 26, 2010
SPECIFICATIONS: ASTM C136	NOTES/OBSERVATIONS NP=Not Provided to PSI

SIEVE ANALYSIS DATA/RESULTS

SIEVE ANALYSIS DATA/RESULTS		TEST METHOD
Original "Wet" Sample Mass (OSM) + Pan:	816.4	ASTM C136
Pan Weight:	94.6	
Original "Wet" Sample Mass (OSM):	721.8	
Total "Dry" Sample Mass (TSM) + Pan:	663.7	
Pan Weight:	94.6	
Total "Dry" Sample Mass (TSM):	569.1	
Total "Dry" Washed Sample Mass (TWM) + Pan Wt.	195.2	
Pan Weight:	94.6	
Total "Dry" Washed Sample Mass (TWM), grams	100.6	

Sieve Size metric (English)	Individual Weight (g)	Cumulative Weight (g)	Percent Retained (%)	Percent Passing (%)	Specification
37.5 (1 1/2)	0.0	0.0	0.0	100.0	NP
25 (1)	0.0	0.0	0.0	100.0	NP
19 (3/4)	0.0	0.0	0.0	100.0	NP
16 (5/8)	0.0	0.0	0.0	100.0	NP
12.5 (1/2)	0.0	0.0	0.0	100.0	NP
9.5 (3/8)	2.5	2.5	0.4	99.6	NP
6.3 (1/4)	0.4	2.9	0.5	99.5	NP
4.75 (4)	0.4	3.3	0.6	99.4	NP
2.36 (8)	1.3	4.6	0.8	99.2	NP
1.18 (16)	3.6	8.2	1.4	98.6	NP
0.6 (30)	7.6	15.8	2.8	97.2	NP
0.425 (40)	0.0	15.8	2.8	97.2	NP
0.3 (50)	10.2	26.0	4.6	95.4	NP
0.15 (100)	31.7	57.7	10.1	89.9	NP
0.075 (200)	41.5	99.2	17.4	82.6	NP
Pan					

SIEVE ANALYSIS WORKSHEET

CLIENT:	CWLP Environmental Health & Safety	PROJECT:	Piezometer Installation CWLP Ash Ponds Springfield, IL
DATE:	April 26, 2010	PSI REPORT NO.	0020522-1 Page 6 of 8

GENERAL SAMPLE INFORMATION

SAMPLE TYPE: Clayey SILT, Some Fine to Coarse Sand	SAMPLED BY: PSI DATE SAMPLED: 4/21/2010
SAMPLE SOURCE: AP-3, 10'-15'	TESTED BY: Don Reed DATE TESTED: April 26, 2010
SPECIFICATIONS: ASTM C136	NOTES/OBSERVATIONS NP=Not Provided to PSI

SIEVE ANALYSIS DATA/RESULTS

		TEST METHOD
Original "Wet" Sample Mass (OSM) + Pan:	1010.5	ASTM C136
Pan Weight:	104.2	
Original "Wet" Sample Mass (OSM):	906.3	
Total "Dry" Sample Mass (TSM) + Pan:	812.2	
Pan Weight:	104.2	
Total "Dry" Sample Mass (TSM):	708.0	
Total "Dry" Washed Sample Mass (TWM) + Pan Wt.	250.7	
Pan Weight:	104.2	
Total "Dry" Washed Sample Mass (TWM), grams	146.5	

Sieve Size metric (English)	Individual Weight (g)	Cumulative Weight (g)	Percent Retained (%)	Percent Passing (%)	Specification
37.5 (1 1/2)	0.0	0.0	0.0	100.0	NP
25 (1)	0.0	0.0	0.0	100.0	NP
19 (3/4)	0.0	0.0	0.0	100.0	NP
16 (5/8)	0.0	0.0	0.0	100.0	NP
12.5 (1/2)	0.0	0.0	0.0	100.0	NP
9.5 (3/8)	0.0	0.0	0.0	100.0	NP
6.3 (1/4)	1.8	1.8	0.3	99.7	NP
4.75 (4)	0.4	2.2	0.3	99.7	NP
2.36 (8)	3.4	5.6	0.8	99.2	NP
1.18 (16)	5.5	11.1	1.6	98.4	NP
0.6 (30)	7.4	18.5	2.6	97.4	NP
0.425 (40)	0.0	18.5	2.6	97.4	NP
0.3 (50)	16.6	35.1	5.0	95.0	NP
0.15 (100)	52.0	87.1	12.3	87.7	NP
0.075 (200)	56.8	143.9	20.3	79.7	NP
Pan					

SIEVE ANALYSIS WORKSHEET

CLIENT: CWLP
Environmental Health & Safety

PROJECT: Piezometer Installation
CWLP Ash Ponds
Springfield, IL

DATE: April 26, 2010

PSI REPORT NO. 0020522-1

GENERAL SAMPLE INFORMATION

SAMPLE TYPE: Composite of FLY ASH and Silty CLAY, With Fine to Coarse Sand, Trace Subround gravel	SAMPLED BY: PSI DATE SAMPLED: 4/20/2010
SAMPLE SOURCE: AP-4, 18'-23'	TESTED BY: Don Reed DATE TESTED: April 26, 2010
SPECIFICATIONS: ASTM C136	NOTES/OBSERVATIONS NP=Not Provided to PSI

SIEVE ANALYSIS DATA/RESULTS

		TEST METHOD
Original "Wet" Sample Mass (OSM) + Pan:	1931.9	ASTM C136
Pan Weight:	147.6	
Original "Wet" Sample Mass (OSM):	1784.3	
Total "Dry" Sample Mass (TSM) + Pan:	1596.1	
Pan Weight:	147.6	
Total "Dry" Sample Mass (TSM):	1448.5	
Total "Dry" Washed Sample Mass (TWM) + Pan Wt.	752.6	
Pan Weight:	147.6	
Total "Dry" Washed Sample Mass (TWM), grams	605.0	

Sieve Size metric (English)	Individual Weight (g)	Cumulative Weight (g)	Percent Retained (%)	Percent Passing (%)	Specification
37.5 (1 1/2)	0.0	0.0	0.0	100.0	NP
25 (1)	0.0	0.0	0.0	100.0	NP
19 (3/4)	0.0	0.0	0.0	100.0	NP
16 (5/8)	8.2	8.2	5.6	94.4	NP
12.5 (1/2)	0.0	8.2	0.6	99.4	NP
9.5 (3/8)	2.5	10.7	0.7	99.3	NP
6.3 (1/4)	12.3	23.0	1.6	98.4	NP
4.75 (4)	10.8	33.8	2.3	97.7	NP
2.36 (8)	52.2	86.0	5.9	94.1	NP
1.18 (16)	144.3	230.3	15.9	84.1	NP
0.6 (30)	132.2	362.5	25.0	75.0	NP
0.425 (40)	0.0	362.5	25.0	75.0	NP
0.3 (50)	110.4	472.9	32.6	67.4	NP
0.15 (100)	75.1	548.0	37.8	62.2	NP
0.075 (200)	53.5	601.5	41.5	58.5	NP
Pan					

SIEVE ANALYSIS WORKSHEET

CLIENT: CWLP
Environmental Health & Safety

PROJECT: Piezometer Installation
CWLP Ash Ponds
Springfield, IL

DATE: April 26, 2010

PSI REPORT NO. 0020522-1

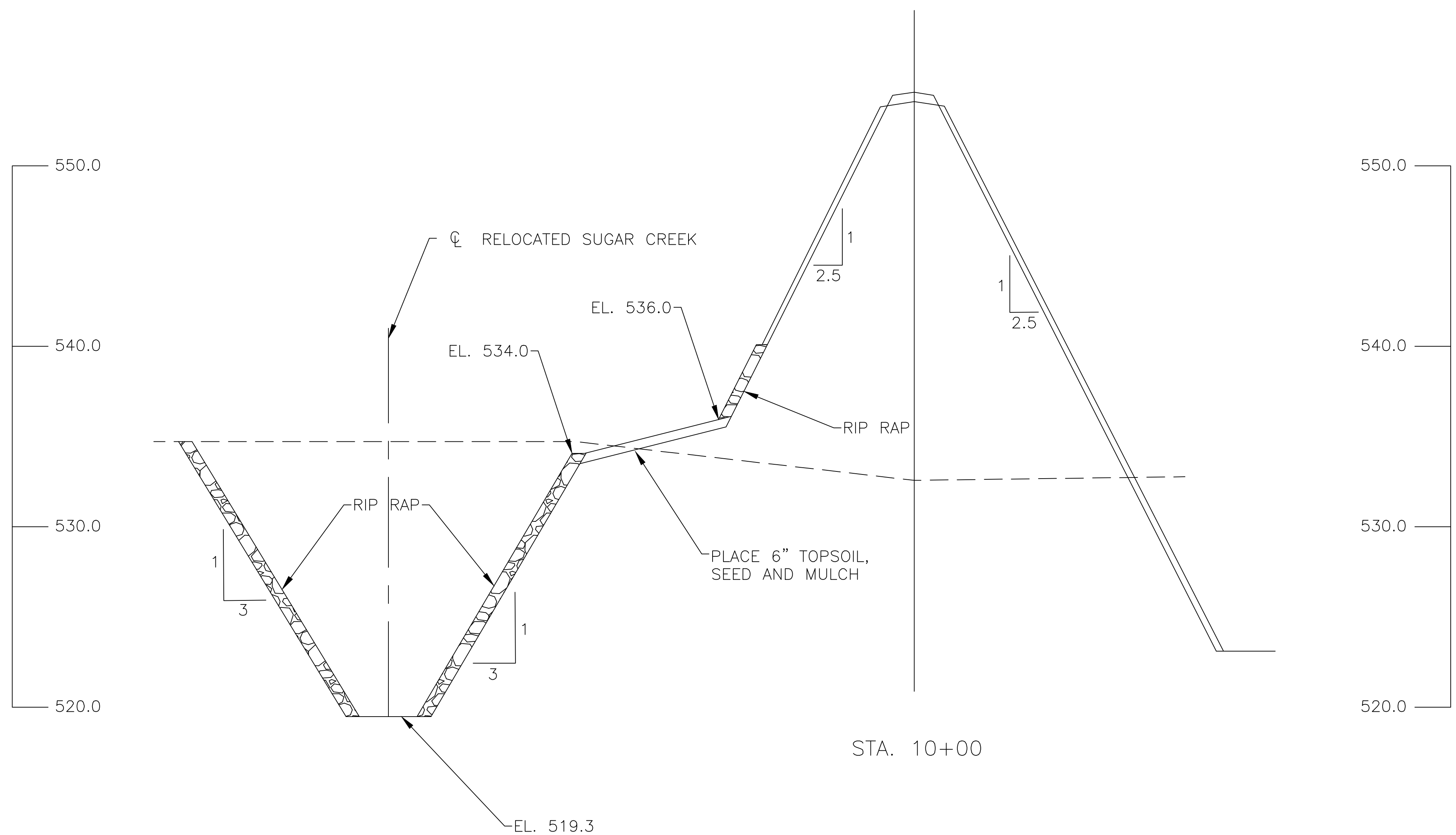
GENERAL SAMPLE INFORMATION

SAMPLE TYPE: Clayey SILT With Fine to Coarse Sand, Trace Subround Gravel	SAMPLED BY: PSI DATE SAMPLED: 4/20/2010
SAMPLE SOURCE: AP-4, 45'-55'	TESTED BY: Don Reed DATE TESTED: April 26, 2010
SPECIFICATIONS: ASTM C136	NOTES/OBSERVATIONS NP=Not Provided to PSI

SIEVE ANALYSIS DATA/RESULTS

		TEST METHOD
Original "Wet" Sample Mass (OSM) + Pan:	1855.4	ASTM C136
Pan Weight:	99.7	
Original "Wet" Sample Mass (OSM):	1755.7	
Total "Dry" Sample Mass (TSM) + Pan:	1509.0	
Pan Weight:	99.7	
Total "Dry" Sample Mass (TSM):	1409.3	
Total "Dry" Washed Sample Mass (TWM) + Pan Wt.	584.6	
Pan Weight:	99.7	
Total "Dry" Washed Sample Mass (TWM), grams	484.9	

