REPORT
2019012439

SIOUX ENERGY CENTER
GYPSUM STACK CCR SURFACE IMPOUNDMENT
REQUEST FOR ALTERNATIVE CLOSURE REQUIREMENT

Prepared for

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November 27, 2020

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

Index and Certification

Ameren Missouri
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Certification

I hereby certify, as a Professional Engineer in the state of Missouri, that the information in this document as noted in the above Index was assembled under my direct personal charge. This document is not intended or represented to be suitable for reuse by Ameren Missouri or others without specific verification or adaptation by the Engineer.

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Date: November 27, 2020

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1. INTRODUCTION

On August 28, 2020, the EPA issued revisions to the CCR Rule (40 C.F.R. Part 257, Subpart D) that require all unlined CCR Surface Impoundments to cease receipt of CCR and non-CCR waste and initiate closure by April 11, 2021, unless an alternative deadline is requested and approved. 40 C.F.R. § 257.101(a)(1) (85 Fed. Reg. 53,516 (Aug. 28, 2020)). Ameren Missouri (Ameren) submits this request for approval of a site-specific alternative deadline to initiate closure of CCR Surface Impoundment SCPC (Cell 1) at the Sioux Energy Center (SEC or Sioux) in St. Charles County, Missouri, pursuant to 40 C.F.R. § 257.103(f)(1).

SCPC is a lined surface impoundment that was developed to manage gypsum from the SEC's flue gas desulfurization system (FGD) in a closed system. The SCPC footprint is over 40 acres as measured from the base of the berms and has a lined internal area of 37.5 acres. Gypsum is sluiced via closed pipe from the FGD system at the plant to SCPC where the wet material is decanted. The sluice water is routed back to the plant via a Recycle Pond for reuse. SCPC and a dry, 14.5-acre landfill (SCL4A, Cell 4A) cell were permitted by the Missouri Department of Natural Resources (MDNR) pursuant to its Utility Waste Landfill (UWL) regulations. SCL4A is used to manage dry CCR and non-CCR waste generated by the plant. SCPC and SCL4A are surrounded by a groundwater monitoring well network that is sampled twice per year since 2008. Both SCPC and SCL4A include composite bottom liners consisting of 60-mil HDPE over 2 feet of clay with a maximum permeability of 1x10-7 cm/sec. Although completed in 2010, with the exception of the location restriction in 40 CFR §257.60(a) (Placement Above the Uppermost Aquifer), both SCPC and SCL4A meet all requirements of the Coal Combustion Residual (CCR) Rule, 40 C.F.R. Part 257 Subpart D.[1] The SEC also has two inactive CCR Units, SCPA (Bottom Ash Pond) and SCPB (Fly Ash Pond), that are in the process of and will complete closure activities by December 2021. The general layout of the plant in relation to its active and closing CCR Surface Impoundments is shown in Figure 1 (also included in Appendix A).

Pursuant to EPA's recent amendments to the CCR Rule, Ameren seeks EPA's concurrence in establishing an alternative closure date for this lined impoundment, SCPC. An extension beyond the upcoming April 11, 2021 cessation of use date is appropriate because there is insufficient disposal capacity and/or methods to manage the wet gypsum material either on or off-site.

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[1] As part of the permitting process in 2011, MDNR approved an engineering demonstration (Attachment 9) that verified the integrity of the liner system notwithstanding the occasional intermittent contact with groundwater that can occur in this location.

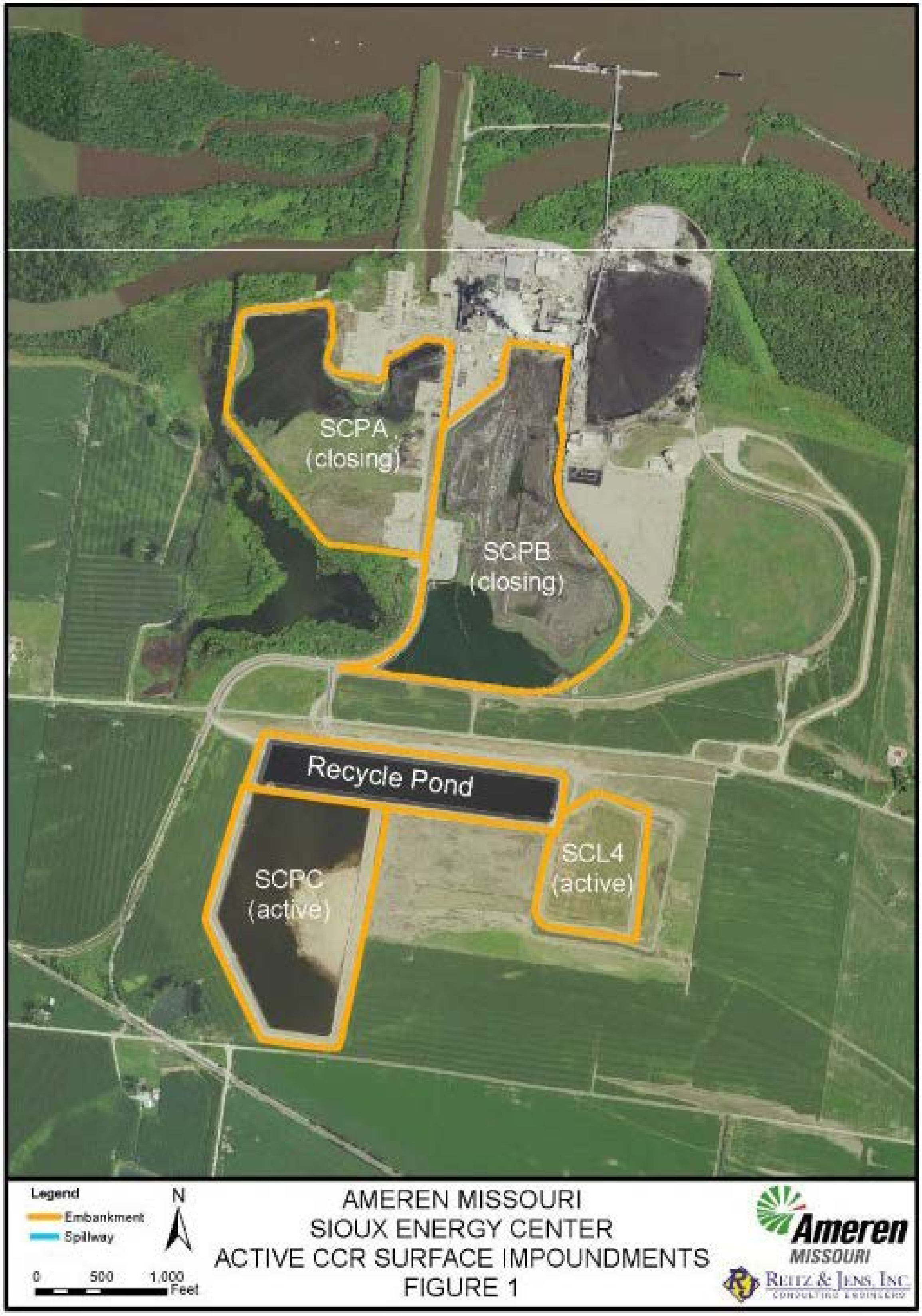

FIGURE 1 – ACTIVE CCR SURFACE IMPOUNDMENTS

1.1 No Alternative Disposal Capacity – 40 CFR 267.103(a)(1)

As recent CCR Rule revisions make clear, in the event of inadequate alternative disposal capacity, an alternative closure deadline may be granted by the EPA if the petitioner demonstrates that there is currently no alternative capacity available on or off-site and that it is not technically feasible to complete the development of alternative capacity prior to April 11, 2021. 40 C.F.R. § 257.103(f)(1). To make this demonstration, the facility is required to provide detailed information regarding the process the facility is undertaking to develop the alternative capacity. 40 C.F.R. § 257.103(f)(1). Regardless of the maximum time allowed under the rule, EPA explains in the preamble to the Part A rule that each impoundment "must still cease receipt of waste as soon as feasible, and may only have the amount of time (the owner/operator) can demonstrate is genuinely necessary." 85 Fed. Reg. at 53,546. Ameren Missouri seeks additional time to allow for the construction of a new CCR Unit that complies with the CCR Rule's location restrictions (i.e. 5-foot separation from groundwater).

This document serves as Ameren's Demonstration for a site-specific alternative deadline to initiate closure pursuant to 40 C.F.R. § 257.103(f)(1) for CCR Surface Impoundment SCPC at the SEC. The EPA should note that this request is limited to only CCR Unit SCPC, a lined impoundment completed in 2010 as part of a state-permitted utility waste landfill. Wet CCR waste (i.e. gypsum) generated by the SEC's pollution control equipment must be managed in a dedicated impoundment and cannot be directly deposited in the onsite dry landfill, SCL4A, or transported off-site for disposal. Thus, a new CCR unit that complies with the CCR Rules location restrictions (i.e. 5-foot separation from groundwater table) must be built.

To obtain an alternative closure deadline under 40 C.F.R. § 257.103(f)(1), a facility must meet the following three criteria:

1. **§ 257.103(f)(1)(i)** - There is no alternative disposal capacity available on-site or off-site. An increase in costs or the inconvenience of existing capacity is not sufficient to support qualification;
2. **§ 257.103(f)(1)(ii)** - Each CCR and/or non-CCR waste stream must continue to be managed in that CCR Surface Impoundment because it was technically infeasible to complete the measures necessary to obtain alternative disposal capacity either on or off-site of the facility by April 11, 2021; and
3. **§ 257.103(f)(1)(iii)** - The facility is in compliance with all the requirements of the CCR rule.

To demonstrate that the first two criteria above have been met, 40 C.F.R. § 257.103(f)(1)(iv)(A) requires the owner or operator to submit a work plan that contains the following elements:

- (1) A written narrative discussing the options considered both on and off-site to obtain alternative capacity for each CCR and/or non-CCR waste stream, the technical infeasibility of obtaining alternative capacity prior to April 11, 2021, and the option selected and justification for the alternative capacity selected. The narrative must also include all of the following:
  - (i) An in-depth analysis of the site and any site-specific conditions that led to the decision to select the alternative capacity being developed;
  - (ii) An analysis of the adverse impact to plant operations if the CCR Surface Impoundment in question were to no longer be available for use; and

  - (iii) A detailed explanation and justification for the amount of time being requested and how it is the fastest technically feasible time to complete the development of the alternative capacity.

- (2) A detailed schedule of the fastest technically feasible time to complete the measures necessary for alternative capacity to be available, including a visual timeline representation. The visual timeline must clearly show all of the following:
  - (i) How each phase and the steps within that phase interact with or are dependent on each other and the other phases;
  - (ii) All of the steps and phases that can be completed concurrently;
  - (iii) The total time needed to obtain the alternative capacity and how long each phase and step within each phase will take; and
  - (iv) At a minimum, the following phases: engineering and design, contractor selection, equipment fabrication and delivery, construction, and start up and implementation.

- (3) A narrative discussion of the schedule and visual timeline representation, which must discuss the following:
  - (i) Why the length of time for each phase and step is needed and a discussion of the tasks that occur during the specific step;
  - (ii) Why each phase and step shown on the chart must happen in the order it is occurring;
  - (iii) The tasks that occur during each of the steps within the phase; and
  - (iv) Anticipated worker schedules.

- (4) A narrative discussion of the progress the owner or operator has made to obtain alternative capacity for the CCR and/or non-CCR waste streams. The narrative must discuss all the steps taken, starting from when the owner or operator initiated the design phase up to the steps occurring when the demonstration is being compiled. It must discuss where the facility currently is on the timeline and the efforts that are currently being undertaken to develop alternative capacity.

To demonstrate that the criterion in (f)(1)(iii) has been met, 40 C.F.R. § 257.103(f)(1)(iv)(B) requires the owner or operator to submit the following information:

- (1) A certification signed by the owner or operator that the facility is in compliance with all of the requirements of 40 C.F.R. Part 257, Subpart D;

- (2) Visual representation of hydrogeologic information at and around the CCR Unit(s) that supports the design, construction and installation of the groundwater monitoring system. This includes all of the following:
  - Map(s) of groundwater monitoring well locations in relation to the CCR Unit(s);
  - Well construction diagrams and drilling logs for all groundwater monitoring wells; and
  - Maps that characterize the direction of groundwater flow accounting for seasonal variations.

- (3) Constituent concentrations, summarized in table form, at each groundwater monitoring well monitored during each sampling event;

- (4) A description of site hydrogeology including stratigraphic cross-sections;
- (5) Any corrective measures assessment conducted as required at § 257.96;
- (6) Any progress reports on corrective action remedy selection and design and the report of final remedy selection required at § 257.97(a);
- (7) The most recent structural stability assessment required at § 257.73(d); and
- (8) The most recent safety factor assessment required at § 257.73(e).

2. DEMONSTRATION

In accordance with the requirements and criteria set forth in 40 C.F.R. § 257.103(f), there is no alternative capacity available on or off-site for CCR Surface Impoundment SCPC. As discussed in more detail below, Ameren Missouri will need to replace SCPC with a new CCR Surface Impoundment at the SEC. The following provides a detailed schedule for the project, including a narrative description of the schedule and an update on the progress already made toward obtaining the alternative capacity. In addition, the narrative includes an analysis of the site-specific conditions that led to the decision to install a new CCR Surface Impoundment and an analysis of the adverse impact to plant operations if an extension is not granted.

2.1 No Alternative Disposal Capacity and Approach to Obtain Alternative Capacity - § 257.103(f)(1)(iv)(A)(1)

In its recently published Integrated Resource Planning (IRP)[2] report filed with the Missouri Public Services Commission; Ameren announced its plans to advance the retirement of its coal fired energy centers in order to achieve its goal of net-zero carbon emissions by 2050. Accordingly, the coal-fired boilers at Sioux will be retired by December 31, 2028. The IRP report also shows new solar and wind generation capacity additions to Ameren's electric system. These renewable facilities are required ahead of the SEC retirement. Until the new renewable generation capacity is installed, the SEC is required to operate to meet Ameren's customer load requirements. Therefore, the SEC must be able to manage the gypsum that is produced as a slurry by the plant’s Flue Gas Desulfurization system until a new gypsum management facility is constructed. Currently, this FGD gypsum is managed in CCR Surface Impoundment SCPC.

2.1.1 CCR Waste Streams

The CCR waste streams generated by the SEC include fly ash, economizer ash, slag, and FGD gypsum. The SEC produces fly ash, economizer ash, and slag as dry materials that are trucked either to the on-site CCR Landfill (SCL4A) for management and permanent disposal, or utilized for beneficial use purposes. The plant’s Flue Gas Desulfurization system produces the gypsum as a wet slurry which is

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[2] https://www.ameren.com/missouri/company/environment-and-sustainability/integrated-resource-plan

pumped to the on-site CCR Surface Impoundment (SCPC) for management and disposal in a closed loop system. When the SEC is operating, it produces FGD gypsum sluice at a rate of approximately 1,000 gallons per minute, which includes approximately 20% gypsum solids.

2.1.2 Non-CCR Waste Streams

The existing site water balance is included in Appendix A of this demonstration (see Figure 2). No non-CCR waste streams produced by the SEC are managed in SCPC.

2.1.3 Site-Specific Conditions Supporting Alternative Capacity Approach - § 257.103(f)(1)(iv)(A)(1)(i)

As shown on Figure 1 in Appendix A, the SEC uses two active CCR Units, SCPC a CCR Surface Impoundment, and SCL4A a CCR Landfill, to manage the CCR and non-CCR waste streams generated by the SEC. SCPA and SCPB no longer receive CCR waste and will both be closed by the end of 2021. The wet Flue Gas Desulfurization (FGD) system at the SEC produces a wet gypsum waste stream that is sluiced from the plant and discharged into Surface Impoundment SCPC. The gypsum solids settle out in SCPC and the decanted water flows by gravity to the UWL's Recycle Pond where it is pumped back to the plant for reuse in a closed loop system.[3] Fly ash, economizer ash, slag, and other CCR and non-CCR waste streams produced dry at the SEC are marketed for off-site beneficial use when possible, or conditioned at the plant before being trucked to the SCL4A for disposal.

So long as the SEC coal fired boilers remain operational, wet FGD gypsum and other CCR waste streams will be produced. The SEC's FGD process cannot be converted to a dry process and therefore the FGD gypsum must be managed as a wet CCR waste.

Ameren has evaluated options for managing the FGD gypsum as a dry CCR waste so that it could be managed on-site in SCL4A, or transported off-site for disposal in a permitted solid waste landfill.

- One option would be to reconfigure the existing FGD system to produce dry CCR waste at the SEC that could then be loaded in trucks and transported to SCL4A or an off-site solid waste landfill for disposal. This would require redesign of the FGD system itself, as well as new loading facilities for transport to and disposal in SLC4A or an off-site solid waste landfill. Changes to the FGD system would require a permit from MDNR and potentially public comment and a public hearing. Design and permitting of these improvements would take a minimum of 3 years to complete, with an additional 2 years minimum needed to construct the improvements and make them operational. It would also require an outage at the SEC to switch the FGD system over from wet to dry operation. **The reconfigured dry FGD system is unlikely to be operational before 2026, during which time the FGD gypsum would need to continue to be managed as a wet CCR waste.** The dry FGD transportation system would also replace the closed loop FGD gypsum sluicing operation from the SEC to SCPC with a high impact 1.25-mile continuous trucking operation from the SEC to SLC4.

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[3] The Recycle Pond contains no CCR or non-CCR waste streams and is not a CCR Unit.

- A second option is similar to the first, except that the existing FGD system would continue to produce wet FGD gypsum that would then be dewatered at the plant with a filter press or other dewatering system. Design of these improvements would also take a minimum of 3 years to design and permit, with an additional 2 years minimum to construct the improvements and make them operational. **The earliest this option would be operational is also 2026, during which time the FGD gypsum would need to continue to be managed as a wet CCR waste.** This alternative would also replace the closed loop FGD gypsum sluicing operation from the SEC to SCPC, with a high impact 1.25 mile continuous trucking operation from the SEC to SLC4. It would also create a new non-CCR decant water waste stream that would need to be managed at the SEC.

- A third option would be to develop the capacity to temporarily store the wet FGD gypsum on the SEC site until it could be transported off site as a wet CCR waste. This option would require the installation of tanks to temporarily store the gypsum sluice as it is generated at a rate of approximately 1,000 gpm, as well infrastructure and facilities at the SEC to transfer the sluice from the tanks to sealed tanker trucks for transportation off-site. If disposed of in this manner, the wet FGD gypsum would need to be disposed of as a liquid waste in an off-site commercial wastewater treatment plant. Ameren is not aware of a waste treatment plant that can accept and treat the quantity of wet FGD gypsum generated from the SEC. Commercial landfills will not accept the wet FGD gypsum waste because it will not pass their permit paint filter test requirement. Design of the on-site tanks and loading facilities would take a minimum of 2 years to design and permit, with an additional 1 to 2 years to construct and make them operational. **The earliest this option would be operational is also 2024, during which time the FGD gypsum would need to continue to be managed on site in SCPC.** This alternative would also replace the closed loop FGD gypsum sluicing operation, with a high impact commercial trucking operation on public roads from the SEC to the off-site treatment and disposal facility.

- All other material handling options would first require the gypsum be discharged into a CCR Surface Impoundment and then removed, dewatered, and transported to SCL4A or an off-site landfill for disposal. All of these options will eliminate any modifications to the existing FGD system at the SEC, and still allow the FGD gypsum to be transported from the SEC to the UWL by closed loop sluicing operation. The time required to design, permit, and construct a new CCR Surface Impoundment would require that SCPC remain in operation after April 11, 2021, and allow SCPC to cease receiving waste and initiate closure by October 15, 2023.

Based on Ameren's evaluation, the SEC must continue to use the SCPC impoundment for management and storage of CCR waste streams until one of the following occurs:

- The SEC stops generating electricity and CCR waste is no longer generated,
- The existing FGD system is converted to a dry system, or
- A new CCR Surface Impoundment that meets all CCR Rule requirements is developed and used to dewater the wet FGD gypsum produced by the SEC.

2.1.4 Impact to Plant Operations if Alternative Capacity Not Obtained – § 257.103(f)(1)(iv)(A)(1)(ii)

Ameren's Integrated Resource Plan committed to permanently cease using the coal fired boilers at the SEC by the end of 2028. Until that date, the plant will continue to produce wet FGD gypsum and other wet and dry CCR and non-CCR waste streams. Without the ability to manage the wet FGD gypsum in Surface Impoundment SCPC or a replacement CCR surface impoundment, the SEC would no longer be able to produce electricity. Until new renewable generation capacity is installed, the SEC is required to operate to meet Ameren's customer load requirements, and maintain electric reliability.

2.1.5 Justification for Time Needed to Complete Development of Alternative Capacity Approach – § 257.103(f)(1)(iv)(A)(1)(iii)

Both SCPC and SCL4A are individual cells of the larger Utility Waste Landfill at the Sioux Energy Center that has been approved by the State of Missouri and St. Charles County under Permit No. 0918301. Any modifications to these CCR units, or new CCR Units must first be approved by these entities. Once approved by the State and County, plans and specifications for construction of a new CCR Surface Impoundment must be developed, the contract advertised and contractor selected, the new impoundment must be constructed, and an operating permit must be obtained. Once the new CCR Surface Impoundment is operational, SCPC must be closed following a similar procedure. Table 1 summarizes each of the steps followed and their actual or expected durations.

A new CCR Surface Impoundment replacing SCPC will not be operational until 2022 and SCPC cannot be closed before 2023 at the earliest. To account for the schedule delays that will be unavoidable on a project of this complexity, SCPC must continue to receive CCR waste streams after April 11, 2021 and be allowed to cease receiving waste and initiate closure by October 15, 2023.

The durations shown in Table 1 are consistent with schedules experienced in other CCR Surface Impoundment construction and closure projects that have recently been completed by Ameren. For example, Ameren designed, constructed, and permitted the 14.5-acre SCL4A CCR Landfill at the SEC over the 19-month period between June 2012 and December 2013. Similarly, they constructed a CCR Rule cap on 39 acres of ponds MOPI and MOPH at the Meramec Energy Center over an 8-month period between in mid-February and mid-October 2020. Both projects required unwatering, contouring, and installation of CCR compliant liners during winter and spring months.

TABLE 1 – SCPC REPLACEMENT PROJECT MILESTONE

Project Step	Estimated Duration	Cumulative Duration	Start (estimated)	Finish (estimated)
New CCR Unit Alternatives Analysis and Preliminary Design	12 months	12 months	October 2018	September 2019
Utility Waste Landfill Permitting (State of Missouri and St. Charles County)	10 months	22 months	October 2019	July 2020
Develop Plans & Specifications	3 months	3 months	October 2020	(December 2020)

Bidding & Contract Award	4 months	7 months	(January 2020)	(April 2021)
New CCR Surface Impoundment Construction	12 months	19 months	(May 2021)	(April 2022)
New CCR Surface Impoundment Operating Permit (State of Missouri and St. Charles County)	3 months	22 months	(May 2022)	(July 2022)
SCPC Closure Plans & Specifications	2 months	24 months	(August 2022)	(September 2022)
SCPC Closure Bidding & Contract Award	4 months	28 months	(October 2022)	(January 2023)
SCPC Closure Construction	9 months	37 months	(February 2023)	(October 2023)

2.2 Detailed Schedule to Obtain Alternative Disposal Capacity - § 257.103(f)(1)(iv)(A)(2)

A visual representation of the timeline outlined in Table 1 is included in Appendix B and described further in Section 2.3 below. Most steps must be completed sequentially with the preceding step being completed before the next step can begin. The primary exceptions are the completion of UWL permitting, and development of Plans & Specifications for the replacement CCR Surface Impoundment. These activities were completed concurrently to the extent possible so that Plans & Specifications for the new CCR will be ready for bidding in December 2020. Similarly, permitting, development of Plans & Specifications, and bidding for closure of SCPC will begin before construction of the new CCR impoundment to replace SCPC is complete and the new impoundment is operational.

2.3 Narrative of Schedule and Visual Timeline - § 257.103(f)(1)(iv)(A)(3)

The third section of this discussion is a "detailed narrative of the schedule and the timeline discussing all the necessary phases and steps in the work plan, in addition to the overall timeframe that will be required to obtain capacity and cease receipt of waste." 85 Fed. Reg. at 53,544. As EPA explained in the preamble to the Part A rule, this section of the work plan must discuss "why the length of time for each phase and step is needed, including a discussion of the tasks that occur during the specific stage of obtaining alternative capacity. It must also discuss the tasks that occur during each of the steps within the phase." 85 Fed. Reg. at 53,544. In addition, the schedule should "explain why each phase and step shown on the chart must happen in the order it is occurring and include a justification for the overall length of the phase" and the "anticipated worker schedule." 85 Fed. Reg. at 53,544. EPA notes the overall "discussion of the schedule assists EPA in understanding why the time requested is accurate." 85 Fed. Reg. at 53,544.

New CCR Unit Alternatives Analysis and Preliminary Design: Upon determining that SCPC did not meet the CCR Rule location restriction in 40 CFR §257.60(a), Placement Above the Uppermost Aquifer, Ameren began internal analyses of alternatives for managing the wet FGD gypsum and other CCR and non-CCR waste streams for the remaining life of the SEC. Concurrently with this analysis, Ameren was developing their Integrated Resource Plan. Because the existing wet FGD scrubbers and supporting infrastructure at the SEC were already fully developed, Ameren's internal alternatives analysis concentrated on alternatives for dewatering the wet gypsum in a CCR Surface Impoundment that met all of the requirements of the CCR Rule. Alternatives for dewatering the wet gypsum at the SEC were evaluated, but quickly abandoned due to the multiple difficulties with implementation considering the expected remaining life of the plant. Multiple alternatives were evaluated, however a decision on which alternative could not be made until the remaining life of the SEC, and the resulting quantities of CCR and non-CCR waste streams that would need to be managed, could be better understood. Ameren made the decision to pursue a new CCR Surface Impoundment that met all of the requirements of the CCR Rule in September 2019 at which time the next phase began.

Utility Waste Landfill Permitting (State of Missouri and St. Charles County): Both SCPC and SCL4A are individual cells of the larger Utility Waste Landfill at the Sioux Energy Center that was approved by the State of Missouri and St. Charles County under Permit No. 0918301. Any new CCR Surface Impoundments at the SEC will require that this UWL permit is modified to reflect the design of the new CCR Unit. According to the Missouri Solid Waste Management Rules 10 CSR 80-2 and 10 CSR 80-11, the State has up to 60 days to approve a Permit Modification after receipt of a complete submittal. Ameren began developing the UWL Permit Modification to include a new CCR Surface Impoundment to replace SCPC in October 2019, and formally submitted the Permit Modification to the State on January 31, 2020. The State of Missouri formally accepted the Permit Modification submittal as complete on May 29, 2020 and approved the UWL Permit Modification to add a new Surface Impoundment that was in compliance with the CCR Rule on July 7, 2020.

Final Design, Develop Plans & Specifications: The approved UWL Permit Modification included a schematic design of the new CCR Surface Impoundment that will replace SCPC at the SEC. However, the capacity of the impoundment could not be determined until further information about the long-term operation of the SEC was determined. This occurred when Ameren published their Integrated Resource Plan in September 2020. Once the IRP was published, the capacity could be determined and final design of the replacement CCR Surface Impoundment could be completed. After the completion of final design, Plans & Specifications for bidding and construction of the replacement CCR Surface Impoundment must be completed and the required land disturbance (NDPES) and floodplain development permits must be obtained. From prior experience on other CCR Unit development projects at the SEC, we anticipate that final design and permitting of the CCR Surface Impoundment to replace SCPC will require at least 3 months to complete.

Bidding & Contract Award: Ameren's standard practice for obtaining bids and awarding contracts for construction of all large capital improvement projects, like the SEC SCPC replacement, includes six primary steps. 1) advertise for bid, 2) hold pre-bid meeting(s), 3) obtain and evaluate bids, 4) negotiate and select the most qualified and lowest evaluated cost bid, 5) approve bidder and costs through Ameren's internal project gate system, and 6) award construction contract. Steps 1 through 4 typically require 1 to 2 months, while steps 5 and 6 require an additional 2 to 3 months to complete.

New CCR Surface Impoundment Construction: Construction of the CCR Surface Impoundment to replace SCPC is similar to any large earth moving operation with two primary clarifications. First, the construction is slowed because all materials, including the soils required, will need to be trucked to the site. Second, the new CCR Surface Impoundment is designed to hold water, which means all construction activities are even more subject to weather delays than typical outside construction. To minimize these potential delays, Ameren always prequalifies only contractors who have prior experience successfully completing other CCR impoundment projects. Nonetheless, previous construction projects of this size at the SEC have required at least 9 months of good weather to complete. The construction is typically spread over two successive construction seasons to accommodate delays due to inclement winter and spring weather.

New CCR Surface Impoundment Operating Permit: Since it will be part of the Utility Waste Landfill at the SEC, the CCR Surface Impoundment to replace SCPC will need to receive operating permits from both the State of Missouri and St. Charles County before it can begin receiving CCR waste streams. According to the Missouri Solid Waste Management Rules 10 CSR 80-2 and 10 CSR 80-11, the State has up to 60 days to issue an Operating Permit after receiving documentation that the CCR Unit was constructed in accordance with the construction documents and State Rules and Regulations. On previous CCR Unit construction projects Ameren has developed this documentation concurrently with construction so that it can be approved by the State of Missouri within 3 months of substantial completion.

SCPC Closure Plans & Specifications: The “Sioux Energy Center Initial Closure Plan for CCR Surface Impoundment SCPC” outlines Ameren’s planned activities for closure of this CCR Unit. SCPC will be closed by leaving the CCR in place and constructing a final cover system in accordance with §257.102(d). The current closure plan is general in nature, and final design of the closure cannot occur until the final volume and surface grades of the CCR in SCPC is determined. This cannot be finalized until the construction of the replacement CCR Surface Impoundment for SCPC is complete and the final quantity of CCR that will be disposed of in SCPC is determined. Once final design is complete, Plans & Specifications for bidding and construction of the SCPC closure can be completed. Because all of the closure activities will occur within SCPC, permits from the State of Missouri and St. Charles County should not be required. From prior experience on other Ameren CCR Unit closure projects, we anticipate that final design and Plans & Specifications for closure of the SCPC closure can be completed in approximately 2 months.

SCPC Closure Bidding & Contract Award: Ameren will use their same standard practice for obtaining bids and awarding contracts for closure of SCPC as they will for construction of its replacement CCR Surface Impoundment. As with the SCPC replacement CCR Surface Impoundment, we anticipate that this process will require approximately 4 months to complete.

SCPC Closure Construction: Closure of SCPC will be similar to the projects Ameren is currently completing for closure of CCR Surface Impoundments SCPA and SCPB at the SEC, and completed for closure of MOPI and MOPH at the Meramec Energy Center in 2020. Construction will be similar to any large earth moving operation, except that it can be even more subject to weather delays. SCPC closure will require unwatering and contouring the CCR material to create acceptable slope stability and positive drainage. Once contouring is complete, the final cover system will be installed over the CCR. The cover system will be constructed to control erosion, and drains, side slope benches, and let downs installed to control stormwater runoff. To minimize potential delays, Ameren will prequalify only contractors who have successfully completed other CCR Unit closure projects. Based on their experience with other CCR Surface Impoundment closure projects of this size, Ameren anticipates that construction of the SCPC closure can be completed over 9 months within a single construction season.

2.4 Progress Towards Obtaining Alternative Capacity - § 257.103(f)(1)(iv)(A)(4)

In the preamble to the final Part A rule, EPA explains that this “section must discuss all of the steps taken, starting from when the owner or operator initiated the design phase all the way up to the current steps occurring while the work plan is being drafted.” 85 Fed. Reg. at 53,544. The discussion also “must indicate where the facility currently is on the timeline and the processes that are currently being undertaken at the facility to develop alternative capacity.” 85 Fed. Reg. at 53,545.

Ameren has been proactive in developing an alternative to managing CCR waste streams in SCPC, since determining that this CCR Surface Impoundment did not meet the location restriction in 40 CFR §257.60(a) on October 10, 2018. Steps taken by Ameren have included completing an Alternatives Analysis and Preliminary Design of a new CCR Surface Impoundment to replace SCPC; obtaining the State of Missouri and St. Charles County’s approval of the Construction Permit Modification for the SEC Utility Waste Landfill in July 2020, of which the SCPC replacement CCR Surface Impoundment will be a part,; and immediately after Ameren’s Integrated Resource Plan was completed in September 2020, beginning final design and developing Plans & Specifications for construction of the CCR Surface Impoundment that will replace SCPC. Ameren’s schedule looking forward will allow construction of the SCPC replacement CCR Surface Impoundment to begin in 2021 and be completed thereafter, so that SCPC can cease receiving waste and initiate closure by October 15, 2023.

3. DOCUMENTATION AND CERTIFCATION OF COMPLIANCE

To demonstrate that the criteria in 40 C.F.R. § 257.103(f)(1)(iii) has been met, the following information and submissions are submitted pursuant to 40 C.F.R. § 257.103(f)(1)(iv)(B) to demonstrate that CCR Surface Impoundment SCPC at the SEC is in compliance with the CCR rule.

3.1 Owner’s Certification of Compliance – § 257.103(f)(1)(iv)(B)(1)

I hereby certify that, based on my inquiry of those persons who are immediately responsible for compliance with environmental regulations for the Sioux Energy Center, the facility is in compliance with all of the requirements contained in 40 C.F.R. Part 257, Subpart D – Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments. The Ameren SEC CCR compliance website is up-to-date and contains all the necessary documentation and notification postings.

AMEREN MISSOURI

Steven C. Whitworth
Senior Director – Environmental Policy & Analysis
November 27, 2020

3.2 Visual Representation of Hydrogeologic Information - § 257.103(f)(1)(iv)(B)(2)

Consistent with the requirements of § 257.103(f)(1)(iv)(B)(2)(i) – (iii), Ameren has attached the following items to this demonstration:

- Map(s) of groundwater monitoring well locations in relation to the CCR unit (Attachment 1)
- Well construction diagrams for all groundwater monitoring wells (Attachment 2)
- Maps characterizing the direction of groundwater flow with seasonal variations (Attachment 3)
- The 40 CFR Part 257 Groundwater Monitoring Plan (Attachment 4)

3.3 Groundwater Monitoring Results - § 257.103(f)(1)(iv)(B)(3)

Both SCPC and SCL4A have a groundwater monitoring network that was approved by the State of Missouri during the Utility Waste Landfill permitting process. Pursuant to MDNR permitting requirements, Ameren Missouri has been collecting groundwater data from these two CCR units since 2008. Importantly, more than a decade's worth of data reflects there are no groundwater impacts from SCPC, a highly engineered and constructed impoundment that complies with all the performance criteria of the CCR Rule.

