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

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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 x 10^{-5} cm/sec to 5.2 x 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 x 10^{-3} to 2.9 x 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 $2.1\text{x}10^{-3}$ 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 x 10^{-4} to 3.6 x 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 x 10^{-7} 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 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

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[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

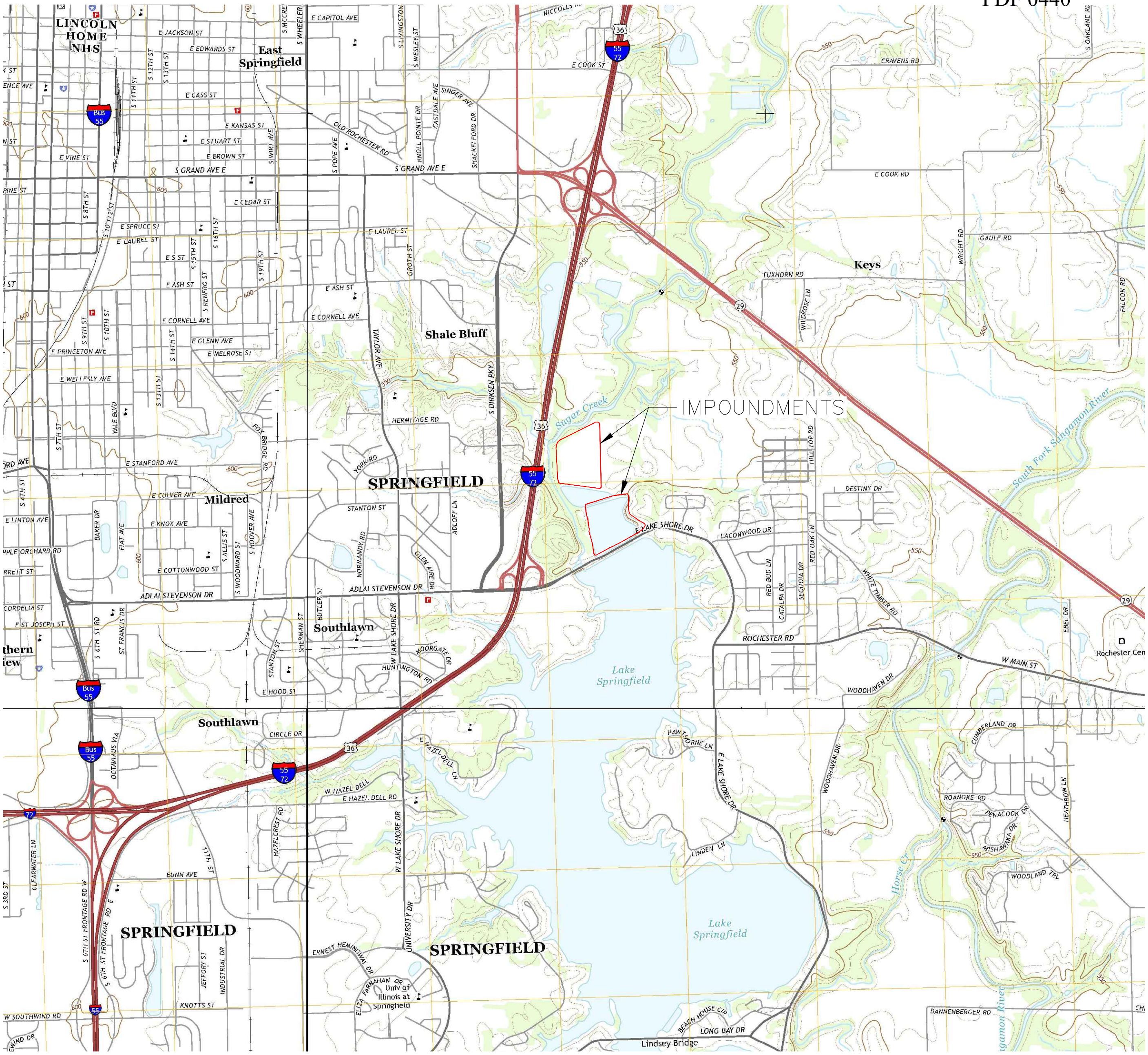
Well ID	Monitoring Position	Material Screened	Ground Surface Elevation (ft MSL)	Top of Casing Elevation (ft MSL)	Approximate Screen Interval (ft MSL)		
AP-1R	Downgradient	Bedrock/unconsolidated interface	533.1	535.6	511.5	-	502.1
AP-2A	Downgradient	Bedrock/unconsolidated interface	533.6	536.1	525.2	-	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