Sieve Size metric (English)	Individual Weight (g)	Cumulative Weight (g)	Percent Retained (%)	Percent Passing (%)	Specification
37.5 (1 1/2)	0.0	0.0	0.0	100.0	NP
25 (1)	0.0	0.0	0.0	100.0	NP
19 (3/4)	0.0	0.0	0.0	100.0	NP
16 (5/8)	0.0	0.0	0.0	100.0	NP
12.5 (1/2)	0.0	0.0	0.0	100.0	NP
9.5 (3/8)	2.7	2.7	0.2	99.8	NP
6.3 (1/4)	6.7	9.4	0.7	99.3	NP
4.75 (4)	11.0	20.4	1.4	98.6	NP
2.36 (8)	31.4	51.8	3.7	96.3	NP
1.18 (16)	35.3	87.1	6.2	93.8	NP
0.6 (30)	55.9	143.0	10.1	89.9	NP
0.425 (40)	0.0	143.0	10.1	89.9	NP
0.3 (50)	162.8	305.8	21.7	78.3	NP
0.15 (100)	94.7	400.5	28.4	71.6	NP
0.075 (200)	82.5	483.0	34.3	65.7	NP
Pan					



HORIZ. 0 20 40 80
VERT. 0 4 8 16
SCALE: IN FEET

NOTES:
CROSS-SECTION BASED ON CONSTRUCTION PLAN DRAWINGS PREPARED BY BURNS & McDONNEL IN AUGUST 1976

NO.	DATE	REVISIONS DESCRIPTION	BY

ANDREWS ENGINEERING, INC.
3300 GINGER CREEK DRIVE
SPRINGFIELD, ILLINOIS 62711-7233
PH (217) 787-2334 FAX (217) 787-9495
PONTIAC, IL • LOMBARD, IL • INDIANAPOLIS, IN • WARRENTON, MO
PROFESSIONAL DESIGN ENGINEERING AND LAND SURVEYING FIRM #184001541

APPROVED BY: PMV | DESIGNED BY: PMV | DRAWN BY: RMC

DALLMAN ASH POND CROSS-SECTION AT STA. 10+00

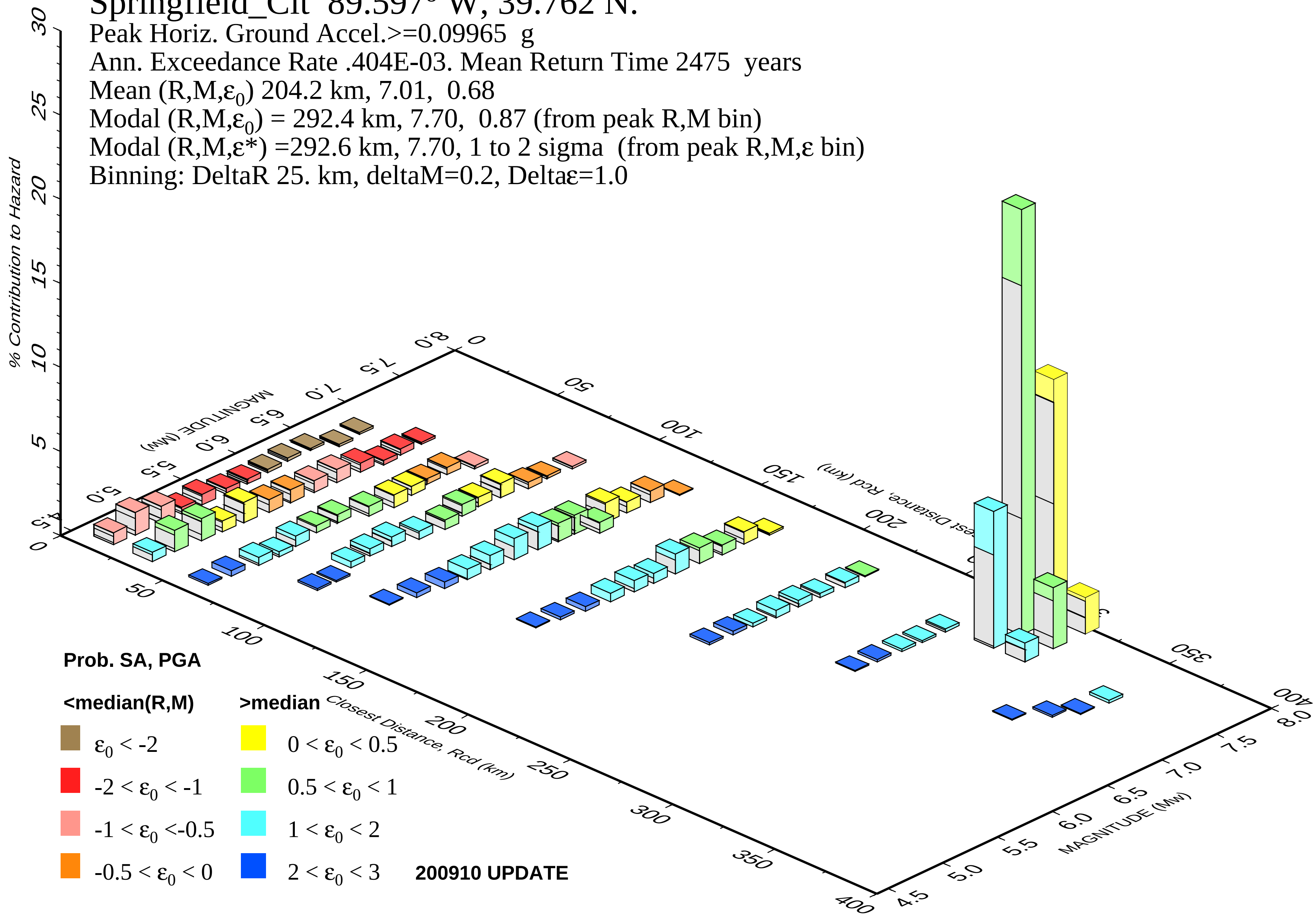
PLANS PREPARED FOR
CITY, WATER, LIGHT & POWER
SPRINGFIELD, SANGAMON COUNTY, ILLINOIS

DATE: OCTOBER 2016
PROJECT ID: 150077/0011
SHEET NUMBER:
X-SEC.

APPENDIX E

USGS Earthquake Hazards Program
Probabilistic Seismic Hazard Analysis

PSH Deaggregation on NEHRP BC rock
Springfield_Cit 89.597° W, 39.762 N.
Peak Horiz. Ground Accel.>=0.09965 g
Ann. Exceedance Rate .404E-03. Mean Return Time 2475 years
Mean (R,M,ε_0) 204.2 km, 7.01, 0.68
Modal (R,M,ε_0) = 292.4 km, 7.70, 0.87 (from peak R,M bin)
Modal (R,M,ε*) =292.6 km, 7.70, 1 to 2 sigma (from peak R,M,ε bin)
Binning: DeltaR 25. km, deltaM=0.2, Deltaε=1.0



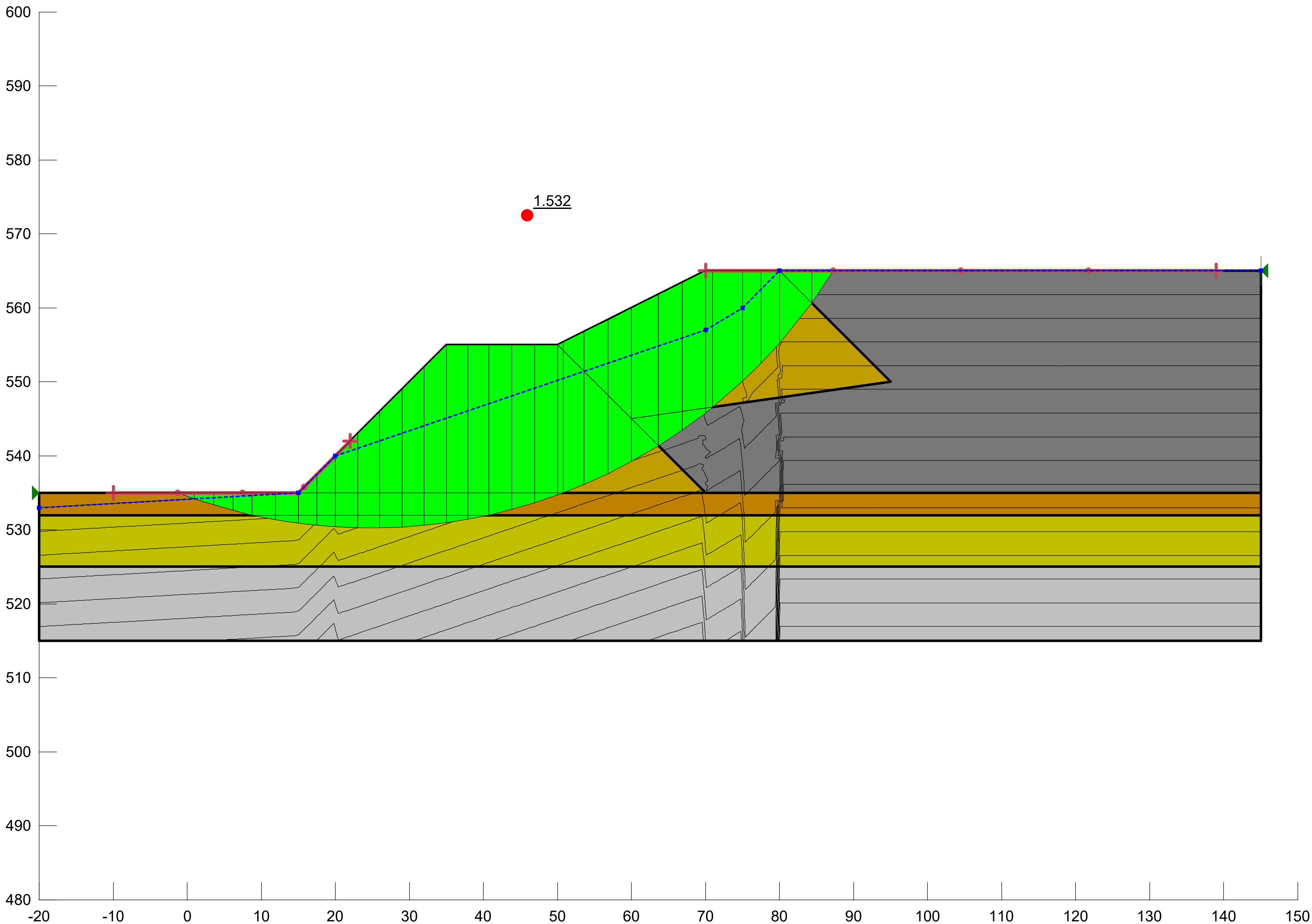
GMT 2016 Sep 28 21:22:05 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on rock with average vs= 760. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

APPENDIX F

Lakeside Ash Pond Slope Stability Analysis

APPENDIX F-1

Long-Term Static Slope Stability Analysis


1.532
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590
580
570
560
550
540
530
520
510
500
490
480
-20
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150

CWLP Lakeside Long Term Static

File Information

File Version: 8.14
Created By: Karl Finke
Last Edited By: Karl Finke
Revision Number: 47
Date: 10/3/2016
Time: 2:09:57 PM
Tool Version: 8.14.1.10087
File Name: CWLP Lakeside Long Term Section 2.gsz
Directory: J:\CWLP Factor of Safety Report\SlopeW\
Last Solved Date: 10/3/2016
Last Solved Time: 2:09:59 PM

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

CWLP Lakeside Long Term Static

Description: CWLP Lakeside
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Piezometric Line
- Apply Phreatic Correction: Yes
- Use Staged Rapid Drawdown: No

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °
Driving Side Maximum Convex Angle: 5 °
Optimize Critical Slip Surface Location: No
Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Brn Gry Sandy Silty Clay

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 145 psf
Phi': 32 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Brn Silty Clay

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 190 psf
Phi': 32 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Yel Brn Gry VF Sandy Silt

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 190 psf
Phi': 32 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Gray Clayey Shale

Model: Mohr-Coulomb

Unit Weight: 130 pcf
Cohesion': 2,000 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Ash

Model: Mohr-Coulomb
Unit Weight: 100 pcf
Cohesion': 0 psf
Phi': 25 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (-10, 535) ft
Left-Zone Right Coordinate: (22, 542) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (70, 565) ft
Right-Zone Right Coordinate: (139, 565) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (-20, 535) ft
Right Coordinate: (145, 565) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-20	533
Coordinate 2	15	535
Coordinate 3	20	540
Coordinate 4	70	557
Coordinate 5	75	560
Coordinate 6	80	565
Coordinate 7	145	565

Points

	X (ft)	Y (ft)
Point 1	15	535
Point 2	35	555
Point 3	50	555
Point 4	60	545
Point 5	70	535
Point 6	70	565
Point 7	80	565
Point 8	95	550
Point 9	145	565
Point 10	-20	535
Point 11	145	535
Point 12	-20	532
Point 13	145	532
Point 14	-20	525
Point 15	145	525
Point 16	-20	515
Point 17	145	515