TABLE 2 – SIOUX ENERGY CENTER CCR SURFACE IMPOUNDMENT SUMMARY

CCR Surface Impoundment Name	Year Placed in Service	Lined?	Meets Location Restrictions?	Groundwater Status
SCPC	2010	Yes	No	Groundwater data collection per State of Missouri requirements began in 2008. More than a decade of monitoring data shows that there are no groundwater impacts from SCPC.

Groundwater data collected as part of State of Missouri Utility Waste Landfill requirements is provided in the summary tables included as Attachment 5. This data establishes that the integrity of the liner is sound and there have been no adverse impacts to groundwater from SCPC.

Baseline groundwater sampling under the CCR Rule at SCPC began in 2018. Consistent with the requirements of § 257.103(f)(2)(v)(C)(3), tables summarizing constituent concentrations at each groundwater monitoring well through December 2019 are included as Attachment 5. Such data indicates impacts associated with the older ash pond system at the SEC, and not the utility waste landfill and gypsum stack pond (SCPC).

3.4 Description of Site Hydrogeology - § 257.103(f)(1)(iv)(B)(4)

Consistent with the requirements of § 257.103(f)(1)(iv)(B), a copy of the 2019 Annual Groundwater Monitoring and Corrective Action Report with a description of the site hydrogeology and stratigraphic cross-sections of the site are included as Attachment 6.

3.5 Corrective Measures Assessment - § 257.103(f)(1)(iv)(B)(5)

Consistent with the requirements of § 257.103(f)(1)(iv)(B)(5), a copy of the 2019 Corrective Measures Assessment Report is included as Attachment 7.

3.6 Remedy Selection Progress Report - § 257.103(f)(1)(iv)(B)(6)

SCPC contains an engineered liner and has been operable for approximately ten years. There are no groundwater impacts associated with this CCR Unit and while corrective action measures will be required with respect to other CCR units at the SEC, no remedy measures are expected with respect to SCPC or SCL4A. Once decommissioned, SCPC will be closed in accordance with State of Missouri UWL requirements and the CCR Rule.

In August 2019, Ameren selected a final remedy of source control through installation of low permeability cover systems on the CCR Units and use of Monitored Natural Attenuation (MNA) at the SEC. This is further discussed in the 2019 Remedy Selection Report included as Attachment 8. This is consistent with the requirements of § 257.103(f)(1)(iv)(B)(6).

3.7 Structural Stability Assessment - § 257.103(f)(1)(iv)(B)(7)

Consistent with the requirements of § 257.103(f)(1)(iv)(B)(7), a copy of the initial Structural Integrity Criteria and Hydrologic/Hydraulic Capacity Assessment for SCPA, SCPB, and SCPC pursuant to § 257.73(d), was completed in October 2016 and is included as Attachment 10. As required for compliance, an additional stability assessment for CCR Surface Impoundment SCPC will be completed in October 2021.

3.8 Safety Factor Assessment - § 257.103(f)(1)(iv)(B)(8)

Consistent with the requirements of § 257.103(f)(2)(iv)(B)(8), a copy of the initial Structural Integrity Criteria and Hydrologic/Hydraulic Capacity Assessment for SCPA, SCPB, and SCPC that includes the Safety Factor assessment pursuant to § 257.73(e) was completed in October 2016 and is included as Attachment 10. As required for compliance, an additional Safety Factor assessment for CCR Surface Impoundment SCPC will be completed in October 2021.

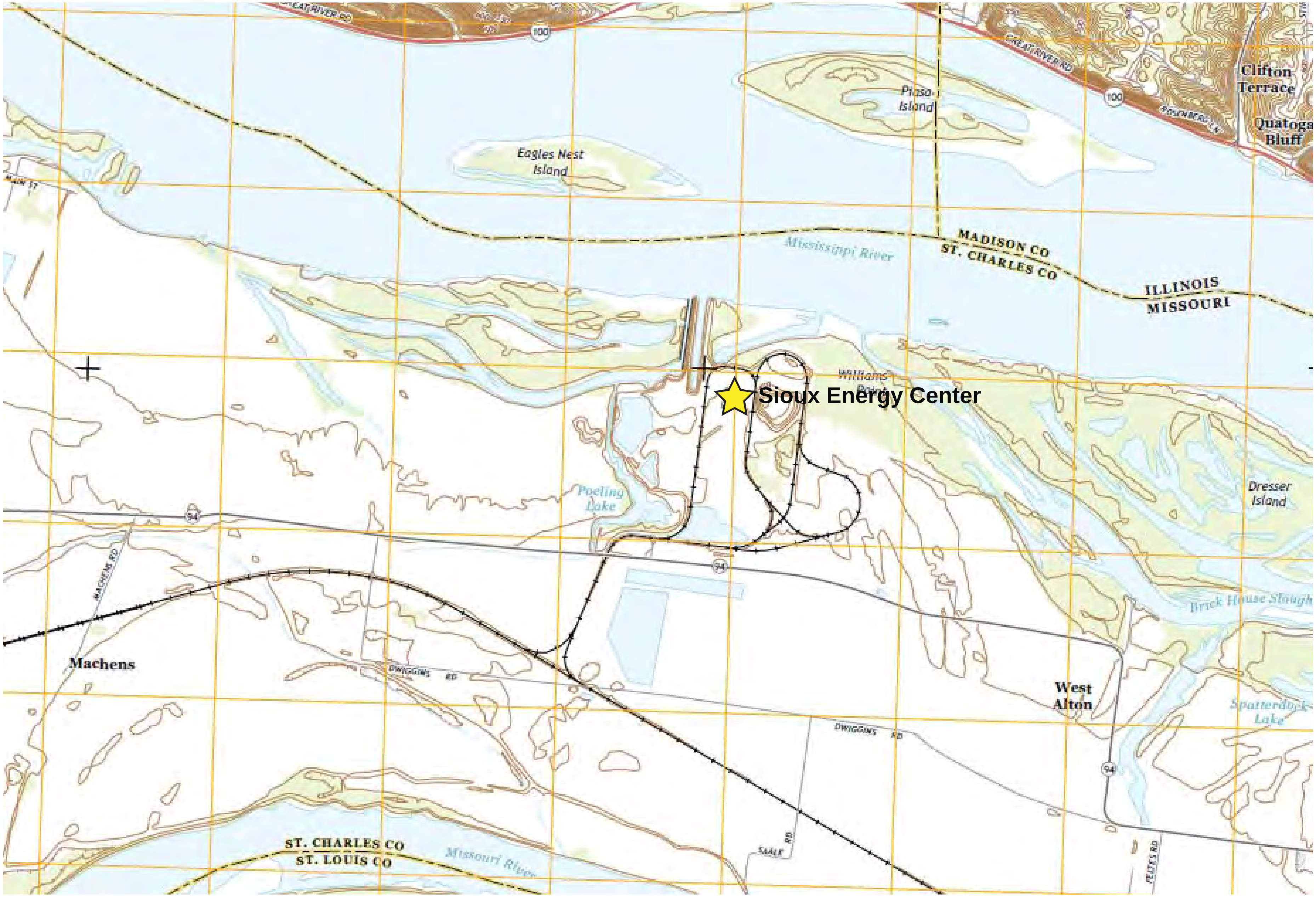
4. CONCLUSION

The information submitted in this demonstration shows that the CCR Surface Impoundment SCPC at the SEC qualifies for the site-specific alternative deadline for the initiation of closure as allowed by 40 C.F.R. § 257.103(f)(1). Ameren requests that the EPA approve this demonstration and allow CCR Surface Impoundment SCPC to continue to receive CCR waste streams after April 11, 2021, provided this impoundment ceases receiving waste and initiates closure by October 15, 2023 as required under 40 C.F.R. § 257.101(a) or (b)(1). Such extension will allow for the construction of a new CCR Unit that complies with the CCR Rule's location requirements.

Ameren will provide an update in its annual reports on the project to replace SCPC and any potential schedule impacts as part of the semi-annual progress reports required at 40 C.F.R. § 257.103(f)(1)(x), and if a need for a later compliance deadline is determined, Ameren will seek additional time as described in 40 C.F.R. § 257.103(f)(1)(vii).

Appendix A

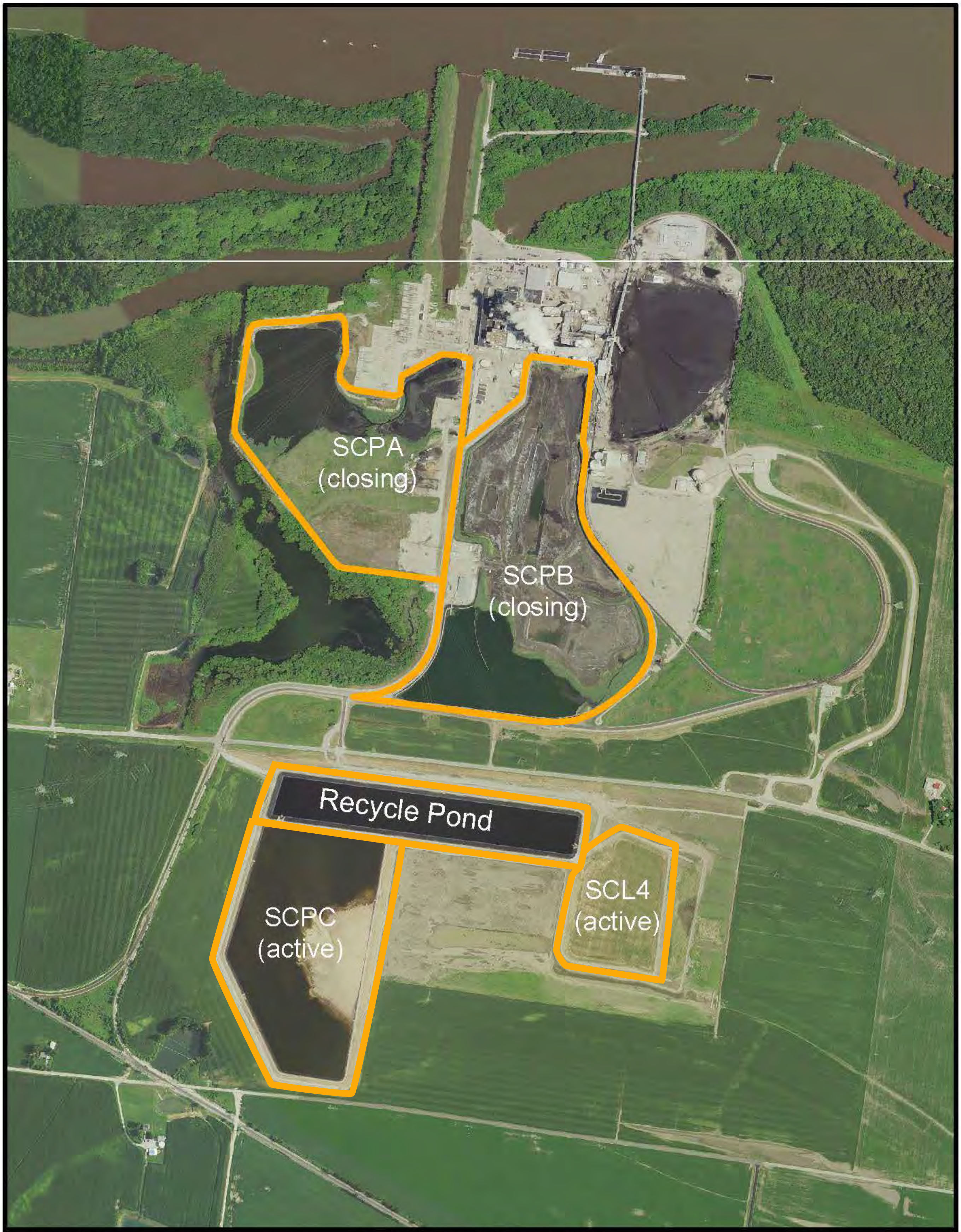
Site Plan and Water Balance Diagram



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

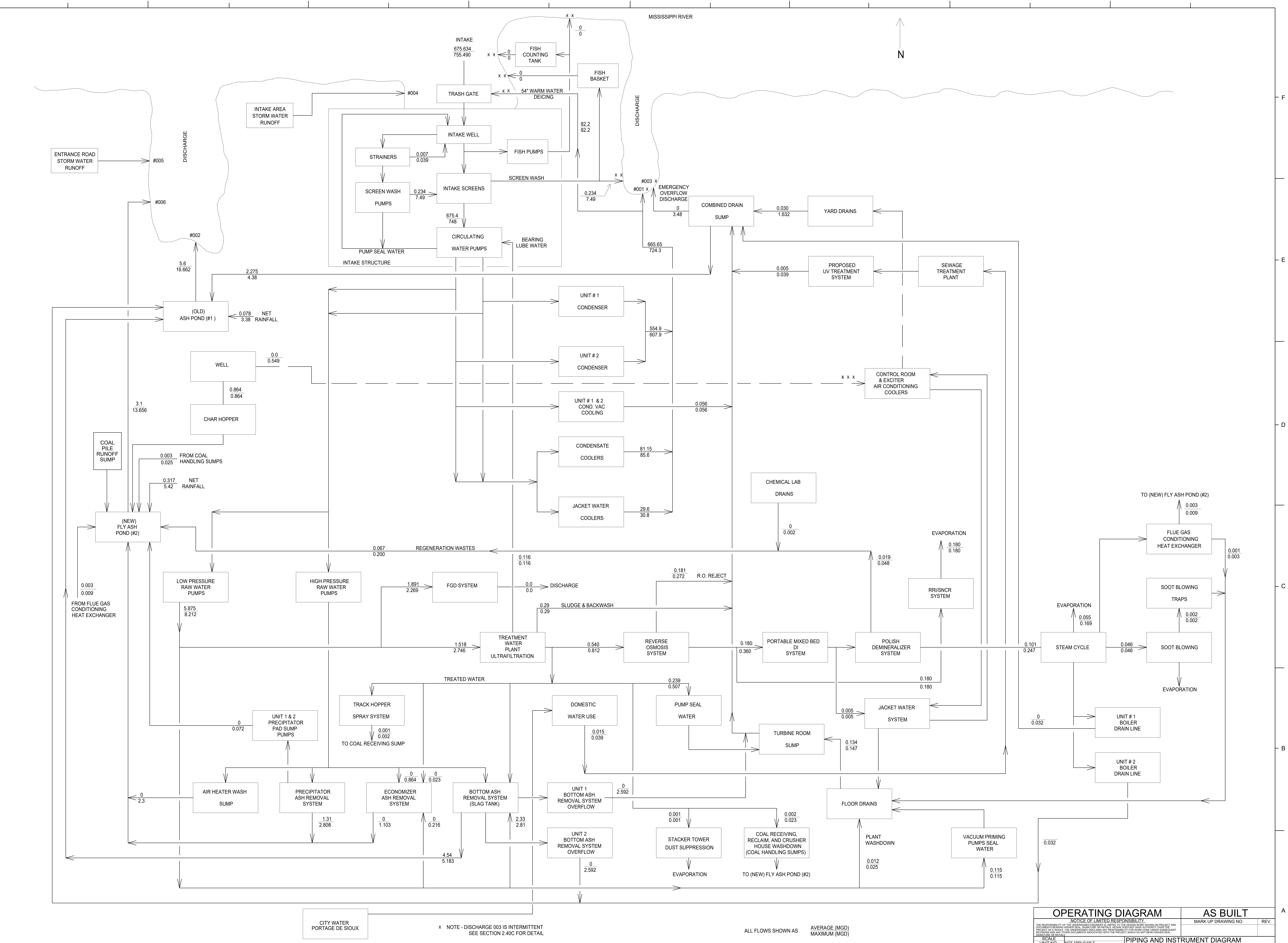
REITZ & JENS, INC.

Figure 1



AMEREN MISSOURI
SIOUX ENERGY CENTER
ACTIVE CCR SURFACE IMPOUNDMENTS
FIGURE 1

Ameren
MISSOURI
REITZ & JENS, INC.
CONSULTING ENGINEERS



X NOTE - DISCHARGE 003 IS INTERMITTENT
SEE SECTION 2.40C FOR DETAIL

X X RETURNS OF RIVER WATER

X X X INTERMITTENT FLOW

ALL FLOWS SHOWN AS AVERAGE (MGD) / MAXIMUM (MGD)

OPERATING DIAGRAM

AS BUILT

MARK UP DRAWING NO. | REV.

NOTICE OF LIMITED RESPONSIBILITY

SCALE	
UNIT NO.	NOT APPLICABLE
DWG. SIZE	34x44
SUB CLASS	05050

PIPING AND INSTRUMENT DIAGRAM
NPDES FLOW DIAGRAM
AND WATER BALANCE

DRAWING RECORD

REV.	DATE	PROJECT NO.	DRFTR	CHK'D	SUPV	ENGR	DESCRIPTION
009	03/29/18	---	KWP	JTW	BMB	---	AS BUILT - RETURN 353 FROM ORBITAL ENGINEERING FOR SX-2018-DC-0002

SITE: SIOUX ENERGY CENTER

Ameren
MISSOURI

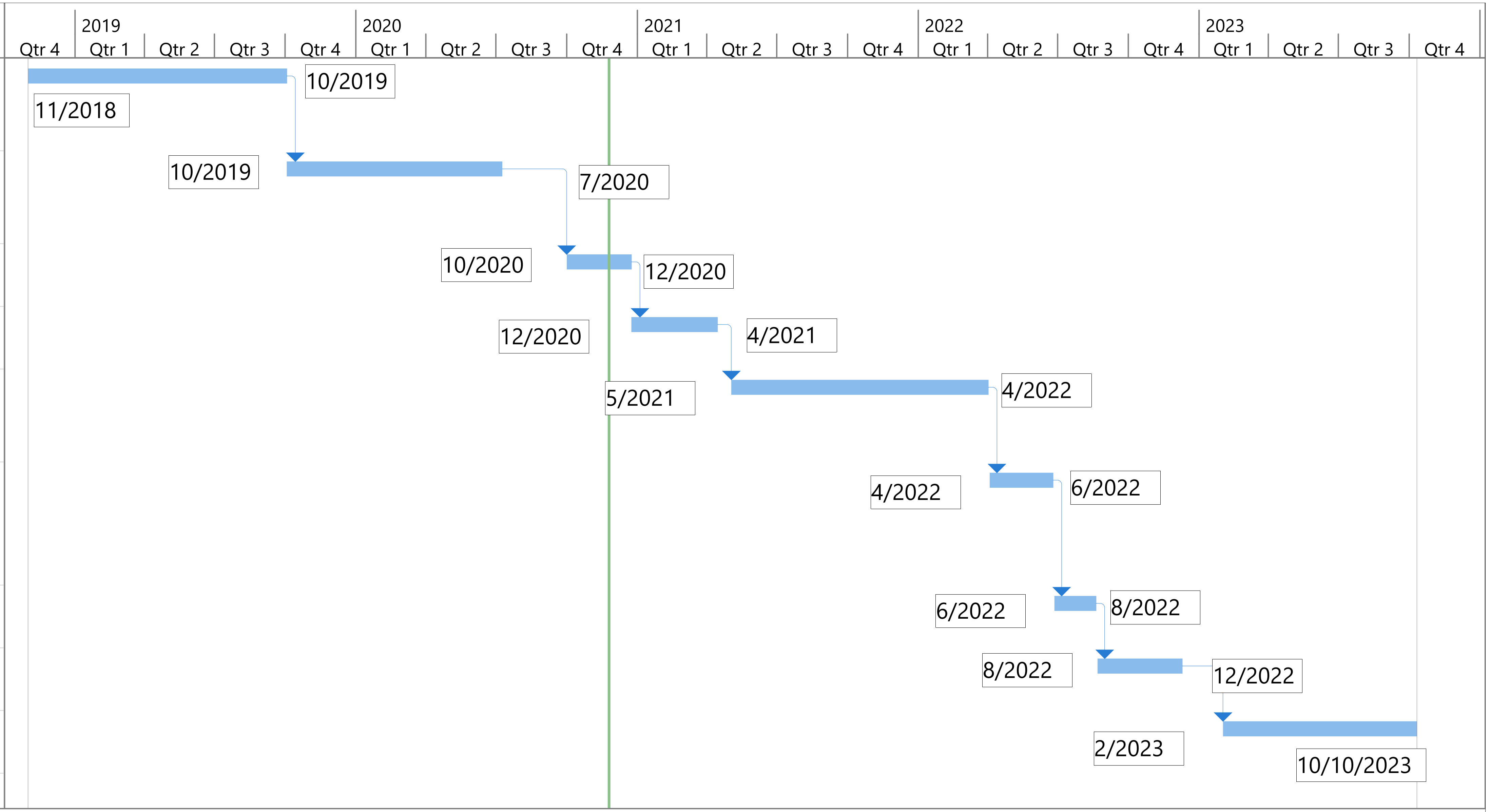
DRAWING NO.
SX-8400-X-052828-001

REVISION NO. 009

Appendix B

Schedule

ID	Task Name	Duration
1	New CCR Unit Alternatives Analysis and Preliminary Design	12 mons
2	Utility Waste Landfill Permitting (State of Missouri and St. Charles County)	10 mons
3	Develop Plans and Specifications	3 mons
4	Bidding & Contract Award	4 mons
5	New CCR Surface Impoundment Construction	12 mons
6	New CCR Surface Impoundment Operating Permit (State of Missouri and St. Charles County)	3 mons
7	SCPC Closure Plans & Specifications	2 mons
8	SCPC Closure Bidding & Contract Award	4 mons
9	SCPC Closure Construction	9 mons



Project: SCPC Replacement Pro
Date: Wed 11/25/20

Task	▬	Inactive Task		Manual Summary Rollup	▬	External Milestone	◆
Split	┈	Inactive Milestone	◇	Manual Summary	┌┐	Deadline	⬇
Milestone	◆	Inactive Summary	┌┐	Start-only	[	Progress	▬
Summary	┌┐	Manual Task	▬	Finish-only	]	Manual Progress	▬
Project Summary	┌┐	Duration-only	▬	External Tasks	▬		

Attachment 1

Groundwater Monitoring Well Locations

LEGEND

🟥 Sioux Energy Center Property Boundary
▭ UWL Perimeter Fence
🟧 SCPC - WFGD Disposal Area
🟦 Water Recycle Pond

Groundwater Monitoring Wells Used for SCPC CCR Rule Monitoring

⌖ SCPC Monitoring Well
⌖ Background Monitoring Well

0 1,000 2,000 3,000
Feet

NOTE(S)
1.) ALL BOUNDARIES AND LOCATIONS ARE APPROXIMATE.
2.) UWL - UTILITY WASTE LANDFILL.
3.) WFGD - WET FLUE GAS DESULFURIZATION.

REFERENCE(S)
1.) AMEREN MISSOURI SIOUX ENERGY CENTER, SIOUX PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2,401 FEET.

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

PROJECT
GROUNDWATER MONITORING PROGRAM

TITLE
SITE LOCATION AERIAL MAP AND MONITORING WELL LOCATIONS

CONSULTANT

YYYY-MM-DD	2020-01-15
DESIGNED	JSI
PREPARED	RJF
REVIEWED	EMS
APPROVED	CMR

PROJECT NO.	CONTROL	REV.	FIGURE
153140601	1240	0	1

PATH: G:\Projects\150 Projects\1531406 - Ameren GW Monitoring Program - MO\Phase 0003 - Sioux Energy\800 - FIGURES-DRAWINGS\PRODUCTION\2019 Annual Report\Figure 1 - SCPC_v2.mxd PRINTED ON: 2020-01-24 AT: 10:47:32 AM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

1 in
0

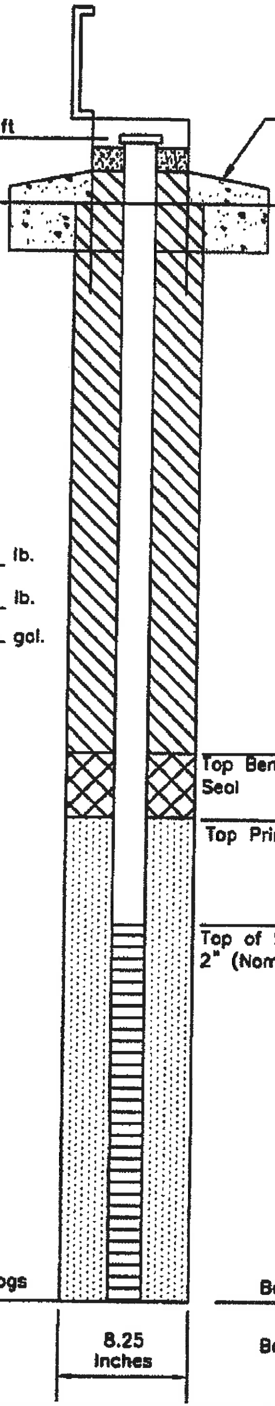
Attachment 2

Monitoring Well Construction Diagrams

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED

Top Casing Elev: 427.74 ft

Ground Surface Elev: 425.18 ft



Well Construction Quantities:

1. Primary Filter Sand – 238 lb.
2. Bentonite Seal – 8 lb.
3. Cement/Bentonite Slurry – 22 gal.

Remarks:

Top Bentonite Seal 416.80 ft

Top Primary Filter Pack 412.80 ft

Top of Screen (10 – Slot): 409.45 ft
2" (Nominal) Schedule 40 PVC (10 ft Length)

Coordinates

N: 1118825.230

E: 877789.760

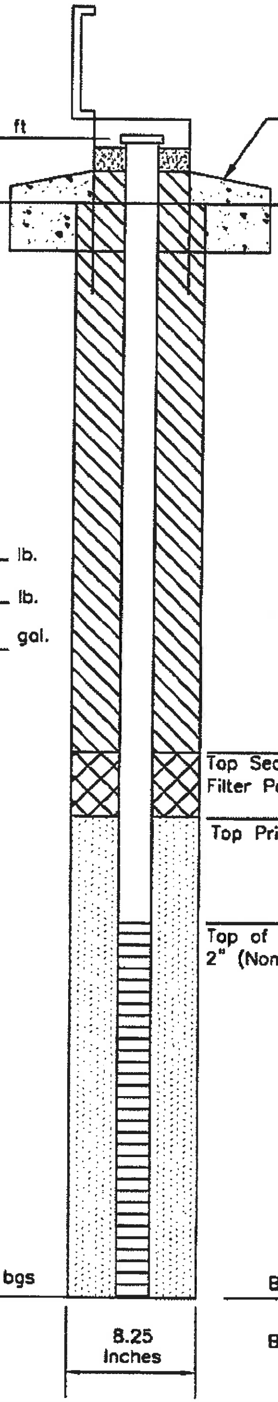
Bottom Hole Depth: 25.6 bgs

Base Sump: 28.54 ' btoc

Base Elev: 399.20 ft

UG–1A	MONITORING WELL CONSTRUCTION DIAGRAM	**GREDELL Engineering Resources, Inc.** **ENVIRONMENTAL ENGINEERING** **LAND AIR WATER** **1505 East High Street** **Jefferson City, Missouri 65101** **Telephone: (573) 659-9078** **Facsimile: (573) 659-9079**
Date Monitoring Well Completed: 6/3/2008	AMERENUE Sioux Power Plant	DATE 05/2008 · SCALE N.T.S. · FIGURE · REV DRAWN BY: WJA · APPROVED BY: MCC · PROJECT NO.

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



Top Casing Elev: 429.27 ft

Ground Surface Elev: 426.46 ft

Well Construction Quantities:

1. Primary Filter Sand – 260 lb.
2. Secondary Filter Sand – 67 lb.
3. Cement/Bentonite Slurry – 39 (est) gal.

Remarks:

Top Secondary Filter Pack 413.52 ft

Top Primary Filter Pack 411.52 ft

Top of Screen (10 – Slot): 409.52 ft
2" (Nominal) Schedule 40 PVC (10 ft Length)

Coordinates

N: 1118859.691

E: 879319.509

Bottom Hole Depth: 26.00 bgs

Base Sump: 30.00 ' btoc

Base Elev: 399.27 ft

UG–2

MONITORING WELL
CONSTRUCTION
DIAGRAM

GREDELL Engineering Resources, Inc.
ENVIRONMENTAL ENGINEERING
LAND AIR WATER
1505 East High Street
Jefferson City, Missouri 65101
Telephone: (573) 659-9078
Facsimile: (573) 659-9079

Date Monitoring Well Completed: 11/7/2007

AMERENUE

Sioux Power Plant

DATE 06/2008

SCALE N.T.S.

FIGURE

REV

DRAWN BY: WJA

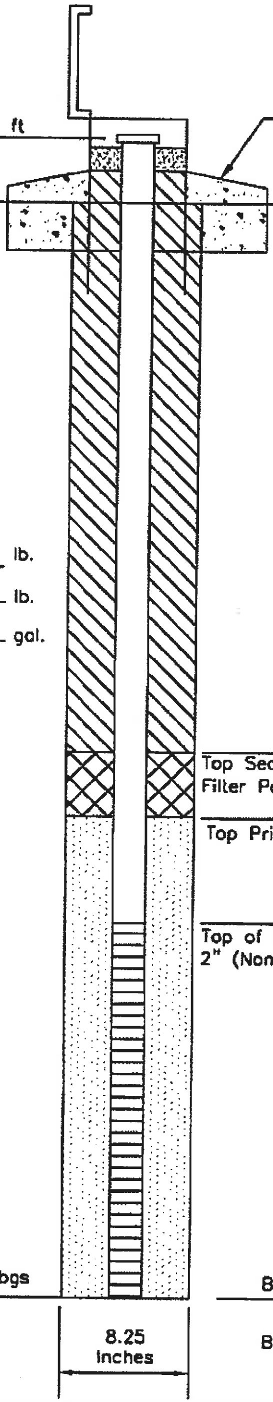
APPROVED BY: MCC

PROJECT NO.

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED

Top Casing Elev: 431.81 ft

Ground Surface Elev: 428.93 ft



Well Construction Quantities:

1. Primary Filter Sand – 325 lb.
2. Secondary Filter Sand – 60 lb.
3. Cement/Bentonite Slurry – 36 gal.

Remarks:

Top Secondary Filter Pack 411.09 ft

Top Primary Filter Pack 409.09 ft

Top of Screen (10 – Slot): 407.09 ft
2" (Nominal) Schedule 40 PVC (10 ft Length)

Coordinates

N: 1117388.316

E: 877383.473

Bottom Hole Depth: 31.0 bgs

Base Sump: 34.97 ' btoc

Base Elev: 396.84 ft

DG–1

MONITORING WELL
CONSTRUCTION
DIAGRAM

GREDELL Engineering Resources, Inc.
ENVIRONMENTAL ENGINEERING
LAND AIR WATER
1505 East High Street
Jefferson City, Missouri 65101
Telephone: (573) 659-9078
Facsimile: (573) 659-9079

Date Monitoring Well Completed: 11/20/2007

AMERENUE

Sioux Power Plant

DATE 06/2008

SCALE N.T.S.

FIGURE

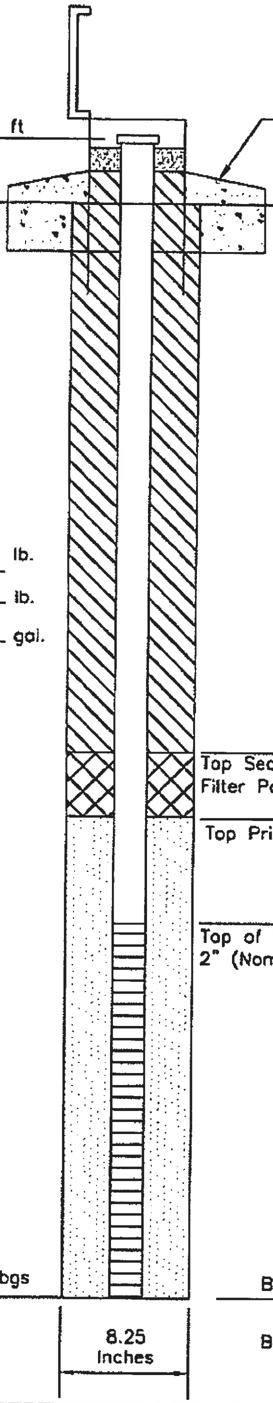
REV

DRAWN BY: MCC

APPROVED BY: MCC

PROJECT NO.

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



Concrete Pad

Top Casing Elev: 431.75 ft

Ground Surface Elev: 428.90 ft

Well Construction Quantities:

1. Primary Filter Sand – 300 lb.
2. Secondary Filter Sand – 60 lb.
3. Cement/Bentonite Slurry – 36 gal.

Remarks:

Top Secondary Filter Pack 411.50 ft

Top Primary Filter Pack 409.50 ft

Top of Screen (10 – Slot): 407.50 ft
2" (Nominal) Schedule 40 PVC (10 ft Length)

Coordinates

N: 1116940.658

E: 877617.717

Bottom Hole Depth: 31.0 bgs

Base Sump: 34.50 ' btoc

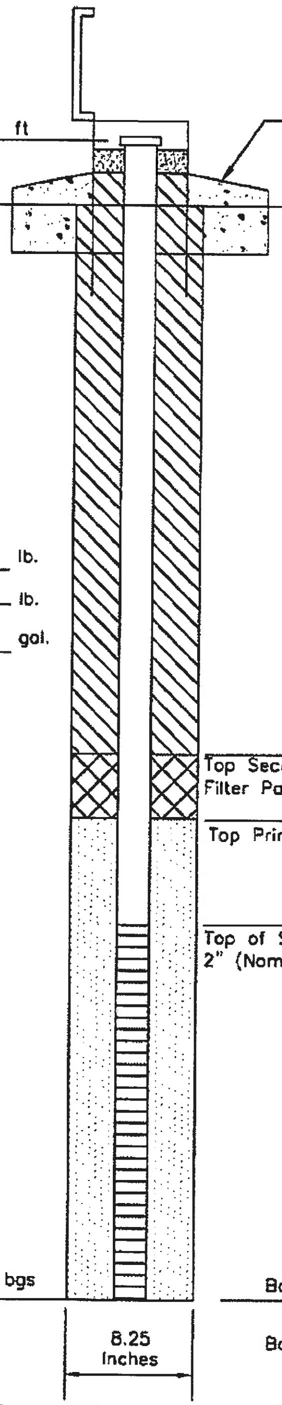
Base Elev: 397.25 ft

8.25 Inches

DG–2	MONITORING WELL CONSTRUCTION DIAGRAM	**GREDELL Engineering Resources, Inc.** **ENVIRONMENTAL ENGINEERING** **LAND AIR WATER** **1505 East High Street** **Jefferson City, Missouri 65101** **Telephone: (573) 659-9078** **Facsimile: (573) 659-9079**

Date Monitoring Well Completed:	AMERENUE	DATE 06/2008	SCALE N.T.S.	FIGURE	REV
11/20/2007	Sioux Power Plant	DRAWN BY: WJA	APPROVED BY: MCC	PROJECT NO.	