PDF 0440



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

APPROVED BY: BJH	DESIGNED BY: BJH	DRAWN BY: MPN

SITE LOCATION

PLANS PREPARED FOR

CITY, WATER, LIGHT & POWER

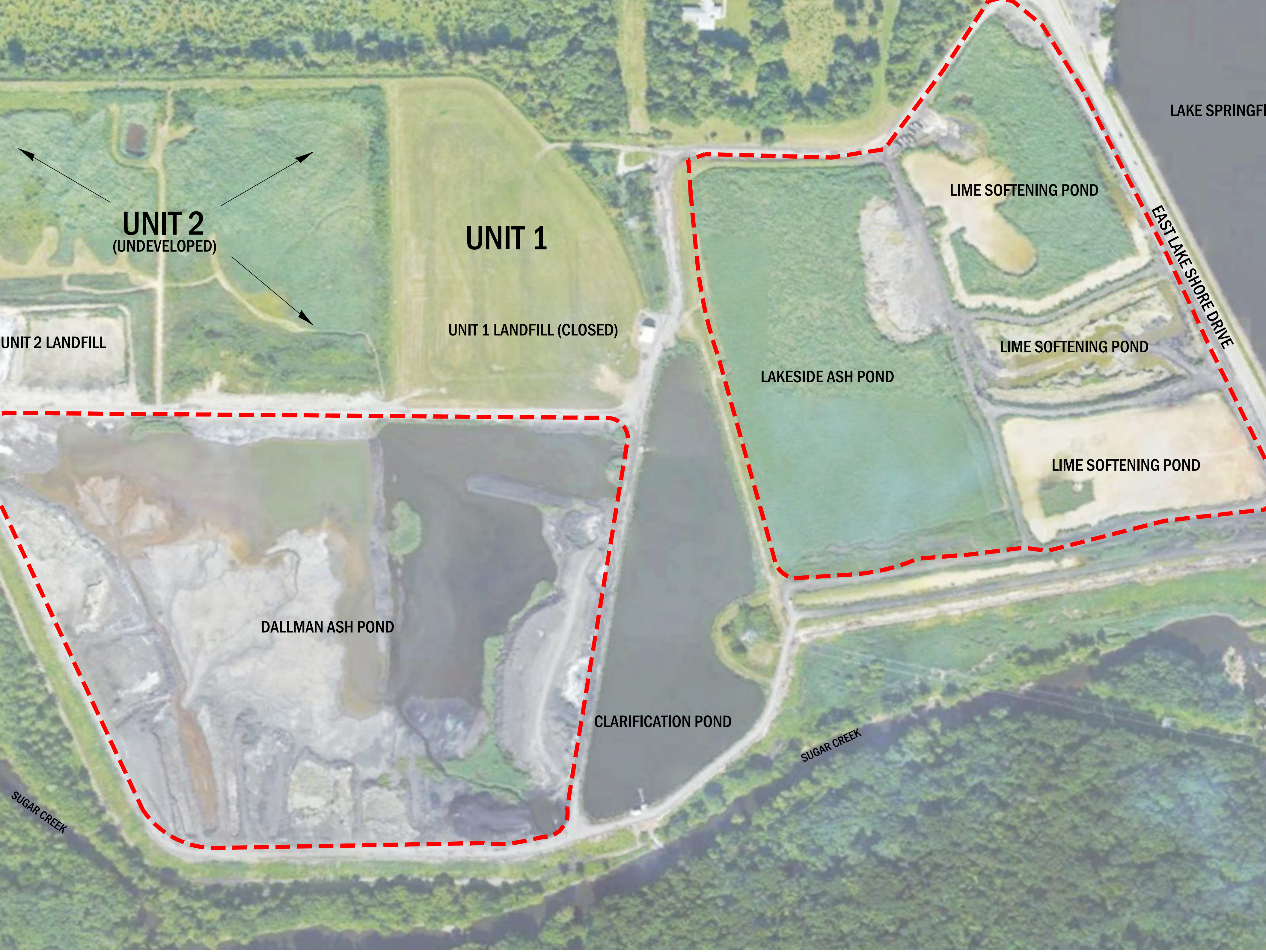
SPRINGFIELD, SANGAMON COUNTY, ILLINOIS

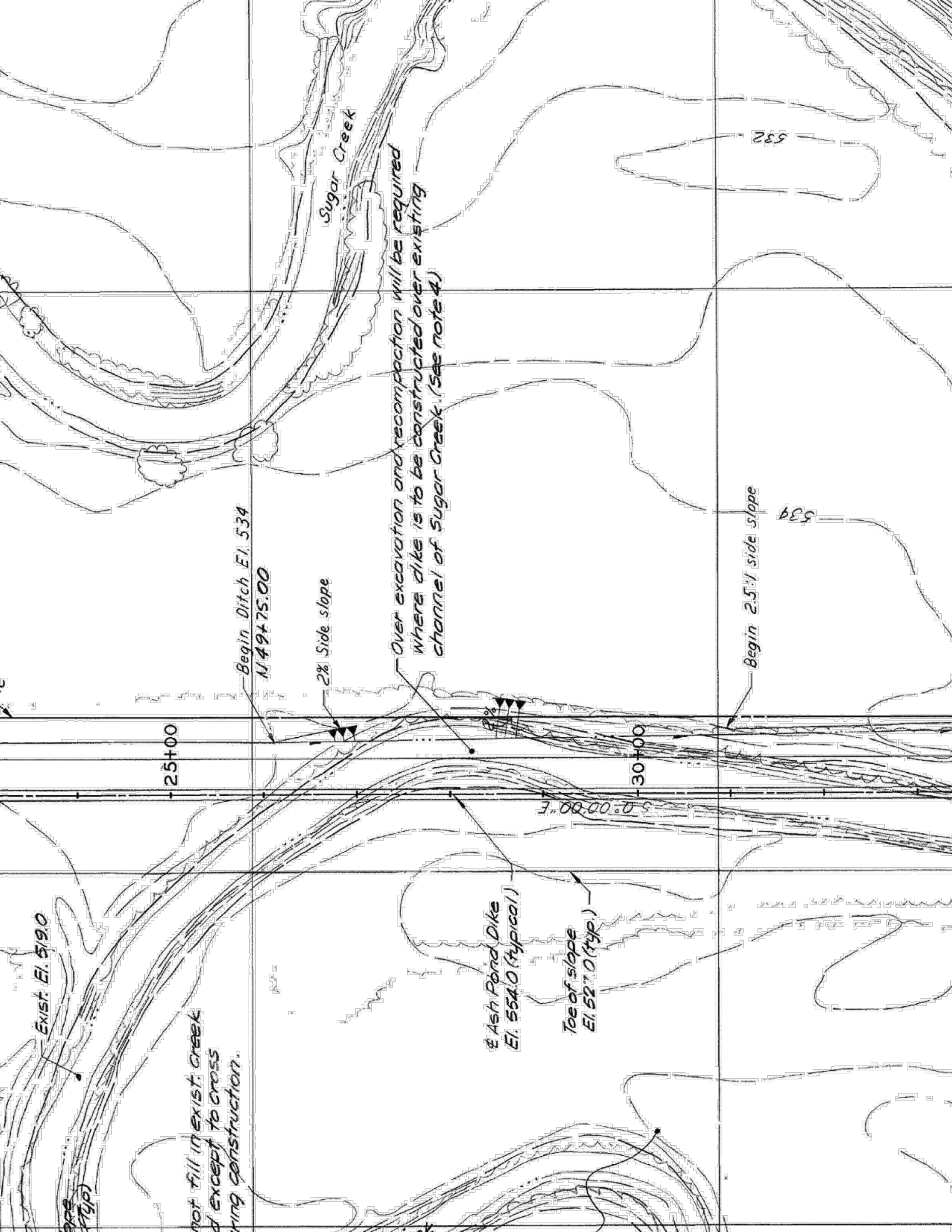
DATE: JULY 2021

PROJECT ID: 200387/0026

SHEET NUMBER:

FIGURE 1


LAKE SPRINGFI
EAST LAKE SHORE DRIVE
LIME SOFTENING POND
LIME SOFTENING POND
LIME SOFTENING POND
LAKESIDE ASH POND
UNIT 2
(UNDEVELOPED)
UNIT 1
UNIT 1 LANDFILL (CLOSED)
UNIT 2 LANDFILL
DALLMAN ASH POND
CLARIFICATION POND
SUGAR CREEK
SUGAR CREEK


Sugar Creek
Over excavation and recompaction will be required where dike is to be constructed over existing channel of Sugar Creek. (See note 4.)
532
534
Begin Ditch El. 534
N49+75.00
2% Side slope
2%
Begin 2.5:1 side slope
25+00
30+00
S 0°00'00" E
℄ Ash Pond Dike El. 554.0 (typical)
Toe of slope El. 527.0 (typ.)
Exist. El. 519.0
not fill in exist. creek
d except to cross
ring construction.
(typ)


LAKE SPRINGFI
EAST LAKE SHORE DRIVE
UNIT 2
(UNDEVELOPED)
UNIT 1
UNIT 1 LANDFILL (CLOSED)
UNIT 2 LANDFILL
LIME SOFTENING POND
LIME SOFTENING POND
LIME SOFTENING POND
LAKESIDE ASH POND
DALLMAN ASH POND
CLARIFICATION POND
SUGAR CREEK
SUGAR CREEK
AP−1
AP−2
AP−3
AP−4
AP−8
AP−9
AP−10
AP−12
AP−13
AP−14
LEG
CCR
EXIST
TEMP
N
0
150

APPENDIX A

BORING LOGS AND WELL CONSTRUCTION REPORTS

RAPPS

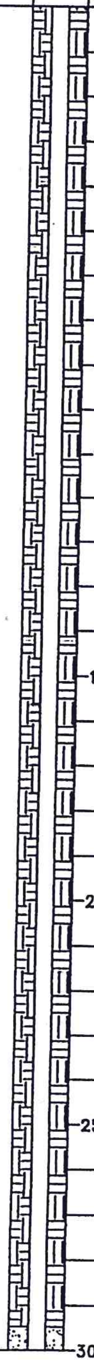
ENGINEERING and APPLIED SCIENCE

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 Gray to brown mottled silty clay; Moist; Firm; Trace sand; Laminated; Fe oxidation stains	1	5' CONTINUOUS SAMPLER	100						0
5		2		100						5
10	Gray sandy clay; Moist; Firm; Finely laminated	3		95				Wet seam @ 11.5'		10
15		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

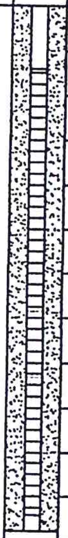
ENGINEERING and APPLIED SCIENCE

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



Water Level_____after_____hrs.

Sheet 2 of 2

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)

Installation Method: Poured

Setting Time: 16 hrs

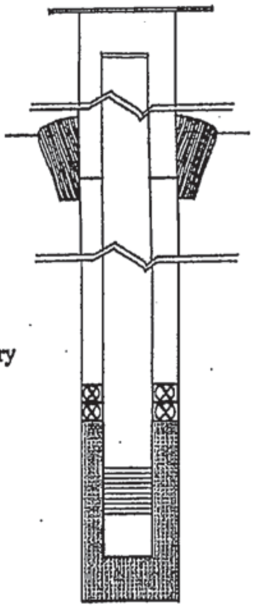
Type of Sand Pack: Quartz Sand

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]
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