Regions

	Material	Points	Area (ft²)
Region 1	Brn Gry Sandy Silty Clay	1,2,3,4,5	700
Region 2	Brn Gry Sandy Silty Clay	3,6,7,8,4	550
Region 3	Brn Silty Clay	10,1,5,11,13,12	495
Region 4	Yel Brn Gry VF Sandy Silt	12,14,15,13	1,155
Region 5	Ash	8,4,5,11,9,7	2,000
Region 6	Gray Clayey Shale	14,16,17,15	1,650

Current Slip Surface

Slip Surface: 33

F of S: 1.532

Volume: 1,258.2941 ft³

Weight: 150,210.74 lbs

Resisting Moment: 5,434,428.4 lbs-ft

Activating Moment: 3,545,823.9 lbs-ft

Resisting Force: 68,187.197 lbs

Activating Force: 44,512.413 lbs

F of S Rank: 1

Exit: (-1.2751263, 535) ft

Entry: (87.25, 565) ft

Radius: 73.560778 ft

Center: (24.754863, 603.80136) ft

PDF 0852

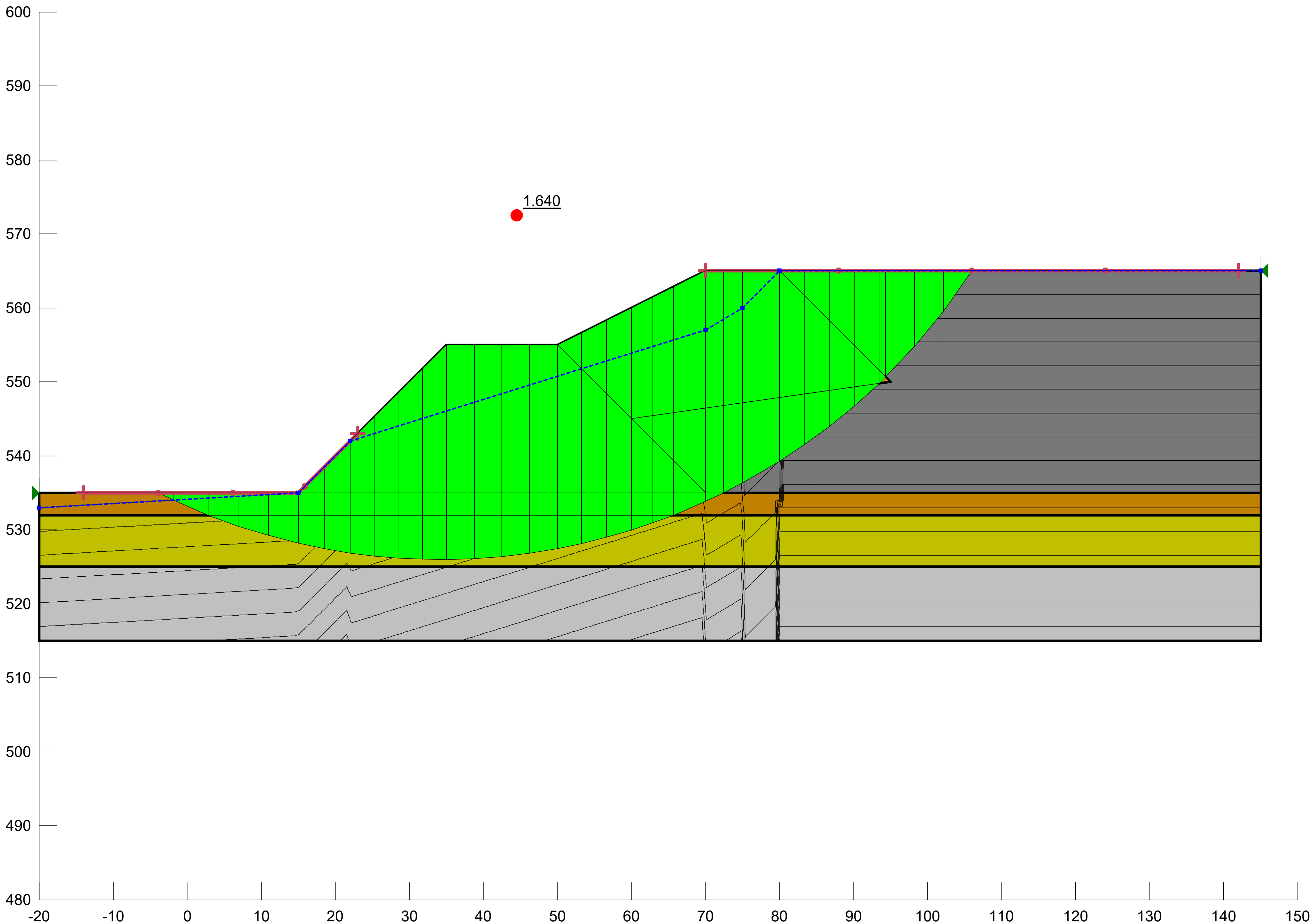
Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	-0.16048362	534.59869	-28.921787	116.63294	72.880347	190
Slice 2	2.2555676	533.77922	30.633885	239.91856	130.77557	190
Slice 3	4.8583846	532.99536	88.638254	357.95512	168.28786	190
Slice 4	7.4612017	532.31483	140.21555	463.62052	202.08585	190
Slice 5	10.321958	531.68791	189.37551	562.23057	232.9857	190
Slice 6	13.440653	531.13303	234.97122	647.75213	257.93414	190
Slice 7	16.25	530.74473	343.52879	872.41907	330.48732	190
Slice 8	18.75	530.49682	514.99863	1,237.8844	451.70913	190
Slice 9	21.5	530.32797	569.52187	1,633.4497	664.81587	190
Slice 10	24.5	530.25632	630.58214	2,026.2219	872.09255	190
Slice 11	27.5	530.30715	684.79174	2,374.6858	1,055.963	190
Slice 12	30.5	530.48071	732.13642	2,676.6103	1,215.0422	190
Slice 13	33.5	530.77789	772.56714	2,932.1543	1,349.4598	190
Slice 14	36.436779	531.18867	805.44064	2,961.7079	1,347.3854	190
Slice 15	39.310336	531.70991	830.93376	2,787.6141	1,222.6696	190
Slice 16	42.289263	532.3786	850.1832	2,595.7963	1,090.7801	190
Slice 17	45.373558	533.20762	862.4684	2,390.7241	954.96017	190
Slice 18	48.457853	534.1831	866.56169	2,182.7153	822.42405	190
Slice 19	50.392426	534.85408	865.82212	2,074.5141	755.2746	190
Slice 20	52.183471	535.56217	860.27695	2,045.1601	740.39712	145
Slice 21	55.186567	536.85367	845.14961	1,991.516	716.32925	145
Slice 22	58.395522	538.40841	819.21351	1,925.9735	691.58041	145
Slice 23	61.820519	540.29639	778.74635	1,813.4119	646.53076	145
Slice 24	65.230778	542.40704	725.54379	1,765.7584	485.06005	0
Slice 25	68.410259	544.62796	661.78492	1,717.5015	492.28874	0
Slice 26	70.482325	546.18359	509.56053	1,647.8538	530.79489	0
Slice 27	72.982325	548.32026	480.3485	1,367.3352	554.25078	145
Slice 28	76.25	551.30019	310.43404	1,075.0936	477.81232	145
Slice	78.75	553.87819	308.00034	862.30889	346.37042	145

29						PDF 0853
Slice 30	82.16908	557.94599	440.16994	557.72891	73.458995	145
Slice 31	85.79408	562.83092	135.35062	184.12653	22.744581	0

APPENDIX F-2

Short-Term Static Slope Stability Analysis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40
50
60
70
80
90
100
110
120
130
140
150

CWLP Lakeside Short Term Static

File Information

- File Version: 8.14
- Created By: Karl Finke
- Last Edited By: Karl Finke
- Revision Number: 48
- Date: 10/3/2016
- Time: 2:12:27 PM
- Tool Version: 8.14.1.10087
- File Name: CWLP Lakeside Short Term Section 2.gsz
- Directory: J:\CWLP Factor of Safety Report\SlopeW\

Project Settings

- Length(L) Units: Feet
- Time(t) Units: Seconds
- Force(F) Units: Pounds
- Pressure(p) Units: psf
- Strength Units: psf
- Unit Weight of Water: 62.4 pcf
- View: 2D
- Element Thickness: 1

Analysis Settings

CWLP Lakeside Short Term Static

- Description: CWLP Lakeside
- Kind: SLOPE/W
- Method: Morgenstern-Price
- Settings
  - Side Function
    - Interslice force function option: Half-Sine
  - PWP Conditions Source: Piezometric Line
  - Apply Phreatic Correction: Yes
  - Use Staged Rapid Drawdown: No
- Slip Surface
  - Direction of movement: Right to Left
  - Use Passive Mode: No
  - Slip Surface Option: Entry and Exit
  - Critical slip surfaces saved: 1
  - Resisting Side Maximum Convex Angle: 1 °
  - Driving Side Maximum Convex Angle: 5 °

Optimize Critical Slip Surface Location: No
Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Brn Gry Sandy Silty Clay

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 1,400 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Brn Silty Clay

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 1,800 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Yel Brn Gry VF Sandy Silt

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 1,000 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Gray Clayey Shale

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,000 psf

Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Ash

Model: Mohr-Coulomb
Unit Weight: 100 pcf
Cohesion': 0 psf
Phi': 15 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (-14, 535) ft
Left-Zone Right Coordinate: (23, 543) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (70, 565) ft
Right-Zone Right Coordinate: (142, 565) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (-20, 535) ft
Right Coordinate: (145, 565) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-20	533
Coordinate 2	15	535
Coordinate 3	22	542
Coordinate 4	70	557
Coordinate 5	75	560
Coordinate 6	80	565
Coordinate 7	145	565

Points

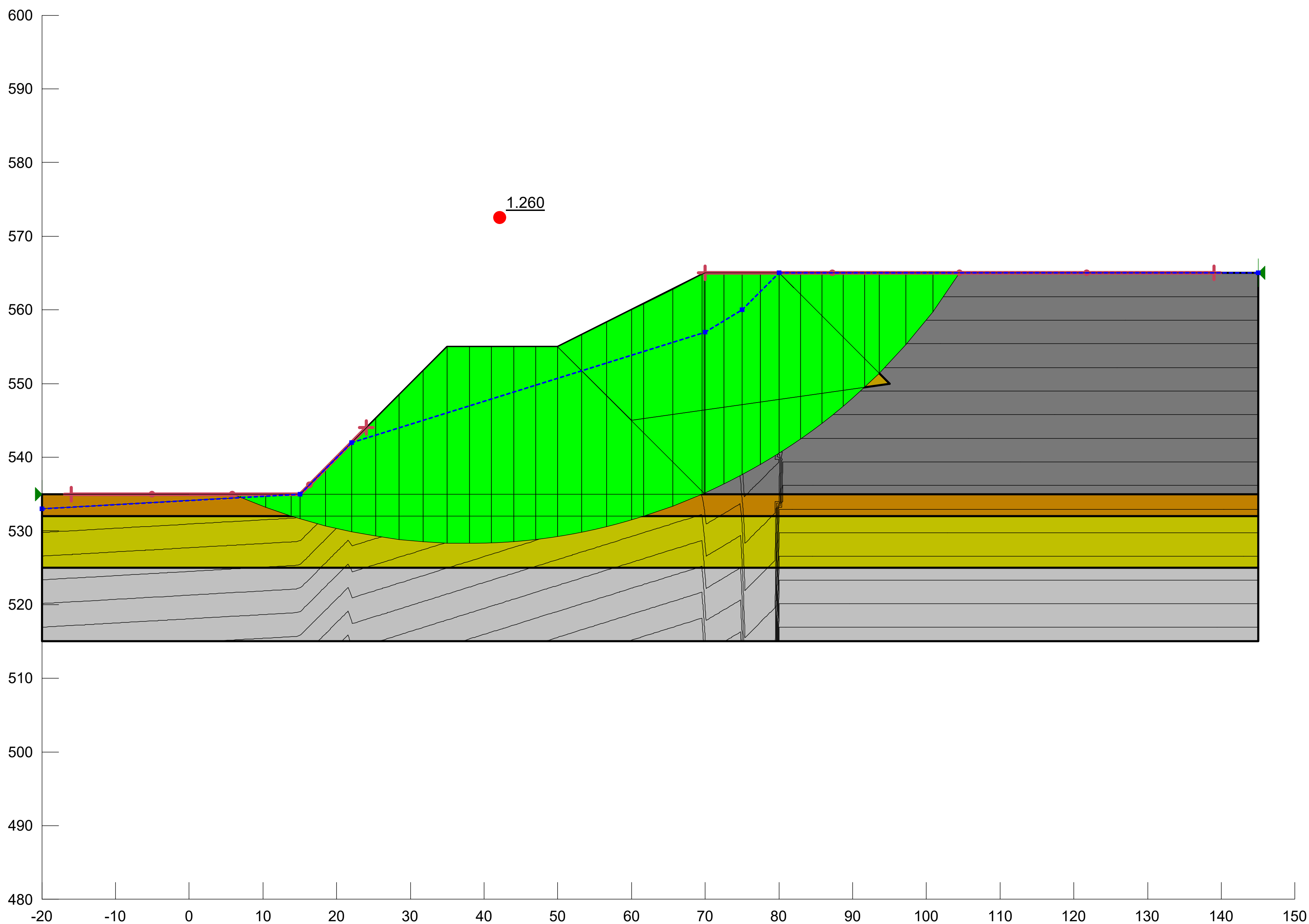
	X (ft)	Y (ft)
Point 1	15	535
Point 2	35	555
Point 3	50	555
Point 4	60	545
Point 5	70	535
Point 6	70	565
Point 7	80	565
Point 8	95	550
Point 9	145	565
Point 10	-20	535
Point 11	145	535
Point 12	-20	532
Point 13	145	532
Point 14	-20	525
Point 15	145	525
Point 16	-20	515
Point 17	145	515