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



Top Casing Elev: 433.84 ft

Concrete Pad

Ground Surface Elev: 430.98 ft

Well Construction Quantities:

1. Primary Filter Sand – 300 lb.
2. Secondary Filter Sand – 60 lb.
3. Cement/Bentonite Slurry – 36 (est) gal.

Remarks:

Top Secondary Filter Pack 413.13 ft

Top Primary Filter Pack 411.13 ft

Top of Screen (10 – Slot): 409.13 ft
2" (Nominal) Schedule 40 PVC (10 ft Length)

Coordinates

N: 1116644.130

E: 877845.171

Bottom Hole Depth: 32.0 bgs

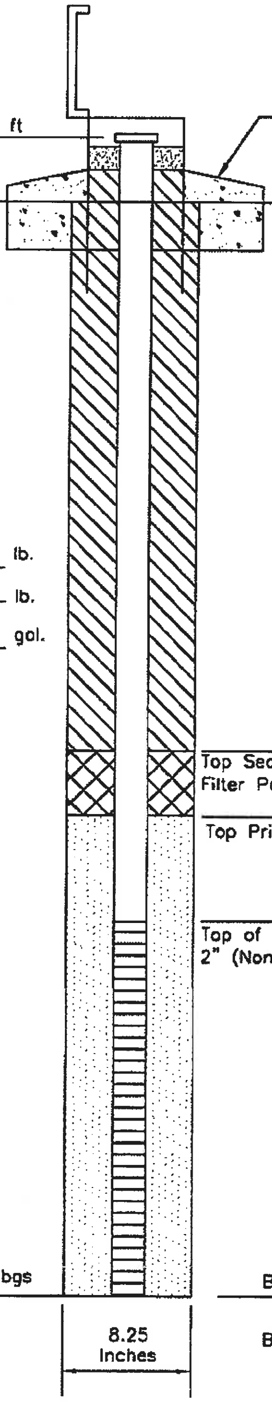
Base Sump: 34.96 ' btoc

8.25 Inches

Base Elev: 398.88 ft

DG-3	MONITORING WELL CONSTRUCTION DIAGRAM	**GREDELL Engineering Resources, Inc.** ENVIRONMENTAL ENGINEERING LAND AIR WATER 1505 East High Street Jefferson City, Missouri 65101 Telephone: (573) 659-9078 Facsimile: (573) 659-9079			
Date Monitoring Well Completed: 11/21/07	AMERENUE	DATE 06/2008	SCALE N.T.S.	FIGURE	REV
	Sioux Power Plant	DRAWN BY: WJA	APPROVED BY: MCC	PROJECT NO.	

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



Top Casing Elev: 431.44 ft

Ground Surface Elev: 428.66 ft

Top Secondary Filter Pack 413.33 ft

Top Primary Filter Pack 411.33 ft

Top of Screen (10 - Slot): 408.83 ft
2" (Nominal) Schedule 40 PVC (10 ft Length)

Bottom Hole Depth: 30.5 bgs

Base Sump: 32.86 ' btoc

Base Elev: 398.58 ft

Well Construction Quantities:

1. Primary Filter Sand – 325 lb.
2. Secondary Filter Sand – 75 lb.
3. Cement/Bentonite Slurry – 44 (est) gal.

Remarks:

Coordinates

N: 1116257.139

E: 879417.113

DG-6	MONITORING WELL CONSTRUCTION DIAGRAM	**GREDELL Engineering Resources, Inc.** **ENVIRONMENTAL ENGINEERING** **LAND AIR WATER** **1505 East High Street** **Jefferson City, Missouri 65101** **Telephone: (573) 659-9078** **Facsimile: (573) 659-9079**
Date Monitoring Well Completed: 11/19/2007	AMERENUE Sioux Power Plant	DATE 06/2008 · SCALE N.T.S. · FIGURE · REV DRAWN BY: WJA · APPROVED BY: MCC · PROJECT NO.

Attachment 3

Groundwater Flow Maps

Path: G:\Projects\150 Projects\1531406 - Ameren GW Monitoring Program - MO\Phase 0003 - Sioux Energy\800 - FIGURES-DRAWINGS\PRODUCTION\NEW_UPDATED_POTMAP_PRODUCTION\20191114_SECPM_153140601.mxd

LEGEND

- Sioux Energy Center Property Boundary

CCR Units

- 🟨 SCPA - Bottom Ash Surface Impoundment
- 🟩 SCPB - Fly Ash Surface Impoundment
- 🟧 SCPC - WFGD Surface Impoundment
- 🟦 SCL4A - Dry CCR Disposal Area
- Groundwater Flow Direction

Groundwater Elevation Contour (FT MSL)

- Inferred Groundwater Elevation Contour (FT MSL)
- Groundwater Elevation Contour (FT MSL)

Ground/Surface Water Measurement Locations

- ▲ SCPA Surface Impoundment Pond Gauge
- ⊙ River Gauge Location
- ⊕ Monitoring Well or Piezometer

NOTES

1.) ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2.) GROUNDWATER AND SURFACE WATER ELEVATIONS DISPLAYED IN FEET ABOVE MEAN SEA LEVEL (FT MSL).
3.) GROUNDWATER ELEVATION MEASUREMENTS OBTAINED BY GOLDER.
4.) MISSOURI RIVER ELEVATION ESTIMATED BASED ON NEARBY UNITED STATES GEOLOGICAL SURVEY (USGS) RIVER GAUGING LOCATIONS.
5.) MISSISSIPPI RIVER ELEVATION PROVIDED BY AMEREN MISSOURI.
6.) DG-11, PZ-6S AND TP-5S WERE NOT USED IN POTENTIOMETRIC CONTOURING.

REFERENCE

1.) AMEREN MISSOURI SIOUX ENERGY CENTER, SIOUX PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2,401 FEET.
3.) USGS NATIONAL WATER INFORMATION SYSTEM, USGS GAUGES 06935965 (ST. CHARLES), 07010000 (ST. LOUIS), 05587498 (ALTON), GRAFTON (05587450).

0 500 1,000 1,500 2,000 Feet

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

PROJECT
CCR GROUNDWATER MONITORING PROGRAM

TITLE
NOVEMBER 13, 2019 POTENTIOMETRIC SURFACE MAP

CONSULTANT
GOLDER

YYYY-MM-DD	2020-01-07
PREPARED	EMS
DESIGN	JSI
REVIEW	TJG
APPROVED	CMR

PROJECT No.
153-140601

PHASE
0003

FIGURE
P4

LEGEND

▬ ▬ Sioux Energy Center Property Boundary

CCR Units

🟨 SCPA - Bottom Ash Surface Impoundment

🟩 SCPB - Fly Ash Surface Impoundment

🟧 SCPC - WFGD Surface Impoundment

🟦 SCL4A - Dry CCR Disposal Area

➚ Groundwater Flow Direction

Groundwater Elevation Contour (FT MSL)

= = Inferred Groundwater Elevation Contour (FT MSL)

— Groundwater Elevation Contour (FT MSL)

Ground/Surface Water Measurement Locations

▲ SCPA Surface Impoundment Pond Gauge

● River Gauge Location

⊕ Monitoring Well or Piezometer

NOTES

1.) ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2.) GROUNDWATER AND SURFACE WATER ELEVATIONS DISPLAYED IN FEET ABOVE MEAN SEA LEVEL (FT MSL).
3.) GROUNDWATER ELEVATION MEASUREMENTS OBTAINED BY GOLDER.
4.) MISSOURI RIVER ELEVATION ESTIMATED BASED ON NEARBY UNITED STATES GEOLOGICAL SURVEY (USGS) RIVER GAUGING LOCATIONS.
5.) MISSISSIPPI RIVER ELEVATION PROVIDED BY AMEREN MISSOURI.
6.) DG-11 AND PZ-6S WERE NOT USED IN POTENTIOMETRIC CONTOURING.

REFERENCE

1.) AMEREN MISSOURI SIOUX ENERGY CENTER, SIOUX PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2,401 FEET.
3.) USGS NATIONAL WATER INFORMATION SYSTEM, USGS GAUGES 06935965 (ST. CHARLES), 07010000 (ST. LOUIS), 05587498 (ALTON), GRAFTON (05587450).

0 500 1,000 1,500 2,000
Feet

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

PROJECT
CCR GROUNDWATER MONITORING PROGRAM

TITLE
OCTOBER 1, 2019 POTENTIOMETRIC SURFACE MAP

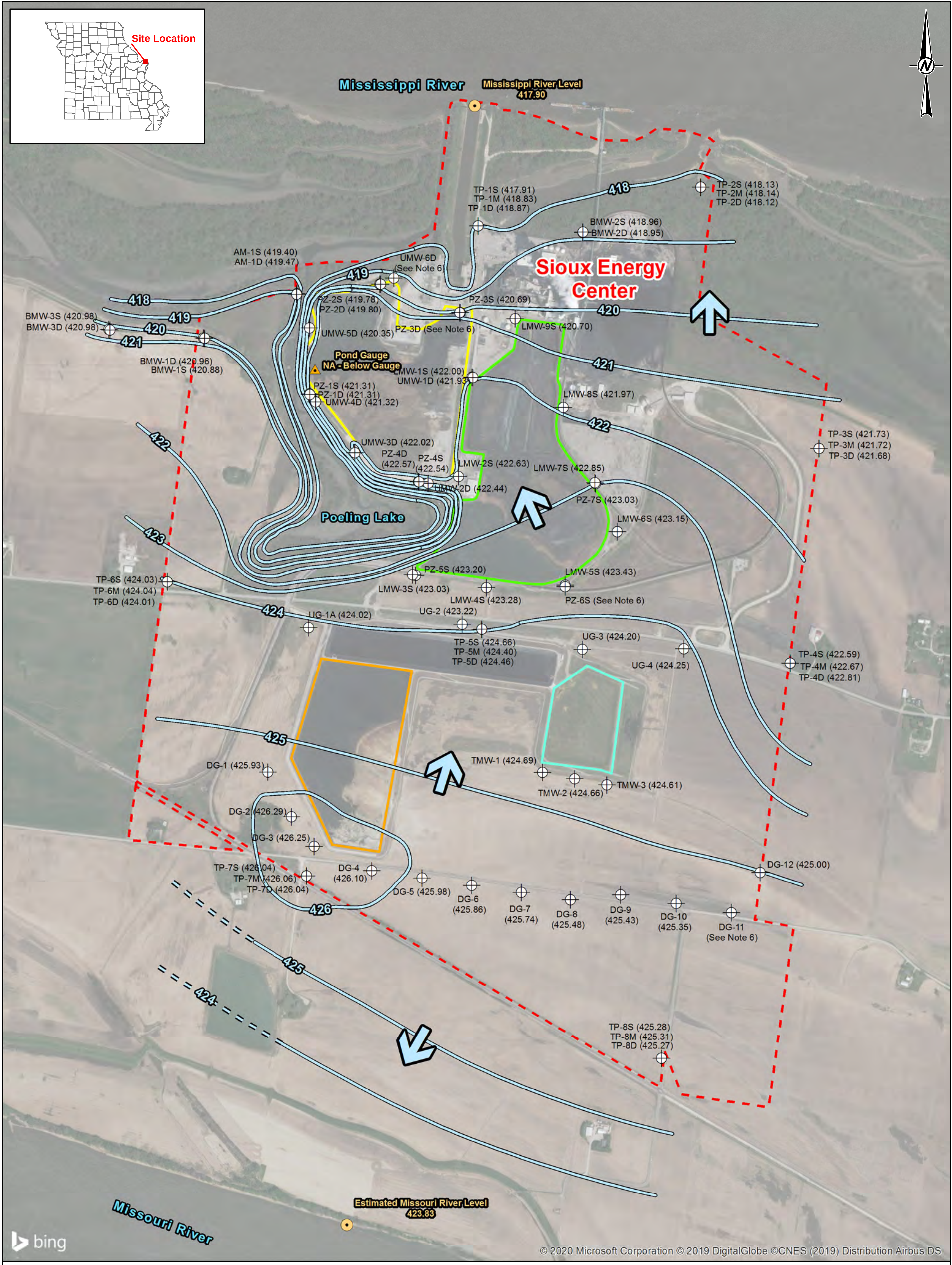
CONSULTANT

YYYY-MM-DD	2019-10-21
PREPARED	AMM
DESIGN	JSI
REVIEW	BCW
APPROVED	MNH

PROJECT No. 153-1406
PHASE 0003
FIGURE P3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
0
1 in

Path: G:\Projects\150 Projects\1531406 - Ameren GW Monitoring Program - MO\Phase 0003 - Sioux Energy\800 - FIGURES-DRAWINGS\PRODUCTION\NEW_UPDATED_POTMAP_PRODUCTION\20190801_SECPM_153140601.mxd



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LEGEND

- 🟥 Sioux Energy Center Property Boundary

CCR Units

- 🟨 SCPA - Bottom Ash Surface Impoundment
- 🟩 SCPB - Fly Ash Surface Impoundment
- 🟧 SCPC - WFGD Surface Impoundment
- 🟦 SCL4A - Dry CCR Disposal Area
- ⬉ Groundwater Flow Direction

Groundwater Elevation Contour (FT MSL)

- = = Inferred Groundwater Elevation Contour (FT MSL)
- — Groundwater Elevation Contour (FT MSL)

Ground/Surface Water Measurement Locations

- ▲ SCPA Surface Impoundment Pond Gauge
- ● River Gauge Location
- ⊕ Monitoring Well or Piezometer

NOTES

1.) ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2.) GROUNDWATER AND SURFACE WATER ELEVATIONS DISPLAYED IN FEET ABOVE MEAN SEA LEVEL (FT MSL).
3.) GROUNDWATER ELEVATION MEASUREMENTS OBTAINED BY GOLDER.
4.) MISSOURI RIVER ELEVATION ESTIMATED BASED ON NEARBY UNITED STATES GEOLOGICAL SURVEY (USGS) RIVER GAUGING LOCATIONS.
5.) MISSISSIPPI RIVER ELEVATION PROVIDED BY AMEREN MISSOURI.
6.) DG-11, PZ-3D, PZ-6S, AND UMW-6D WERE NOT USED IN POTENTIOMETRIC CONTOURING.

REFERENCE

1.) AMEREN MISSOURI SIOUX ENERGY CENTER, SIOUX PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2,401 FEET.
3.) USGS NATIONAL WATER INFORMATION SYSTEM, USGS GAUGES 06935965 (ST. CHARLES), 07010000 (ST. LOUIS), 05587498 (ALTON), GRAFTON (05587450).

0 500 1,000 1,500 2,000
Feet

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

PROJECT
CCR GROUNDWATER MONITORING PROGRAM

TITLE
AUGUST 1, 2019 POTENTIOMETRIC SURFACE MAP

CONSULTANT
GOLDER

YYYY-MM-DD	2019-10-09
PREPARED	EMS
DESIGN	JSI
REVIEW	AMM
APPROVED	MNH

PROJECT No.
153-1406

PHASE
0003

FIGURE
P2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
1 in
0

Path: G:\Projects\150 Projects\1531406 - Ameren GW Monitoring Program - MO\Phase 0003 - Sioux Energy\800 - FIGURES-DRAWINGS\PRODUCTION\NEW_UPDATED_POTMAP_PRODUCTION\20190107_SECPM_153140601.mxd

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LEGEND

🟥 Sioux Energy Center Property Boundary

CCR Units

🟨 SCPA - Bottom Ash Surface Impoundment

🟩 SCPB - Fly Ash Surface Impoundment

🟧 SCPC - WFGD Surface Impoundment

🟦 SCL4A - Dry CCR Disposal Area

➚ Groundwater Flow Direction

Groundwater Elevation Contour (FT MSL)

= = Inferred Groundwater Elevation Contour (FT MSL)

— Groundwater Elevation Contour (FT MSL)

Ground/Surface Water Measurement Locations

▲ SCPA Surface Impoundment Pond Gauge

● River Gauge Location

⌖ Monitoring Well or Piezometer

NOTES

1.) ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2.) GROUNDWATER AND SURFACE WATER ELEVATIONS DISPLAYED IN FEET ABOVE MEAN SEA LEVEL (FT MSL).
3.) GROUNDWATER ELEVATION MEASUREMENTS OBTAINED BY GOLDER.
4.) MISSOURI RIVER ELEVATION ESTIMATED BASED ON NEARBY UNITED STATES GEOLOGICAL SURVEY (USGS) RIVER GAUGING LOCATIONS.
5.) MISSISSIPPI RIVER ELEVATION PROVIDED BY AMEREN MISSOURI.
6.) TP-1S, PZ-6S, AND DG-11 WERE NOT USED IN POTENTIOMETRIC CONTOURING.

REFERENCE

1.) AMEREN MISSOURI SIOUX ENERGY CENTER, SIOUX PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2,401 FEET.
3.) USGS NATIONAL WATER INFORMATION SYSTEM, USGS GAUGES 06935965 (ST. CHARLES), 07010000 (ST. LOUIS), 05587498 (ALTON), GRAFTON (05587450).

0 500 1,000 1,500 2,000 Feet

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

PROJECT
CCR GROUNDWATER MONITORING PROGRAM

TITLE
JANUARY 07, 2019 POTENTIOMETRIC SURFACE MAP

CONSULT

GOLDER

YYYY-MM-DD	2020-01-24
PREPARED	JSI
DESIGN	JSI
REVIEW	AMM
APPROVED	MNH

PROJECT No. 153-1406
PHASE 0003
FIGURE **P1**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
1 in
0

Path: G:\Projects\150 Projects\1531406 - Ameren GW Monitoring Program - MO\Phase 0003 - Sioux Energy\800 - FIGURES-DRAWINGS\PRODUCTION\GMP\2018 potmaps\Figure 3_SCPB-SCPC-SCL4A-Nov_18.mxd

LEGEND

🟥 Sioux Energy Center Property Boundary

🟩 SCPB - Fly Ash Surface Impoundment

Ground/Surface Water Measurement Locations

⊕ SCL4A - UWL Cell 4A Monitoring Well

⊕ Groundwater Elevation Piezometer

⊕ Background Monitoring Well

⊕ SCPB - Fly Ash Surface Impoundment Monitoring Well

⊕ SCPC - WFGD Surface Impoundment Monitoring Well

▲ SCPA Pond Gauge

● River Elevation

Utility Waste Landfill (UWL)

▭ SCL4A - UWL Cell 4A

▭ SCPC - WFGD Surface Impoundment

▭ Water Recycle Pond

▭ UWL Future Perimeter Fence

Groundwater Elevation Contours

— Groundwater Elevation Contour (FT MSL)

-- Inferred Groundwater Elevation Contour (FT MSL)

⬉ Groundwater Flow Direction

NOTES

1.) ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2.) GOLDER GROUNDWATER MONITORING WELLS SURVEYED BY ZAHNER AND ASSOCIATES, INC. ON JANUARY 14, APRIL 29, AND DECEMBER 8, 2016.
3.) GROUNDWATER AND SURFACE WATER ELEVATIONS DISPLAYED IN FT MSL (FEET ABOVE MEAN SEA LEVEL).
4.) GROUNDWATER MEASUREMENTS OBTAINED BY GOLDER.
5.) MISSOURI RIVER ELEVATION ESTIMATED BASED ON NEARBY USGS (UNITED STATES GEOLOGICAL SURVEY) RIVER GAUGING LOCATIONS.
6.) MISSISSIPPI RIVER ELEVATION PROVIDED BY AMEREN MISSOURI.
7.) POND GAUGE LEVEL OBTAINED ONSITE BY GOLDER.
8.) UWL BOUNDARIES, DESIGNATIONS AND STATE MONITORING WELL LOCATIONS BASED ON DRAWINGS IN THE UWL PROPOSED LANDFILL PERMIT (#0918301).
9.) WFGD - WET FLUE GAS DESULFURIZATION.

REFERENCE

1.) AMEREN MISSOURI SIOUX ENERGY CENTER, SIOUX PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2,401 FEET.
3.) USGS NATIONAL WATER INFORMATION SYSTEM, USGS GAUGES 06935965 (ST. CHARLES), 07010000 (ST. LOUIS), 05587498 (ALTON), GRAFTON (05587450).
4.) AMEREN MISSOURI SIOUX POWER PLANT UTILITY WASTE LANDFILL PROPOSED CONSTRUCTION PERMIT MODIFICATION (#0918301), AUGUST 2014.

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

Ameren

PROJECT
CCR GROUNDWATER MONITORING PROGRAM

TITLE
SCPC POTENTIOMETRIC SURFACE MAP - NOVEMBER 12, 2018

CONSULTANT

GOLDER

YYYY-MM-DD	2018-12-20
PREPARED	EFT
DESIGN	JSI
REVIEW	JAP
APPROVED	MNH

PROJECT No.	PHASE	FIGURE
153-1406	0003	3

Path: G:\Projects\150 Projects\1531406 - Ameren GW Monitoring Program - MO\Phase 0003 - Sioux Energy\800 - FIGURES-DRAWINGS\PRODUCTION\GMP\2018 potmaps\Figure 2_SCPB-SCPC-SCL4A-May_18.mxd

LEGEND

- Sioux Energy Center Property Boundary
- SCPB - Fly Ash Surface Impoundment

Ground/Surface Water Measurement Locations

- SCL4A - UWL Cell 4A Monitoring Well
- Groundwater Elevation Piezometer
- Background Monitoring Well
- SCPB - Fly Ash Surface Impoundment Monitoring Well
- SCPC - WFGD Surface Impoundment Monitoring Well

- ▲ SCPA Pond Gauge
- ● River Elevation

Utility Waste Landfill (UWL)

- SCL4A - UWL Cell 4A
- SCPC - WFGD Surface Impoundment
- Water Recycle Pond
- UWL Future Perimeter Fence

Groundwater Elevation Contours

- Groundwater Elevation Contour (FT MSL)
- Inferred Groundwater Elevation Contour (FT MSL)
- Groundwater Flow Direction

NOTES

1.) ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2.) GOLDER GROUNDWATER MONITORING WELLS SURVEYED BY ZAHNER AND ASSOCIATES, INC. ON JANUARY 14, APRIL 29, AND DECEMBER 8, 2016.
3.) GROUNDWATER AND SURFACE WATER ELEVATIONS DISPLAYED IN FT MSL (FEET ABOVE MEAN SEA LEVEL).
4.) GROUNDWATER MEASUREMENTS OBTAINED BY GOLDER.
5.) MISSOURI RIVER ELEVATION ESTIMATED BASED ON NEARBY USGS (UNITED STATES GEOLOGICAL SURVEY) RIVER GAUGING LOCATIONS.
6.) MISSISSIPPI RIVER ELEVATION PROVIDED BY AMEREN MISSOURI.
7.) POND GAUGE LEVEL OBTAINED ONSITE BY GOLDER.
8.) UWL BOUNDARIES, DESIGNATIONS AND STATE MONITORING WELL LOCATIONS BASED ON DRAWINGS IN THE UWL PROPOSED LANDFILL PERMIT (#0918301).
9.) WFGD - WET FLUE GAS DESULFURIZATION..

REFERENCE

1.) AMEREN MISSOURI SIOUX ENERGY CENTER, SIOUX PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2,401 FEET.
3.) USGS NATIONAL WATER INFORMATION SYSTEM, USGS GAUGES 06935965 (ST. CHARLES), 07010000 (ST. LOUIS), 05587498 (ALTON), GRAFTON (05587450).
4.) AMEREN MISSOURI SIOUX POWER PLANT UTILITY WASTE LANDFILL PROPOSED CONSTRUCTION PERMIT MODIFICATION (#0918301), AUGUST 2014.

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

Ameren

PROJECT
CCR GROUNDWATER MONITORING PROGRAM

TITLE
SCPC POTENTIOMETRIC SURFACE MAP - MAY 14, 2018

CONSULTANT

GOLDER

YYYY-MM-DD	2018-12-20
PREPARED	EFT
DESIGN	JSI
REVIEW	JAP
APPROVED	MNH

PROJECT No.	PHASE	FIGURE
153-1406	0003	2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
0
1 in

LEGEND

🟥 Sioux Energy Center Property Boundary

🟩 SCPB - Fly Ash Surface Impoundment

Ground/Surface Water Measurement Locations

⊕ SCL4A - UWL Cell 4A Monitoring Well

⊕ Groundwater Elevation Piezometer

⊕ Background Monitoring Well

⊕ SCPB - Fly Ash Surface Impoundment Monitoring Well

⊕ SCPC - WFGD Surface Impoundment Monitoring Well

▲ SPCA Pond Gauge

● River Elevation

Utility Waste Landfill (UWL)

▭ SCL4A - UWL Cell 4A

▭ SCPC - WFGD Surface Impoundment

▭ Water Recycle Pond

▭ UWL Future Perimeter Fence

Groundwater Elevation Contours

— Groundwater Elevation Contour (FT MSL)

= Inferred Groundwater Elevation Contour (FT MSL)

↖ Groundwater Flow Direction

NOTES

1.) ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2.) GOLDER GROUNDWATER MONITORING WELLS SURVEYED BY ZAHNER AND ASSOCIATES, INC. ON JANUARY 14, APRIL 29, AND DECEMBER 8, 2016.
3.) GROUNDWATER AND SURFACE WATER ELEVATIONS DISPLAYED IN FT MSL (FEET ABOVE MEAN SEA LEVEL).
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5.) MISSOURI RIVER ELEVATION ESTIMATED BASED ON NEARBY USGS (UNITED STATES GEOLOGICAL SURVEY) RIVER GAUGING LOCATIONS.
6.) MISSISSIPPI RIVER ELEVATION PROVIDED BY AMEREN MISSOURI.
7.) UWL BOUNDARIES, DESIGNATIONS AND STATE MONITORING WELL LOCATIONS BASED ON DRAWINGS IN THE UWL PROPOSED LANDFILL PERMIT (#0918301).
8.) WFGD - WET FLUE GAS DESULFURIZATION.

REFERENCE

1.) AMEREN MISSOURI SIOUX ENERGY CENTER, SIOUX PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2,401 FEET.
3.) USGS NATIONAL WATER INFORMATION SYSTEM, USGS GAUGES 06935965 (ST. CHARLES), 07010000 (ST. LOUIS), 05587498 (ALTON), GRAFTON (05587450).
4.) AMEREN MISSOURI SIOUX POWER PLANT UTILITY WASTE LANDFILL PROPOSED CONSTRUCTION PERMIT MODIFICATION (#0918301), AUGUST 2014.

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

PROJECT
CCR GROUNDWATER MONITORING PROGRAM

TITLE
SCPC POTENTIOMETRIC SURFACE MAP
DETECTION MONITORING - NOVEMBER 13, 2017

CONSULTANT

YYYY-MM-DD	2017-11-22
PREPARED	RJF
DESIGN	JSI
REVIEW	JS
APPROVED	MNH

PROJECT No.
153-1406

PHASE
0003D

FIGURE
P9

Path: G:\Projects\150 Projects\1531406 - Ameren GW Monitoring Program - MO\Phase 0003 - Sioux Energy\800 - FIGURES-DRAWINGS\PRODUCTION\GMP\Updated Pot Maps\Final\Updated Shallow\SCPC-E8.mxd

LEGEND

- 🟥 Sioux Energy Center Property Boundary
- 🟩 SCPB - Fly Ash Surface Impoundment

Ground/Surface Water Measurement Locations

- ⊕ SCL4A - UWL Cell 4A Monitoring Well
- ⊕ Groundwater Elevation Piezometer
- ⊕ Background Monitoring Well
- ⊕ SCPB - Fly Ash Surface Impoundment Monitoring Well
- ⊕ SCPC - WFGD Surface Impoundment Monitoring Well

- ▲ SPCA Pond Gauge
- ● River Elevation

Utility Waste Landfill (UWL)

- ▭ SCL4A - UWL Cell 4A
- ▭ SCPC - WFGD Surface Impoundment
- ▭ Water Recycle Pond
- ▭ UWL Future Perimeter Fence

Groundwater Elevation Contours

- — Groundwater Elevation Contour (FT MSL)
- = - Inferred Groundwater Elevation Contour (FT MSL)
- ↖ Groundwater Flow Direction

NOTES

1.) ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2.) GOLDER GROUNDWATER MONITORING WELLS SURVEYED BY ZAHNER AND ASSOCIATES, INC. ON JANUARY 14, APRIL 29, AND DECEMBER 8, 2016.
3.) GROUNDWATER AND SURFACE WATER ELEVATIONS DISPLAYED IN FT MSL (FEET ABOVE MEAN SEA LEVEL).
4.) GROUNDWATER MEASUREMENTS OBTAINED BY GOLDER.
5.) MISSOURI RIVER ELEVATION ESTIMATED BASED ON NEARBY USGS (UNITED STATES GEOLOGICAL SURVEY) RIVER GAUGING LOCATIONS.
6.) MISSISSIPPI RIVER ELEVATION PROVIDED BY AMEREN MISSOURI.
7.) POND GAUGE LEVEL OBTAINED ONSITE BY GOLDER.
8.) UWL BOUNDARIES, DESIGNATIONS AND STATE MONITORING WELL LOCATIONS BASED ON DRAWINGS IN THE UWL PROPOSED LANDFILL PERMIT (#0918301).
9.) WFGD - WET FLUE GAS DESULFURIZATION.

REFERENCE

1.) AMEREN MISSOURI SIOUX ENERGY CENTER, SIOUX PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2,401 FEET.
3.) USGS NATIONAL WATER INFORMATION SYSTEM, USGS GAUGES 06935965 (ST. CHARLES), 07010000 (ST. LOUIS), 05587498 (ALTON), GRAFTON (05587450).
4.) AMEREN MISSOURI SIOUX POWER PLANT UTILITY WASTE LANDFILL PROPOSED CONSTRUCTION PERMIT MODIFICATION (#0918301), AUGUST 2014.

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

Ameren

PROJECT
CCR GROUNDWATER MONITORING PROGRAM

TITLE
SCPC POTENTIOMETRIC SURFACE MAP
BACKGROUND EVENT 8 - JUNE 5, 2017

CONSULTANT

Golder Associates

YYYY-MM-DD	2017-07-05
PREPARED	JSI
DESIGN	JSI
REVIEW	RJF
APPROVED	MNH

PROJECT No.
153-1406

PHASE
0003D

FIGURE
P8

Path: G:\Projects\150 Projects\1531406 - Ameren GW Monitoring Program - MO\Phase 0003 - Sioux Energy\800 - FIGURES-DRAWINGS\PRODUCTION\GMP\Updated Pot Maps\Final\Updated Shallow\SCPC-E7.mxd

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LEGEND

- Sioux Energy Center Property Boundary
- SCPB - Fly Ash Surface Impoundment

Ground/Surface Water Measurement Locations

- SCL4A - UWL Cell 4A Monitoring Well
- Groundwater Elevation Piezometer
- Background Monitoring Well
- SCPB - Fly Ash Surface Impoundment Monitoring Well
- SCPC - WFGD Surface Impoundment Monitoring Well
- SPCA Pond Gauge
- River Elevation

Utility Waste Landfill (UWL)

- SCL4A - UWL Cell 4A
- SCPC - WFGD Surface Impoundment
- Water Recycle Pond
- UWL Future Perimeter Fence

Groundwater Elevation Contours

- Groundwater Elevation Contour (FT MSL)
- Inferred Groundwater Elevation Contour (FT MSL)
- Groundwater Flow Direction

NOTES

1.) ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2.) GOLDER GROUNDWATER MONITORING WELLS SURVEYED BY ZAHNER AND ASSOCIATES, INC. ON JANUARY 14, APRIL 29, AND DECEMBER 8, 2016.
3.) GROUNDWATER AND SURFACE WATER ELEVATIONS DISPLAYED IN FT MSL (FEET ABOVE MEAN SEA LEVEL).
4.) GROUNDWATER MEASUREMENTS OBTAINED BY GOLDER.
5.) MISSOURI RIVER ELEVATION ESTIMATED BASED ON NEARBY USGS (UNITED STATES GEOLOGICAL SURVEY) RIVER GAUGING LOCATIONS.
6.) MISSISSIPPI RIVER ELEVATION PROVIDED BY AMEREN MISSOURI.
7.) POND GAUGE LEVEL OBTAINED ONSITE BY GOLDER.
8.) UWL BOUNDARIES, DESIGNATIONS AND STATE MONITORING WELL LOCATIONS BASED ON DRAWINGS IN THE UWL PROPOSED LANDFILL PERMIT (#0918301).
9.) WFGD - WET FLUE GAS DESULFURIZATION.

REFERENCE

1.) AMEREN MISSOURI SIOUX ENERGY CENTER, SIOUX PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2,401 FEET.
3.) USGS NATIONAL WATER INFORMATION SYSTEM, USGS GAUGES 06935965 (ST. CHARLES), 07010000 (ST. LOUIS), 05587498 (ALTON), GRAFTON (05587450).
4.) AMEREN MISSOURI SIOUX POWER PLANT UTILITY WASTE LANDFILL PROPOSED CONSTRUCTION PERMIT MODIFICATION (#0918301), AUGUST 2014.

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

PROJECT
CCR GROUNDWATER MONITORING PROGRAM

TITLE
SCPC POTENTIOMETRIC SURFACE MAP
BACKGROUND EVENT 7 - MARCH 8, 2017

CONSULTANT

YYYY-MM-DD	2017-03-14
PREPARED	JSI
DESIGN	JSI
REVIEW	JS
APPROVED	MNH

PROJECT No.
153-1406

PHASE
0003D

FIGURE
P7

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
1 in
0

Path: G:\Projects\150 Projects\1531406 - Ameren GW Monitoring Program - MO\Phase 0003 - Sioux Energy\800 - FIGURES-DRAWINGS\PRODUCTION\GMP\Updated Pot Maps\Final\Updated Shallow\SCPC-E6.mxd

LEGEND

- Sioux Energy Center Property Boundary
- 🟩 SCPB - Fly Ash Surface Impoundment

Ground/Surface Water Measurement Locations

- ⊕ SCL4A - UWL Cell 4A Monitoring Well
- ⊕ Groundwater Elevation Piezometer
- ⊕ Background Monitoring Well
- ⊕ SCPB - Fly Ash Surface Impoundment Monitoring Well
- ⊕ SCPC - WFGD Surface Impoundment Monitoring Well
- ▲ SPCA Pond Gauge
- ● River Elevation

Utility Waste Landfill (UWL)

- ▭ SCL4A - UWL Cell 4A
- 🟧 SCPC - WFGD Surface Impoundment
- 🟦 Water Recycle Pond
- ▭ UWL Future Perimeter Fence

Groundwater Elevation Contours

- Groundwater Elevation Contour (FT MSL)
- Inferred Groundwater Elevation Contour (FT MSL)
- Groundwater Flow Direction

NOTES

1.) ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2.) GOLDER GROUNDWATER MONITORING WELLS SURVEYED BY ZAHNER AND ASSOCIATES, INC. ON JANUARY 14, APRIL 29, AND DECEMBER 8, 2016.
3.) GROUNDWATER AND SURFACE WATER ELEVATIONS DISPLAYED IN FT MSL (FEET ABOVE MEAN SEA LEVEL).
4.) GROUNDWATER MEASUREMENTS OBTAINED BY GOLDER.
5.) MISSOURI RIVER ELEVATION ESTIMATED BASED ON NEARBY USGS (UNITED STATES GEOLOGICAL SURVEY) RIVER GAUGING LOCATIONS.
6.) MISSISSIPPI RIVER ELEVATION PROVIDED BY AMEREN MISSOURI.
7.) POND GAUGE LEVEL OBTAINED ONSITE BY GOLDER.
8.) UWL BOUNDARIES, DESIGNATIONS AND STATE MONITORING WELL LOCATIONS BASED ON DRAWINGS IN THE UWL PROPOSED LANDFILL PERMIT (#0918301).
9.) WFGD - WET FLUE GAS DESULFURIZATION.