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

LOG OF BORING AP-1

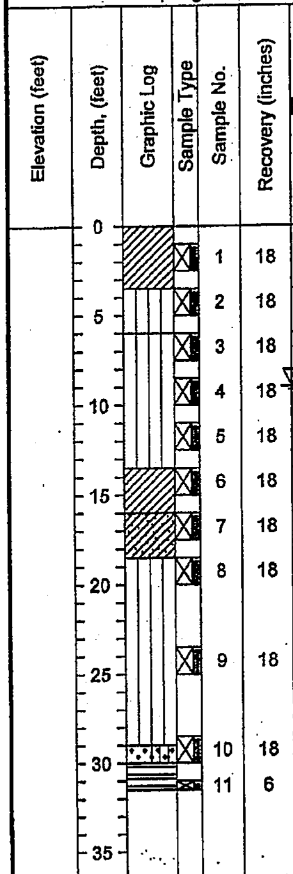
Sheet 1 of 1

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

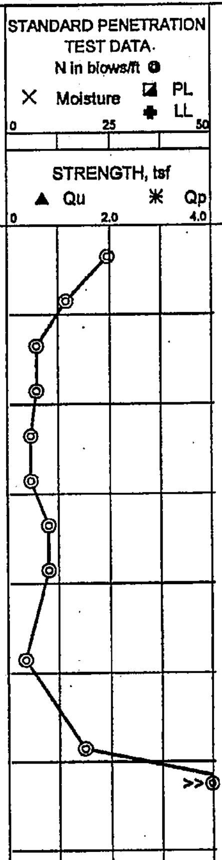
Drilling Method: Hollow Stem Auger
Sampling Method: Split Spoon
Hammer Type: CME Automatic; ETR = 86%
Boring Location: See attached boring location plan.

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

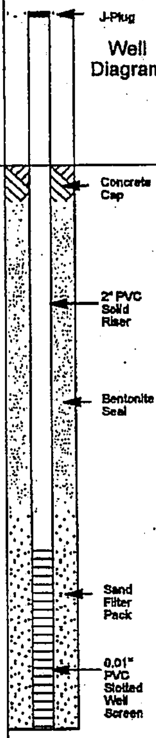
Station: N/A
Offset: N/A



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



Additional Remarks



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.

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LOG OF BORING AP-2

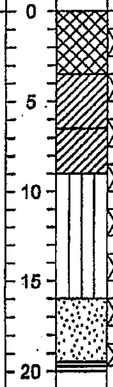
Sheet 1 of 1

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

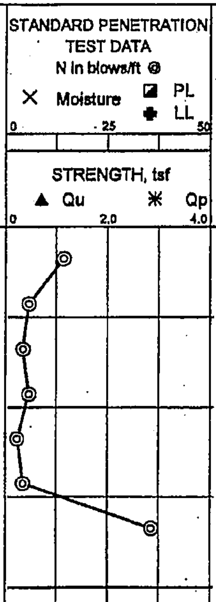
Drilling Method: Hollow Stem Auger
Sampling Method: Split Spoon
Hammer Type: CME Automatic; ETR = 86%
Boring Location: See attached boring location plan.

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

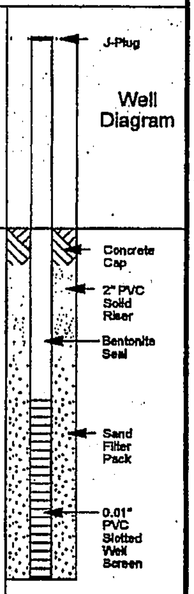
Station: N/A
Offset: N/A



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



Additional Remarks



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.