Regions

	Material	Points	Area (ft^2)
Region 1	Brn Gry Sandy Silty Clay	1,2,3,4,5	700
Region 2	Brn Gry Sandy Silty Clay	3,6,7,8,4	550
Region 3	Brn Silty Clay	10,1,5,11,13,12	495
Region 4	Yel Brn Gry VF Sandy Silt	12,14,15,13	1,155
Region 5	Ash	8,4,5,11,9,7	2,000
Region 6	Gray Clayey Shale	14,16,17,15	1,650

APPENDIX F-3

Lakeside Seismic Slope Stability Analysis



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590
580
570
560
550
540
530
520
510
500
490
480
-20
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150

CWLP Lakeside Short Term Seismic

File Information

File Version: 8.14
Created By: Karl Finke
Last Edited By: Karl Finke
Revision Number: 52
Date: 10/3/2016
Time: 2:14:02 PM
Tool Version: 8.14.1.10087
File Name: CWLP Lakeside Short Term Seismic Section 2.gsz
Directory: J:\CWLP Factor of Safety Report\SlopeW\
Last Solved Date: 10/3/2016
Last Solved Time: 2:14:06 PM

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

CWLP Lakeside Short Term Seismic

Description: CWLP Lakeside
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Piezometric Line
- Apply Phreatic Correction: Yes
- Use Staged Rapid Drawdown: No

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1

Resisting Side Maximum Convex Angle: 1 °
Driving Side Maximum Convex Angle: 5 °
Optimize Critical Slip Surface Location: No
Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Brn Gry Sandy Silty Clay

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 1,400 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Brn Silty Clay

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 1,800 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Yel Brn Gry VF Sandy Silt

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 1,000 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Gray Clayey Shale

Model: Mohr-Coulomb

Unit Weight: 130 pcf
Cohesion': 2,000 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Ash

Model: Mohr-Coulomb
Unit Weight: 100 pcf
Cohesion': 0 psf
Phi': 15 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (-16, 535) ft
Left-Zone Right Coordinate: (24, 544) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (70, 565) ft
Right-Zone Right Coordinate: (139, 565) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (-20, 535) ft
Right Coordinate: (145, 565) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	-20	533
Coordinate 2	15	535
Coordinate 3	22	542
Coordinate 4	70	557
Coordinate 5	75	560
Coordinate 6	80	565
Coordinate 7	145	565

Seismic Coefficients

Horz Seismic Coef.: 0.1

Vert Seismic Coef.: 0

Points

	X (ft)	Y (ft)
Point 1	15	535
Point 2	35	555
Point 3	50	555
Point 4	60	545
Point 5	70	535
Point 6	70	565
Point 7	80	565
Point 8	95	550
Point 9	145	565
Point 10	-20	535
Point 11	145	535
Point 12	-20	532
Point 13	145	532
Point 14	-20	525
Point 15	145	525
Point 16	-20	515
Point 17	145	515

Regions

	Material	Points	Area (ft^2)
Region 1	Brn Gry Sandy Silty Clay	1,2,3,4,5	700
Region 2	Brn Gry Sandy Silty Clay	3,6,7,8,4	550
Region 3	Brn Silty Clay	10,1,5,11,13,12	495
Region 4	Yel Brn Gry VF Sandy Silt	12,14,15,13	1,155
Region 5	Ash	8,4,5,11,9,7	2,000
Region 6	Gray Clayey Shale	14,16,17,15	1,650

Current Slip Surface

Slip Surface: 63

F of S: 1.260

Volume: 1,901.9136 ft^3

Weight: 220,860.5 lbs

Resisting Moment: 7,130,465.7 lbs-ft

Activating Moment: 5,657,637.6 lbs-ft

Resisting Force: 85,224.85 lbs

Activating Force: 67,622.745 lbs

F of S Rank: 1

Exit: (5.863961, 535) ft
Entry: (104.5, 565) ft
Radius: 79.109148 ft
Center: (37.720356, 607.41151) ft

PDF 0866

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	6.3985031	534.76952	-16.235239	666.78022	0	1,800
Slice 2	8.6540842	533.85892	48.417777	824.15224	0	1,800
Slice 3	12.096162	532.5894	139.61124	1,052.2735	0	1,800
Slice 4	14.408601	531.81762	195.83209	915.79274	0	1,000
Slice 5	16.75	531.15401	349.18995	1,237.5437	0	1,000
Slice 6	20.25	530.27641	622.35204	1,804.3101	0	1,000
Slice 7	23.625	529.58574	734.59908	2,313.1757	0	1,000
Slice 8	26.875	529.06648	821.85486	2,760.4465	0	1,000
Slice 9	30.125	528.68475	901.29201	3,161.9008	0	1,000
Slice 10	33.375	528.43857	973.0241	3,515.7678	0	1,000
Slice 11	36.5	528.32601	1,034.9389	3,637.264	0	1,000
Slice 12	39.5	528.33662	1,087.631	3,541.0214	0	1,000
Slice 13	42.5	528.46119	1,133.8449	3,421.4585	0	1,000
Slice 14	45.5	528.70025	1,173.5497	3,282.3533	0	1,000
Slice 15	48.5	529.05487	1,206.6858	3,127.2166	0	1,000
Slice 16	51.619048	529.55023	1,233.9353	3,039.0174	0	1,000
Slice 17	54.928571	530.21608	1,254.8771	3,014.6722	0	1,000
Slice 18	58.309524	531.04871	1,267.6066	2,974.7747	0	1,000
Slice 19	60.811756	531.75225	1,272.0639	2,922.9997	0	1,000
Slice 20	63.611822	532.68895	1,268.5574	2,836.2034	0	1,800
Slice 21	67.588442	534.18895	1,253.9299	2,627.4289	0	1,800
Slice 22	69.723473	535.0649	1,242.0626	2,534.1139	0	1,400
Slice 23	69.935097	535.15874	1,240.4874	2,588.738	361.26267	0
Slice 24	71.25	535.77273	1,008.3689	2,514.1676	403.47755	0
Slice 25	73.75	536.99738	1,021.0026	2,378.8723	363.8401	0
Slice 26	76.25	538.3342	714.97294	2,233.9803	407.0168	0

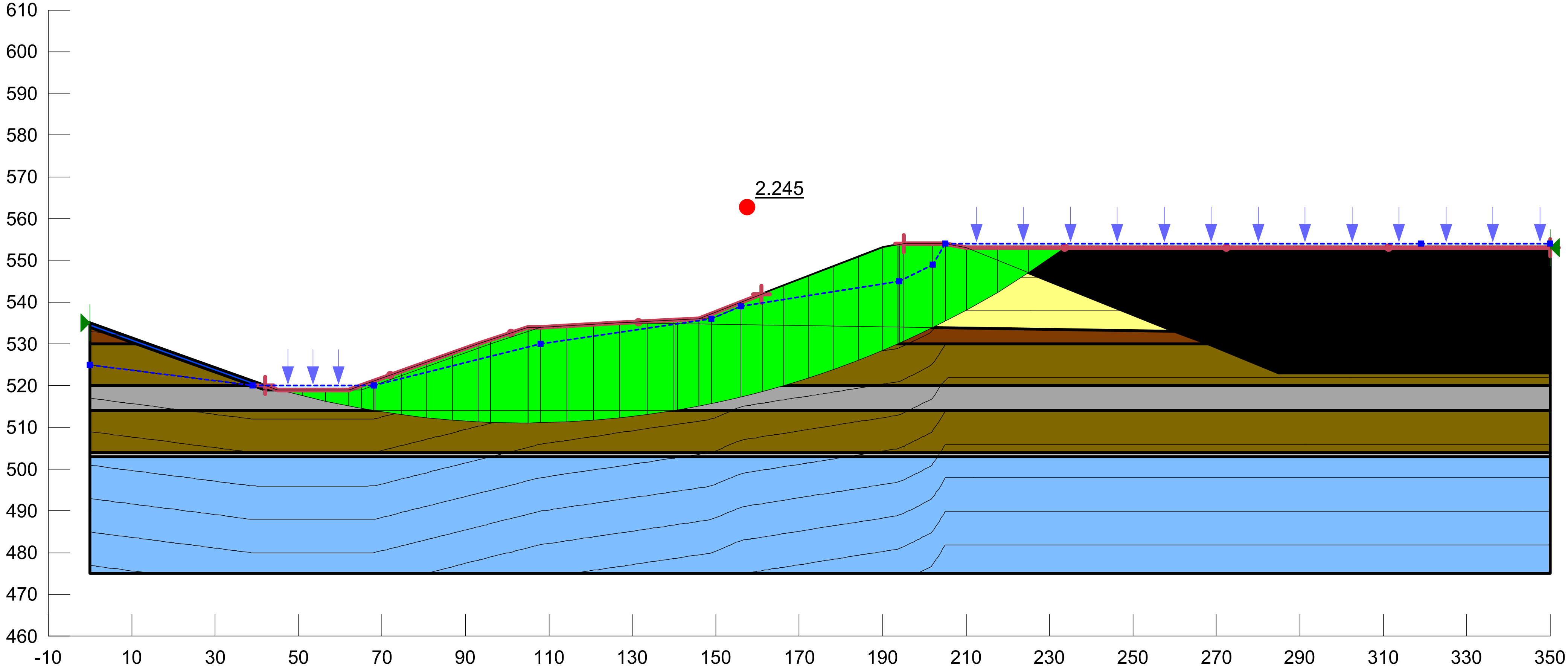
Slice 27	78.75	539.78986	747.55632	2,103.0434	363.20167	0
Slice 28	81.454318	541.51348	1,465.559	1,988.8949	140.22742	0
Slice 29	84.362954	543.54069	1,339.0611	1,797.0107	122.70723	0
Slice 30	87.27159	545.77183	1,199.8378	1,598.0888	106.71104	0
Slice 31	90.180226	548.23008	1,046.4432	1,386.8062	91.199981	0
Slice 32	92.613771	550.46311	907.10183	416.08203	-0	1,400
Slice 33	95.410831	553.34674	727.16315	925.16796	53.055228	0
Slice 34	99.046499	557.52099	466.69001	618.90263	40.785248	0
Slice 35	102.68217	562.37775	163.62838	227.05533	16.995201	0

APPENDIX G

Dallman Ash Pond Slope Stability Analysis

APPENDIX G-1

Long-Term Static Slope Stability Analysis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Dallman Long Term Static

File Information

File Version: 8.14
Created By: Karl Finke
Last Edited By: Karl Finke
Revision Number: 45
Date: 10/3/2016
Time: 2:45:37 PM
Tool Version: 8.14.1.10087
File Name: CWLP Dallman Long Term Static.gsz
Directory: J:\CWLP Factor of Safety Report\SlopeW\
Last Solved Date: 10/3/2016
Last Solved Time: 2:45:42 PM

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Dallman Long Term Static

- Kind: SLOPE/W
- Method: Morgenstern-Price
- Settings
  - Side Function
    - Interslice force function option: Half-Sine
  - PWP Conditions Source: Piezometric Line
  - Apply Phreatic Correction: No
  - Use Staged Rapid Drawdown: No
- Slip Surface
  - Direction of movement: Right to Left
  - Use Passive Mode: No
  - Slip Surface Option: Entry and Exit
  - Critical slip surfaces saved: 1
  - Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °
Optimize Critical Slip Surface Location: No
Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Embankment

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 145 psf
Phi': 32 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Dk Brn Silty Clay

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 190 psf
Phi': 32 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Clayey Silt