REFERENCE

1.) AMEREN MISSOURI SIOUX ENERGY CENTER, SIOUX PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2,401 FEET.
3.) USGS NATIONAL WATER INFORMATION SYSTEM, USGS GAUGES 06935965 (ST. CHARLES), 07010000 (ST. LOUIS), 05587498 (ALTON), GRAFTON (05587450).
4.) AMEREN MISSOURI SIOUX POWER PLANT UTILITY WASTE LANDFILL PROPOSED CONSTRUCTION PERMIT MODIFICATION (#0918301), AUGUST 2014.

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

PROJECT
CCR GROUNDWATER MONITORING PROGRAM

TITLE
SCPC POTENTIOMETRIC SURFACE MAP
BACKGROUND EVENT 6 - JANUARY 3, 2017

CONSULTANT

Golder Associates

YYYY-MM-DD	2017-01-03
PREPARED	JS
DESIGN	JSI
REVIEW	JSI
APPROVED	MNH

PROJECT No. 153-1406
PHASE 0003D
FIGURE **P6**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
0 1 in

Path: G:\Projects\150 Projects\1531406 - Ameren GW Monitoring Program - MO\Phase 0003 - Sioux Energy\800 - FIGURES-DRAWINGS\PRODUCTION\GMP\Updated Pot Maps\Final\Updated Shallow\SCPC-E5.mxd

LEGEND

- Sioux Energy Center Property Boundary
- SCPB - Fly Ash Surface Impoundment

Ground/Surface Water Measurement Locations

- SCL4A - UWL Cell 4A Monitoring Well
- Groundwater Elevation Piezometer
- Background Monitoring Well
- SCPB - Fly Ash Surface Impoundment Monitoring Well
- SCPC - WFGD Surface Impoundment Monitoring Well
- SPCA Pond Gauge
- River Elevation

Utility Waste Landfill (UWL)

- SCL4A - UWL Cell 4A
- SCPC - WFGD Surface Impoundment
- Water Recycle Pond
- UWL Future Perimeter Fence

Groundwater Elevation Contours

- Groundwater Elevation Contour (FT MSL)
- Inferred Groundwater Elevation Contour (FT MSL)
- Groundwater Flow Direction

NOTES

1.) ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2.) GOLDER GROUNDWATER MONITORING WELLS SURVEYED BY ZAHNER AND ASSOCIATES, INC. ON JANUARY 14, APRIL 29, AND DECEMBER 8, 2016.
3.) GROUNDWATER AND SURFACE WATER ELEVATIONS DISPLAYED IN FT MSL (FEET ABOVE MEAN SEA LEVEL).
4.) GROUNDWATER MEASUREMENTS OBTAINED BY GOLDER.
5.) MISSOURI RIVER ELEVATION ESTIMATED BASED ON NEARBY USGS (UNITED STATES GEOLOGICAL SURVEY) RIVER GAUGING LOCATIONS.
6.) MISSISSIPPI RIVER ELEVATION PROVIDED BY AMEREN MISSOURI.
7.) POND GAUGE LEVEL OBTAINED ONSITE BY GOLDER.
8.) UWL BOUNDARIES, DESIGNATIONS AND STATE MONITORING WELL LOCATIONS BASED ON DRAWINGS IN THE UWL PROPOSED LANDFILL PERMIT (#0918301).
9.) WFGD - WET FLUE GAS DESULFURIZATION.

REFERENCE

1.) AMEREN MISSOURI SIOUX ENERGY CENTER, SIOUX PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2,401 FEET.
3.) USGS NATIONAL WATER INFORMATION SYSTEM, USGS GAUGES 06935965 (ST. CHARLES), 07010000 (ST. LOUIS), 05587498 (ALTON), GRAFTON (05587450).
4.) AMEREN MISSOURI SIOUX POWER PLANT UTILITY WASTE LANDFILL PROPOSED CONSTRUCTION PERMIT MODIFICATION (#0918301), AUGUST 2014.

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

PROJECT
CCR GROUNDWATER MONITORING PROGRAM

TITLE
SCPC POTENTIOMETRIC SURFACE MAP
BACKGROUND EVENT 5 - NOVEMBER 7, 2016

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-11-07
PREPARED	JSI
DESIGN	JSI
REVIEW	MSG
APPROVED	MNH

PROJECT No. 153-1406
PHASE 0003D
FIGURE **P5**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
1 in
0

Path: G:\Projects\150 Projects\1531406 - Ameren GW Monitoring Program - MO\Phase 0003 - Sioux Energy\800 - FIGURES-DRAWINGS\PRODUCTION\GMP\Updated Pot Maps\Final\Updated Shallow\SCPC-E4.mxd

LEGEND

- 🟥 Sioux Energy Center Property Boundary
- 🟩 SCPB - Fly Ash Surface Impoundment

Ground/Surface Water Measurement Locations

- ⊕ SCL4A - UWL Cell 4A Monitoring Well
- ⊕ Groundwater Elevation Piezometer
- ⊕ Background Monitoring Well
- ⊕ SCPB - Fly Ash Surface Impoundment Monitoring Well
- ⊕ SCPC - WFGD Surface Impoundment Monitoring Well
- ▲ SPCA Pond Gauge
- ● River Elevation

Utility Waste Landfill (UWL)

- ▭ SCL4A - UWL Cell 4A
- ▭ SCPC - WFGD Surface Impoundment
- ▭ Water Recycle Pond
- ▭ UWL Future Perimeter Fence

Groundwater Elevation Contours

- — Groundwater Elevation Contour (FT MSL)
- - - Inferred Groundwater Elevation Contour (FT MSL)
- ➚ Groundwater Flow Direction

NOTES

1.) ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2.) GOLDER GROUNDWATER MONITORING WELLS SURVEYED BY ZAHNER AND ASSOCIATES, INC. ON JANUARY 14, APRIL 29, AND DECEMBER 8, 2016.
3.) GROUNDWATER AND SURFACE WATER ELEVATIONS DISPLAYED IN FT MSL (FEET ABOVE MEAN SEA LEVEL).
4.) GROUNDWATER MEASUREMENTS OBTAINED BY GOLDER.
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6.) MISSISSIPPI RIVER ELEVATION PROVIDED BY AMEREN MISSOURI.
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9.) WFGD - WET FLUE GAS DESULFURIZATION.

REFERENCE

1.) AMEREN MISSOURI SIOUX ENERGY CENTER, SIOUX PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2,401 FEET.
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4.) AMEREN MISSOURI SIOUX POWER PLANT UTILITY WASTE LANDFILL PROPOSED CONSTRUCTION PERMIT MODIFICATION (#0918301), AUGUST 2014.

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

Ameren

PROJECT
CCR GROUNDWATER MONITORING PROGRAM

TITLE
SCPC POTENTIOMETRIC SURFACE MAP
BACKGROUND EVENT 4 - SEPTEMBER 14, 2016

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-09-27
PREPARED	JSI
DESIGN	JSI
REVIEW	JS
APPROVED	MNH

PROJECT No.	PHASE	FIGURE
153-1406	0003D	P4

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LEGEND

- Sioux Energy Center Property Boundary
- SCPB - Fly Ash Surface Impoundment

Ground/Surface Water Measurement Locations

- SCL4A - UWL Cell 4A Monitoring Well
- Groundwater Elevation Piezometer
- Background Monitoring Well
- SCPB - Fly Ash Surface Impoundment Monitoring Well
- SCPC - WFGD Surface Impoundment Monitoring Well
- SPCA Pond Gauge
- River Elevation

Utility Waste Landfill (UWL)

- SCL4A - UWL Cell 4A
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CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

PROJECT
CCR GROUNDWATER MONITORING PROGRAM

TITLE
SCPC POTENTIOMETRIC SURFACE MAP
BACKGROUND EVENT 3 - JULY 5, 2016

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-08-16
PREPARED	JS
DESIGN	JS
REVIEW	JSI
APPROVED	MNH

PROJECT No.
153-1406

PHASE
0003D

FIGURE
P3

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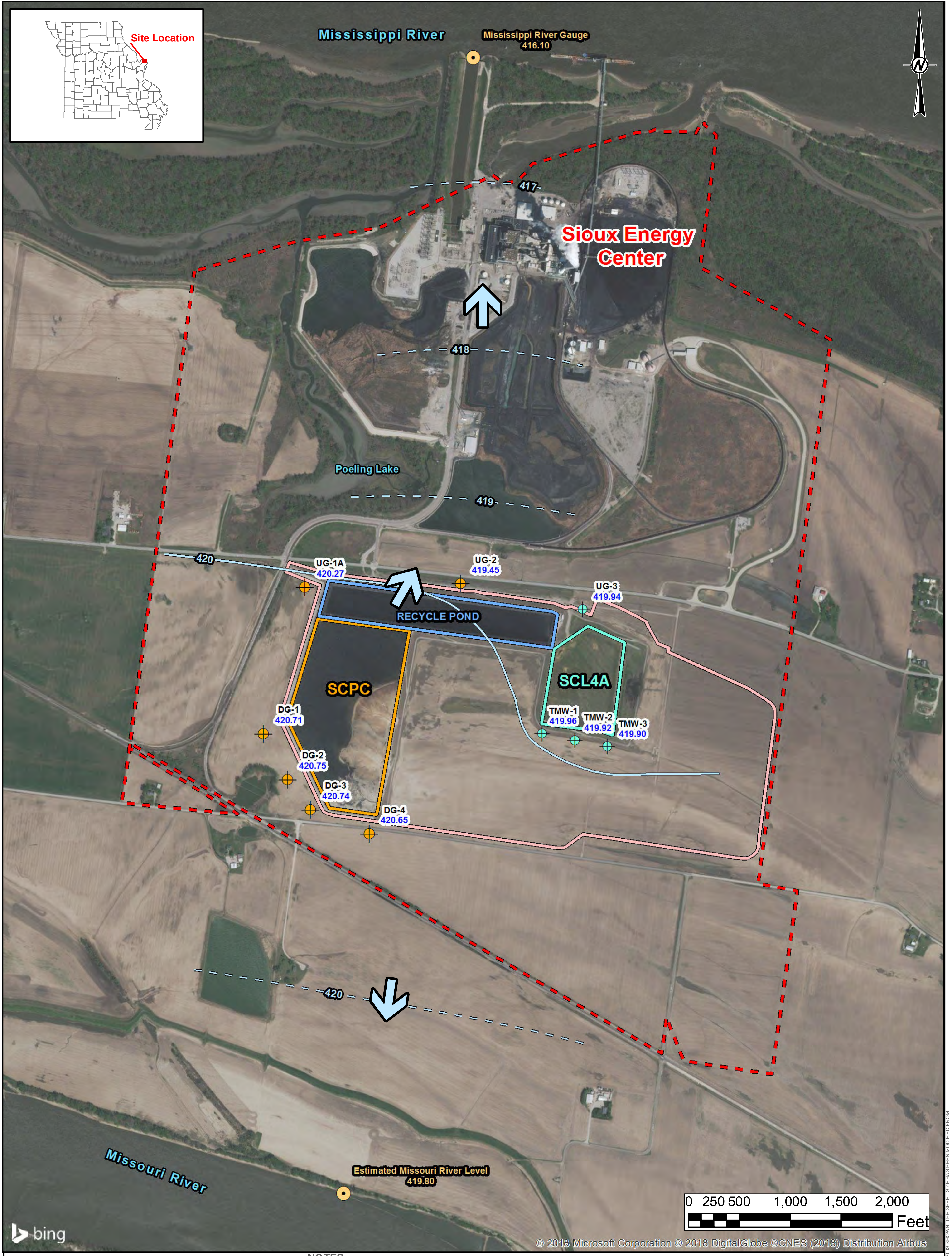

LEGEND

- 🟥 Sioux Energy Center Property Boundary

Ground/Surface Water Measurement Locations

- ⊕ SCL4A - UWL Cell 4A Monitoring Well
- ⊕ SCPC - WFGD Surface Impoundment Monitoring Well
- ● River Elevation

Utility Waste Landfill (UWL)

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- ▭ UWL Future Perimeter Fence

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CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

PROJECT
CCR GROUNDWATER MONITORING PROGRAM

TITLE
SCPC POTENTIOMETRIC SURFACE MAP
BACKGROUND EVENT 2 - JUNE 13, 2016

CONSULTANT

YYYY-MM-DD	2016-05-25
PREPARED	JSI
DESIGN	JSI
REVIEW	JS
APPROVED	MNH

PROJECT No.
153-1406

PHASE
0003D

FIGURE
P2

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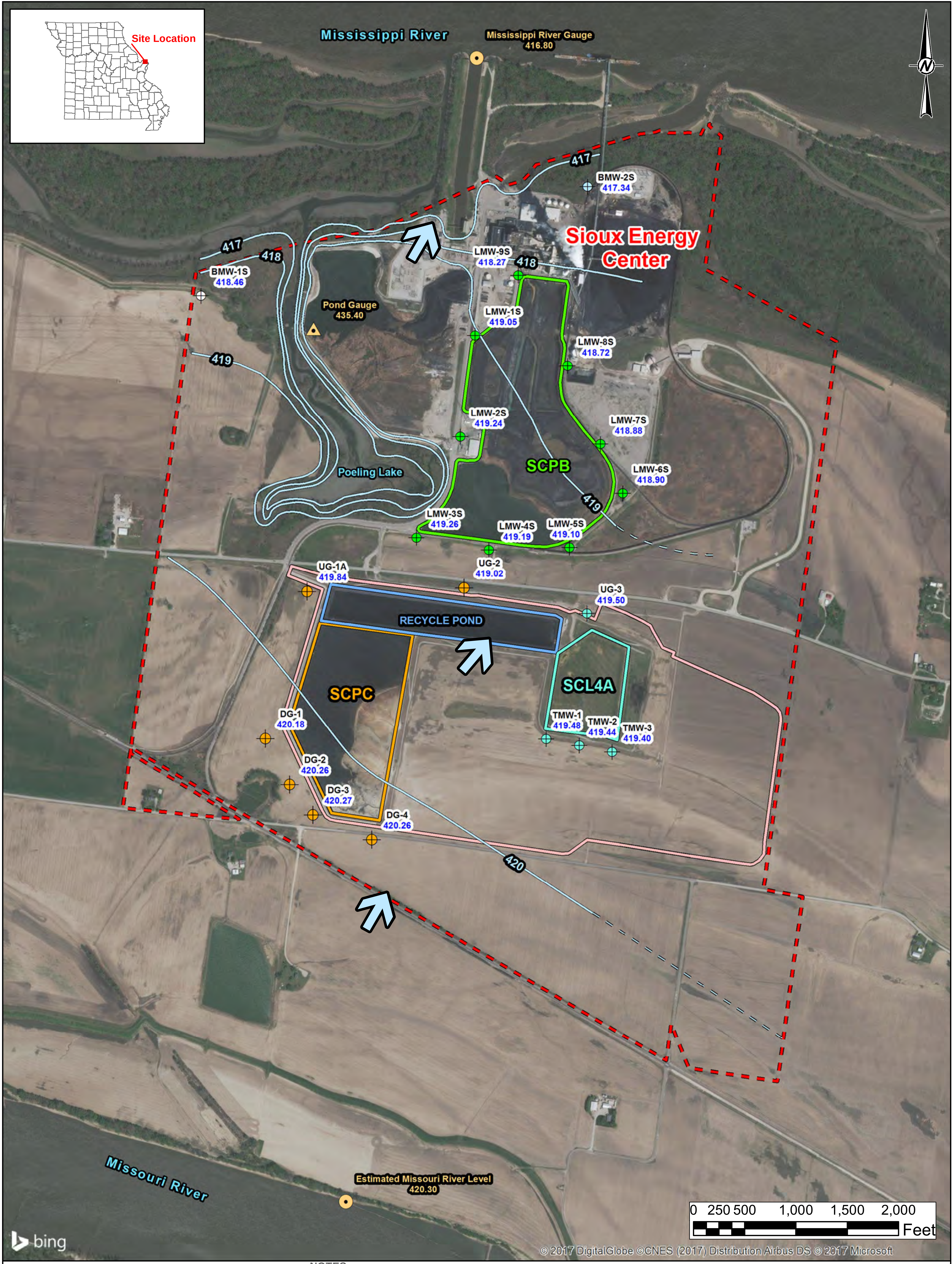

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- 🟩 SCPB - Fly Ash Surface Impoundment

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- ⊕ Groundwater Elevation Piezometer
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- ▲ SPCA Pond Gauge
- ● River Elevation

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- ▢ UWL Future Perimeter Fence

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CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

PROJECT
CCR GROUNDWATER MONITORING PROGRAM

TITLE
SCPC POTENTIOMETRIC SURFACE MAP
BACKGROUND EVENT 1 - MAY 9, 2016

CONSULTANT

YYYY-MM-DD	2016-05-25
PREPARED	JSI
DESIGN	JSI
REVIEW	JS
APPROVED	MNH

PROJECT No.	PHASE	FIGURE
153-1406	0003D	P1

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Attachment 4

Groundwater Monitoring Plan

REPORT

40 CFR PART 257 GROUNDWATER MONITORING PLAN

SCPC - Sioux Energy Center

St. Charles County, Missouri, USA

Ameren

Submitted To: Ameren Missouri
1901 Chouteau Avenue
St. Louis, Missouri 63103

Submitted By: Golder Associates Inc.
820 S. Main Street, Suite 100
St. Charles, MO 63301 USA

Distribution:	1 Electronic Copy	Ameren Missouri
	1 Hard Copy	Golder Associates

Date: October 12, 2017

Project No.153-1406

Golder Associates

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1.0 INTRODUCTION

This Groundwater Monitoring Plan (GMP) presents information on the design of the groundwater monitoring system, groundwater sampling and analysis procedures, and groundwater statistical analysis methods for the Utility Waste Landfill (UWL) Cell SCPC Surface Impoundment at Ameren Missouri's (Ameren) Sioux Energy Center (Facility) in St. Charles County, Missouri (see location on **Figure 1**). The SCPC manages Coal Combustion Residuals (CCR) from the Facility. The SCPC is approximately 35 acres in size and is located south of the generating plant across Highway 94.

This GMP was developed to meet the requirements of United States Environmental Protection Agency (USEPA) 40 CFR Part 257 "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities; Final Rule" (the CCR Rule). The CCR Rule requires owners or operators of an existing CCR Surface Impoundment or landfill to install a groundwater monitoring system and develop a sampling and analysis program (§§ 257.90 - 257.94). Ameren Missouri has determined that the SCPC is subject to the requirements of the CCR Rule. For this GMP, the Sioux Energy Center generating plant is referred to as the SEC and the SEC and its surrounding facilities, including the UWL, are referred to as the Facility or Site.

2.0 SITE SETTING

Ameren owns and operates the Facility in St. Charles County, Missouri located approximately 12 miles west-northwest of the confluence of the Mississippi and Missouri Rivers. **Figure 1** depicts the location of the Facility and property boundaries referenced to local topographic features. **Figure 2** depicts Facility structures relative to the site boundaries as well as the Mississippi and Missouri Rivers. The Facility encompasses approximately 1,025 acres and is located within the floodplain between the Mississippi and Missouri Rivers. The Facility is bounded to the north by wooded areas associated with the Mississippi River. The property is bounded to the south by a railroad. The Facility is bounded to the east and west by agricultural fields.

The UWL Surface Impoundment SCPC is located to the south of the SEC. The SCPC is bounded immediately on the west, south, and east sides by low lying agricultural floodplain. The SCPC has a berm elevation of approximately 446 feet above mean sea level (MSL), about 12 to 18 feet above the surrounding low lying farmland. The northern boundary of the SCPC is the UWL Water Recycle Pond. The SCPC is approximately 35 acres in size as shown in **Figures 1** and **2**. A generalized cross-section through the UWL and surrounding area is shown as **Figure 3**. To the north of the UWL across highway 94 are the CCR units called the Bottom Ash Surface Impoundment (SCPA) and the Fly Ash Surface Impoundment (SCPB). Beyond the SCPA and SCPB Surface Impoundments to the north lies the generating plant followed by the Mississippi River. Approximately 3,500 feet to the south of the UWL is the Missouri River.

2.1 Coal Combustion Residuals (CCR) UWL

Collectively, the UWL consists of a series of CCR Surface Impoundment cells (3 cells) and CCR Landfill cells (4 cells). Most of the information provided in the following paragraphs about the construction and use of the UWL is based on an August 2014 revision entitled “Ameren Missouri Sioux Power Plant – Utility Waste Landfill – Proposed Construction Permit Modification – Construction Permit Number 0918301 – St. Charles County, Missouri” by Reitz & Jens, Inc., and GREDELL Engineering Resources Inc. The UWL is in current operation in accordance with Solid Waste Disposal Area Operating Permit Number 0918301 issued by MDNR on July 30th, 2010.

The UWL is located to the south of the Facility on the south side of Highway 94 as shown in **Figures 1** and **2**. The UWL is located within an approximately 400 acre tract of land, of which 183.5 acres is planned to be used as an active disposal area. Of these 183.5 acres, 96.9 acres (Cells 1 (SCPC), 2, and 3) are to be constructed as a gypsum stack using wet disposal methods of Wet Flue Gas Desulphurization (WFGD) by-products. The other 86.6 acres (Cells 4 (SCL4A), 5, 6 and 7) are to be used for dry disposal of fly ash, bottom ash, slag, and flue gas wastes generated from the combustion of coal or other fossil fuels. In addition to these two disposal areas, a 19.6 acre process water recycle pond (Recycle Pond) is located on the northern side of the UWL footprint. The Recycle Pond is to be permitted as a waste water facility only. Currently, the Recycle Pond, Cell 1 (SCPC) and Cell 4A (SCL4A) are in use.

The perimeter berm surrounding the cells and Recycle Pond will be built up to an elevation of 446 feet MSL, (Mean Sea Level) which is approximately 5 feet above 100-year flood elevation of 441.2 feet MSL. Additionally, the cells as well as the Recycle Pond are (or will be) lined with a bottom composite liner system consisting of two feet of compacted clay soil and a flexible geomembrane liner. This liner system will have a base elevation (top of liner/base of CCR) of 422 feet MSL at its lowest point.

2.2 Geology

Much of the following information was derived from previous studies completed onsite which are described in the following paragraph. In 2005-2006, a Detailed Site Investigation (DSI) report was conducted by GREDELL Engineering Resources, Inc. (GREDELL, August 2006) in which 114 borings and piezometers were installed in order to characterize the geology and hydrogeology of the proposed UWL located just south of the SEC (Figure 1). Since 2008, a monitoring well network used for monitoring the UWL south of Highway 94 provides hydrogeological information from its 16 monitoring wells. In 2015 and 2016, 24 monitoring wells were installed for CCR groundwater monitoring for all CCR Units at the SEC as required by the CCR Rule. These wells provided hydrogeological and geological information about the site. Additional site specific information on the sites hydrogeology and geology is provided in EPRI, 1998.

2.2.1 Physiographic Setting and Regional Geology

The Facility is located in the extreme southeastern corner of the Central Lowland Physiographic Province and the Dissected Till Plains (DSI). However, because the Facility lies between two major river systems in an area that has been mostly deposited by flow and deposition of river deposits, the regional physiographic setting is not representative of local Site geology.

2.2.2 Local Geology

Based on the site specific borings (**Appendix A**), alluvial deposits associated with the Missouri and Mississippi Rivers overlie older sedimentary bedrock. These alluvial deposits comprise the surficial alluvial aquifer, which lies unconformably on top of bedrock and is typically 100 to 120 feet thick. Overall, this aquifer is described as a fining-upwards sequence of stratified sands and gravels with varying amounts of silts and clays. Drilling in the alluvial aquifer identified different sub-units, including flood basin deposits, floodplain deposits, natural levee deposits, and channel deposits along with volumetrically less important loess deposits. Grain sizes of the alluvial deposits are highly variable.

According to the DSI, bedrock below the alluvial aquifer includes Mississippian-aged rocks of the Meramecian Series. Formations include primarily limestone, dolomite, and shale and are comprised of the Salem Formation, Warsaw Formation, and the Osagean aged Burlington-Keokuk Formation.

2.3 Site Hydrogeology

2.3.1 Uppermost Aquifer

The CCR Rule requires that a groundwater monitoring system be completed in the uppermost aquifer around each CCR Surface Impoundment (§257.91(a)). As shown on **Figure 3**, the uppermost aquifer beneath all of the CCR impoundments and landfills is the alluvial deposits consisting primarily of alluvial sands with some silt, clay, and gravel associated with the Missouri and Mississippi River Valley alluvium. This alluvium overlies Mississippian-aged sedimentary bedrock formations. As generally described above, these alluvial deposits typically exhibit a fining-upward sequence with some silts and clays present within the shallow zone and mostly coarse sands and gravels present at depth. The thickness of the alluvial aquifer typically ranges from approximately 100 to 120 feet BGS with base elevations of approximately 300 to 330 feet MSL.

2.3.2 Surface Water and Groundwater Elevations

2.3.2.1 CCR Surface Impoundment Water

The SCPC is a lined CCR Unit that typically has a ponded water level approximately 10 feet or more above the surrounding natural groundwater level. Water within the unit is not interconnected with the surrounding alluvial aquifer due to the liner system and no mounding effects are displayed in the wells surrounding this CCR Unit. To the north of the SCPC lies the SCPA, which is an unlined surface impoundment. SCPA pond levels in this facility typically range from 12 to 20 feet above the natural groundwater level of the surrounding aquifer.

2.3.2.2 Alluvial Aquifer

During the DSI investigation in the area around the UWL, groundwater in the shallow alluvial aquifer had a relatively flat hydraulic gradient. Maximum groundwater elevation variation at any piezometer location was approximately three feet (3’). Over the year-long groundwater monitoring period, the maximum and minimum groundwater elevations were approximately 417 feet MSL and 411 feet MSL, respectively. Groundwater potentiometric surface maps from the DSI are included in **Appendix B**.

Golder obtained groundwater elevation measurements from March 2016 through June 2017 within the alluvial aquifer for the CCR monitoring wells. For each of the 8 background sampling events, groundwater elevations were measured at monitoring wells within a 24-hour timeframe and a potentiometric map was generated from these data (**Appendix C and Table 1**). Groundwater elevations throughout the aquifer ranged during this period from approximately 414 to 424 feet MSL. However, during any specific sampling event, Site wide groundwater elevations ranged from 1 to 4 feet difference across the entire site.

2.3.3 Groundwater Flow Directions

Site groundwater conditions are directly controlled by river stages of the Mississippi and Missouri Rivers since the alluvial aquifer is hydraulically connected to these water bodies. These rivers display large seasonal changes in elevation. Under normal aquifer conditions, groundwater flow in the alluvial aquifer would be expected to have a flow direction component parallel to the rivers and a flow component from the higher of the two rivers towards the lower of the two rivers.

Although the movement of groundwater within the alluvial aquifer at the Facility is complex, the movement has been characterized by frequent groundwater elevation measurements and the generation of potentiometric surface maps generated by GREDELL and Golder (**Appendix B, Appendix C** and **Table 1**). The potentiometric surface maps display large variability in the groundwater flow direction. These changes in flow direction are related to the water levels within the adjacent Missouri and Mississippi Rivers.

Beginning in August 2005, DSI groundwater measurements were taken every month to determine the changes in groundwater flow (**Appendix B**). During the year-long monitoring period, the direction of groundwater flow was always southward from the Mississippi River toward the Missouri River. In this study, groundwater level was mostly controlled by the elevation of the Mississippi River with minor fluctuations in gradients caused by changes in elevation of the Missouri River. The majority of the time, the elevation of the Mississippi River to the north of the Facility was a higher water elevation than the Missouri River to the south of the Facility. The DSI reports that the Missouri River elevation exceeded the Mississippi River elevation less than 5% of the time.

Quarterly groundwater level measurements are obtained as part of the groundwater monitoring program performed in accordance with the Missouri Department of Natural Resources (MDNR) UWL permit. These data indicate similar trends in groundwater gradients and flow directions to DSI results and support the predominant flow direction towards the Missouri River. However, temporary reverse gradients and near flat gradient conditions have been rarely observed due to high water conditions in the Missouri River. According to this study, in 2008 the Missouri River elevation exceeded the Mississippi River elevation in 1 of the 4 sampling events (**Appendix B**).

Potentiometric surface maps generated as a part of the initial baseline sampling events for this GMP do not always display the same results as those completed for the UWL (**Appendix C**). These maps display larger variations in groundwater flow direction. Of the 8 baseline samples, the Missouri River level was higher than the Mississippi River level for 5 of the events and the Mississippi River was higher for 3 of the events. However, localized flow directly around the SCPC typically demonstrates a southward flow direction towards the Missouri River.

Groundwater flow direction and hydraulic gradient were estimated for the CCR wells using the EPA's On-line Tool for Site Assessment (USEPA, 2016). Estimated results from this analysis using groundwater elevations within the CCR monitoring wells are provided in **Table 2**. These results indicate that while groundwater flow direction is variable, overall net groundwater flow during the baseline sampling period for the compliance wells surrounding the SCPC was overall towards the southeast, flowing towards the Missouri River.

2.3.3.1 Horizontal Gradients

Horizontal groundwater gradients in the alluvial aquifer are typically low and flat. The gradients are very dependent on river water levels (bank recharge and bank discharge conditions described earlier). Horizontal flow gradients calculated for the UWL DSI ranged from 0.0004 to 0.0013 feet/foot near the UWL. Gradients calculated as a part of the UWL sampling display similar results to the DSI, with groundwater gradients ranging from 0.0001 to 0.0008 feet/foot.

Site-wide horizontal gradients were also calculated for each of the CCR groundwater baseline sampling events and the results of these are displayed on **Table 2**. The horizontal groundwater gradients are low, ranging from 0.0001 to 0.0007 feet/foot.

A review of the potentiometric surface maps confirms the gradient estimates for a larger scale, but also demonstrates that localized horizontal gradients can be higher especially in areas near the Mississippi and Missouri Rivers.

2.3.3.2 Vertical Gradients

A review of downward gradients observed in piezometers was completed by comparing groundwater elevations obtained by Golder's initial baseline sampling data. This analysis was completed between shallow and intermediate/deep zone piezometers locations where the piezometers are nested (two or more piezometers in close proximity, screened at different elevations). From the review of these data, variable vertical gradients exist that fluctuate between upward and downward with no consistent vertical gradient present between shallow and deeper zones of the alluvial aquifer.

2.3.4 Hydraulic Conductivities

In-situ hydraulic conductivity tests (slug tests) were conducted as part of the DSI within the shallow portion of the alluvial aquifer to the south of the existing Surface Impoundments in the area of the UWL. The hydraulic conductivity in the area is highly dependent of the geology present within the screening interval of the piezometer. Estimates of the hydraulic conductivity within the aquifer were made using data acquired from slug tests from the DSI piezometers. The calculated average hydraulic conductivity of the fluvial channel sediments was 4.2 x 10^{-2} centimeters per second (cm/sec), Natural levee deposits was 1.8 x 10^{-2} cm/sec, and floodplain deposits were 7.0 x 10^{-3} cm/sec. Generally, there is a tendency toward higher hydraulic conductivity values where the screened interval intersects with relatively coarse-grained sands interpreted as channel deposits. For relatively homogenous flood plain/levee sequences containing fine-grained sediments, calculated values are demonstrably lower. Similarly, in piezometers where the screen interval intersects finer-grained, clayey backswamp/cut-off deposits, the DSI indicates lower hydraulic conductivity values were measured.

Groundwater flow velocities were calculated as a part of the DSI using these hydraulic conductivity values, hydraulic gradients, and an estimated value for effective porosity (Figure 33 of the DSI). The DSI suggests a representative range of prevailing groundwater movement at the Site is between 14 to 188 feet per year, depending on hydraulic conductivity and effective porosity.

Golder also performed rising head hydraulic conductivity tests on the 15 newly installed CCR monitoring wells used to monitor several CCR Units in the alluvial aquifer in order to estimate the hydraulic conductivities in February and November, 2016. The tests were conducted using a pneumatic slug (Hi-K slug) and a downhole pressure transducer. The results of Golder's hydraulic conductivity testing estimated the geometric mean of hydraulic conductivity to be approximately 2 x 10^{-2} cm/sec for the CCR groundwater monitoring wells at the SCPC. Golder's findings for hydraulic conductivity values are summarized below in **Table 3** and are consistent with the conductivities calculated in the DSI.

Estimated groundwater flow velocities were calculated using the CCR monitoring well hydraulic conductivity, hydraulic gradients and an estimated value for effective porosity (**Table 2**). Using these values, groundwater flow velocities were estimated to range between 0.04 and 0.12 feet per day at the SCPC.