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LOG OF BORING AP-3

Sheet 1 of 1

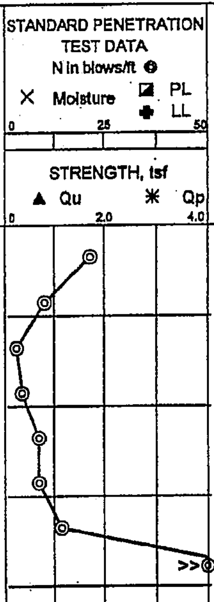
PSI Job No.: 0020522
Project: Piezometer Installation
Location: CWLP Ash Pond
East Lake Shore Drive
Springfield, Illinois

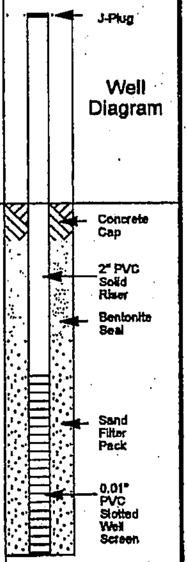
Drilling Method: Hollow Stem Auger
Sampling Method: Split Spoon
Hammer Type: CME Automatic; ETR = 86%
Boring Location: See attached boring location plan.

WATER LEVELS	
▽ While Drilling	None feet
▼ Upon Completion	N/A
▽ Delay	N/A

Station: N/A
Offset: N/A

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





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	Shelby Tube
☒ Split-Spoon	Hand Auger
Rock Core	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.

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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

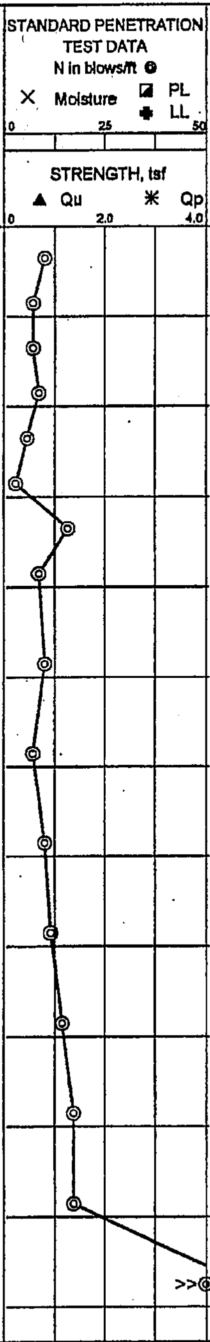
Drilling Method: Hollow Stem Auger
Sampling Method: Split Spoon
Hammer Type: CME Automatic; ETR = 86%
Boring Location: See attached boring location plan.

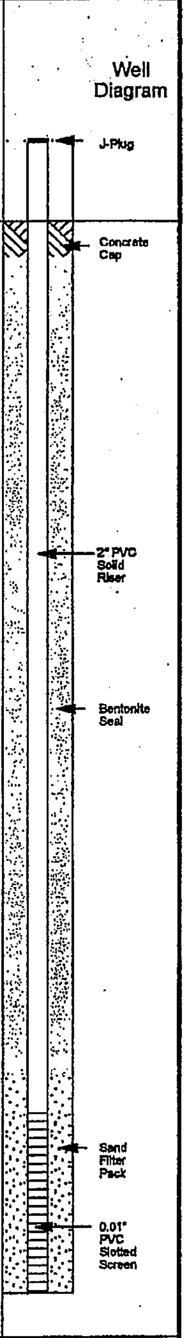
WATER LEVELS	
∇ While Drilling	11 feet
∇ Upon Completion	N/A
∇ Delay	N/A

Station: N/A
Offset: N/A

Sample Type	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	Black FLY ASH, some fine sub-round gravel, stiff to very stiff, moist to saturated (FILL)	FLY ASH	6-6-5 N_{60}=16
☒	8	18	Gray/green (organic?) CLAY, stiff, trace fine sand, moist to saturated		3-3-3 N_{60}=9
☒	9	1		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	Gray fine to coarse SAND, medium dense, saturated	SW	4-5-7 N_{60}=17
☒	15	18			5-5-7 N_{60}=17
☒	16	1	Gray SHALE, hard, moist	CL	50/1"
			Boring terminated at -60'		

Elevation (feet) · Depth, (feet): 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60 · Graphic Log · Moisture, % · Additional Remarks





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.