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 190 psf
Phi': 32 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Gry Snd Silty Clay

Model: Mohr-Coulomb
Unit Weight: 120 pcf

Cohesion': 190 psf
Phi': 32 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Gry Sand w/Silt

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

Shale

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 2,000 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Rip-Rap

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 40 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Ash

Model: Mohr-Coulomb
Unit Weight: 100 pcf
Cohesion': 0 psf
Phi': 25 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (42, 520) ft
Left-Zone Right Coordinate: (161, 541.91176) ft
Left-Zone Increment: 4

Right Projection: Range
Right-Zone Left Coordinate: (195, 554) ft
Right-Zone Right Coordinate: (350, 553) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 535) ft
Right Coordinate: (350, 553) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	525
Coordinate 2	39	520
Coordinate 3	68	520
Coordinate 4	108	530
Coordinate 5	149	536
Coordinate 6	156	539
Coordinate 7	194	545
Coordinate 8	202	549
Coordinate 9	205	554
Coordinate 10	319	554
Coordinate 11	350	554

Seismic Coefficients

Horz Seismic Coef.: 0
Vert Seismic Coef.: 0

Points

	X (ft)	Y (ft)
Point 1	0	535
Point 2	105	534
Point 3	146	536
Point 4	190	553
Point 5	195	554
Point 6	205	554
Point 7	210	553
Point 8	260	533
Point 9	285	523

Point 10	319	523
Point 11	108	534
Point 12	149	536
Point 13	156	539
Point 14	156	540
Point 15	127	535
Point 16	0	534
Point 17	0	530
Point 18	0	520
Point 19	0	514
Point 20	0	504
Point 21	0	503
Point 22	0	490
Point 23	319	490
Point 24	319	503
Point 25	319	504
Point 26	319	514
Point 27	319	520
Point 28	268	530
Point 29	96	530
Point 30	93	530
Point 31	68	520
Point 32	65	520
Point 33	65	519
Point 34	62	519
Point 35	45	519
Point 36	42	519
Point 37	42	520
Point 38	39	520
Point 39	14	530
Point 40	11	530
Point 41	319	553
Point 42	319	554
Point 43	0	475
Point 44	319	475
Point 45	350	475
Point 46	350	503
Point 47	350	504
Point 48	350	514
Point 49	350	520
Point 50	350	523
Point 51	350	553
Point 52	350	554

Regions

	Material	Points	Area (ft²)
Region 1	Embankment	15,3,12,13,14,4,5,6,7,8	1,329

PDF 0876

Region 2	Dk Brn Silty Clay	8,28,29,11,15	653.5
Region 3	Dk Brn Silty Clay	16,17,40	22
Region 4	Clayey Silt	17,18,38,40	250
Region 5	Clayey Silt	31,29,28,9,50,49	2,165.5
Region 6	Gry Snd Silty Clay	18,19,48,49,31,33,34,35,36,38	2,074
Region 7	Clayey Silt	19,20,47,48	3,500
Region 8	Gry Sand w/Silt	20,21,46,47	350
Region 9	Shale	21,22,43,45,46	9,800
Region 10	Rip-Rap	14,13,12,3	9.5
Region 11	Rip-Rap	11,2,30,32,34,33,31,29	45
Region 12	Rip-Rap	1,16,40,38,36,35,37,39	46
Region 13	Ash	50,9,28,8,7,51	3,072.5

Current Slip Surface

Slip Surface: 7
F of S: 2.245
Volume: 3,200.3592 ft³
Weight: 383,171.01 lbs
Resisting Moment: 36,423,187 lbs-ft
Activating Moment: 16,221,979 lbs-ft
Resisting Force: 158,991.47 lbs
Activating Force: 70,815.407 lbs
F of S Rank: 1
Exit: (45.522783, 519) ft
Entry: (233.67574, 553) ft
Radius: 221.12319 ft
Center: (104.14305, 732.21147) ft

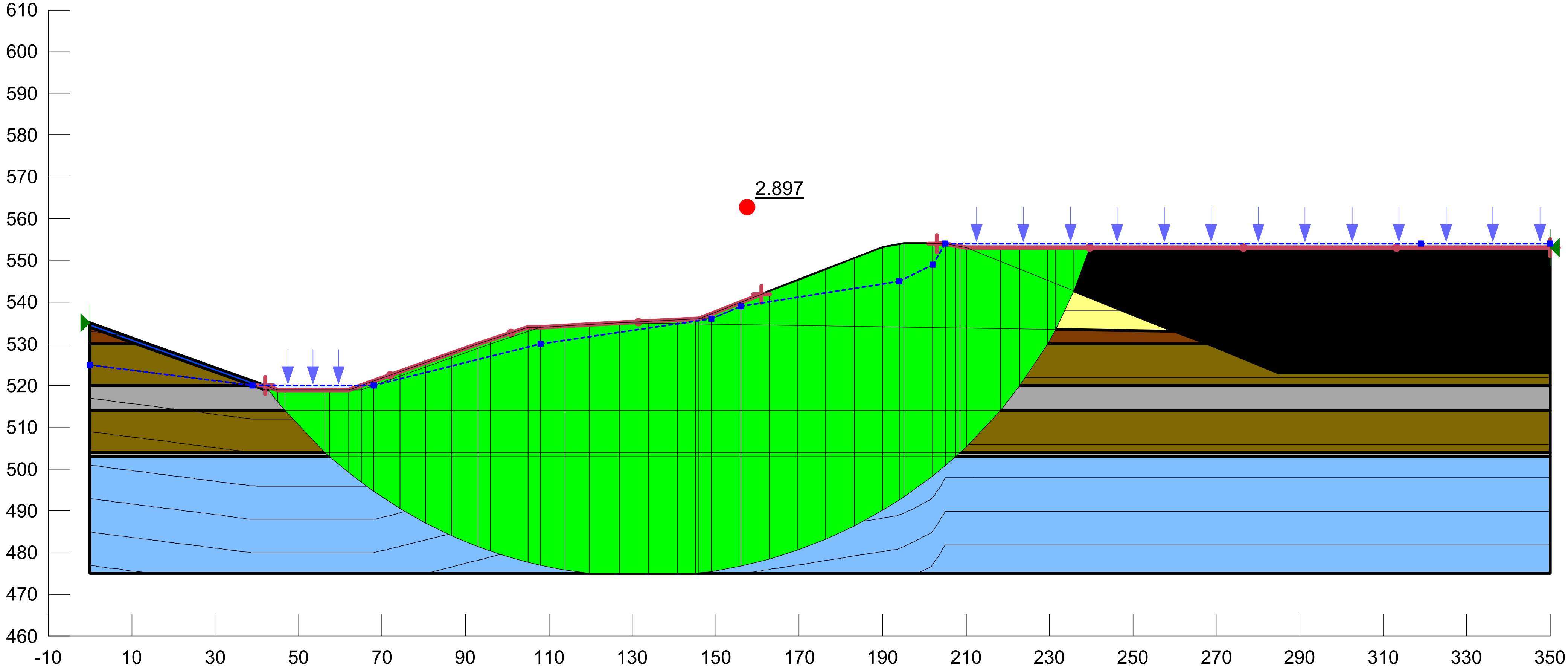
Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	48.268985	518.28274	107.15674	178.87139	44.812287	190
Slice 2	53.761391	516.92283	192.01571	353.71493	101.04088	190
Slice 3	59.253797	515.71076	267.64836	511.69752	152.49884	190
Slice 4	63.5	514.86088	320.68133	660.9906	212.64883	190
Slice 5	66.5	514.32124	354.35436	839.15316	302.93591	190
Slice 6	68.188424	514.03105	375.40183	956.76282	363.27466	190
Slice 7	71.454742	513.5399	457.00431	1,171.6028	446.53067	190
Slice 8	77.61053	512.70776	604.96029	1,562.4615	598.31313	190
Slice 9	83.766318	512.05084	741.98189	1,926.5541	740.20288	190
Slice 10	89.922106	511.5676	868.16684	2,261.6771	870.76189	190
Slice 11	94.5	511.30374	956.04651	2,488.3181	957.46953	190
Slice 12	100.5	511.1641	1,058.3602	2,738.6197	1,049.9427	190
Slice 13	106.5	511.10593	1,155.5902	2,901.8597	1,091.1903	190

Slice 14	111.16667	511.22256	1,200.6293	2,877.0302	1,047.5315	190
Slice 15	117.5	511.51486	1,240.2241	2,843.683	1,001.9523	190
Slice 16	123.83333	511.98965	1,268.4315	2,784.2952	947.21677	190
Slice 17	130.22731	512.6562	1,285.2263	2,699.9685	884.02907	190
Slice 18	136.68194	513.51981	1,290.2789	2,592.4107	813.66226	190
Slice 19	140.33133	514.07002	1,289.2711	2,525.18	772.28159	190
Slice 20	143.3767	514.61303	1,283.1968	2,460.0575	735.38418	190
Slice 21	147.5	515.38596	1,272.6186	2,435.0091	726.34218	190
Slice 22	152.5	516.4704	1,312.2468	2,513.0909	750.37068	190
Slice 23	158.57153	517.90802	1,341.4759	2,572.8352	769.43867	190
Slice 24	163.71458	519.28057	1,306.5016	2,609.0957	813.95114	190
Slice 25	169.25034	520.91337	1,259.1564	2,631.83	857.74164	190
Slice 26	175.17882	522.83241	1,197.8192	2,639.2275	900.69184	190
Slice 27	181.10729	524.93876	1,124.7941	2,628.7031	939.74661	190
Slice 28	187.03576	527.2382	1,039.7203	2,600.2125	975.10375	190
Slice 29	191.80962	529.21848	963.18591	2,530.9234	979.63114	190
Slice 30	193.80962	530.08446	928.85427	2,475.0325	966.15936	190
Slice 31	194.5	530.39277	927.09136	2,455.6885	955.17346	190
Slice 32	198.5	532.26834	934.8556	2,265.3266	831.37054	190
Slice 33	203.5	534.67452	1,049.9097	2,031.1828	613.16748	145
Slice 34	207.5	536.75096	1,076.3401	1,798.7329	451.40109	145
Slice 35	213.74088	540.20827	860.60409	1,381.2735	325.35038	145
Slice 36	221.22264	544.6791	581.62409	853.3867	169.81613	145
Slice 37	229.31963	550.0073	249.14466	341.52741	43.078784	0

APPENDIX G-2

Short-Term Static Slope Stability Analysis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Dallman Short Term Static

File Information

File Version: 8.14
Created By: Karl Finke
Last Edited By: Karl Finke
Revision Number: 40
Date: 10/3/2016
Time: 1:54:59 PM
Tool Version: 8.14.1.10087
File Name: CWLP Dallman Short Term Static.gsz
Directory: J:\CWLP Factor of Safety Report\SlopeW\
Last Solved Date: 10/3/2016
Last Solved Time: 1:55:04 PM

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Dallman Short Term Static

Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Piezometric Line
- Apply Phreatic Correction: No
- Use Staged Rapid Drawdown: No

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °
Optimize Critical Slip Surface Location: No
Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Embankment

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 1,400 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Dk Brn Silty Clay

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 1,800 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Clayey Silt

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 1,400 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Gry Snd Silty Clay

Model: Mohr-Coulomb
Unit Weight: 120 pcf

Cohesion': 1,000 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Gry Sand w/Silt

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

Shale

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 2,000 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Rip-Rap

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 40 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Ash

Model: Mohr-Coulomb
Unit Weight: 100 pcf
Cohesion': 0 psf
Phi': 15 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (42, 520) ft
Left-Zone Right Coordinate: (161, 541.91176) ft
Left-Zone Increment: 4

Right Projection: Range
Right-Zone Left Coordinate: (203, 554) ft
Right-Zone Right Coordinate: (350, 553) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 535) ft
Right Coordinate: (350, 553) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	525
Coordinate 2	39	520
Coordinate 3	68	520
Coordinate 4	108	530
Coordinate 5	149	536
Coordinate 6	156	539
Coordinate 7	194	545
Coordinate 8	202	549
Coordinate 9	205	554
Coordinate 10	319	554
Coordinate 11	350	554

Seismic Coefficients

Horz Seismic Coef.: 0
Vert Seismic Coef.: 0

Points

	X (ft)	Y (ft)
Point 1	0	535
Point 2	105	534
Point 3	146	536
Point 4	190	553
Point 5	195	554
Point 6	205	554
Point 7	210	553
Point 8	260	533
Point 9	285	523