Table 3: CCR Monitoring Well Hydraulic Conductivities

Well ID	Total Depth (feet BTOC)	Well Screen Interval (feet BTOC)	Well Screen interval (feet MSL)	Estimated Hydraulic Conductivity (feet/day)	Estimated Hydraulic Conductivity (cm/sec)
Background Monitoring Wells					
BMW-1S	26.0	15.8 - 25.6	402.2 - 412.0	16	5.5E-03
BMW-3S	26.7	16.5 - 26.3	400.4 - 410.2	53	1.9E-02
SCPB Fly Ash Surface Impoundment Monitoring Wells					
LMW-1S	42.5	32.3 - 42.1	405.0 - 414.8	31	1.1E-02
LMW-2S	42.7	32.5 - 42.3	404.9 - 414.7	56	2.0E-02
LMW-3S	26.2	16.0 - 25.8	404.4 - 414.2	35	1.2E-02
LMW-4S	27.2	17.0 - 26.8	402.6 - 412.4	28	9.9E-03
LMW-5S	47.5	37.3 - 47.1	400.3 - 410.1	56	2.0E-02
LMW-6S	42.1	31.9 - 41.7	404.3 - 414.1	56	2.0E-02
LMW-7S	42.2	32.0 - 41.8	402.5 - 412.3	45	1.6E-02
LMW-8S	47.2	37.0 - 46.8	400.0 - 409.8	75	2.6E-02
LMW-9S	41.6	31.4 - 41.2	404.4 - 414.2	22	7.9E-03
SCL4A Utility Waste Landfill Monitoring Wells					
UG-3*	30.0	19.8 - 30.0	399.7 - 410.0	51	1.8E-02
TMW-1	28.9	18.7 - 28.5	399.6 - 409.4	75	2.6E-02
TMW-2	30.4	20.2 - 30.0	398.2 - 408.0	45	1.6E-02
TMW-3	30.1	19.9 - 29.7	398.2 - 408.0	56	2.0E-02
SCPC Utility Waste Landfill Monitoring Wells					
UG-1A*	28.5	18.3 - 28.5	399.2 - 409.5	51	1.8E-02
UG-2*	30.0	19.8 - 30.0	399.3 - 409.5	51	1.8E-02
DG-1*	35.0	24.7 - 35.0	396.8 - 407.1	51	1.8E-02
DG-2*	34.5	24.3 - 34.5	397.3 - 407.5	51	1.8E-02
DG-3*	35.0	24.7 - 35.0	398.9 - 409.1	51	1.8E-02
DG-4*	34.7	24.4 - 34.7	398.1 - 408.4	51	1.8E-02

Notes
1. feet BTOC - feet below top of casing
2. feet MSL - feet above mean sea level.
3. cm/sec - centimeters per second.
4. Rising head tests were completed by Golder Associates using a Pneumatic Hi-K Slug®.
5. * - Hydraulic conductivity values based on results from the UWL DSI.

2.3.5 Porosity and Effective Porosity

Porosities were estimated based on the grain size distributions of an aquifer soil sample collected during monitoring well drilling. A representative grain size distribution was collected from the screen intervals at LMW-3S and LMW-8S using the ASTM D6912 Method B and the results are provided in **Appendix D**. The samples from LMW-3S and LMW-8S were similar in field classification to other well drilling samples and the results indicate that the screened intervals of the alluvial aquifer are mostly comprised of sand (at least 90%) with lesser amounts of gravel, silt and clay. Also, the typical grain size of the sand ranges from fine to coarse sand. Textbook values of porosities for sands and sand/gravel mixes range from 25-50% (Fetter, 2000 and Freeze and Cherry, 1979) and fine sands typically range from 29-46%, whereas coarse sands typically range from 26-43% (Das, 2008). An average porosity of 35% is estimated for the alluvial aquifer based on the site data.

Effective porosity is the porosity that is available for fluid flow. Studies completed in unconsolidated sediments have determined that water molecules pass through all pores and the effective porosity is approximately equal to the total porosity (Fetter, 2000). Therefore, the effective porosity of the alluvial aquifer is also estimated to be 35%.

3.0 GROUNDWATER MONITORING NETWORK

3.1 Monitoring Network Design Criteria

§257.91 of the CCR Rule sets out the requirements for development of a groundwater monitoring system for both new and existing CCR landfills and Surface Impoundments. The performance standard in the CCR Rule (§257.91(a)) states that the groundwater monitoring system must consist of a sufficient number of wells at appropriate locations to yield groundwater samples in the uppermost aquifer that accurately represent:

- The quality of background groundwater
- The quality of groundwater passing the waste boundary of the CCR unit

3.2 Design of the Groundwater Monitoring System

The detection monitoring well network for the Facility is depicted on **Figure 2**. The network consists of eight (8) monitoring wells screened in the uppermost aquifer for the purpose of monitoring the SCPC. The monitoring well network includes 2 background groundwater monitoring wells (BMW-1S and BMW-3S) that are located approximately 3,000 to 4,000 feet northwest of the SCPC in areas unaffected by CCR disposal. Six (6) of the groundwater monitoring wells are placed ringing the SCPC and are considered to be the compliance wells. The groundwater monitoring well locations were selected based on site-specific information presented in section 2.0 of this document, as well as the preferential migration pathway analysis below.

3.2.1 Preferential Migration Pathway Analysis

After detailed review of the information outlined in section 2.0 of this document, a preferential migration pathway for potential groundwater impacts coming from the SCPC Surface Impoundment was determined. The SCPC is lined and has a bottom elevation of approximately 422 feet MSL. Potential constituent migration pathways are likely to be downward to groundwater level then laterally in the direction of groundwater flow in the alluvial aquifer. Groundwater flow within the alluvial aquifer is variable depending on levels within the Missouri and Mississippi Rivers and can flow in a variety of directions, however, overall net flow is towards the Missouri River at the SCPC. Based on water level readings, the groundwater surface in the alluvial aquifer can range from approximately 414 to 424 feet MSL. In order to place monitoring well screens within the migration pathway from the unit, monitoring wells were installed with screen interval elevations that range below the seasonal low groundwater levels so that the well screen is submerged below the water table surface to allow for groundwater sampling.

3.3 Groundwater Monitoring Well Placement

3.3.1 Background/Upgradient Monitoring Well Locations

As described above, the flow of groundwater in the alluvial aquifer is generally from either the Mississippi River towards the Missouri River or from the Missouri River towards the Mississippi River. Alluvial aquifer flow is also locally influenced by water levels in the SCPA and the Mississippi and Missouri River levels. The CCR Rule (§257.91(a)(1)) requires that background groundwater samples from the uppermost aquifer;

- *"Accurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit."*

At SCPC, groundwater typically flows southeast towards the Missouri River. Two Background monitoring well locations were placed to the north and west of SCPC, in upgradient locations. As shown in **Figure 2**, the background monitoring wells BMW-1S and BMW-3S are northwest of the SCPC at a location south of the Mississippi River. These wells provide background groundwater quality for SCPC monitoring.

3.3.2 Downgradient Monitoring Well Locations

As discussed above, downgradient monitoring wells are located adjacent to the SCPC to monitor potential migration pathways. **Figure 2** shows that the downgradient well network consists of six groundwater monitoring wells (UG-1A, UG-2, DG-1, DG-2, DG-3, and DG-4) around the SCPC at locations that are located as close to the waste boundary as practical.

3.3.1 Groundwater Monitoring Well Screen Intervals

The system of monitoring wells ringing the SCPC are screened in the shallow alluvial aquifer zone near the base elevation of the SCPC. Details on the construction of the groundwater monitoring wells are provided in **Table 4**, **Appendix E** and **Appendix G**. Screen intervals range from approximately 397 - 412 feet MSL in sandy alluvial deposits.

3.3.2 Future Cell Construction for the SCPC

As Cells 2-3 of the UWL's SCPC are being constructed, the monitoring well network will need to be adjusted to incorporate these cells. This may include the abandonment of various wells and the installation of several new wells. An initial set of 8 samples will need to be collected in both the background and compliance wells either: (1) prior to the receipt of ash in the CCR unit or (2) within the first 6 months of sampling and placement of ash. After collecting the initial eight background samples, SSI evaluation must then be completed during the first semi-annual sampling event. When new cells are added, this Groundwater Monitoring Plan will need to be updated to reflect the changes in the Groundwater Monitoring System.

4.0 INSTALLATION OF THE GROUNDWATER MONITORING SYSTEM

The CCR Rule Groundwater Monitoring System for the SCPC was installed by GREDELL Engineering Resources, Inc. (December 2007 and June 2008) and Golder (December 2015 and November 2016). The installation of monitoring wells installed by Golder is described in the following subsections. Information on the monitoring wells installed by GREDELL is provided in **Appendix G**.

4.1 Drilling Methods and Monitoring Well Constructions

Cascade Drilling LP installed the Golder monitoring wells (BMW-1S, BMW-2S and BMW-3S) using a rotosonic drill rig (Mini Sonic CDD 1415 and Geoprobe 8040) under direct supervision of a Golder Geologist or Engineer. Continuous soil core samples were obtained at each Golder well borehole location and were logged in the field by Golder. Soils were classified according to the Unified Soil Classification System. Boring logs and well construction diagrams for the Golder wells are provided in **Appendix A**, and **Appendix E**, respectively.

Groundwater monitoring wells were installed in accordance with Missouri Department of Natural Resources (MDNR) Well Construction Rules (10 CSR 23-4.060 Construction Standards for Monitoring Wells). All groundwater monitoring wells were installed with 2-inch diameter PVC well riser pipe and 10-foot long, 0.010-inch machine slotted well screens. Wells were installed with a sand filter pack, bentonite seal, and annular space in accordance with MDNR Well Construction Rules. Details on the construction of the groundwater monitoring wells are provided in **Table 4** and **Appendix E**.

Monitoring wells were completed with an aluminum protective cover with a locking lid that extends approximately 2 to 3 feet above ground surface and a small concrete pad. Yellow protective posts (concrete filled steel bollards) have been installed around each monitoring well.

4.2 Groundwater Monitoring Well Development

After well construction, a Golder geologist or engineer developed the Golder groundwater monitoring wells using surging and purging techniques. During development, field parameters (pH, conductivity, temperature, and turbidity) were recorded and development was complete once a minimum of three well-bore volumes of water were purged, turbidity was typically less than 20 nephelometric turbidity units (NTU) or ± 10% and consecutive measurements of field parameter values were within 10 percent difference. Groundwater monitoring wells were developed using an inertial pump with a surge block ring attached to a foot valve to surge and purge the well. Well development forms are attached in **Appendix F**.

4.3 Dedicated Pump Installation

A dedicated pump was installed in BMW-1S and BWM-3S well after development and hydraulic conductivity testing. The dedicated pumps provide a consistent, repeatable sampling method to reduce likelihood of cross contamination, reduce water sample turbidity, and expedite sampling. For the purposes of this groundwater monitoring network, low-flow QED brand PVC MicroPurge bladder pumps with Dura-Flex Teflon bladders were installed in each well. Monitoring wells UG-1A, UG-2, DG-1, DG-2, DG-3, and DG-4 are sampled using peristaltic pumping methods and dedicated tubing.

4.4 Surveying and Well Registration

Zahner and Associates, Inc., a Professional Land Surveyor licensed in Missouri, surveyed the location and top of casing elevation of the Golder monitoring wells. A drawing showing the location of the groundwater monitoring wells is shown in **Figure 2** and a summary of survey information is provided in **Table 4**. Upon completion of monitoring well installation and surveying, MDNR Well Construction Registration Forms were prepared for each well and submitted to MDNR. Copies of these forms are provided in **Appendix G**.

5.0 GROUNDWATER MONITORING PROGRAM

The groundwater monitoring program for the SCPC is described in the following sections.

5.1 Baseline Sampling Events

In accordance with section 257.94(b) of the CCR Rule, before starting detection monitoring, eight baseline (or background) samples were collected for all Appendix III and Appendix IV parameters at all downgradient and upgradient/background monitoring wells prior to October 17, 2017. These samples establish initial baseline datasets that are used for the statistical evaluation of groundwater results.

5.2 Detection Monitoring

The Detection Monitoring Program is defined in the CCR Rule in section 257.94 and the following sections outline the procedures for the detection monitoring program.

5.2.1 Sampling Constituents and Monitoring Frequency

Detection monitoring should be completed at a minimum of semi-annually (approximately every 6 months) for all Appendix III constituents (**Table 5**) unless a demonstration that the need for an alternative monitoring schedule is required. **Table 6** lists the analytical methods and practical quantitation limits used for the monitoring program.

5.2.2 Data Evaluation and Response

As required in the CCR Rule, a statistical evaluation of the groundwater data must be completed within 90 days of receiving data from the laboratory. The data will be analyzed using the methods and procedures outlined in the statistical analysis plan (**Appendix H**).

5.3 Assessment Monitoring

Assessment monitoring is outlined in section 257.95 of the CCR Rule and is initiated after a confirmed SSI has been identified and no alternate source demonstration has been completed. In accordance with the CCR Rule, a notification must be prepared and placed within the Facility operating record and on the publically available website stating that an Assessment Monitoring program has been initiated. The purpose of Assessment Monitoring is to determine whether or not groundwater concentrations are at a Statistically Significant Level (SSL) compared to Groundwater Protection Standards (GWPS). Detection Monitoring sampling continues during Assessment Monitoring.

5.3.1 Sampling Constituents and Monitoring Frequency

As outlined in section 257.95 of the CCR Rule, Assessment Monitoring groundwater sampling must begin within 90 days of a confirmed SSI determination. Sampling must be completed at all monitoring wells used in the detection monitoring program, for all Appendix IV analytes (**Table 5**). Within 90 days of receiving data from this initial Assessment Monitoring sampling event, a second sampling event must be completed analyzing the Appendix IV constituents detected in groundwater during the initial sampling event.

Following this initial phase of the Assessment Monitoring Program, the CCR Rule requires sampling of the full list of Appendix IV constituents on an annual basis (Annual Assessment Event). During the other semi-annual Assessment Sampling Event, only those Appendix IV constituents that are detected during the annual sampling event are to be analyzed and reported. Additionally, verification resampling will be performed within 90 days of receiving data from the laboratory for all detected Appendix IV constituents for each event.

5.3.2 Data Evaluation and Response

As required in the CCR Rule, a statistical evaluation of the groundwater data must be completed within 90 days of receiving data from the laboratory. The data will be analyzed using the methods and procedures outlined in the Statistical Analysis Plan (**Appendix H**).

A GWPS is required for each Appendix IV constituent and must be included in the annual report. The GWPS will be either the MCL or a value based on background data, whichever is higher. The generation of the GWPS is discussed in more detail in the Statistical Analysis Plan (**Appendix H**). Statistical analysis must be completed within 90 days of receiving data from the laboratory. The statistical analysis will determine if any constituents are SSLs greater than the GWPS.

In order to discontinue Assessment Monitoring and return to Detection Monitoring, the concentration of all Appendix III and Appendix IV constituents for all compliance wells must be at levels statistically lower than background levels for two consecutive sampling events (257.95(e)). If any constituent is present at a statistical level above background levels, but below the GWPS, then Assessment Monitoring continues.

5.3.2.1 Responding to a SSL

If the Assessment Monitoring statistical evaluations demonstrate that a SSL has been triggered, then the owner/operator of the CCR unit must complete the following four actions as described in 257.95(g):

1. Prepare a notification identifying the constituents in Appendix IV that have exceeded a CCR Unit specific GWPS. This notification must be placed in the facility operating record within 30 days of identifying the SSL (257.95(g)) and 257.105(h)). Additionally, within 30 days of placing the notification in the operating record, the notification must be posted to the internet site (257.107(h)).
2. Define the character and extent of the release and any relevant site conditions that may affect the corrective action remedy that is ultimately selected. The characterization must be sufficient to support a complete and accurate assessment of the corrective measures necessary to effectively clean up releases from the CCR Unit and must include at least the following: (No timeframe is specified in the CCR Rule for this action)

   A. Installation of additional monitoring wells that are necessary to define the contaminant plume
   B. Collect data on the nature and estimated quantity of the material released
   C. Install and sample at least one additional monitoring well at the facility boundary in the direction of the contaminant plume migration

3. Notify off-site property owners if the contamination plume has migrated offsite on to their property within 30 days of this determination.
4. If possible, provide an alternate source demonstration that determines that the SSL is not caused by a release at the facility within 90 days of completing the statistical evaluation. If no alternate source demonstration can be made and the plume is determined to have originated from the CCR Unit, then proceed to corrective action steps in the CCR Rule.

   D. If no alternate source demonstration is made, and the CCR Unit is an unlined surface impoundment, the closure or retrofit must be initiated.

Actions 1-3 must be completed regardless of whether or not an alternate source demonstration can be made.

5.3.3 Annual Reporting Requirements

In addition to the periodical reporting listed above, an annual groundwater monitoring report will be prepared according to the requirements of 40 CFR §257.90(e). At a minimum, the annual groundwater monitoring report will contain the following information:

- The current status of the groundwater monitoring program
- A projection of key activities planned for the upcoming year
- A map showing the CCR unit and all background (or upgradient) and downgradient monitoring wells included in this monitoring plan
- A discussion of any monitoring wells that were installed or decommissioned during the preceding year or any other changes made to the groundwater monitoring system
- Analytical results from groundwater sampling
- The monitoring data obtained under §§ 257.90 through 257.98, including a summary of the number of groundwater samples that were collected for analysis for each background and downgradient well, the dates the samples were collected, and whether the sample was required by the detection monitoring or assessment monitoring programs
- A narrative discussion of any transition between monitoring programs (e.g., the date and circumstances for transitioning from detection monitoring to assessment monitoring in addition to identifying the constituent(s) detected at a statistically significant increase over background levels)
- If required, an alternate source demonstration that is certified by a professional engineer
- If required, a demonstration that an alternate sampling frequency is needed
- If assessment monitoring is required, a listing of GWPS for each Appendix IV constituent

6.0 GROUNDWATER SAMPLING METHODOLOGY

Sampling will be performed in accordance with accepted practices within the industry and with the provisions of Missouri regulations. The following sections provide details regarding procedures that will be used to collect groundwater samples. Although this section provides reference to specific forms, the use of other equivalent forms to record the necessary data is permissible.

6.1 Equipment Calibration

Equipment used to record field water quality parameters will be calibrated each day prior to use following manufacturers' recommendations. Calibration solutions for standardization materials will be freshly prepared or from non-expired stock. In the absence of manufacturer or regulatory guidance, field equipment should be calibrated to within +/- 10 percent of the standard (or 0.1 standard units for pH meters). Equipment that fails calibration may not be used. Calibration records will be maintained. A sample field Instrument Calibration Form is included in **Appendix I**.

6.2 Monitoring Well Inspection

Prior to performing any water purging or sampling, each monitoring well will be inspected to assess its integrity. The condition of each monitoring well will be evaluated for any physical damage or other breach of integrity. The security of each monitoring well will be assessed in order to confirm that no outside source constituents have been introduced to the monitoring well.

6.3 Water Level Measurement

To meet the requirements of §257.93(c), water level measurements will be taken at all monitoring wells and prior to the start of any groundwater purging. These measurements will be taken within a 24 hour period and will be recorded on the Record of Water Level Readings form or Groundwater Sample Collection Form (included in **Appendix I**). Static water levels will be measured in each monitoring well prior to purging using an electric meter accurate to 0.01 foot. The measuring probe will be rinsed with distilled or deionized water before and after use at each well.

6.4 Monitoring Well Purging

Prior to collecting samples, each monitoring well will be purged. Purging will be accomplished using either:

- Low-flow (a.k.a., minimal drawdown, or Micropurge) techniques
- Traditional purging techniques where at least three well volumes are evacuated before samples are collected

6.4.1 Low-Flow Sampling Technique

Low-flow groundwater sampling procedures will be used for purging and sampling monitoring wells that are equipped with dedicated pumps and will sustain a pumping rate of at least 100 milliliters per minute (ml/min).

Water will be purged from these wells at low rates in order to minimize drawdown in the well during purging and sampling. Depth to water measurements and field water quality parameters (temperature, pH, turbidity, and conductivity) recorded during purging will be used as criteria to determine when purging has been completed. Sample collection will be initiated immediately after purging at each well.

During water purging, wells will be pumped at rates that minimize drawdown in the well. Purging rates in the range of 100-500 ml/min typically will be used; however, higher rates may be used if sustained by the well. Stabilization of the water column will be considered achieved when three consecutive water level measurements vary by 0.3 foot or less at a pumping rate of no less than 100 ml/min.

At a minimum, field water quality parameter measurements of temperature, pH, turbidity, and conductivity, will be measured during purging at each well. Prior to collecting the initial set of field water quality parameters, the water in the sampling pump and discharge tubing (i.e., pump system volume) remaining from the previous sampling event will be removed.

After evacuating the water in the pump system, collecting field measurements will begin. Depth to water measurements and field water quality parameter measurements will be made during purging. If a field meter equipped with a flow cell is used, an amount of water equal to the volume of the flow cell should be allowed to pass through the flow cell between individual field stabilization measurements. Stabilization will be attained and purging considered complete when three consecutive measurements of each field parameter vary within the following limits:

- ± 0.2 for pH
- ± 3% for Conductivity
- ± 10% for Temperature
- Less than 10 nephelometric turbidity units (NTU) or ± 10% for Turbidity

All data gathered during monitoring well purging will be recorded on a form, an example of which is included in **Appendix I**.

6.4.2 Traditional Purge Techniques

If low-flow sampling is not performed, wells will be purged a minimum of 3 well volumes before collecting a sample. Purging procedures will generally follow those for low-flow sampling including measurement of the field parameters listed above with two exceptions:

- Higher flow rate may be used during purging
- Purging is completed after a minimum of 3 well volumes have been removed (see below)

Even where low-flow sampling is not performed, the sampling goals are to:

- Stabilize field parameters (listed in previous section) prior to collecting samples
- Minimize drawdown in the well

When traditional purge techniques are used, field stabilization measurements will be collected at the beginning of purging and between each well volume purged. The stability criteria will be those described above for low-flow sampling.

6.4.3 Low Yielding Wells

If a monitoring well purges dry, it will be allowed to recover up to 24 hours before samples are collected. No additional purging will be performed after initially purging the monitoring well dry. If recharge is insufficient to fill all necessary sample bottles, samplers will note this on the field form, and fill as many sample bottles as possible.

6.5 Sample Collection

Sampling should take place immediately after purging is complete. Samples will be transferred directly from field sampling equipment into containers supplied by the analytical laboratory appropriate for the constituents being monitored as listed in **Table 6**. Sample containers will be kept closed until the time each set of sample containers is filled.

6.6 Equipment Decontamination

All non-dedicated field equipment that is used for purging or sample collection shall be cleaned with a phosphate-free detergent and triple-rinsed, inside and out, with deionized or distilled water prior to use and between each monitoring well. Decontamination water shall be disposed of at an Ameren approved location. Any disposable tubing used with non-dedicated pumps should be discarded after use at each monitoring well. Clean latex gloves will be worn by sampling personnel during monitoring well purging and sample collection.

6.7 Sample Preservation and Handling

In accordance with §257.93 of the CCR Rule, groundwater samples collected as part of the monitoring program will not be filtered prior to analysis. Once groundwater samples have been collected and preserved in laboratory supplied containers, they will be packed into insulated, ice-filled coolers to be maintained at a temperature as close as possible to 4 degrees Celsius. Groundwater samples will be collected in the designated size and type of containers required for specific parameters. Sample containers will be filled in such a manner as not to lose preservatives by spilling or overfilling. Samples will be delivered to the laboratory or sent via overnight courier following chain-of-custody procedures.

6.8 Chain-of-Custody Program

The chain-of-custody (COC) program will allow for tracing sample possession and handling from the time of field collection through laboratory analysis. The COC program includes sample labels, sample seals, field Groundwater Sample Collection Forms, and COC record. A sample Chain-of-Custody (COC) form is provided in **Appendix I**.

Each sample will be assigned a unique sample identification number to be recorded on the sample label. The sample identification number for all samples will be designated differently based on the nature of the samples. Each sample identification number and description will be recorded on the field Groundwater Sample Collection Form and on the COC document.

6.8.1 Sample Labels

Sample labels will be sufficiently durable to remain legible when wet and will contain the following information, written with indelible ink:

- Site and sample identification number
- Monitoring well number or other location
- Date and time of collection
- Name of collector
- Parameters to be analyzed
- Preservative, if applicable

6.8.2 Sample Seal

The shipping container will be sealed to prevent the samples from being disturbed during transport to the laboratory.

6.8.3 Field Forms

All field information must be completely and accurately documented to become part of the final report for the groundwater monitoring event. Example field forms are included in **Appendix I**. The field forms will document the following information:

- Identification of the monitoring well
- Sample identification number
- Field meter calibration information
- Static water level depth
- Purge volume
- Time monitoring well was purged
- Date and time of collection
- Parameters requested for analysis
- Preservative used
- Field water quality parameter measurements

- Field observations on sampling event
- Name of collector(s)
- Weather conditions including air temperature and precipitation

6.8.4 Chain-of-Custody Record

The COC record is required for tracing sample possession from time of collection to time of receipt at the laboratory. The National Enforcement Investigations Center (NEIC) of USEPA considers a sample to be in custody under any of the following conditions:

- It is in the individual's possession
- It is in the individual's view after being in his possession
- It was in the individual's possession and he locked it up
- It is in a designated secure area

All environmental samples will be handled under strict COC procedures beginning in the field. The field team leader will be the field sample custodian and will be responsible for ensuring that COC procedures are followed. A COC record will accompany each individual shipment. The record will contain the following information:

- Sample destination and transporter
- Sample identification numbers
- Signature of collector
- Date and time of collection
- Sample type
- Identification of monitoring well
- Number of sample containers in shipping container
- Parameters requested for analysis
- Signature of person(s) involved in the chain of possession
- Inclusive dates of possession

A copy of the completed COC form will be placed in a water resistant bag and accompany the shipment and will be returned to the shipper after the shipping container reaches its destination. The COC record will also be used as the analysis request sheet. When shipping by courier, the courier does not sign the COC record: copies of shipping forms are retained to document custody.

6.9 Temperature Control and Sample Transportation

After collection, sample preservation, and labeling, sample containers will be placed in coolers containing water-ice with the goal of reducing the groundwater samples to a temperature of approximately 4°C or less.

All samples included in the shipping container will be packed in such a manner to minimize the potential for container breakage. Samples will be either hand-delivered or shipped via commercial carrier to the certified analytical laboratory. Custody seals will be placed on the shipping containers if a third party courier is used.

7.0 ANALYTICAL AND QUALITY CONTROL PROCEDURES

7.1 Data Quality Objectives

As part of the evaluation component of the Quality Assurance (QA) program, analytical results will be evaluated for precision, accuracy, representativeness, completeness, and comparability (PARCC). These are defined as follows:

- Precision is the agreement or reproducibility among individual measurements of the same property, usually made under the same conditions
- Accuracy is the degree of agreement of a measurement with the true or accepted value
- Representativeness is the degree to which a measurement accurately and precisely represents a characteristic of a population, parameter, or variations at a sampling point, a process condition, or an environmental condition
- Completeness is a measure of the amount of valid data obtained from a measurement system compared with the amount that was expected to be obtained under correct normal conditions
- Comparability is an expression of the confidence with which one data set can be compared with another data set in regard to the same property

The accuracy, precision and representativeness of data will be functions of the sample origin, analytical procedures and the specific sample matrices. Quality Control (QC) practices for the evaluation of these data quality indicators include the use of accepted analytical procedures, adherence to hold time, and analysis of QC samples (e.g., blanks, replicates, spikes, calibration standards and reference standards).

Quantitative QA objectives for precision and accuracy, along with sensitivity (detection limits) are established in accordance with the specific analytical methodologies, historical data, laboratory method validation studies, and laboratory experience with similar samples. The Representativeness of the analytical data is a function of the procedures used to process the samples.

Completeness is a qualitative characteristic which is defined as the fraction of valid data obtained from a measurement system (e.g., sampling and analysis) compared to that which was planned. Completeness can be less than 100 percent due to poor sample recovery, sample damage, or disqualification of results which are outside of control limits due to laboratory error or matrix-specific interferences. Completeness is documented by including sufficient information in the laboratory reports to allow the data user to assess the quality of the results. The overall completeness goal for each task is difficult to determine prior to data acquisition. For this project, all reasonable attempts will be made to attain 90% completeness or better (laboratory).

Comparability is a qualitative characteristic which allows for comparison of analytical results with those obtained by other laboratories. This may be accomplished through the use of standard accepted methodologies, traceability of standards to the National Bureau of Standards (NBS) or USEPA sources, use of appropriate levels of quality control, reporting results in consistent, standard units of measure, and participation in inter-laboratory studies designed to evaluate laboratory performance.

Data quality and the standard commercial report package will be evaluated with respect to PARCC criteria using the laboratory's QA practices, use of standard analytical methods, certifications, participation in inter-laboratory studies, temperature control, adherence to hold times, and COC documentation (also called Data Validation).

7.2 Quality Assurance/Quality Control Samples

This section describes the various Quality Assurance/Quality Control (QA/QC) samples that will be collected in the field and analyzed in the laboratory and the frequency at which they will be performed.

7.2.1 Field Equipment Rinsate Blanks

In cases where sampling equipment is not dedicated or disposable, an equipment rinsate blank will be collected. The equipment rinsate blanks are prepared in the field using laboratory-supplied analyte-free water. The water is poured over and through each type of sampling equipment following decontamination and submitted to the laboratory for analysis of target constituents. **One rinsate blank will be collected for every 10 samples.**

7.2.2 Field Duplicates

Field duplicates are collected by sampling the same location twice, but the field duplicate is assigned a unique sample identification number. Samplers will document which location is used for the duplicate sample. **One field duplicate will be collected for every 10 samples.**

7.2.3 Field Blank

Field blanks are collected in the field using laboratory-supplied analyte-free water. The water is poured directly into the supplied sample containers in the field and submitted to the laboratory for analysis of target constituents. **One field blank will be collected for every 10 samples.**

7.2.4 Laboratory Quality Control Samples

The laboratory will have an established QC check program using procedural (method) blanks, laboratory control spikes, matrix spikes, and duplicates. Details of the internal QC checks used by the laboratory will be found in the laboratory QAP and the published analytical methods. These QC samples will be used to determine if results may have been affected by field activities or procedures used in sample transportation or if matrix interferences are an issue. **One (1) Matrix Spike (MS)/ Matrix Spike Duplicate (MSD) set** (i.e. one sample plus one MS, and one MSD sample at one location) **will be collected per 20 samples.** MS/MSD samples will have a naming convention as follows:

- Sample: S-UWL-DG-1
- MS: S-UWL-DG-1-MS
- MSD: S-UWL-DG-1-MSD

8.0 DATA EVALUATION AND STATISTICAL ANALYSIS

The following sections describe the evaluation and analysis procedures that are followed upon receipt of the analytical report.

8.1 Evaluation of Rate and Direction of Groundwater Flow

Groundwater elevations will be determined for each sampling event and will be used to develop a groundwater elevation contour map that will be submitted with reports. The direction of groundwater flow will be determined from upgradient and downgradient relationships as depicted on the potentiometric surface map. Based on these maps, groundwater flow velocities will be estimated for each event.

8.2 Data Validation

Before the data are used for statistical analysis, they will be evaluated by examining the quality control data accompanying the data report from the laboratory. Relevant quality control data could include measures of accuracy (percent recovery), precision (relative percent difference, RPD), and sample contamination (blank determinations). Data that fail any of these checks will be flagged for further evaluation. A Data Quality Review (DQR) may be initiated with the laboratory for any anomalous data.

8.3 Statistical Analysis

Upon completion of the data validation, the data will be submitted for statistical analysis in compliance with 40 CFR §257.93. The detailed statistical analysis plan for the Facility will be included in **Appendix H**.

9.0 REFERENCES

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TABLES

Table 1
Groundwater Level Data
SCPC Surface Impoundment
Sioux Energy Center, St. Charles County, MO

Well ID	Location[6]		Top of Casing[7]	Ground Surface[7]	Background Event 1 5/9/2016		Background Event 2 6/13/2016		Background Event 3 7/5/2016		Background Event 4 9/14/2016		Background Event 5 11/7/2016		Background Event 6 1/3/2017		Background Event 7 3/8/2017		Background Event 8 6/5/2017	
	Northing	Easting	Feet MSL[5]	Feet MSL[5]	DTW[3]	GWE[4]	DTW[3]	GWE[4]	DTW[3]	GWE[4]	DTW[3]	GWE[4]	DTW[3]	GWE[4]	DTW[3]	GWE[4]	DTW[3]	GWE[4]	DTW[3]	GWE[4]
UG-1A[8]	1118825.2	877789.8	427.74	425.2	7.90	419.84	7.47	420.27	8.75	418.99	9.45	418.29	9.91	417.83	11.46	416.28	11.88	415.86	4.16	423.58
UG-2[8]	1118859.7	879319.5	429.27	426.5	10.25	419.02	9.82	419.45	10.89	418.38	11.59	417.68	11.98	417.29	13.36	415.91	13.84	415.43	6.29	422.98
DG-1[8]	1117388.3	877383.5	431.81	428.9	11.63	420.18	11.10	420.71	13.01	418.80	13.80	418.01	14.92	416.89	16.96	414.85	17.16	414.65	7.56	424.25
DG-2[8]	1116940.7	877617.7	431.75	428.9	11.49	420.26	11.00	420.75	13.04	418.71	13.84	417.91	15.21	416.54	17.30	414.45	17.46	414.29	7.38	424.37
DG-3[8]	1116644.1	877845.2	433.84	431.0	13.57	420.27	13.10	420.74	15.14	418.70	15.92	417.92	17.49	416.35	19.57	414.27	19.69	414.15	9.44	424.40
DG-4[8]	1116403.2	878420.7	432.75	430.1	12.49	420.26	12.10	420.65	14.10	418.65	14.85	417.90	16.52	416.23	18.58	414.17	18.70	414.05	8.42	424.33
BMW-1S[1]	1121709.2	876755.6	427.77	426.0	9.31	418.46	NA	NA	9.62	418.15	10.25	417.52	9.77	418.00	9.98	417.79	10.82	416.95	5.30	422.47
BMW-2S[1,12]	1122772.1	880524.1	437.86	436.1	20.52	417.34	NA	NA	20.43	417.43	21.19	416.67	20.33	417.53	19.90	417.96	21.07	416.79	16.00	421.86
BMW-3S[1]	1121792.9	875809.5	426.69	424.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.65	418.04	9.76	416.93	4.17	422.52
Mississippi River	1124029 [2]	879444 [2]	NA	NA	NA	416.80	NA	416.10	NA	417.30	NA	416.50	NA	417.80	NA	418.50	NA	416.90	NA	422.00
Missouri River	1112870 [2]	878170 [2]	NA	NA	NA	420.30	NA	419.80	NA	421.19	NA	418.20	NA	415.39	NA	415.39	NA	413.90	NA	422.94

Notes:

1.) Groundwater monitoring wells surveyed by Zahner & Associates, Inc. on January 14, 2016 and April 29, 2016.

2.) Mississippi and Missouri River gauge locations are estimated.

3.) DTW - Depth to water measured in feet below top of casing.

4.) GWE - Groundwater elevation measured in feet above mean sea level.

5.) MSL - Feet above mean sea level.

6.) Horizontal Datum: State Plane Coordinates NAD83 (2000) Missouri East Zone feet.

7.) Vertical Datum: NAVD88 feet.

8.) Groundwater monitoring wells installed by GREDELL Engineering Resources and surveyed by KdG.

9.) River Elevation for the Mississippi River is provided by Ameren.

10.) River Elevation for the Missouri River are calculated based on nearby USGS (United States Geological Survey) river elevation gauges.

11.) NA - Not Applicable.

12.) BMW-2S is used as a groundwater elevation piezometer only and is not used for CCR groundwater sampling.

Prepared	JSI
Check	JS/RJF
Reviewed	MNH

Table 2
Generalized Hydraulic Properties of Uppermost Aquifer
SCPC Surface Impoundment
Sioux Energy Center, St. Charles County, MO

SCPC Compliance Wells (UG-1A, UG-2, DG-1, DG-2, DG-3, DG-4)							
Baseline Sampling Event	Baseline Sampling Event Date	Average Groundwater Flow Direction (Azimuth)	Estimated Hydraulic Gradient (Feet/Foot)	Mean Hydraulic Conductivity (Feet/Day)	Mean Hydraulic Conductivity (cm/sec)	Estimated Effective Porosity	Estimated Groundwater Velocity (Feet/Day)
1	5/9/2016	54.5	0.0005	51.00	1.8E-02	0.35	0.07
2	6/13/2016	58.3	0.0005	51.00	1.8E-02	0.35	0.08
3	7/5/2016	103.6	0.0003	51.00	1.8E-02	0.35	0.04
4	9/14/2016	110.7	0.0003	51.00	1.8E-02	0.35	0.04
5	11/7/2016	158.2	0.0006	51.00	1.8E-02	0.35	0.09
6	1/3/2017	173.8	0.0008	51.00	1.8E-02	0.35	0.12
7	3/8/2017	169.4	0.0007	51.00	1.8E-02	0.35	0.10
8	6/5/2017	41.3	0.0005	51.00	1.8E-02	0.35	0.08

Estimated Results (USEPA Tool)	
Resultant Groundwater Flow Direction (Azimuth)	138
Estimated Annual Net Groundwater Movement (Feet/Year)	19

Prepared By: JSI
Checked By: RJF
Reviewed By: MNH

Notes:

1. Azimuth and Hydraulic Gradient calculated using the United States Environmental Protection Agency (USEPA) On-Line Tools for Site Assessment Calculation for Hydraulic Gradient (magnitude and direction) available at https://www3.epa.gov/ceampubl/learn2model/part-two/onsite/gradient4plus-ns.html
2. Hydraulic conductivity value is the geometric mean of slug test results for the SCPB monitoring wells.
3. An effective porosity of 0.35 was used based on grain size distributions and published values (Fetter 2000, Cohen 1953, and Johnson 1967) .
4. Azimuth is measured clockwise in degrees from north.
5. cm/sec - Centimeters per second.

Table 4
Monitoring Well Construction Details
SCPC Surface Impoundment
Sioux Energy Center, St. Charles County, MO

		Location[4]		Top of Casing Elevation	Ground Surface Elevation	Top of Screen	Bottom of Screen	Base of Well	Total Depth
Well ID	Date Installed	Northing	Easting	(FT MSL)[5]	(FT MSL)[5]	(FT MSL)[5]	(FT MSL)[5]	(FT MSL)[5]	(FT BGS)[5]
UG-1A*	6/3/2008	1118825.2	877789.8	427.74	425.2	409.5	399.2	399.2	26.0
UG-2*	12/16/2007	1118859.7	879319.5	429.27	426.5	409.5	399.3	399.3	27.2
DG-1*	12/16/2007	1117388.3	877383.5	431.81	428.9	407.1	396.8	396.8	32.1
DG-2*	12/16/2007	1116940.7	877617.7	431.75	428.9	407.5	397.3	397.3	31.7
DG-3*	12/16/2007	1116644.1	877845.2	433.84	431.0	409.1	398.9	398.9	32.1
DG-4*	12/16/2007	1116403.2	878420.7	432.75	430.1	408.4	398.1	398.1	32.0
BMW-1S	12/8/2015	1121709.2	876755.6	427.77	426.0	412.0	402.2	401.8	24.2
BMW-3S	11/8/2016	1121792.9	875809.5	426.69	424.1	410.2	400.4	400.0	24.2

Notes:

1.) All elevations and coordinates were surveyed on January 14, 2016 and December 8, 2016 by Zahner and Associates, Inc.

2.) FT MSL = Feet Above Mean Sea Level.

3.) FT BGS = Feet Below Ground Surface.

4.) Horizontal Datum: State Plane Coordinates NAD83 (2000) Missouri East Zone Feet.

5.) Vertical Datum: NAVD88 Feet.

6.) *Groundwater monitoring wells installed by GREDELL Engineering Resources and surveyed by KdG.

Prepared By: JSI
Checked By: JS
Reviewed By: MNH

Table 5
Groundwater Quality Monitoring Parameters
SCPC Surface Impoundment
Sioux Energy Center, St. Charles County, MO

Monitoring Parameter		Background[2]	Detection[3]	Assessment[4]
Field Parameters	Temperature, pH, Conductivity and Dissolved Oxygen	X	X	X
Appendix III[1]	Boron	X	X	X
	Calcium	X	X	X
	Chloride	X	X	X
	Fluoride	X	X	X
	Sulfate	X	X	X
	pH	X	X	X
	Total Dissolved Solids (TDS)	X	X	X
Appendix IV[1]	Antimony	X		X
	Arsenic	X		X
	Barium	X		X
	Beryllium	X		X
	Cadmium	X		X
	Chromium	X		X
	Cobalt	X		X
	Fluoride	X		X
	Lead	X		X
	Lithium	X		X
	Mercury	X		X
	Molybdenum	X		X
	Selenium	X		X
	Thallium	X		X
	Radium 226 & 228	X		X

Notes:

1.) Analyte lists match requirements for monitoring from USEPA Rule 40 CFR parts 257 and 261.
2.) Background will be performed through October 2017 until at least 8 samples are collected.
3.) Approximately 6 months will separate each semi-annual sampling event.
4.) If necessary, assessment monitoring will be performed in accordance with USEPA Rule.

Prepared By: JS
Checked By: MWD
Reviewed By: MNH

Table 6
Analytical Methods and Practical Quantitation Limits
SCPC Surface Impoundment
Sioux Energy Center, St. Charles County, MO

Analyte	Method Reference	Preservative	Hold Times	PQL (µg/L)	MCL (mg/L)
Appendix III - Detection Monitoring					
Boron	SW-846 6010/MCAWW 200.7	HNO3	6 months	20.0	NA
Calcium	SW-846 6010/MCAWW 200.7	HNO3	6 months	500.0	NA
Chloride	EPA 300.0/325.5/MCAWW 300/SW8463 9251/9056	NA	28 days	500.0	NA
Fluoride	EPA 300.0, 300.1	NA	28 days	-	4
pH	4500 H+B-2000	NA	NA	-	NA
Sulfate	EPA 300.0/SW8463 300	NA	28 days	2000.0	NA
Total Dissolved Solids (TDS)	2540 C-1997/SM18-20 2540 C	NA	7 days	10000.0	NA
Appendix IV - Assessment Monitoring					
Antimony	SW-846 6010/6020/MCAWW 200.7/200.8	HNO3	6 months	1.0	0.006
Arsenic	SW-846 6010/6020/MCAWW 200.7/200.8	HNO3	6 months	1.0	0.01
Barium	SW-846 6010/6020/MCAWW 200.7/200.8	HNO3	6 months	2.0	2
Beryllium	SW-846 6010/6020/MCAWW 200.7/200.8	HNO3	6 months	1.0	0.004
Cadmium	SW-846 6010/6020/MCAWW 200.7/200.8	HNO3	6 months	0.5	0.005
Chromium	SW-846 6010/6020/MCAWW 200.7/200.8	HNO3	6 months	1.5	0.1
Cobalt	SW-846 6010/6020/MCAWW 200.7/200.8	HNO3	6 months	4.0	NP
Fluoride	EPA 300.0	N/A	28 days	-	4
Lead	SW-846 6020	HNO3	6 months	0.005	0.015
Lithium	SW-846 6010	HNO3	6 months	-	NA
Mercury	SW-846 7470	HNO3	28 days	-	0.002
Molybdenum	SW-846 6010	HNO3	6 months	-	NP
Selenium	SW-846 6010/6020/MCAWW 200.7/200.8	HNO3	6 months	1.0	0.05
Thallium	SW-846 6010/6020/MCAWW 200.7/200.8	HNO3	6 months	0.2	0.002
Radium 226 & 228	SW-846 903.1/SM 6500 904	-	-	1.0 (pCi/L)	5.0 (pCi/L)

Notes:
1.) NA - not applicable.
2.) Analyte lists matches requirements for detection and assessment monitoring from United States Environmental Protection Agency (USEPA) Rule 40 CFR parts 257 and 261.
3.) SW-846 3rd denotes Test Methods for Evaluating Solid Waste, Physical- Chemical Methods, EPA publication SW-846, 3rd edition, and subsequent updates.
4.) MCAWW denotes Methods for the Chemical Analysis of Water and Wastes (MCAWW), United States Environmental Protection Agency (USEPA) published in the 1983.
5.) EPA 300 denotes Methods for the Determination of Organic Compounds in Drinking Water Environmental Monitoring Systems Laboratory, Office of Research and Development, USEPA, Cincinnati, Ohio 45268. EPA-300/4-88/039, December 1988 (Revised July 1991).
6.) SM18-20 denotes Standard Methods for the Examination of Water and Wastewater, 18th, 19th, and 20th Editions, published by the American Public Health Association, Water Environment Federation, and the American Water Works Association.
7.) Other industry-used or agency-approved methods may be used provided that they produce the necessary level of precision and accuracy for data use and reporting.
8.) Updates to the methods listed here are approved for use.
9.) PQL - Practical Quantitation Limit.
10.) MCL - Maximum Contaminant Level from USEPA 2014 Edition of the Drinking Water Standards and Health Advisories. October 2014. http://water.epa.gov/drink/contaminants/index.cfm.
11.) Dash (-) - Indicates no information available.
12.) µg/L - Micrograms per liter.
13.) pCi/L - Picocuries per liter.
14.) NP - Not Promulgated.
15.) mg/L - Milligrams per liter.

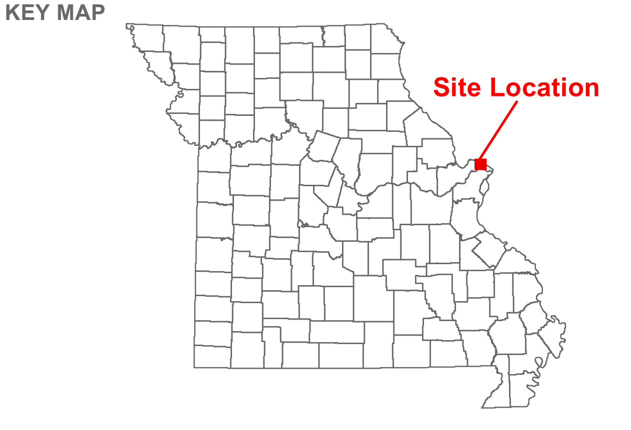
Prepared By: JS
Checked By: MWD
Reviewed By: MNH

FIGURES

LEGEND

🟥	Sioux Energy Center Property Boundary
▭	UWL Perimeter Fence
▭	SCPC - WFGD Disposal Area
▭	SCPC - Water Recycle Pond

KEY MAP



NOTES

1.) ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2.) WFGD - WASTE FLUE GAS DESULFURIZATION.

REFERENCES

1.) AMEREN MISSOURI SIOUX ENERGY CENTER, SIOUX PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2401 FEET.
3.) AMEREN MISSOURI DRAWING SX-8420-X-182001.
4.) UWL BOUNDARIES, DESIGNATIONS AND EXISTING MONITORING WELL LOCATIONS BASED ON DRAWINGS IN THE UWL PROPOSED LANDFILL PERMIT (#0918301).

0 500 1,000 2,000 3,000 4,000
Feet

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

PROJECT
GROUNDWATER MONITORING PROGRAM

TITLE
SITE LOCATION TOPOGRAPHIC MAP

CONSULTANT

YYYY-MM-DD	2017-08-28
PREPARED	JSI
DESIGN	JSI
REVIEW	JS
APPROVED	MNH

PROJECT No.	PHASE	Rev.	FIGURE
153-1406	0003D	0	1

Path: G:\Projects\150 Projects\1531406 - Ameren GW Monitoring Program - MO\Phase 0003 - Sioux Energy\800 - FIGURES-DRAWINGS\PRODUCTION\GMP\SCPC\Figure 1 - SCPC - Topo Map.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:

0
1 in

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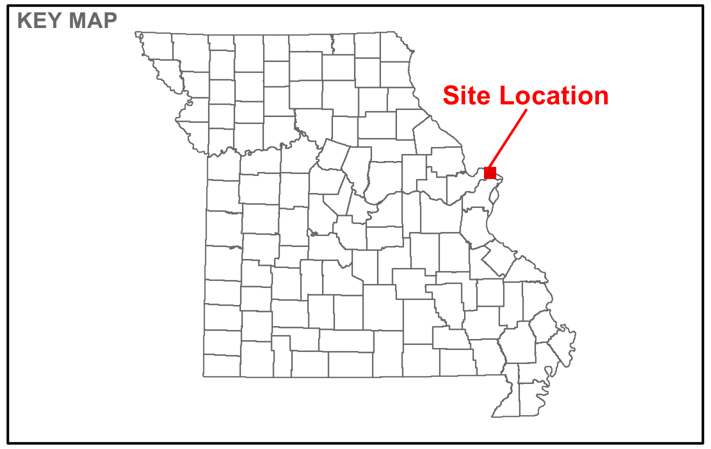
LEGEND

- ▭ Sioux Energy Center Property Boundary
- ▭ UWL Perimeter Fence
- ▭ SCPC - WFGD Disposal Area
- ▭ SCPC - Water Recycle Pond

Ground/Surface Elevation Measurement Location

- ⊕ SCPC Monitoring Well
- ⊕ Background Monitoring Well
- ⊕ Groundwater Elevation Piezometer

KEY MAP



NOTES

1.) ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2.) GROUNDWATER MONITORING WELLS SURVEYED BY ZAHNER AND ASSOCIATES, INC. ON JANUARY 14 AND DECEMBER 8, 2016.
3.) UWL BOUNDARIES, DESIGNATIONS AND EXISTING MONITORING WELL LOCATIONS BASED ON DRAWINGS IN THE UWL PROPOSED LANDFILL PERMIT (#0918301).
4.) WFGD - WASTE FLUE GAS DESULFURIZATION.

REFERENCES

1.) AMEREN MISSOURI SIOUX ENERGY CENTER, SIOUX PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2401 FEET.
3.) AMEREN MISSOURI DRAWING SX-8420-X-182001.
4.) GOOGLE EARTH®.

0 500 1,000 2,000 3,000 4,000
Feet

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

Ameren

PROJECT
GROUNDWATER MONITORING PROGRAM

TITLE
SITE LOCATION AERIAL MAP

CONSULTANT
Golder Associates

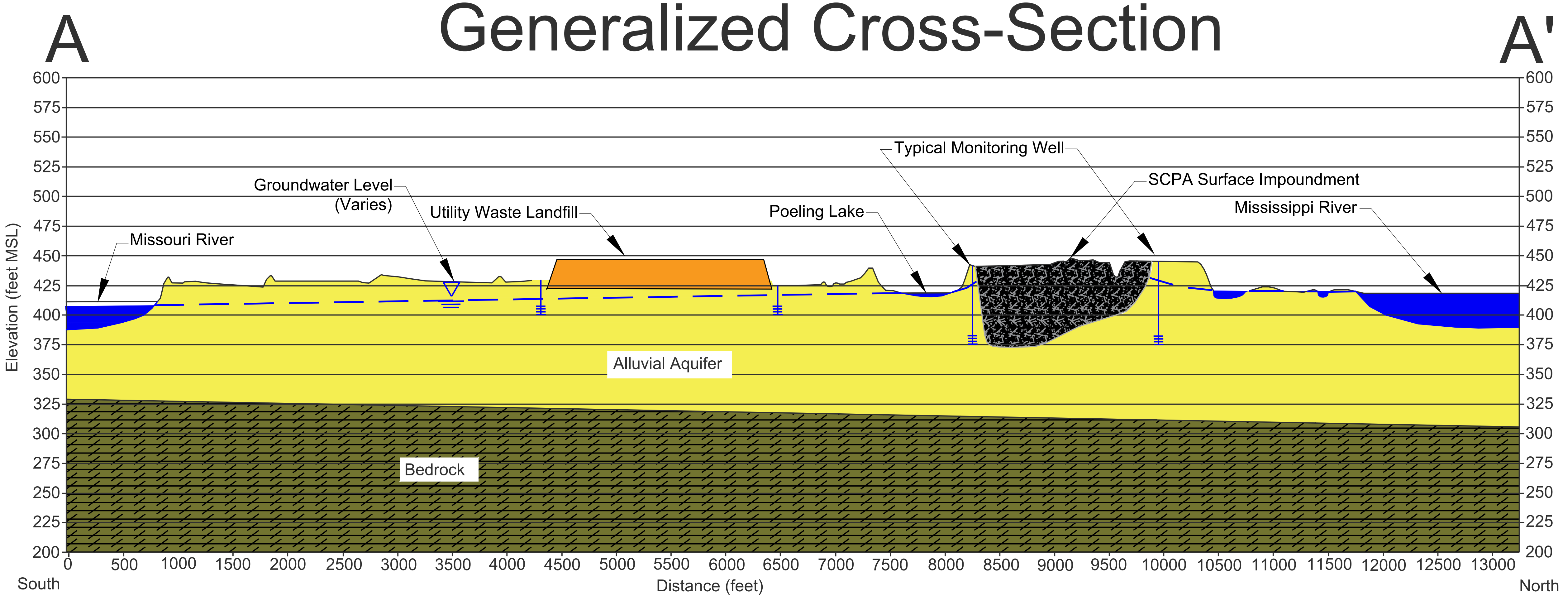
YYYY-MM-DD	2017-08-29
PREPARED	JSI
DESIGN	JSI
REVIEW	JS
APPROVED	MNH

PROJECT No.	PHASE	Rev.	FIGURE
153-1406	0003D	0.0	**2**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
1 in
0

Path: G:\Projects\150 Projects\1531406 - Ameren GW Monitoring Program - MO\Phase 0003 - Sioux Energy\800 - FIGURES-DRAWINGS\PRODUCTION\GMP\SCPC\Figure 2 - SCPC - Aerial Map.mxd

Generalized Cross-Section



Overview Map

Not To Scale

NOTES
1.) ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2.) CROSS-SECTION IS NOT TO SCALE AND IS ONLY A VISUAL REPRESENTATION OF THE SUBSURFACE GEOLOGY.
3.) MSL - MEAN SEA LEVEL.

REFERENCES
1.) AMEREN, 2011. AMEREN MISSOURI SIOUX ENERGY CENTER, SIOUX PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) GREDELL ENGINEERING RESOURCES, INC. 2006. DETAILED GEOLOGIC AND HYDROLOGIC SITE INVESTIGATION REPORT. AMEREN UE SIOUX POWER PLANT PROPOSED UTILITY WASTE DISPOSAL AREA. ST. CHARLES COUNTY, MISSOURI. AUGUST 2006.
3.) EPRI, 1998. FIELD EVALUATION OF THE COMANAGEMENT OF UTILITY LOW-VOLUME WASTES WITH HIGH-VOLUME COAL COMBUSTION BY-PRODUCTS: SX SITE. TR-108409.
4.) REITZ & JENS, INC., AND GREDELL ENGINEERING RESOURCES, INC. 2014. AMEREN MISSOURI SIOUX POWER PLANT UTILITY WASTE LANDFILL PROPOSED CONSTRUCTION PERMIT MODIFICATION CONSTRUCTION PERMIT NUMBER 0918301 ST, CHARLES COUNTY, MISSOURI.

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

Ameren

CONSULTANT

Golder Associates

YYYY-MM-DD	2017-08-29
DESIGNED	JSI
PREPARED	JSI
REVIEWED	JS
APPROVED	MNH

PROJECT
GROUNDWATER MONITORING PROGRAM

TITLE
GENERALIZED CROSS-SECTION

PROJECT NO.	PHASE	REV.	FIGURE
153-1406	00003D	0.0	3

APPENDIX A
CCR MONITORING WELL BORING LOGS

RECORD OF BOREHOLE BMW-1S

SHEET 1 of 1

PROJECT: Ameren CCR GW Monitoring	DRILLING METHOD: 6" Sonic	DATUM: NAVD88	ELEVATION: 425.98
PROJECT NUMBER: 153-1406.003B	DRILLING DATE: 12/8/2015	AZIMUTH: N/A	INCLINATION: -90
LOCATION: Sioux Energy Center	DRILL RIG: Mini Sonic (CDD1415)	COORDINATES: N: 1,121,709.18 E: 876,755.57	

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE				SAMPLES			REMARKS
		DESCRIPTION	USCS	GRAPHIC LOG	ELEVATION DEPTH (ft)	NUMBER	TYPE	REC / ATT	
0	6" Sonic	(0.0-8.5) (ML) sandy SILT, non-plastic to very low plasticity fines, fine sand, trace organics (roots); brownish gray (5YR 4/1); non-cohesive, moist, loose	ML	░		1	SO	2.4 / 5.0	
5		(5.0) SAA (Same As Above), no organics		░	421.0 5.0	2	SO	3.7 / 5.0	∇ Water Level 6.33 ft bgs 2/16/2016
		(8.5-15.6) (CL) SILTY CLAY, medium plasticity fines, trace fine sand; light brownish gray (5YR 6/1); cohesive, w~PL, firm	CL	▨	417.5 8.5				
10				▨		3	SO	2.8 / 5.0	
15				▨		4	SO	7.5 / 10.0	Run #4, Sample appears to be compacted while being extruded into sample bags. Measured field recovery: 5.2/10.0. Estimated actual recovery: 7.5/10.0.
		(15.6-17.5) (SP-SM) SAND, fine sand, some non-plastic fines; light brown (5YR 5/6); non-cohesive, wet, compact	SP-SM	░	410.4 15.6				
		(17.5-18.5) (CL) SILTY CLAY, medium plasticity fines, trace fine sand; medium dark gray (N4); cohesive, w~PL, firm	CL	▨	408.5 17.5				
		(18.5-25.0) (SP-SM) SAND, fine sand, some non-plastic fines; medium dark gray (N4); non-cohesive, wet, compact	SP-SM	░	407.5 18.5				
20				░					
25		END OF BORING AT 25.0 FEET BELOW GROUND SURFACE. FOR WELL DETAILS, SEE WELL CONSTRUCTION LOG BMW-1S.			401.0 25.0				
30									

SCALE: 1 in = 3.8 ft	LOGGED: JSI/JS
DRILLING CONTRACTOR: Cascade	CHECKED: JSI
DRILLER: J. Drabek	REVIEWED: PJJ/MNH

Golder Associates

RECORD OF BOREHOLE BMW-3S

SHEET 1 of 1

PROJECT: Ameren CCR GW Monitoring	DRILLING METHOD: 6" Sonic	DATUM: NAVD88	ELEVATION: 424.12
PROJECT NUMBER: 153-1406.003B	DRILLING DATE: 11/8/2016	AZIMUTH: N/A	INCLINATION: -90
LOCATION: Sioux Energy Center	DRILL RIG: Geoprobe (8140CC)	COORDINATES: N: 1,121,792.93 E: 875,809.46	

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEVATION DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC/ATT	REMARKS
0	6" Sonic	(0.0-1.2) (CH) CLAY, high plasticity fines, some organics; dusky brown (5YR 2/2); cohesive, w~PL, firm	CH		422.9 1.2	1	SO	4.4/5.0	
		(1.2-12.0) (CL) SILTY CLAY, medium plasticity fines; pale brown (5YR 5/2); cohesive, w~PL, moist	CL						
5						2	SO	3.2/5.0	
10					412.1 12.0	3	SO	3.7/5.0	
		(12.0-22.2) (SP) SAND, fine to medium sub-angular sand, trace non-plastic fines; light brown (5YR 6/4); non-cohesive, wet, compact	SP		409.1 15.0				
15		(15.0) Same As Above (SAA) excpet color to pale brown (5YR 5/2)				4	SO	3.4/5.0	
20					401.9 22.2	5	SO	3.3/4.0	
		(22.2-24.0) (SM) SILTY SAND, fine to medium sand, some non-plastic fines; medium gray (N5); non-cohesive, wet, compact	SM		400.1 24.0				
25		END OF BORING AT 24.2 FEET BELOW GROUND SURFACE. FOR WELL DETAILS, SEE WELL CONSTRUCTION LOG BMW-3S.							
30									

SCALE: 1 in = 3.8 ft
DRILLING CONTRACTOR: Cascade
DRILLER: M. Rodrigues

LOGGED: MSG
CHECKED: JS
REVIEWED: MNH

Golder Associates

APPENDIX B
HISTORIC POTENTIOMETRIC SURFACE MAPS

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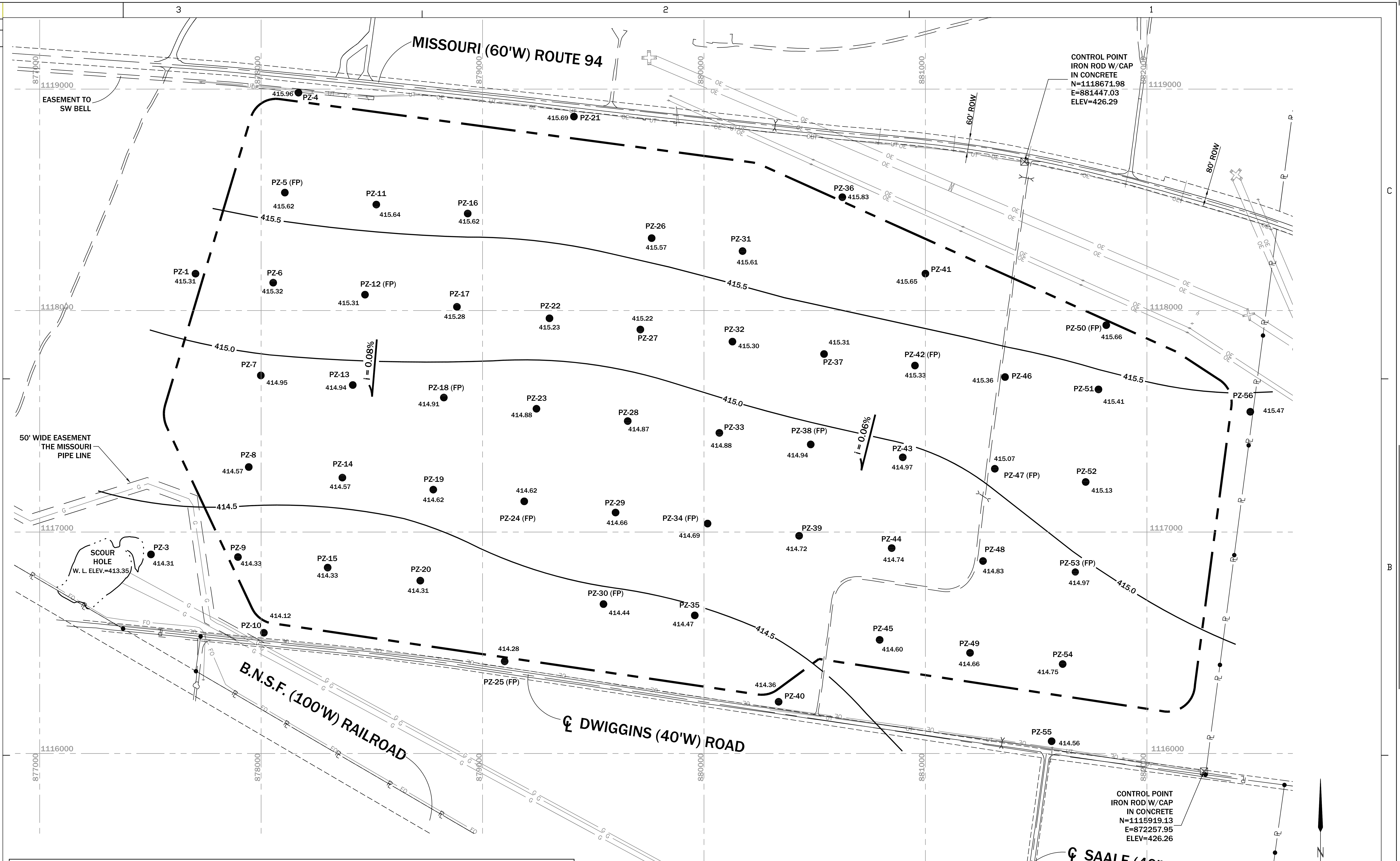

LEGEND

PZ ●	PIEZOMETER BORING (57)	═	PAVED ROAD
B ◕	TEMPORARY BORING (54)	i = 0.08%	HYDRAULIC GRADIENT (%)
B ◎	TEMPORARY BORING (DEEP) (3)	⟶	GROUNDWATER FLOW DIRECTION
(FP) ●	FIELD PERMEABILITY TEST LOCATION	= = = =	ACCESS ROAD
⊠	CONTROL POINT	—— ℞ ——	PROPERTY LINE (APPROX.)
•	℞ SURVEY POINT	—— — ——	CENTERLINE OF EXISTING ROAD
✕	METAL TRANSMISSION TOWER	━ ━ ━	PROPOSED UTILITY WASTE DISPOSAL AREA FOOTPRINT
-○-	EXISTING POWER POLE	—— G ——	EXISTING MISSOURI PIPELINE
≻—≺	CULVERT	—UT— —UT—	EXISTING UNDERGROUND UTILITIES
415.0	GROUND WATER ELEVATION (FT.)	—— FO ——	EXISTING FIBER OPTIC
—— 415.0 ——	GROUNDWATER CONTOUR NOTE: CONTOUR INTERVAL (C.I.)=0.5 FT.	—OE— —OE—	EXISTING OVERHEAD ELECTRIC

NOTES

1. GROUNDWATER DATA NOT AVAILABLE FOR TEMPORARY BORINGS.
2. MEASUREMENTS RECORDED BY REITZ & JENS.
3. USE OF SMALL CONTOUR INTERVAL (0.5 FT.) EXAGGERATES APPARENT "SLOPE" OF WATER TABLE SURFACE.
4. MAP REPRESENTATIVE OF GROUNDWATER CONDITIONS OCCURRING ON DATE OF MEASUREMENT: SEPTEMBER 13, 2005.
5. GROUNDWATER ELEVATION READINGS FOR PZ-2 AND PZ-57 WERE BELIEVED TO BE ANOMALOUS AND THEREFORE WERE NOT INCLUDED IN WATER TABLE SURFACE MAP.
6. HYDRAULIC GRADIENTS CALCULATED USING GROUNDWATER ELEVATIONS MEASURED IN PIEZOMETERS PZ-4, PZ-21, PZ-10, PZ-36, PZ-50 AND PZ-40.

SCALE: 1" = 200'
0 100 200 400

A

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Facsimile: (573) 659-9079

PREPARED FOR AmerenUE

DRAWN 080806 W.J.A. (G.E.R.)	FIGURE 21 DETAILED SITE INVESTIGATION PROPOSED UTILITY WASTE DISPOSAL AREA WATER TABLE SURFACE MAP - SEPTEMBER 2005
CHKD. A.R.C. (G.E.R.)	
SUPV. D.E.K. (G.E.R.)	
APPD. D.E.K. (G.E.R.)	LOCATION 001009 | SIOUX PLANT | CLASS 02010
AmerenUE ST. LOUIS, MISSOURI	8430-Y-0168601-22 | REV.

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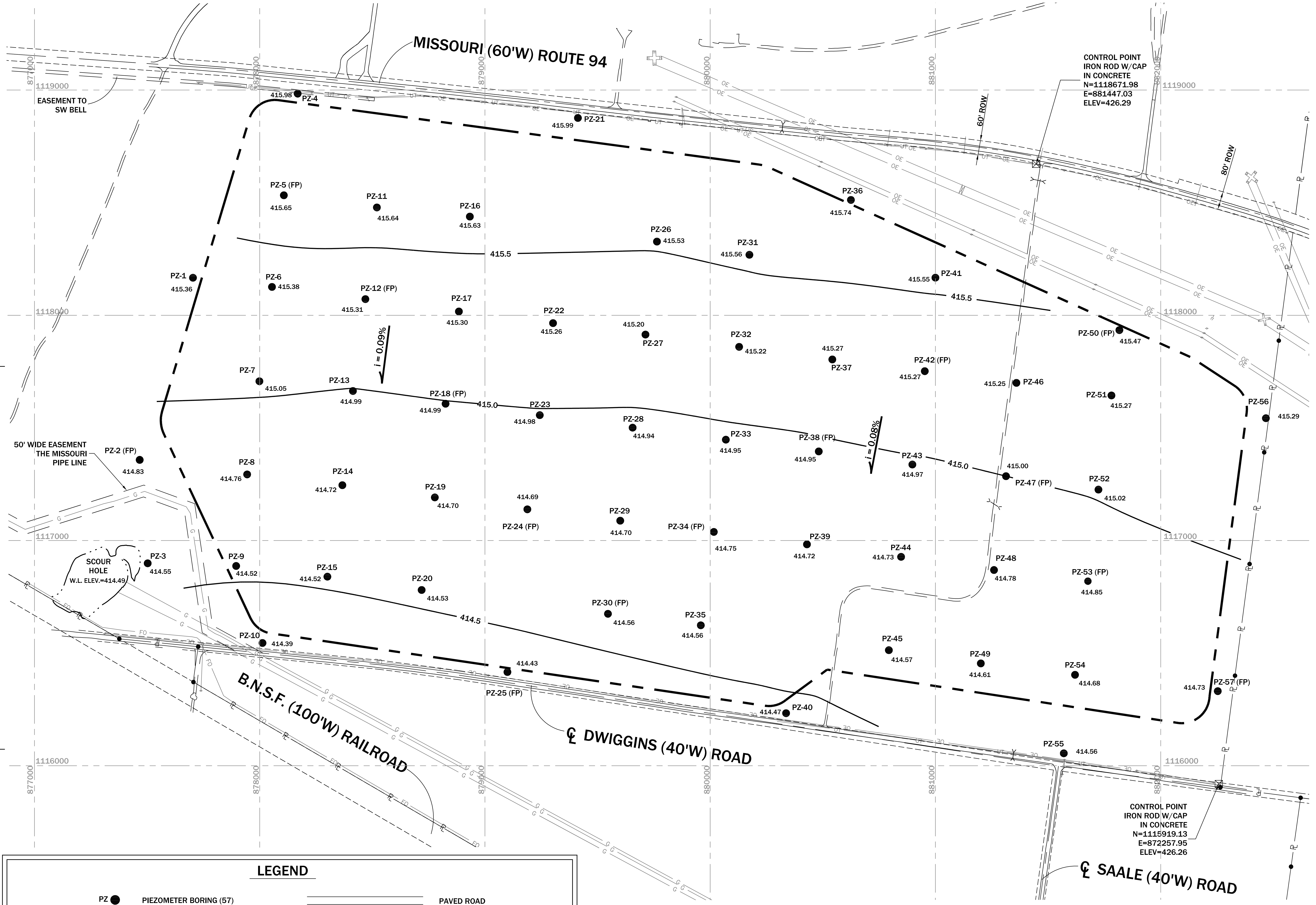

LEGEND

PZ ●	PIEZOMETER BORING (57)	═══	PAVED ROAD
B ◕	TEMPORARY BORING (54)	i = 0.08%	HYDRAULIC GRADIENT (%)
B ◎	TEMPORARY BORING (DEEP) (3)	⟶	GROUNDWATER FLOW DIRECTION
(FP) ●	FIELD PERMEABILITY TEST LOCATION	= = = =	ACCESS ROAD
☒	CONTROL POINT	—— P̲L ——	PROPERTY LINE (APPROX.)
•	P̲L SURVEY POINT	—— — ——	CENTERLINE OF EXISTING ROAD
✕	METAL TRANSMISSION TOWER	▬ ▬ ▬ ▬	PROPOSED UTILITY WASTE DISPOSAL AREA FOOTPRINT
-○-	EXISTING POWER POLE	—— G ——	EXISTING MISSOURI PIPELINE
≻—≺	CULVERT	—UT——UT—	EXISTING UNDERGROUND UTILITIES
415.0	GROUND WATER ELEVATION (FT.)	—— FO ——	EXISTING FIBER OPTIC
—— 415.0 ——	GROUNDWATER CONTOUR NOTE: CONTOUR INTERVAL (C.I.)=0.5 FT.	—OE——OE—	EXISTING OVERHEAD ELECTRIC

NOTES

1. GROUNDWATER DATA NOT AVAILABLE FOR TEMPORARY BORINGS.
2. MEASUREMENTS RECORDED BY REITZ & JENS, INC.
3. USE OF SMALL CONTOUR INTERVAL (0.5 FT.) EXAGGERATES APPARENT "SLOPE" OF WATER TABLE SURFACE.
4. MAP REPRESENTATIVE OF GROUNDWATER CONDITIONS OCCURRING ON DATE OF MEASUREMENT: OCTOBER 11, 2005.
5. HYDRAULIC GRADIENTS CALCULATED USING GROUNDWATER ELEVATIONS MEASURED IN PIEZOMETERS PZ-4, PZ-21, PZ-10, PZ-36, PZ-50 AND PZ-40.