Point 10	319	523
Point 11	108	534
Point 12	149	536
Point 13	156	539
Point 14	156	540
Point 15	127	535
Point 16	0	534
Point 17	0	530
Point 18	0	520
Point 19	0	514
Point 20	0	504
Point 21	0	503
Point 22	0	490
Point 23	319	490
Point 24	319	503
Point 25	319	504
Point 26	319	514
Point 27	319	520
Point 28	268	530
Point 29	96	530
Point 30	93	530
Point 31	68	520
Point 32	65	520
Point 33	65	519
Point 34	62	519
Point 35	45	519
Point 36	42	519
Point 37	42	520
Point 38	39	520
Point 39	14	530
Point 40	11	530
Point 41	319	553
Point 42	319	554
Point 43	0	475
Point 44	319	475
Point 45	350	475
Point 46	350	503
Point 47	350	504
Point 48	350	514
Point 49	350	520
Point 50	350	523
Point 51	350	553
Point 52	350	554

Regions

	Material	Points	Area (ft²)
Region 1	Embankment	15,3,12,13,14,4,5,6,7,8	1,329

Region 2	Dk Brn Silty Clay	8,28,29,11,15	653.5
Region 3	Dk Brn Silty Clay	16,17,40	22
Region 4	Clayey Silt	17,18,38,40	250
Region 5	Clayey Silt	31,29,28,9,50,49	2,165.5
Region 6	Gry Snd Silty Clay	18,19,48,49,31,33,34,35,36,38	2,074
Region 7	Clayey Silt	19,20,47,48	3,500
Region 8	Gry Sand w/Silt	20,21,46,47	350
Region 9	Shale	21,22,43,45,46	9,800
Region 10	Rip-Rap	14,13,12,3	9.5
Region 11	Rip-Rap	11,2,30,32,34,33,31,29	45
Region 12	Rip-Rap	1,16,40,38,36,35,37,39	46
Region 13	Ash	50,9,28,8,7,51	3,072.5

Current Slip Surface

Slip Surface: 9
F of S: 2.897
Volume: 9,136.4623 ft³
Weight: 1,093,861.8 lbs
Resisting Moment: 47,499,602 lbs-ft
Activating Moment: 16,395,280 lbs-ft
Resisting Force: 357,222.23 lbs
Activating Force: 123,292.08 lbs
F of S Rank: 1
Exit: (42, 520) ft
Entry: (239.67574, 553) ft
Radius: 112.36371 ft
Center: (132.46693, 586.64336) ft

Slip Slices

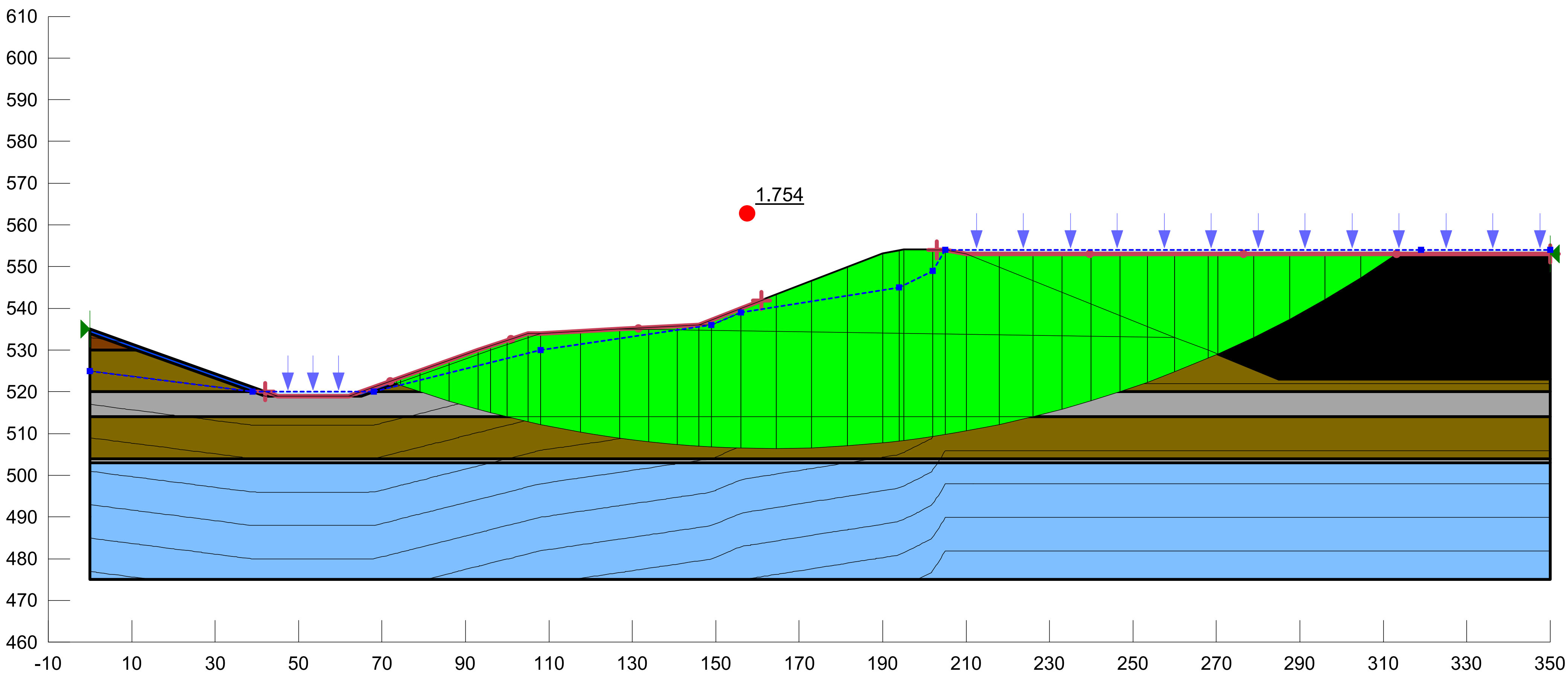
	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	42.372628	519.5	31.2	73.027936	35.097806	0
Slice 2	43.872628	517.55435	152.60873	711.94304	0	1,000
Slice 3	45.871637	515.05435	308.60873	974.73547	0	1,000
Slice 4	51.540427	509	686.4	1,850.0351	0	1,400
Slice 5	56.88762	503.5	1,029.6	2,336.2148	881.32283	0
Slice 6	59.71883	501.06093	1,181.7983	3,000.1174	0	2,000
Slice 7	63.5	497.9554	1,375.5833	3,409.4613	0	2,000
Slice 8	66.5	495.70089	1,516.2646	3,784.4612	0	2,000
Slice 9	71.125	492.57502	1,760.0687	4,370.811	0	2,000
Slice 10	77.375	488.77803	2,094.5006	5,106.8708	0	2,000
Slice 11	83.625	485.50966	2,395.9473	5,767.5331	0	2,000
Slice 12	89.875	482.71971	2,667.54	6,353.5021	0	2,000
Slice 13	94.5	480.90039	2,853.2155	6,740.4066	0	2,000

Slice 14	100.5	479.02514	3,063.8314	7,152.3338	0	2,000
Slice 15	106.5	477.33213	3,263.075	7,458.84	0	2,000
Slice 16	110.94101	476.40154	3,371.4003	7,514.7108	0	2,000
Slice 17	116.82303	475.41364	3,486.7583	7,567.0138	0	2,000
Slice 18	123.38202	475	3,572.4641	7,392.9072	0	2,000
Slice 19	130.43835	475	3,636.9005	7,390.4633	0	2,000
Slice 20	137.31506	475	3,699.6965	7,383.8323	0	2,000
Slice 21	142.96161	475	3,751.2592	7,375.7445	0	2,000
Slice 22	145.58491	475.04879	3,772.1697	7,172.558	0	2,000
Slice 23	147.5	475.30011	3,773.9755	7,179.3671	0	2,000
Slice 24	152.5	476.13713	3,829.0431	7,210.3691	0	2,000
Slice 25	159.4	477.61149	3,864.1417	7,194.7724	0	2,000
Slice 26	166.2	479.52204	3,811.9215	7,137.3757	0	2,000
Slice 27	173	481.90854	3,730.0017	7,036.0639	0	2,000
Slice 28	179.8	484.80463	3,616.2836	6,889.9686	0	2,000
Slice 29	186.6	488.25558	3,467.9422	6,695.9509	0	2,000
Slice 30	192	491.37608	3,326.4275	6,468.2458	0	2,000
Slice 31	194.5	492.95696	3,263.0859	6,318.1096	0	2,000
Slice 32	198.5	495.83306	3,208.4168	5,963.0255	0	2,000
Slice 33	203.5	499.60223	3,238.4207	5,489.861	0	2,000
Slice 34	206.2481	501.91318	3,250.2175	5,189.8481	0	2,000
Slice 35	208.04624	503.5	3,151.2	5,153.528	1,350.5873	0
Slice 36	209.29814	504.65773	3,078.9575	4,990.2829	0	1,400
Slice 37	214.09529	509.65773	2,766.9575	4,364.4456	0	1,400
Slice 38	220.56223	517	2,308.8	3,606.2371	0	1,000
Slice 39	226.22135	525	1,809.6	2,420.3273	0	1,400

Slice 40	230.46996	531.7148	1,390.5962	1,289.2997	-0	1,800
Slice 41	233.64675	538.04232	995.7594	636.10168	-0	1,400
Slice 42	237.76908	547.82751	385.16317	531.44729	39.196713	0

APPENDIX G-3

Seismic Slope Stability Analysis


1.754
610
600
590
580
570
560
550
540
530
520
510
500
490
480
470
460
-10
10
30
50
70
90
110
130
150
170
190
210
230
250
270
290
310
330
350

Dallman Short Term Seismic

File Information

- File Version: 8.14
- Created By: Karl Finke
- Last Edited By: Karl Finke
- Revision Number: 39
- Date: 10/3/2016
- Time: 2:01:36 PM
- Tool Version: 8.14.1.10087
- File Name: CWLP Dallman Short Term Seismic.gsz
- Directory: J:\CWLP Factor of Safety Report\SlopeW\
- Last Solved Date: 10/3/2016
- Last Solved Time: 2:01:42 PM

Project Settings

- Length(L) Units: Feet
- Time(t) Units: Seconds
- Force(F) Units: Pounds
- Pressure(p) Units: psf
- Strength Units: psf
- Unit Weight of Water: 62.4 pcf
- View: 2D
- Element Thickness: 1

Analysis Settings

Dallman Short Term Seismic

- Kind: SLOPE/W
- Method: Morgenstern-Price
- Settings
  - Side Function
    - Interslice force function option: Half-Sine
  - PWP Conditions Source: Piezometric Line
  - Apply Phreatic Correction: No
  - Use Staged Rapid Drawdown: No
- Slip Surface
  - Direction of movement: Right to Left
  - Use Passive Mode: No
  - Slip Surface Option: Entry and Exit
  - Critical slip surfaces saved: 1
  - Resisting Side Maximum Convex Angle: 1 °

Driving Side Maximum Convex Angle: 5 °
Optimize Critical Slip Surface Location: No
Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Embankment

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 1,400 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Dk Brn Silty Clay

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 1,800 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Clayey Silt

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 1,400 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Gry Snd Silty Clay

Model: Mohr-Coulomb
Unit Weight: 120 pcf

Cohesion': 1,000 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Gry Sand w/Silt

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

Shale

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 2,000 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Rip-Rap

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 40 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Ash

Model: Mohr-Coulomb
Unit Weight: 100 pcf
Cohesion': 0 psf
Phi': 15 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (42, 520) ft
Left-Zone Right Coordinate: (161, 541.91176) ft
Left-Zone Increment: 4

Right Projection: Range
Right-Zone Left Coordinate: (203, 554) ft
Right-Zone Right Coordinate: (350, 553) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 535) ft
Right Coordinate: (350, 553) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	525
Coordinate 2	39	520
Coordinate 3	68	520
Coordinate 4	108	530
Coordinate 5	149	536
Coordinate 6	156	539
Coordinate 7	194	545
Coordinate 8	202	549
Coordinate 9	205	554
Coordinate 10	319	554
Coordinate 11	350	554

Seismic Coefficients

Horz Seismic Coef.: 0.1
Vert Seismic Coef.: 0

Points

	X (ft)	Y (ft)
Point 1	0	535
Point 2	105	534
Point 3	146	536
Point 4	190	553
Point 5	195	554
Point 6	205	554
Point 7	210	553
Point 8	260	533
Point 9	285	523