SCALE: 1" = 200'
0 100 200 400

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DRAWN 080806 W.J.A. (G.E.R.)	
CHKD. A.R.C. (G.E.R.)	
SUPV. D.E.K. (G.E.R.)	
APPD. D.E.K. (G.E.R.)	LOCATION 001009

FIGURE 22
DETAILED SITE INVESTIGATION
PROPOSED UTILITY WASTE DISPOSAL AREA
WATER TABLE SURFACE MAP - OCTOBER 2005

SIOUX PLANT

CLASS 02010

AmerenUE ST. LOUIS, MISSOURI

8430-Y-0168601-23

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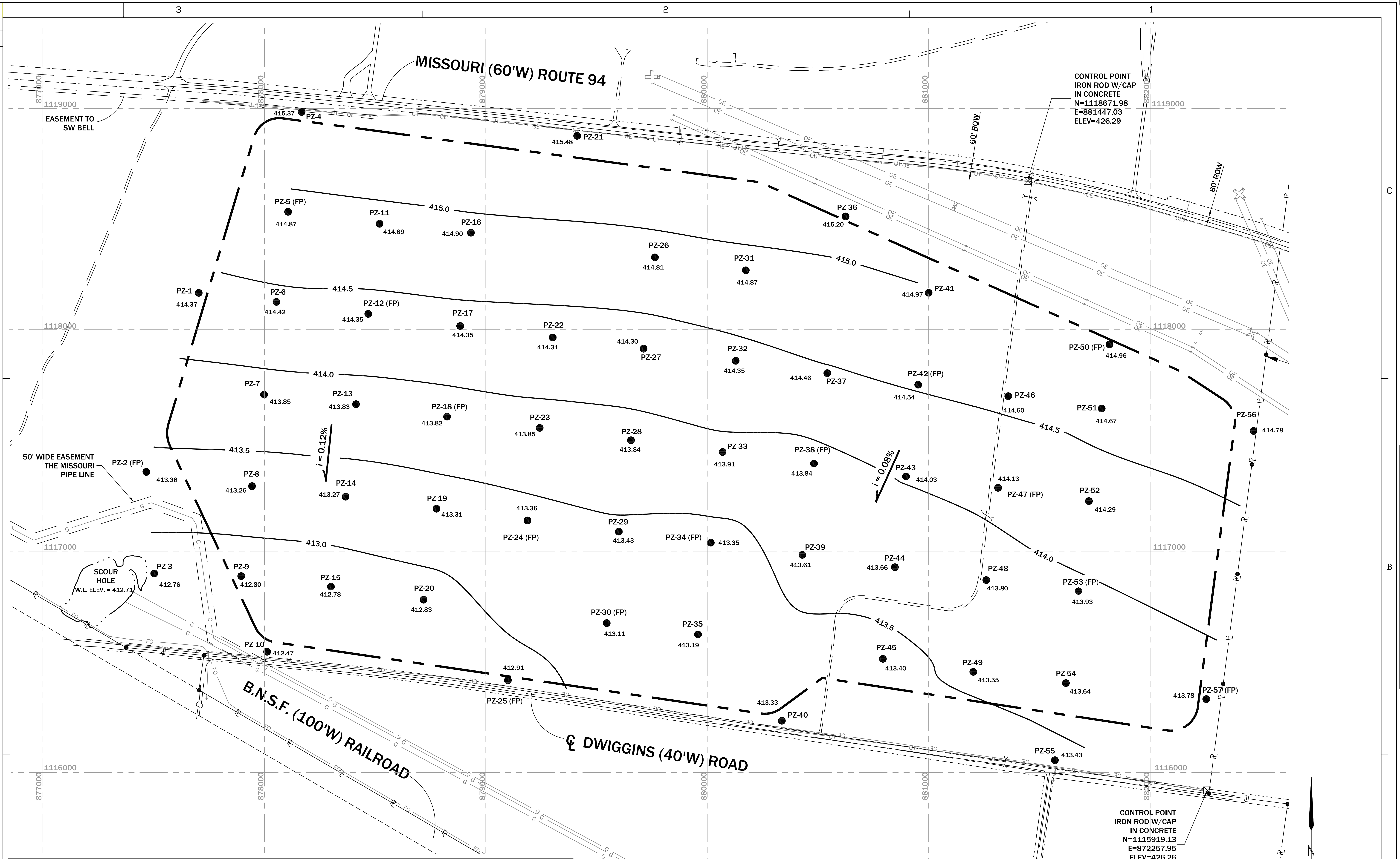

SCALE: 1" = 200'
0 100 200 400

LEGEND

PZ ●	PIEZOMETER BORING (57)	═══	PAVED ROAD
B ◕	TEMPORARY BORING (54)	i = 0.08%	HYDRAULIC GRADIENT (%)
B ◎	TEMPORARY BORING (DEEP) (3)	➝	GROUNDWATER FLOW DIRECTION
(FP) ●	FIELD PERMEABILITY TEST LOCATION	= = = =	ACCESS ROAD
☒	CONTROL POINT	—— ℞ ——	PROPERTY LINE (APPROX.)
●	℞ SURVEY POINT	— — —	CENTERLINE OF EXISTING ROAD
✕	METAL TRANSMISSION TOWER	▬ ▬ ▬	PROPOSED UTILITY WASTE DISPOSAL AREA FOOTPRINT
-○-	EXISTING POWER POLE	—— G ——	EXISTING MISSOURI PIPELINE
≻—≺	CULVERT	—UT—UT—	EXISTING UNDERGROUND UTILITIES
415.0	GROUND WATER ELEVATION (FT.)	—— FO ——	EXISTING FIBER OPTIC
—— 415.0 ——	GROUNDWATER CONTOUR NOTE: CONTOUR INTERVAL (C.I.)=0.5 FT.	—OE—OE—	EXISTING OVERHEAD ELECTRIC

NOTES

1. GROUNDWATER DATA NOT AVAILABLE FOR TEMPORARY BORINGS.
2. MEASUREMENTS RECORDED BY REITZ & JENS.
3. USE OF SMALL CONTOUR INTERVAL (0.5 FT.) EXAGGERATES APPARENT "SLOPE" OF WATER TABLE SURFACE.
4. MAP REPRESENTATIVE OF GROUNDWATER CONDITIONS OCCURRING ON DATE OF MEASUREMENT: NOVEMBER 10, 2005.
5. HYDRAULIC GRADIENTS CALCULATED USING GROUNDWATER ELEVATIONS MEASURED IN PIEZOMETERS PZ-4, PZ-21, PZ-10, PZ-36, PZ-50 AND PZ-40.

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CHKD. A.R.C. (G.E.R.)
SUPV. D.E.K. (G.E.R.)
APPD. D.E.K. (G.E.R.)

FIGURE 23
DETAILED SITE INVESTIGATION
PROPOSED UTILITY WASTE DISPOSAL AREA
WATER TABLE SURFACE MAP - NOVEMBER 2005

LOCATION 001009
SIOUX PLANT
CLASS 02010

AmerenUE ST. LOUIS, MISSOURI
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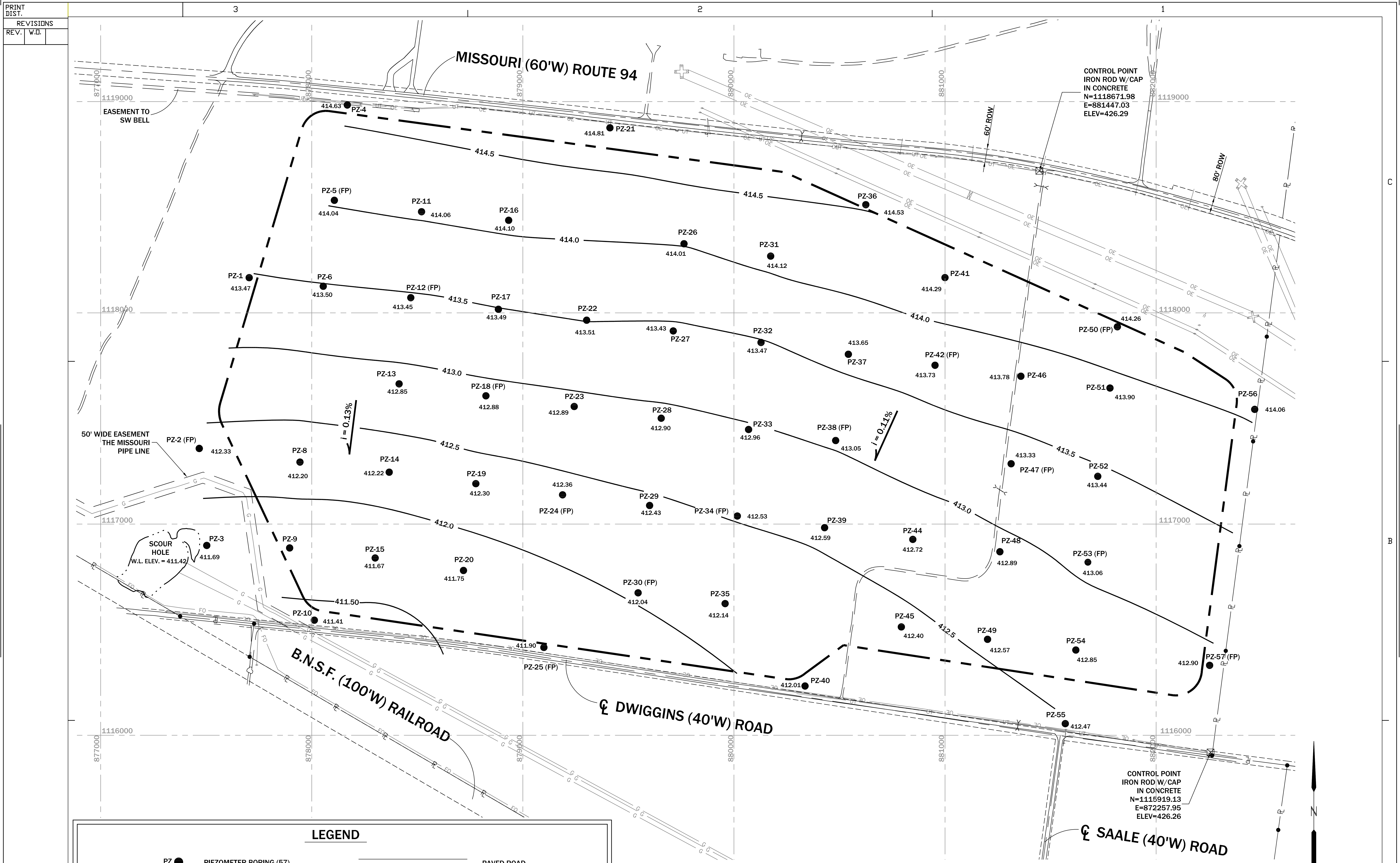

LEGEND

PZ ●	PIEZOMETER BORING (57)	═══	PAVED ROAD
B ◒	TEMPORARY BORING (54)	i = 0.08%	HYDRAULIC GRADIENT (%)
B ◎	TEMPORARY BORING (DEEP) (3)	───	GROUNDWATER FLOW DIRECTION
(FP) ●	FIELD PERMEABILITY TEST LOCATION	= = = =	ACCESS ROAD
☒	CONTROL POINT	── ℞ ──	PROPERTY LINE (APPROX.)
•	℞ SURVEY POINT	── ─ ──	CENTERLINE OF EXISTING ROAD
✕	METAL TRANSMISSION TOWER	━━ ━ ━ ━━	PROPOSED UTILITY WASTE DISPOSAL AREA FOOTPRINT
─○─	EXISTING POWER POLE	── G ──	EXISTING MISSOURI PIPELINE
≻─≺	CULVERT	──UT──UT──	EXISTING UNDERGROUND UTILITIES
415.0	GROUND WATER ELEVATION (FT.)	── FO ──	EXISTING FIBER OPTIC
── 415.0 ──	GROUNDWATER CONTOUR NOTE: CONTOUR INTERVAL (C.I.)=0.5 FT.	──OE──OE──	EXISTING OVERHEAD ELECTRIC

NOTES

1. GROUNDWATER DATA NOT AVAILABLE FOR TEMPORARY BORINGS.
2. MEASUREMENTS RECORDED BY REITZ & JENS.
3. USE OF SMALL CONTOUR INTERVAL (0.5 FT.) EXAGGERATES APPARENT "SLOPE" OF WATER TABLE SURFACE.
4. MAP REPRESENTATIVE OF GROUNDWATER CONDITIONS OCCURRING ON DATE OF MEASUREMENT: DECEMBER 9, 2005.
5. HYDRAULIC GRADIENTS CALCULATED USING GROUNDWATER ELEVATIONS MEASURED IN PIEZOMETERS PZ-4, PZ-21, PZ-10, PZ-36, PZ-50 AND PZ-40.
6. GROUNDWATER ELEVATION READINGS FOR PZ-7 AND PZ-43 WERE BELIEVED TO BE ANOMALOUS AND THEREFORE WERE NOT INCLUDED IN WATER TABLE SURFACE MAP.

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DRAWN 080806 W.J.A. (G.E.R.)	FIGURE 24
CHKD. A.R.C. (G.E.R.)	DETAILED SITE INVESTIGATION
SUPV. D.E.K. (G.E.R.)	PROPOSED UTILITY WASTE DISPOSAL AREA WATER TABLE SURFACE MAP - DECEMBER 2005
APPD. D.E.K. (G.E.R.)	LOCATION 001009 · SIOUX PLANT · CLASS 02010
AmerenUE ST. LOUIS, MISSOURI	8430-Y-0168601-25 · REV.

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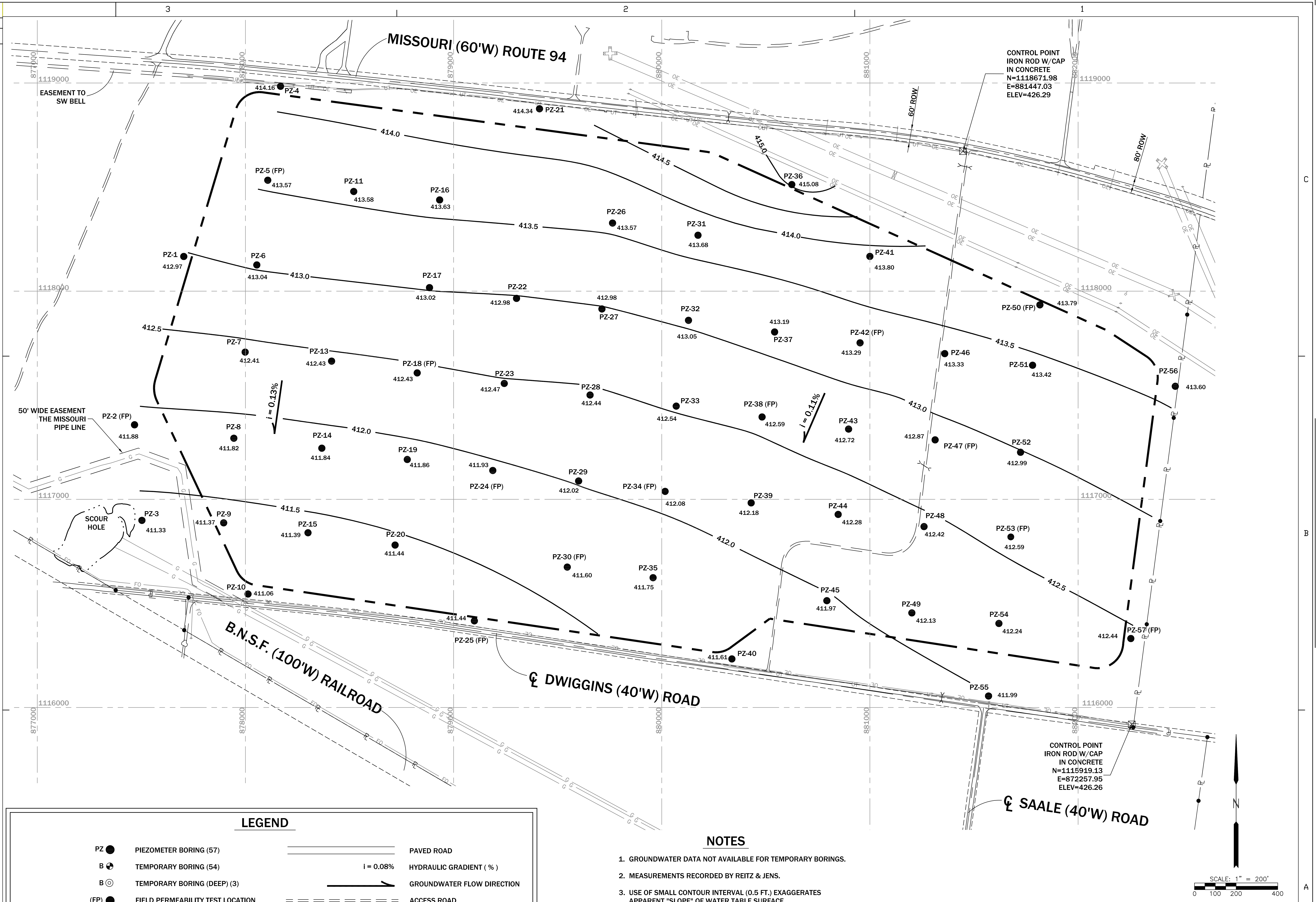

LEGEND

PZ ●	PIEZOMETER BORING (57)
B ◑	TEMPORARY BORING (54)
B ◎	TEMPORARY BORING (DEEP) (3)
(FP) ●	FIELD PERMEABILITY TEST LOCATION
☒	CONTROL POINT
•	℄ SURVEY POINT
	METAL TRANSMISSION TOWER
	EXISTING POWER POLE
	CULVERT
415.0	GROUND WATER ELEVATION (FT.)
415.0	GROUNDWATER CONTOUR NOTE: CONTOUR INTERVAL (C.I.)=0.5 FT.
	PAVED ROAD
i = 0.08%	HYDRAULIC GRADIENT (%)
	GROUNDWATER FLOW DIRECTION
	ACCESS ROAD
℄	PROPERTY LINE (APPROX.)
	CENTERLINE OF EXISTING ROAD
	PROPOSED UTILITY WASTE DISPOSAL AREA FOOTPRINT
G	EXISTING MISSOURI PIPELINE
UT	EXISTING UNDERGROUND UTILITIES
FO	EXISTING FIBER OPTIC
OE	EXISTING OVERHEAD ELECTRIC

NOTES

1. GROUNDWATER DATA NOT AVAILABLE FOR TEMPORARY BORINGS.
2. MEASUREMENTS RECORDED BY REITZ & JENS.
3. USE OF SMALL CONTOUR INTERVAL (0.5 FT.) EXAGGERATES APPARENT "SLOPE" OF WATER TABLE SURFACE.
4. MAP REPRESENTATIVE OF GROUNDWATER CONDITIONS OCCURRING ON DATE OF MEASUREMENT: JANUARY 6, 2006.
5. GROUNDWATER ELEVATION READING FOR PZ-12 WAS BELIEVED TO BE ANOMALOUS AND THEREFORE WAS NOT INCLUDED IN WATER TABLE SURFACE MAP.
6. HYDRAULIC GRADIENTS CALCULATED USING GROUNDWATER ELEVATIONS MEASURED IN PIEZOMETERS PZ-4, PZ-21, PZ-10, PZ-36, PZ-50 AND PZ-40.
7. ELEVATION DATA FOR "SCOUR HOLE" WAS NOT AVAILABLE FOR DATE OF GROUNDWATER MEASUREMENTS.

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DRAWN 080806 W.J.A. (G.E.R.)	**FIGURE 25** **DETAILED SITE INVESTIGATION** **PROPOSED UTILITY WASTE DISPOSAL AREA** **WATER TABLE SURFACE MAP - JANUARY 2006**
CHKD. A.R.C. (G.E.R.)	
SUPV. D.E.K. (G.E.R.)	
APPD. D.E.K. (G.E.R.)	LOCATION 001009 / **SIOUX PLANT** / CLASS 02010
AmerenUE ST. LOUIS, MISSOURI	8430-Y-0168601-26 / REV.

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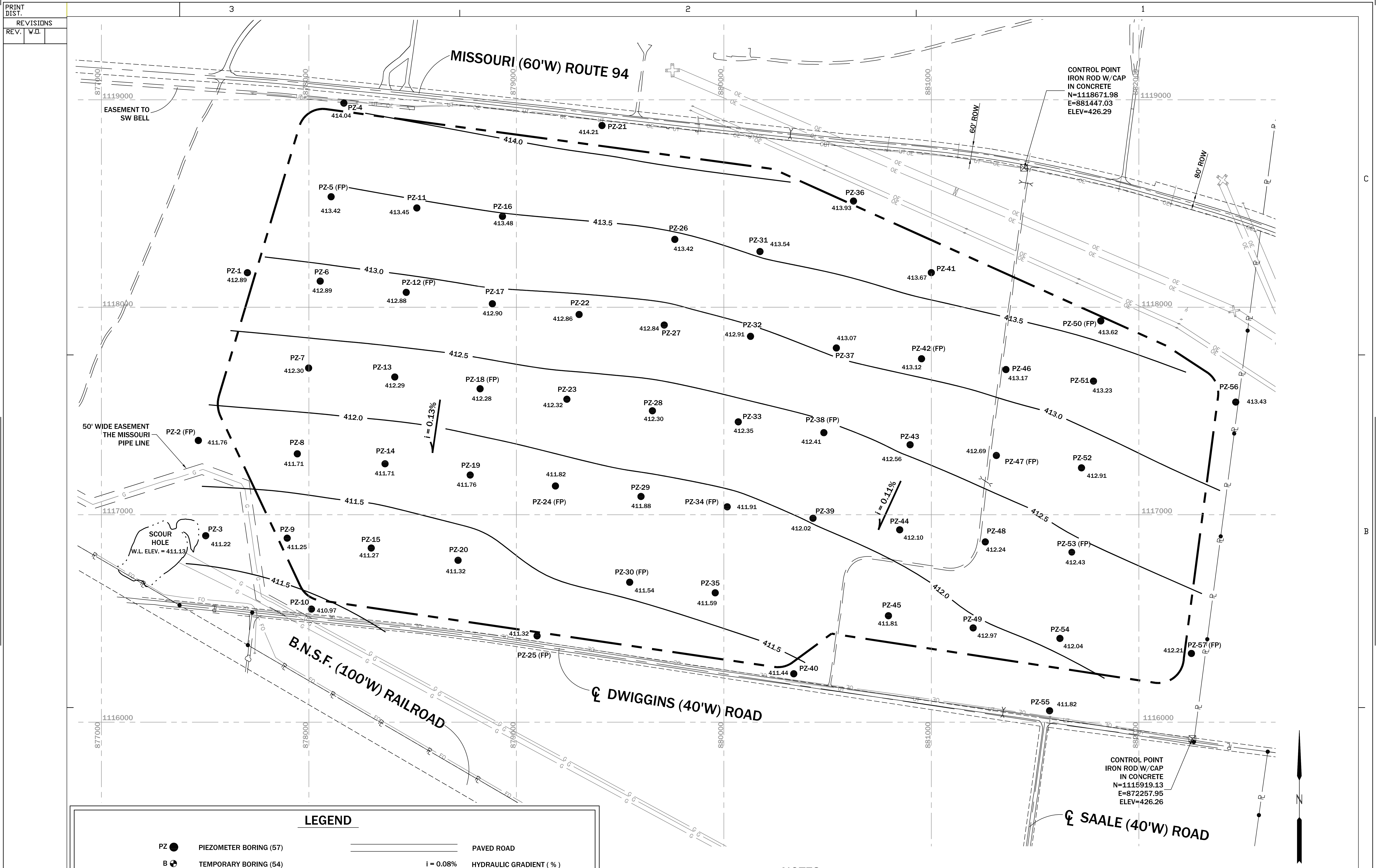

LEGEND

PZ ●	PIEZOMETER BORING (57)	═══	PAVED ROAD
B ◕	TEMPORARY BORING (54)	i = 0.08%	HYDRAULIC GRADIENT (%)
B ◎	TEMPORARY BORING (DEEP) (3)	⟶	GROUNDWATER FLOW DIRECTION
(FP) ●	FIELD PERMEABILITY TEST LOCATION	═ ═ ═ ═	ACCESS ROAD
☒	CONTROL POINT	── ℄ ──	PROPERTY LINE (APPROX.)
•	℄ SURVEY POINT	── — ──	CENTERLINE OF EXISTING ROAD
✕	METAL TRANSMISSION TOWER	━━ ━ ━ ━━	PROPOSED UTILITY WASTE DISPOSAL AREA FOOTPRINT
─○─	EXISTING POWER POLE	── G ──	EXISTING MISSOURI PIPELINE
≻─≺	CULVERT	──UT──UT──	EXISTING UNDERGROUND UTILITIES
415.0	GROUND WATER ELEVATION (FT.)	── FO ──	EXISTING FIBER OPTIC
━━ 415.0 ━━	GROUNDWATER CONTOUR NOTE: CONTOUR INTERVAL (C.I.)=0.5 FT.	──OE──OE──	EXISTING OVERHEAD ELECTRIC

NOTES

1. GROUNDWATER DATA NOT AVAILABLE FOR TEMPORARY BORINGS.
2. MEASUREMENTS RECORDED BY REITZ & JENS.
3. USE OF SMALL CONTOUR INTERVAL (0.5 FT.) EXAGGERATES APPARENT "SLOPE" OF WATER TABLE SURFACE.
4. MAP REPRESENTATIVE OF GROUNDWATER CONDITIONS OCCURRING ON DATE OF MEASUREMENT: FEBRUARY 2, 2006.
5. HYDRAULIC GRADIENTS CALCULATED USING GROUNDWATER ELEVATIONS MEASURED IN PIEZOMETERS PZ-4, PZ-21, PZ-10, PZ-36, PZ-50 AND PZ-40.

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CHKD. A.R.C. (G.E.R.)
SUPV. D.E.K. (G.E.R.)
APPD. D.E.K. (G.E.R.)

FIGURE 26
DETAILED SITE INVESTIGATION
PROPOSED UTILITY WASTE DISPOSAL AREA
WATER TABLE SURFACE MAP - FEBRUARY 2006

LOCATION 001009
SIOUX PLANT
CLASS 02010

AmerenUE ST. LOUIS, MISSOURI
8430-Y-0168601-27
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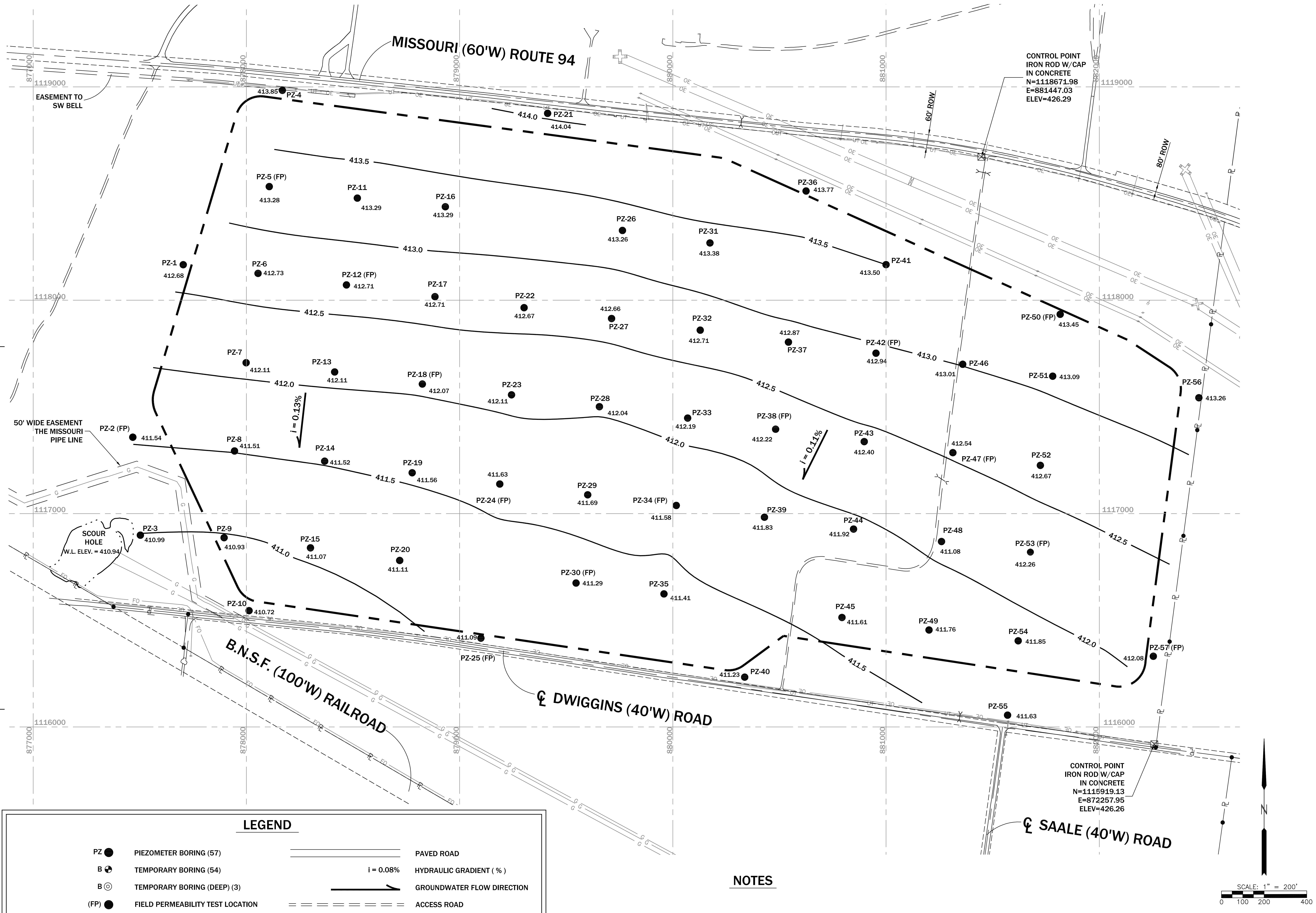

LEGEND

PZ ●	PIEZOMETER BORING (57)	═	PAVED ROAD
B ◕	TEMPORARY BORING (54)	i = 0.08%	HYDRAULIC GRADIENT (%)
B ◎	TEMPORARY BORING (DEEP) (3)	⟶	GROUNDWATER FLOW DIRECTION
(FP) ●	FIELD PERMEABILITY TEST LOCATION	= = = =	ACCESS ROAD
☒	CONTROL POINT	—— ℞ ——	PROPERTY LINE (APPROX.)
•	℞ SURVEY POINT	—— — ——	CENTERLINE OF EXISTING ROAD
✕	METAL TRANSMISSION TOWER	▬ ▬ ▬	PROPOSED UTILITY WASTE DISPOSAL AREA FOOTPRINT
-○-	EXISTING POWER POLE	—— G ——	EXISTING MISSOURI PIPELINE
⟩—⟨	CULVERT	—UT——UT—	EXISTING UNDERGROUND UTILITIES
415.0	GROUND WATER ELEVATION (FT.)	—— FO ——	EXISTING FIBER OPTIC
—— 415.0 ——	GROUNDWATER CONTOUR NOTE: CONTOUR INTERVAL (C.I.)=0.5 FT.	—OE——OE—	EXISTING OVERHEAD ELECTRIC

NOTES

1. GROUNDWATER DATA NOT AVAILABLE FOR TEMPORARY BORINGS.
2. MEASUREMENTS RECORDED BY REITZ & JENS.
3. USE OF SMALL CONTOUR INTERVAL (0.5 FT.) EXAGGERATES APPARENT "SLOPE" OF WATER TABLE SURFACE.
4. MAP REPRESENTATIVE OF GROUNDWATER CONDITIONS OCCURRING ON DATE OF MEASUREMENT: MARCH 6, 2006.
5. HYDRAULIC GRADIENTS CALCULATED USING GROUNDWATER ELEVATIONS MEASURED IN PIEZOMETERS PZ-4, PZ-21, PZ-10, PZ-36, PZ-50 AND PZ-40.