Point 10	319	523
Point 11	108	534
Point 12	149	536
Point 13	156	539
Point 14	156	540
Point 15	127	535
Point 16	0	534
Point 17	0	530
Point 18	0	520
Point 19	0	514
Point 20	0	504
Point 21	0	503
Point 22	0	490
Point 23	319	490
Point 24	319	503
Point 25	319	504
Point 26	319	514
Point 27	319	520
Point 28	268	530
Point 29	96	530
Point 30	93	530
Point 31	68	520
Point 32	65	520
Point 33	65	519
Point 34	62	519
Point 35	45	519
Point 36	42	519
Point 37	42	520
Point 38	39	520
Point 39	14	530
Point 40	11	530
Point 41	319	553
Point 42	319	554
Point 43	0	475
Point 44	319	475
Point 45	350	475
Point 46	350	503
Point 47	350	504
Point 48	350	514
Point 49	350	520
Point 50	350	523
Point 51	350	553
Point 52	350	554

Regions

	Material	Points	Area (ft²)
Region 1	Embankment	15,3,12,13,14,4,5,6,7,8	1,329

Region 2	Dk Brn Silty Clay	8,28,29,11,15	653.5
Region 3	Dk Brn Silty Clay	16,17,40	22
Region 4	Clayey Silt	17,18,38,40	250
Region 5	Clayey Silt	31,29,28,9,50,49	2,165.5
Region 6	Gry Snd Silty Clay	18,19,48,49,31,33,34,35,36,38	2,074
Region 7	Clayey Silt	19,20,47,48	3,500
Region 8	Gry Sand w/Silt	20,21,46,47	350
Region 9	Shale	21,22,43,45,46	9,800
Region 10	Rip-Rap	14,13,12,3	9.5
Region 11	Rip-Rap	11,2,30,32,34,33,31,29	45
Region 12	Rip-Rap	1,16,40,38,36,35,37,39	46
Region 13	Ash	50,9,28,8,7,51	3,072.5

Current Slip Surface

Slip Surface: 42

F of S: 1.754

Volume: 6,598.2566 ft³

Weight: 766,725.5 lbs

Resisting Moment: 71,665,768 lbs-ft

Activating Moment: 40,847,042 lbs-ft

Resisting Force: 263,139.9 lbs

Activating Force: 149,983.87 lbs

F of S Rank: 1

Exit: (71.965012, 522.4875) ft

Entry: (313.22525, 553) ft

Radius: 265.53272 ft

Center: (162.97654, 771.93595) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	72.710494	522.21803	-64.921586	84.576094	70.967769	0
Slice 2	73.938352	521.77687	-18.238546	472.45788	0	1,400
Slice 3	76.758491	520.80259	86.550781	718.90818	0	1,400
Slice 4	82.57219	518.89551	296.24629	1,134.4225	0	1,000
Slice 5	89.524063	516.79035	536.05734	1,710.1262	0	1,000
Slice 6	94.5	515.38931	701.10704	2,105.3764	0	1,000
Slice 7	97.957845	514.49447	810.88759	2,362.8992	0	1,000
Slice 8	102.45784	513.40492	949.07567	2,767.0697	0	1,400
Slice 9	106.5	512.48332	1,069.641	2,986.2009	0	1,400
Slice 10	112.75	511.24165	1,213.8969	3,170.3135	0	1,400
Slice 11	122.25	509.5891	1,403.7668	3,429.6314	0	1,400
Slice 12	130.43835	508.42715	1,551.0464	3,605.8766	0	1,400
Slice 13	137.31506	507.6687	1,661.1696	3,715.8515	0	1,400

Slice 14	143.3767	507.14065	1,749.4733	3,787.6752	0	1,400
Slice 15	147.5	506.8589	1,804.7072	3,890.9901	0	1,400
Slice 16	152.5	506.63311	1,926.094	4,125.6573	0	1,400
Slice 17	160.25	506.45125	2,072.9157	4,430.4254	0	1,400
Slice 18	168.75	506.50004	2,153.6184	4,724.8943	0	1,400
Slice 19	177.25	506.8213	2,217.3194	4,975.4526	0	1,400
Slice 20	185.75	507.41601	2,263.9567	5,186.2206	0	1,400
Slice 21	192	508.00184	2,288.98	5,279.8551	0	1,400
Slice 22	194.5	508.28155	2,306.8313	5,276.83	0	1,400
Slice 23	198.5	508.81386	2,398.4152	5,183.9269	0	1,400
Slice 24	203.5	509.51802	2,619.6756	5,051.391	0	1,400
Slice 25	207.5	510.17489	2,734.6872	4,909.4629	0	1,400
Slice 26	214.00935	511.38541	2,659.1506	4,657.9989	0	1,400
Slice 27	222.02804	513.08535	2,553.0742	4,341.2089	0	1,400
Slice 28	229.50729	514.89814	2,439.9562	4,038.4685	0	1,000
Slice 29	236.4471	516.79547	2,321.5624	3,744.462	0	1,000
Slice 30	243.38691	518.89734	2,190.4062	3,435.4115	0	1,000
Slice 31	250.14261	521.14201	2,050.3384	3,081.8957	0	1,400
Slice 32	256.7142	523.52391	1,901.7079	2,742.488	0	1,400
Slice 33	264	526.40963	1,721.6393	2,341.8376	0	1,400
Slice 34	269.14655	528.55562	1,587.7296	2,046.5904	0	1,400
Slice 35	274.58632	531.04491	1,432.3974	2,013.5709	155.72496	0
Slice 36	283.17275	535.21394	1,172.2503	1,660.0611	130.7085	0
Slice 37	291.75918	539.77533	887.61932	1,267.4716	101.78111	0
Slice 38	300.3456	544.75278	577.02659	827.27814	67.054701	0
Slice 39	308.93203	550.17436	238.71985	329.37161	24.290066	0

ATTACHMENT 18 – INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN AND ACCOMPANYING CERTIFICATION

City Water, Light & Power
Ash Impoundments
Springfield, Sangamon County, Illinois

Inflow Design Flood Control Report for Coal Combustion Residuals Surface Impoundments

October 2021

Prepared for:
City Water, Light & Power
3100 Stevenson Drive
Springfield, Illinois 62703

ANDREWS ENGINEERING

3300 Ginger Creek Drive, Springfield, IL 62711 | 217.787.2334

ILLINOIS | MISSOURI | INDIANA

TABLE OF CONTENTS

APPENDICES

1. INTRODUCTION

City Water, Light and Power (CWLP) ash ponds are coal combustion residuals (CCR) surface impoundments, which include both the Lakeside and Dallman ash ponds. A plan for the inflow design flood control system plans for the CCR surface impoundments was conducted as required by 35 IAC Part 845.510(c):

Andrews Engineering, Inc. (AEI) performed the review of information, which included the following documents:

- Coal Ash Impoundment Site Assessment Final Report (May 2011)
- Historical Aerial Photographs (April 1995 – March 2014)
- Engineering Report: Proposed Embankment Modification; CWLP Ash Disposal Area (July 1987).
- Construction Grading Plan for the Dallman Ash Pond (August 1976)

2. CCR UNIT INFORMATION

Both the Lakeside Ash Pond and the Dallman Ash Pond are owned and operated by CWLP. The ponds are operated under National Pollutant Discharge Elimination System (NPDES) Permit Number IL0024767.

The Lakeside Ash Pond is primarily a diked embankment with some incising along the east perimeter and was placed into service prior to 1958. The original Lakeside Ash Pond was been divided into four separate ponds since it was expanded vertically in 1988: three lime softening ponds and the settling pond. The current Lakeside Ash Pond is approximately 27.6 acres and ceased receiving ash in 2009.

The second impoundment, the Dallman Ash Pond, which is a diked embankment, was placed into service in approximately 1976 and is approximately 34.5 acres. Fly ash and bottom ash are sluiced to the Dallman Ash Pond with raw lake water.

Settled water from both the Dallman Ash Pond and Lakeside Ash Pond flow into opposite sides of a Clarification Pond before being discharged to Sugar Creek at Outfall 004 pursuant to the aforementioned NPDES permit.

3. INFLOW

Both the Dallman Ash Pond and the Lakeside Ash Ponds are diked surface impoundments built vertically above the existing grades. Both CCR units are built in a manner in which there is no surficial flow of stormwater into the pond during precipitation events. Therefore, the only water that would flow into the pond during a precipitation event is that which falls directly into the ponds. Ditches located adjacent to the south and east of the impoundments route surface water around the impoundment area ultimately discharging to the South Fork of Sugar Creek. The creek is present along the west and much of the north periphery of the Dallman Ash Pond.

4. FLOOD CONTROL DESIGN

According to the National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Volume 2, Version 3, the 100-year, 24 hour rainfall estimate for the site location is 6.22 inches (See Appendix A).

Both ash ponds contain at least 6.22 inches of freeboard, and therefore do not require any additional flood controls. The normal pool level for the Dallman Ash Pond is 545.5 feet with a maximum elevation of 554.0 feet, yielding a typical freeboard of 8.5 feet. The normal pool level for the Lakeside Ash Pond is 564.0 feet with a maximum elevation of 565.0 feet, yielding a typical freeboard of 1.0 feet.

5. STATEMENT

This Inflow Design Flood Control Report for Coal Combustion Residuals Surface Impoundments was completed for CWLP by Andrews Engineering, Inc. in accordance with the requirements under 35 IAC Part 845.510(c).

Paul M. Van Metre, P.E.

10-20-21

Date

STATE OF ILLINOIS
PAUL
VAN METRE
062-064175
REGISTERED
PROFESSIONAL ENGINEER

APPENDIX A

Precipitation Frequency Data

NOAA Atlas 14, Volume 2, Version 3
Location name: Springfield, Illinois, USA*
Latitude: 39.7642°, Longitude: -89.5979°
Elevation: 540.91 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.398 (0.365-0.438)	0.474 (0.434-0.521)	0.566 (0.518-0.621)	0.637 (0.581-0.699)	0.726 (0.660-0.794)	0.796 (0.721-0.871)	0.863 (0.778-0.943)	0.933 (0.837-1.02)	1.02 (0.913-1.12)	1.09 (0.969-1.20)
10-min	0.619 (0.567-0.681)	0.741 (0.677-0.814)	0.879 (0.805-0.966)	0.983 (0.897-1.08)	1.11 (1.01-1.22)	1.21 (1.09-1.32)	1.30 (1.17-1.42)	1.39 (1.25-1.52)	1.51 (1.34-1.65)	1.59 (1.41-1.74)
15-min	0.759 (0.695-0.834)	0.906 (0.828-0.995)	1.08 (0.988-1.19)	1.21 (1.10-1.33)	1.37 (1.25-1.50)	1.49 (1.35-1.64)	1.61 (1.46-1.76)	1.73 (1.55-1.89)	1.88 (1.67-2.06)	1.99 (1.76-2.18)
30-min	1.00 (0.919-1.10)	1.21 (1.11-1.33)	1.48 (1.35-1.62)	1.68 (1.53-1.84)	1.94 (1.76-2.12)	2.13 (1.93-2.34)	2.33 (2.10-2.55)	2.53 (2.27-2.76)	2.79 (2.48-3.05)	2.99 (2.64-3.27)
60-min	1.23 (1.12-1.35)	1.49 (1.36-1.63)	1.85 (1.70-2.04)	2.14 (1.95-2.35)	2.51 (2.28-2.75)	2.81 (2.55-3.08)	3.11 (2.81-3.40)	3.43 (3.08-3.75)	3.85 (3.43-4.21)	4.20 (3.71-4.59)
2-hr	1.45 (1.33-1.59)	1.76 (1.61-1.94)	2.21 (2.02-2.42)	2.56 (2.33-2.80)	3.03 (2.76-3.31)	3.42 (3.10-3.73)	3.81 (3.44-4.15)	4.23 (3.79-4.61)	4.80 (4.27-5.24)	5.28 (4.66-5.75)
3-hr	1.54 (1.41-1.69)	1.87 (1.71-2.05)	2.34 (2.14-2.58)	2.72 (2.48-2.99)	3.25 (2.95-3.56)	3.68 (3.32-4.02)	4.13 (3.70-4.51)	4.61 (4.11-5.04)	5.29 (4.66-5.78)	5.84 (5.11-6.39)
6-hr	1.81 (1.66-1.98)	2.18 (2.00-2.40)	2.73 (2.51-3.00)	3.18 (2.91-3.48)	3.80 (3.46-4.15)	4.30 (3.89-4.69)	4.84 (4.35-5.27)	5.40 (4.83-5.88)	6.20 (5.49-6.74)	6.86 (6.03-7.47)
12-hr	2.11 (1.94-2.29)	2.54 (2.34-2.77)	3.16 (2.92-3.45)	3.66 (3.37-3.98)	4.35 (3.99-4.73)	4.91 (4.48-5.33)	5.50 (4.98-5.96)	6.12 (5.51-6.63)	6.99 (6.23-7.57)	7.70 (6.81-8.34)
24-hr	2.42 (2.25-2.61)	2.93 (2.73-3.16)	3.66 (3.41-3.95)	4.24 (3.94-4.56)	5.00 (4.65-5.38)	5.60 (5.20-6.02)	6.22 (5.75-6.67)	6.84 (6.33-7.35)	7.70 (7.10-8.27)	8.37 (7.70-8.97)
2-day	2.84 (2.64-3.06)	3.43 (3.20-3.69)	4.26 (3.97-4.59)	4.91 (4.57-5.28)	5.76 (5.35-6.20)	6.44 (5.97-6.92)	7.12 (6.58-7.65)	7.81 (7.21-8.39)	8.75 (8.06-9.39)	9.48 (8.72-10.2)
3-day	3.00 (2.80-3.22)	3.62 (3.38-3.90)	4.50 (4.20-4.84)	5.18 (4.82-5.56)	6.08 (5.65-6.52)	6.79 (6.30-7.27)	7.50 (6.95-8.03)	8.22 (7.60-8.81)	9.20 (8.48-9.85)	9.96 (9.17-10.7)
4-day	3.17 (2.96-3.39)	3.82 (3.57-4.10)	4.74 (4.43-5.09)	5.45 (5.08-5.84)	6.39 (5.95-6.84)	7.13 (6.63-7.62)	7.88 (7.31-8.42)	8.63 (7.99-9.23)	9.65 (8.91-10.3)	10.4 (9.63-11.2)
7-day	3.75 (3.50-4.00)	4.49 (4.21-4.81)	5.51 (5.15-5.89)	6.27 (5.86-6.70)	7.25 (6.77-7.75)	8.01 (7.46-8.55)	8.77 (8.15-9.36)	9.52 (8.84-10.2)	10.5 (9.76-11.2)	11.3 (10.4-12.1)
10-day	4.24 (3.97-4.52)	5.08 (4.77-5.43)	6.18 (5.80-6.61)	7.00 (6.56-7.48)	8.07 (7.55-8.62)	8.89 (8.30-9.49)	9.70 (9.05-10.4)	10.5 (9.79-11.2)	11.6 (10.8-12.4)	12.4 (11.5-13.2)
20-day	5.72 (5.40-6.06)	6.84 (6.46-7.26)	8.23 (7.77-8.74)	9.24 (8.72-9.80)	10.5 (9.94-11.2)	11.5 (10.9-12.2)	12.5 (11.7-13.3)	13.5 (12.6-14.3)	14.7 (13.8-15.6)	15.7 (14.6-16.6)
30-day	7.11 (6.73-7.53)	8.49 (8.04-8.99)	10.1 (9.59-10.7)	11.3 (10.7-12.0)	12.8 (12.1-13.5)	13.9 (13.1-14.7)	15.0 (14.1-15.9)	16.0 (15.1-17.0)	17.4 (16.3-18.5)	18.5 (17.3-19.6)
45-day	8.95 (8.51-9.43)	10.7 (10.1-11.2)	12.6 (12.0-13.3)	14.0 (13.3-14.7)	15.7 (14.9-16.5)	17.0 (16.1-17.9)	18.2 (17.2-19.2)	19.4 (18.3-20.4)	21.0 (19.8-22.1)	22.1 (20.8-23.3)
60-day	10.6 (10.1-11.2)	12.6 (12.0-13.3)	14.8 (14.1-15.6)	16.4 (15.5-17.2)	18.3 (17.4-19.3)	19.8 (18.7-20.8)	21.2 (20.0-22.3)	22.5 (21.3-23.7)	24.3 (22.9-25.5)	25.5 (24.1-26.9)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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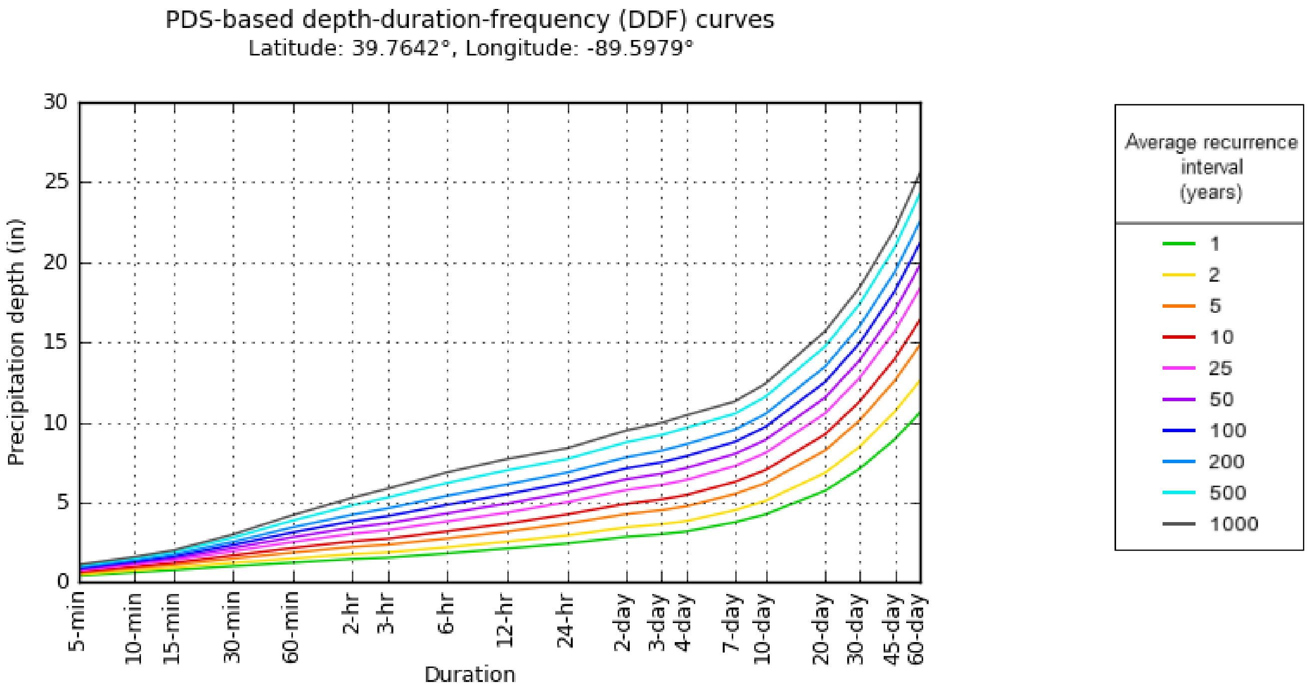
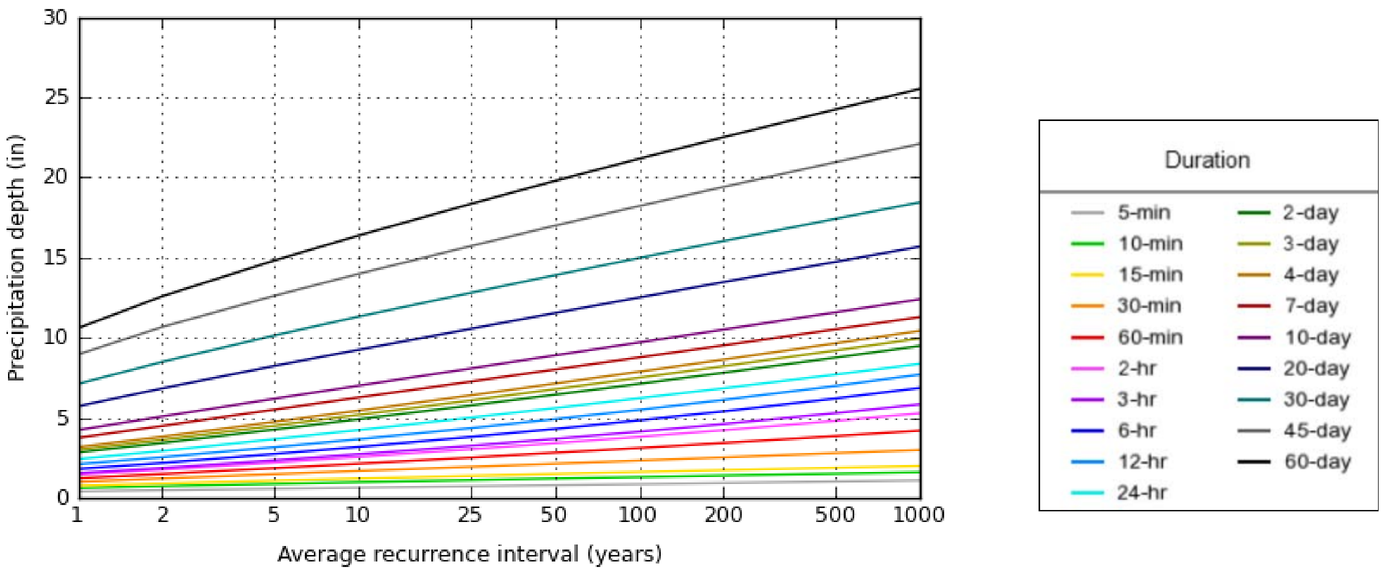
PF graphical





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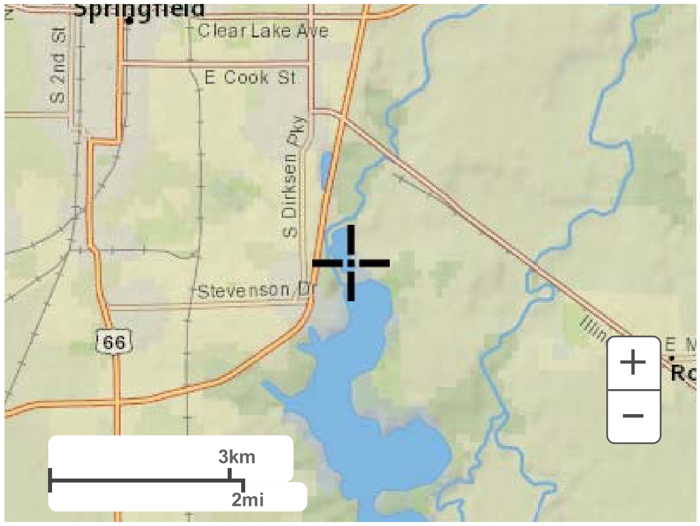
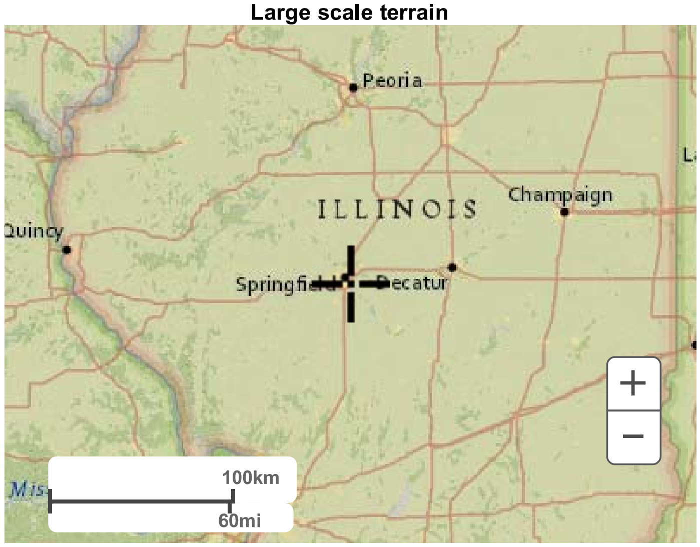
Maps & aerials

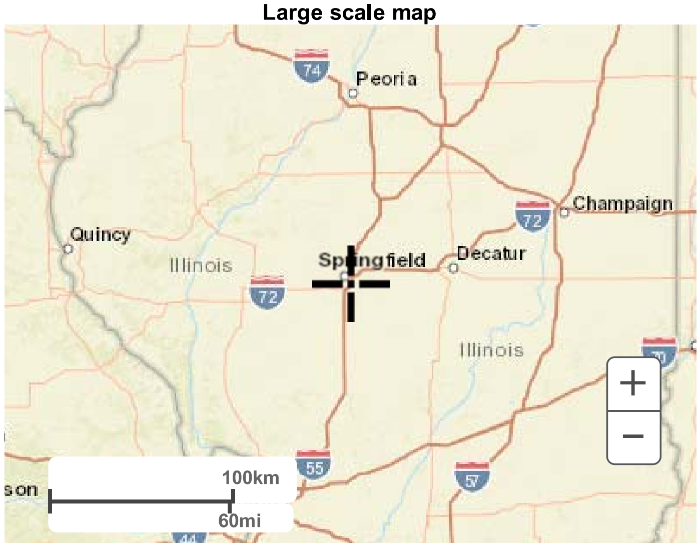
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial

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