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SUPV. D.E.K. (G.E.R.)
APPD. D.E.K. (G.E.R.)

FIGURE 27
DETAILED SITE INVESTIGATION
PROPOSED UTILITY WASTE DISPOSAL AREA
WATER TABLE SURFACE MAP - MARCH 2006

LOCATION 001009
SIOUX PLANT
CLASS 02010

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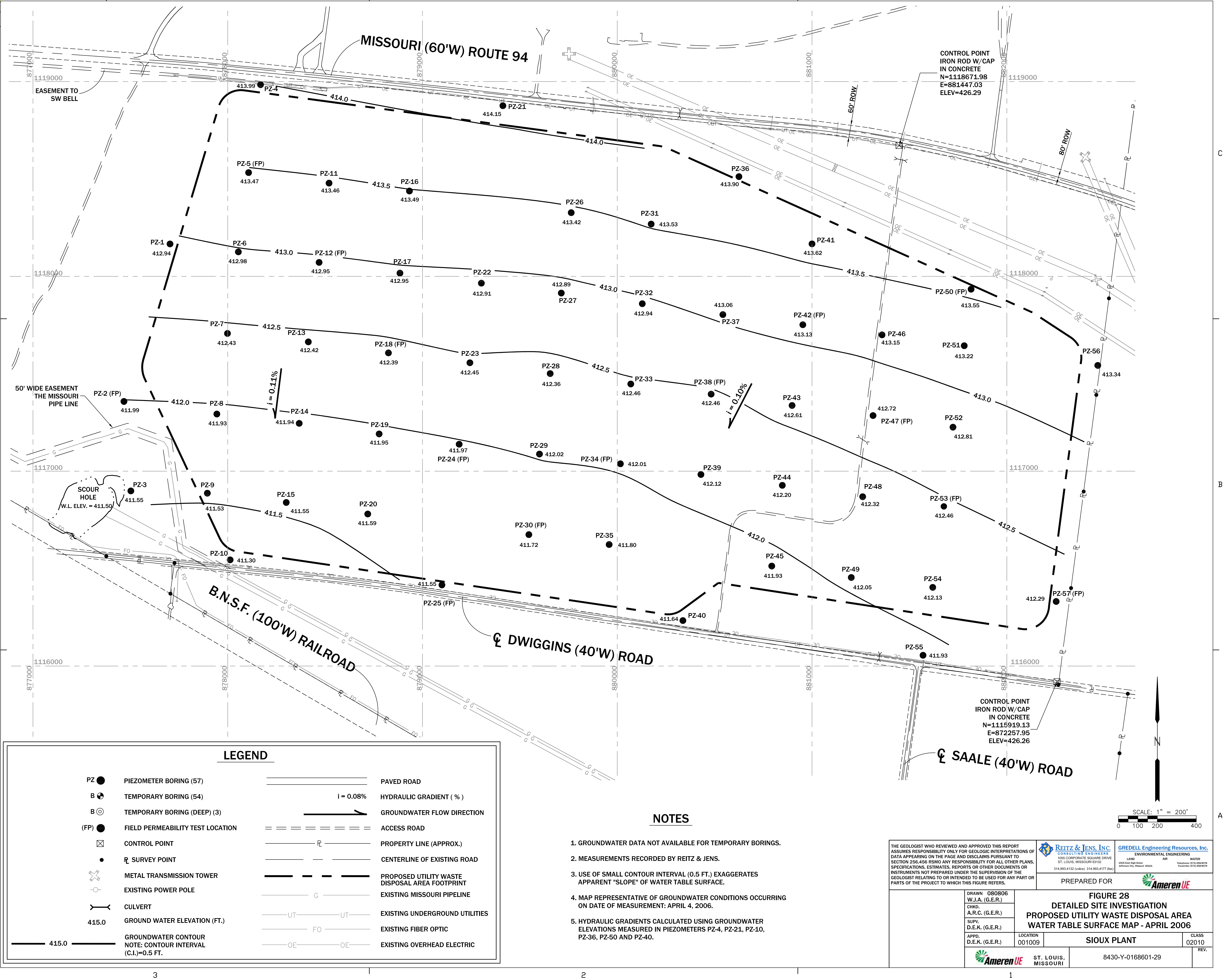

NOTES

1. GROUNDWATER DATA NOT AVAILABLE FOR TEMPORARY BORINGS.
2. MEASUREMENTS RECORDED BY REITZ & JENS.
3. USE OF SMALL CONTOUR INTERVAL (0.5 FT.) EXAGGERATES APPARENT "SLOPE" OF WATER TABLE SURFACE.
4. MAP REPRESENTATIVE OF GROUNDWATER CONDITIONS OCCURRING ON DATE OF MEASUREMENT: APRIL 4, 2006.
5. HYDRAULIC GRADIENTS CALCULATED USING GROUNDWATER ELEVATIONS MEASURED IN PIEZOMETERS PZ-4, PZ-21, PZ-10, PZ-36, PZ-50 AND PZ-40.

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FIGURE 28
DETAILED SITE INVESTIGATION
PROPOSED UTILITY WASTE DISPOSAL AREA
WATER TABLE SURFACE MAP - APRIL 2006

LOCATION 001009
SIOUX PLANT
CLASS 02010

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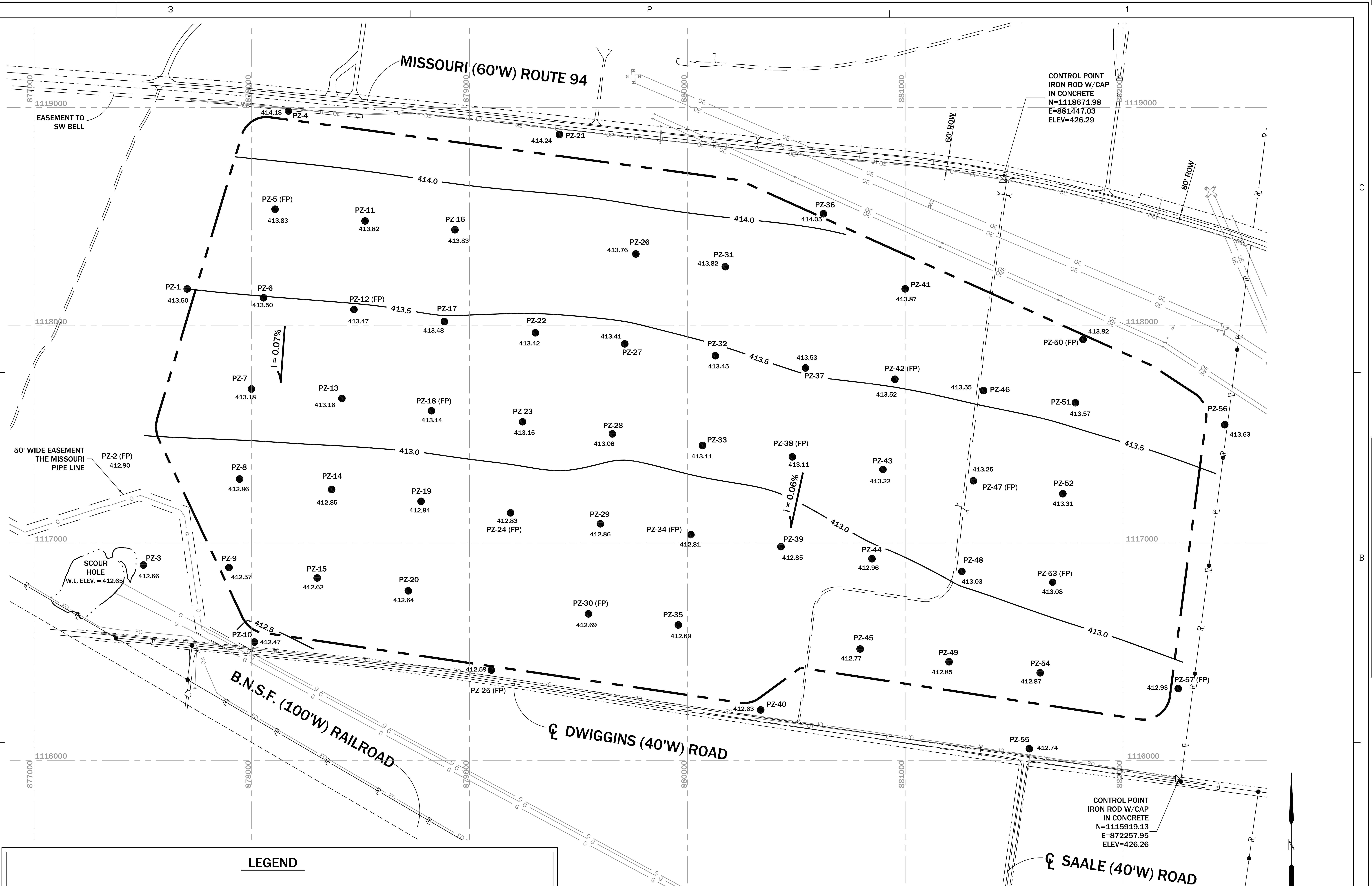

LEGEND

PZ ●	PIEZOMETER BORING (57)		PAVED ROAD
B ◒	TEMPORARY BORING (54)	i = 0.08%	HYDRAULIC GRADIENT (%)
B ◎	TEMPORARY BORING (DEEP) (3)		GROUNDWATER FLOW DIRECTION
(FP) ●	FIELD PERMEABILITY TEST LOCATION		ACCESS ROAD
☒	CONTROL POINT	℞	PROPERTY LINE (APPROX.)
•	℞ SURVEY POINT		CENTERLINE OF EXISTING ROAD
	METAL TRANSMISSION TOWER		PROPOSED UTILITY WASTE DISPOSAL AREA FOOTPRINT
	EXISTING POWER POLE	G	EXISTING MISSOURI PIPELINE
	CULVERT	UT UT	EXISTING UNDERGROUND UTILITIES
415.0	GROUND WATER ELEVATION (FT.)	FO	EXISTING FIBER OPTIC
415.0	GROUNDWATER CONTOUR NOTE: CONTOUR INTERVAL (C.I.)=0.5 FT.	OE OE	EXISTING OVERHEAD ELECTRIC

NOTES

1. GROUNDWATER DATA NOT AVAILABLE FOR TEMPORARY BORINGS.
2. MEASUREMENTS RECORDED BY REITZ & JENS.
3. USE OF SMALL CONTOUR INTERVAL (0.5 FT.) EXAGGERATES APPARENT "SLOPE" OF WATER TABLE SURFACE.
4. MAP REPRESENTATIVE OF GROUNDWATER CONDITIONS OCCURRING ON DATE OF MEASUREMENT: MAY 1, 2006.
5. HYDRAULIC GRADIENTS CALCULATED USING GROUNDWATER ELEVATIONS MEASURED IN PIEZOMETERS PZ-4, PZ-21, PZ-10, PZ-36, PZ-50 AND PZ-40.

SCALE: 1" = 200'
0 100 200 400

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APPD. D.E.K. (G.E.R.)

FIGURE 29
DETAILED SITE INVESTIGATION
PROPOSED UTILITY WASTE DISPOSAL AREA
WATER TABLE SURFACE MAP - MAY 2006

LOCATION 001009

SIOUX PLANT

CLASS 02010

AmerenUE ST. LOUIS, MISSOURI

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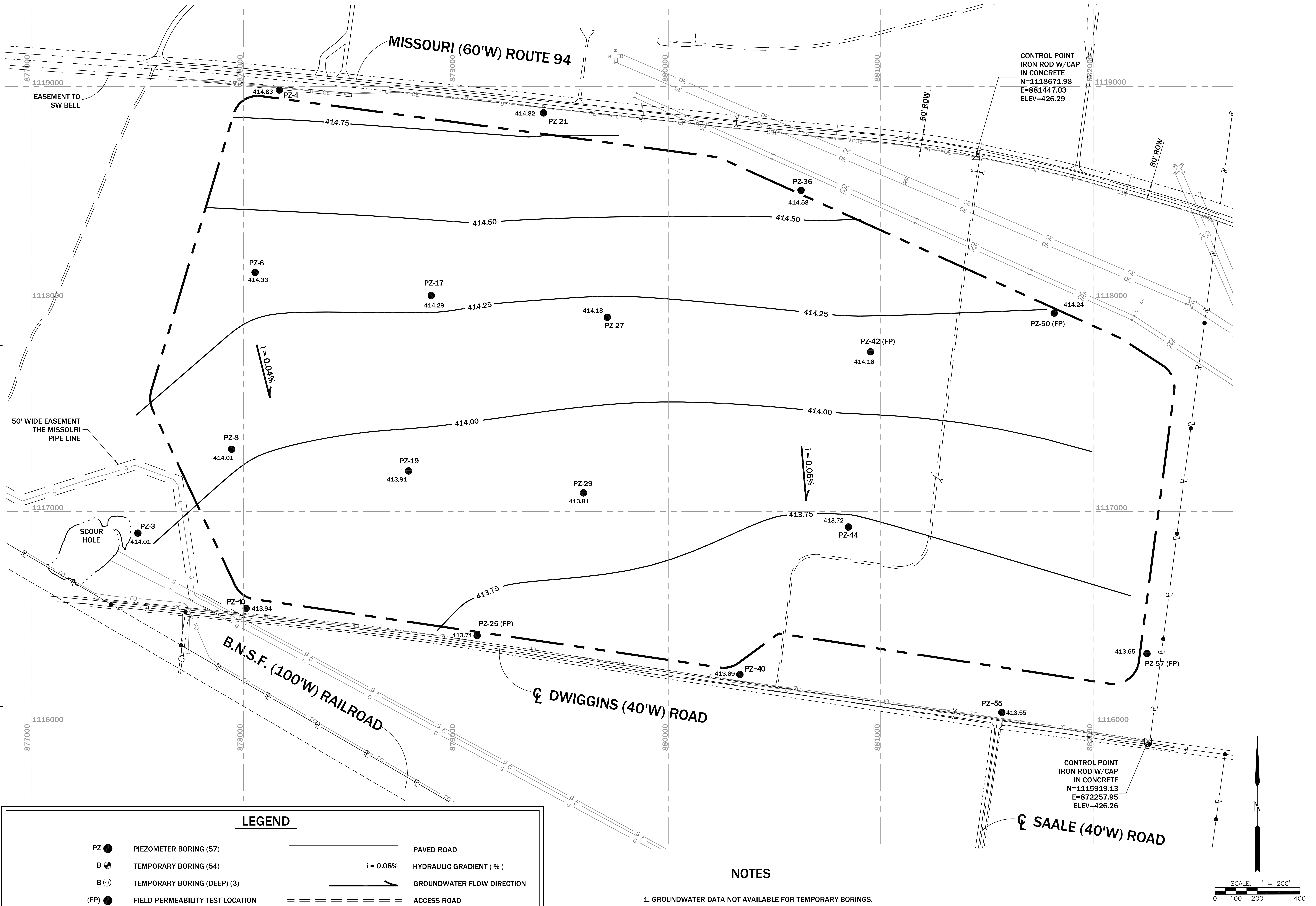

LEGEND

PZ ●	PIEZOMETER BORING (57)	═	PAVED ROAD
B ◕	TEMPORARY BORING (54)	i = 0.08%	HYDRAULIC GRADIENT (%)
B ◎	TEMPORARY BORING (DEEP) (3)	⟶	GROUNDWATER FLOW DIRECTION
(FP) ●	FIELD PERMEABILITY TEST LOCATION	═ ═ ═ ═	ACCESS ROAD
☒	CONTROL POINT	—— ℞ ——	PROPERTY LINE (APPROX.)
●	℞ SURVEY POINT	—— — ——	CENTERLINE OF EXISTING ROAD
✕	METAL TRANSMISSION TOWER	▬ ▬ ▬	PROPOSED UTILITY WASTE DISPOSAL AREA FOOTPRINT
-○-	EXISTING POWER POLE	—— G ——	EXISTING MISSOURI PIPELINE
>—<	CULVERT	—UT—UT—	EXISTING UNDERGROUND UTILITIES
415.0	GROUND WATER ELEVATION (FT.)	—— FO ——	EXISTING FIBER OPTIC
—— 415.0 ——	GROUNDWATER CONTOUR NOTE: CONTOUR INTERVAL (C.I.)=0.25 FT.	—OE—OE—	EXISTING OVERHEAD ELECTRIC

NOTES

1. GROUNDWATER DATA NOT AVAILABLE FOR TEMPORARY BORINGS.
2. MEASUREMENTS RECORDED BY REITZ & JENS.
3. USE OF SMALL CONTOUR INTERVAL (0.25 FT.) EXAGGERATES APPARENT "SLOPE" OF WATER TABLE SURFACE.
4. MAP REPRESENTATIVE OF GROUNDWATER CONDITIONS OCCURRING ON DATE OF MEASUREMENT: MAY 15, 2006.
5. HYDRAULIC GRADIENTS CALCULATED USING GROUNDWATER ELEVATIONS MEASURED IN PIEZOMETERS PZ-4, PZ-21, PZ-10, PZ-36, PZ-50 AND PZ-40.
6. ELEVATION DATA FOR "SCOUR HOLE" WAS NOT AVAILABLE FOR DATE OF GROUNDWATER MEASURMENTS.

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FIGURE 30
DETAILED SITE INVESTIGATION
PROPOSED UTILITY WASTE DISPOSAL AREA
ACCELERATED GROUNDWATER MONITORING

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CHKD.	A.R.C. (G.E.R.)
SUPV.	D.E.K. (G.E.R.)
APPD.	D.E.K. (G.E.R.)
LOCATION	001009
	SIOUX PLANT
CLASS	02010
REV.	

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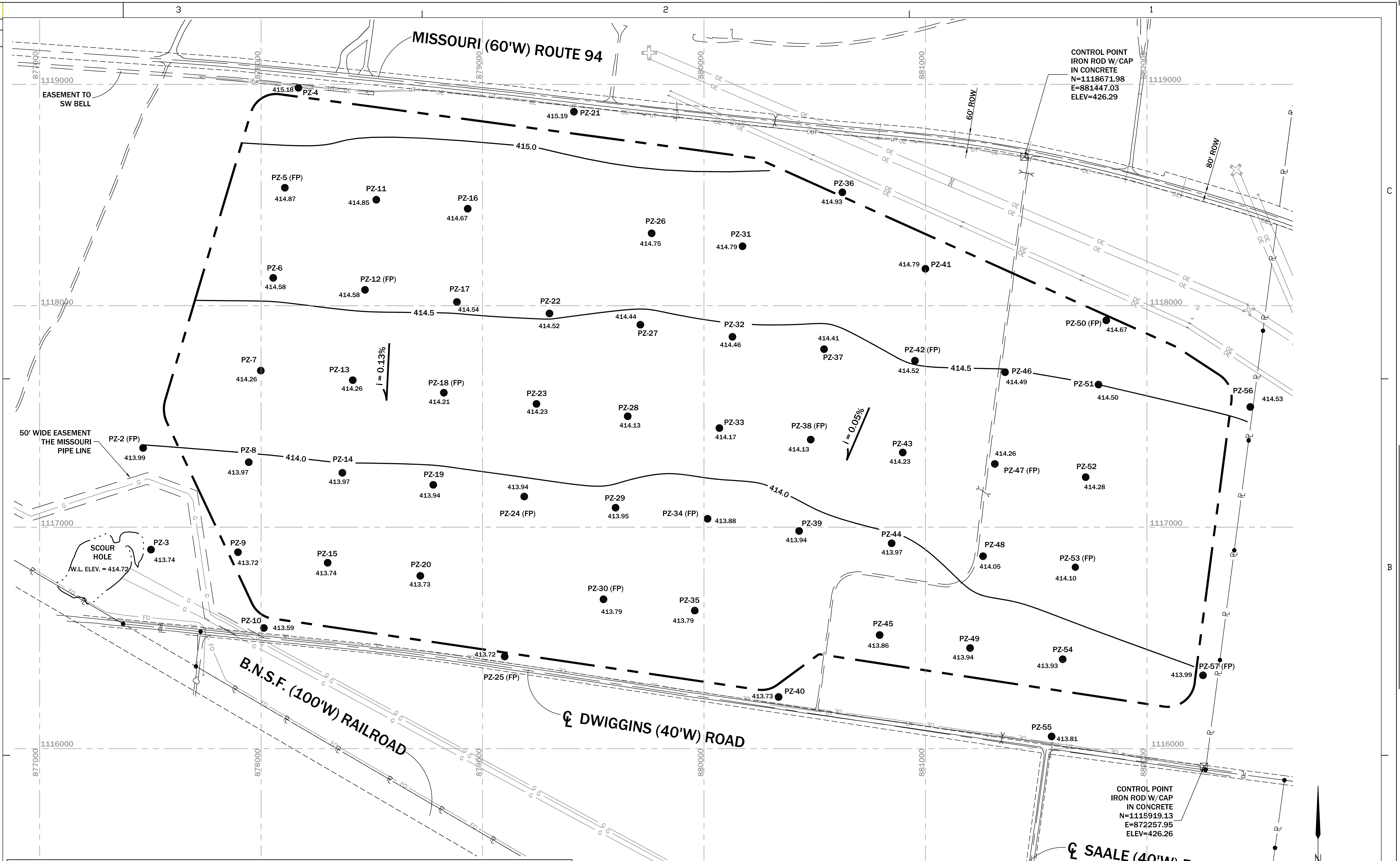

LEGEND

PZ ●	PIEZOMETER BORING (57)	═══════	PAVED ROAD
B ◕	TEMPORARY BORING (54)	i = 0.08%	HYDRAULIC GRADIENT (%)
B ◎	TEMPORARY BORING (DEEP) (3)	——→	GROUNDWATER FLOW DIRECTION
(FP) ●	FIELD PERMEABILITY TEST LOCATION	= = = = = = = =	ACCESS ROAD
☒	CONTROL POINT	—— ℞ ——	PROPERTY LINE (APPROX.)
•	℞ SURVEY POINT	—— — ——	CENTERLINE OF EXISTING ROAD
✕	METAL TRANSMISSION TOWER	━━ ━ ━ ━━	PROPOSED UTILITY WASTE DISPOSAL AREA FOOTPRINT
-○-	EXISTING POWER POLE	—— G ——	EXISTING MISSOURI PIPELINE
≻—≺	CULVERT	—UT——UT—	EXISTING UNDERGROUND UTILITIES
415.0	GROUND WATER ELEVATION (FT.)	—— FO ——	EXISTING FIBER OPTIC
—— 415.0 ——	GROUNDWATER CONTOUR NOTE: CONTOUR INTERVAL (C.I.)=0.5 FT.	—OE——OE—	EXISTING OVERHEAD ELECTRIC

NOTES

1. GROUNDWATER DATA NOT AVAILABLE FOR TEMPORARY BORINGS.
2. MEASUREMENTS RECORDED BY REITZ & JENS.
3. USE OF SMALL CONTOUR INTERVAL (0.5FT.) EXAGGERATES APPARENT "SLOPE" OF WATER TABLE SURFACE.
4. MAP REPRESENTATIVE OF GROUNDWATER CONDITIONS OCCURRING ON DATE OF MEASUREMENT: JUNE 1, 2006.
5. HYDRAULIC GRADIENTS CALCULATED USING GROUNDWATER ELEVATIONS MEASURED IN PIEZOMETERS PZ-4, PZ-21, PZ-10, PZ-36, PZ-50 AND PZ-40.
6. GROUNDWATER ELEVATION READING FOR PZ-1 WAS BELIEVED TO BE ANOMALOUS AND THEREFORE WAS NOT INCLUDED IN WATER TABLE SURFACE MAP.

SCALE: 1" = 200'
0 100 200 400

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APPD.	D.E.K. (G.E.R.)

FIGURE 31
DETAILED SITE INVESTIGATION
PROPOSED UTILITY WASTE DISPOSAL AREA
WATER TABLE SURFACE MAP - JUNE 2006

LOCATION		CLASS
001009	SIOUX PLANT	02010

AmerenUE ST. LOUIS, MISSOURI

8430-Y-0168601-32

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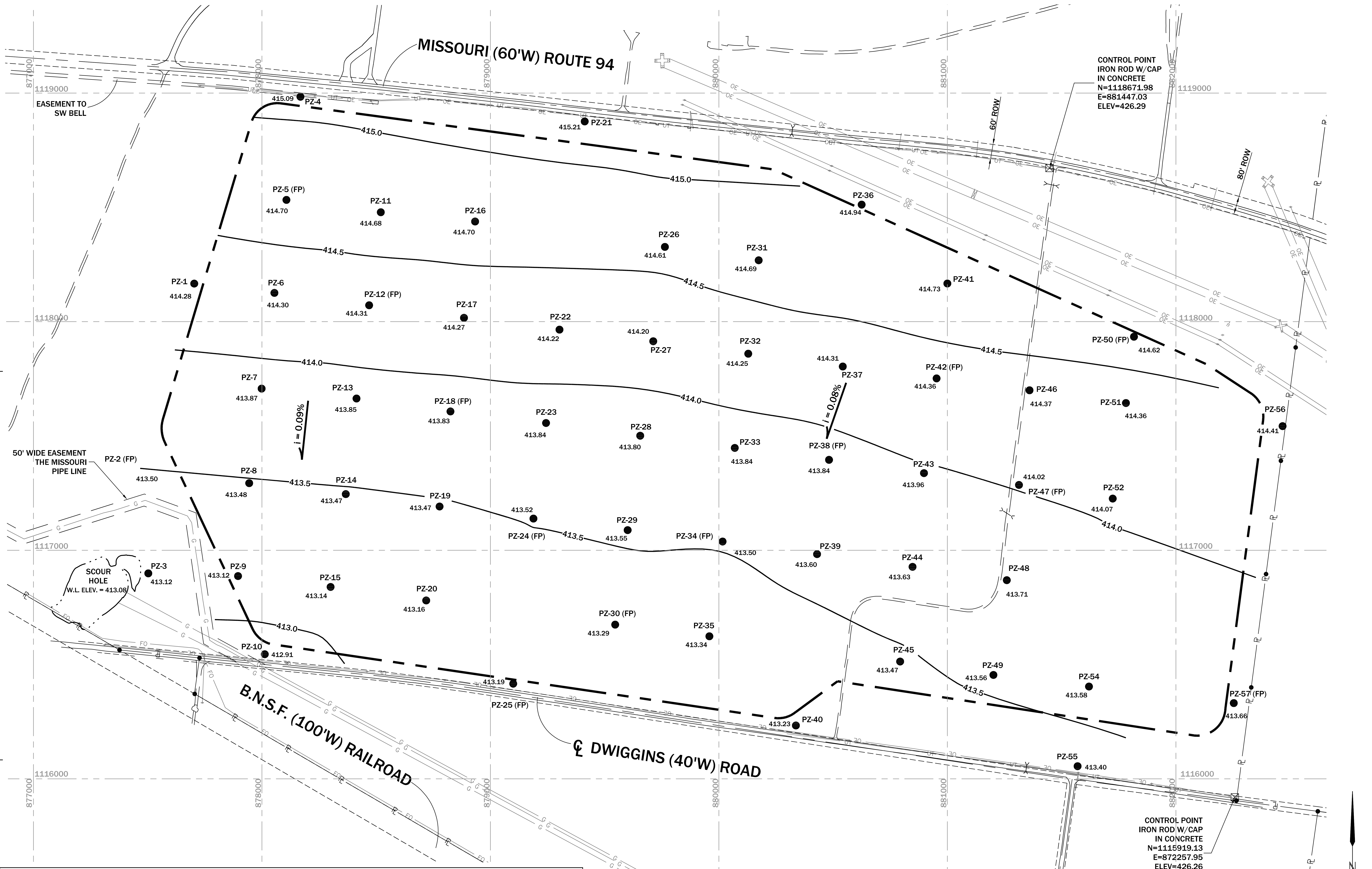

LEGEND

PZ ●	PIEZOMETER BORING (57)	═══	PAVED ROAD
B ◕	TEMPORARY BORING (54)	i = 0.08%	HYDRAULIC GRADIENT (%)
B ◎	TEMPORARY BORING (DEEP) (3)	➔	GROUNDWATER FLOW DIRECTION
(FP) ●	FIELD PERMEABILITY TEST LOCATION	═ ═ ═	ACCESS ROAD
☒	CONTROL POINT	—— ℞ ——	PROPERTY LINE (APPROX.)
• ℞	SURVEY POINT	—— — ——	CENTERLINE OF EXISTING ROAD
✕	METAL TRANSMISSION TOWER	━ ━ ━	PROPOSED UTILITY WASTE DISPOSAL AREA FOOTPRINT
-○-	EXISTING POWER POLE	—— G ——	EXISTING MISSOURI PIPELINE
≻—≺	CULVERT	—UT——UT—	EXISTING UNDERGROUND UTILITIES
415.0	GROUND WATER ELEVATION (FT.)	—— FO ——	EXISTING FIBER OPTIC
—— 415.0 ——	GROUNDWATER CONTOUR NOTE: CONTOUR INTERVAL (C.I.)=0.5 FT.	—OE——OE—	EXISTING OVERHEAD ELECTRIC

NOTES

1. GROUNDWATER DATA NOT AVAILABLE FOR TEMPORARY BORINGS.
2. MEASUREMENTS RECORDED BY REITZ & JENS.
3. USE OF SMALL CONTOUR INTERVAL (0.5 FT.) EXAGGERATES APPARENT "SLOPE" OF WATER TABLE SURFACE.
4. MAP REPRESENTATIVE OF GROUNDWATER CONDITIONS OCCURRING ON DATE OF MEASUREMENT: JULY 3, 2006.
5. HYDRAULIC GRADIENTS CALCULATED USING GROUNDWATER ELEVATIONS MEASURED IN PIEZOMETERS PZ-4, PZ-21, PZ-10, PZ-36, PZ-50 AND PZ-40.
6. GROUNDWATER ELEVATION READING FOR PZ-53 WAS BELIEVED TO BE ANOMALOUS AND THEREFORE WAS NOT INCLUDED IN WATER TABLE SURFACE MAP.

SCALE: 1" = 200'
0 100 200 400

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DRAWN 080806 W.J.A. (G.E.R.)	FIGURE 32 DETAILED SITE INVESTIGATION PROPOSED UTILITY WASTE DISPOSAL AREA WATER TABLE SURFACE MAP - JULY 2006
CHKD. A.R.C. (G.E.R.)	
SUPV. D.E.K. (G.E.R.)	
APPD. D.E.K. (G.E.R.)	LOCATION 001009 · SIOUX PLANT · CLASS 02010
AmerenUE ST. LOUIS, MISSOURI	8430-Y-0168601-33 · REV.

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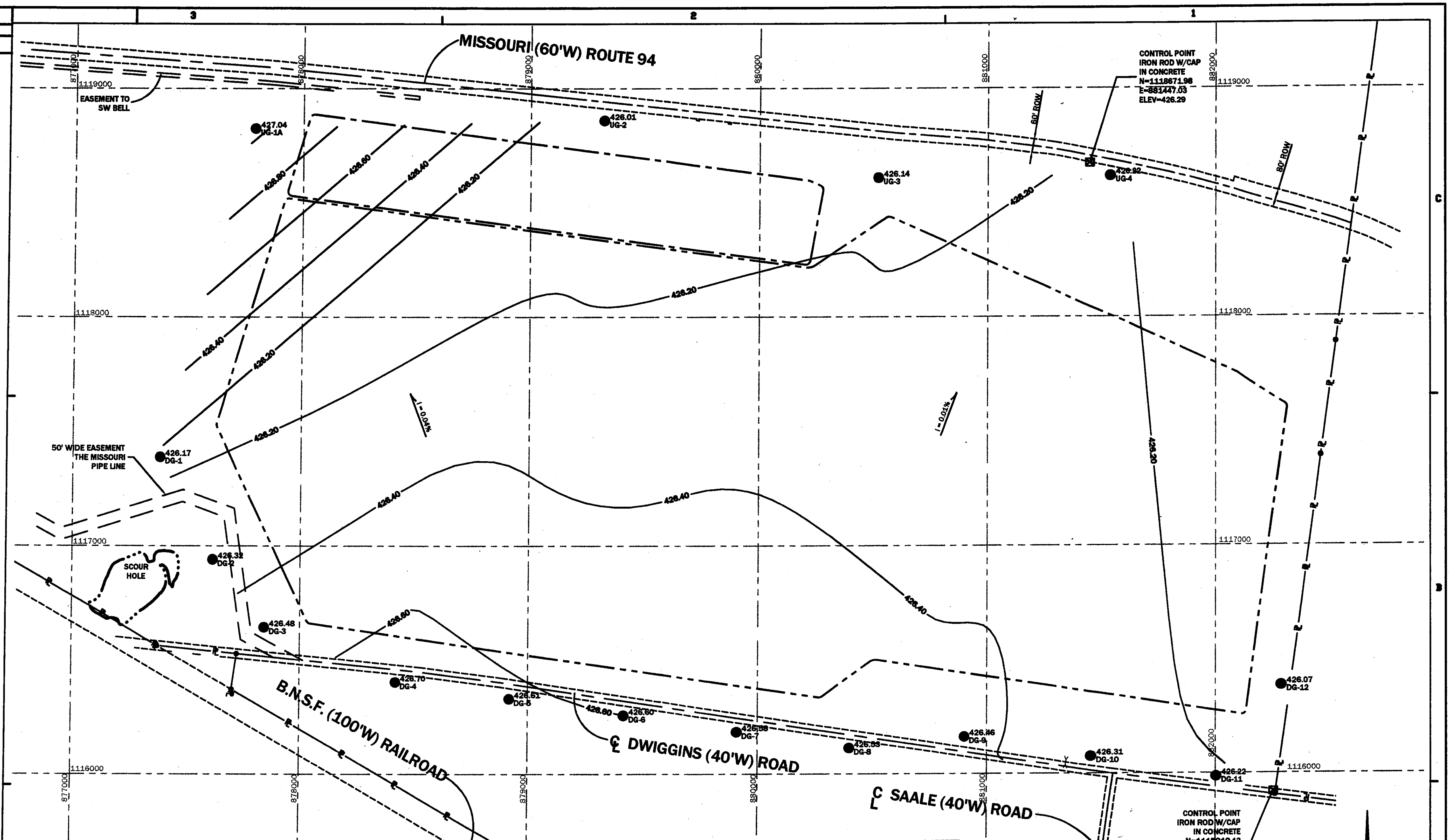

AmerenUE - SIOUX PLANT
GROUNDWATER MONITIORING WATER TABLE SURFACE MAP
GROUNDWATER ELEVATION TABLE

Ameren Sioux Power Plant Elevations for Contour Map				
Well ID	Groundwater Elevation NGVD	Groundwater Elevation NGVD	Groundwater Elevation NGVD	Groundwater Elevation NGVD
	2Q08	3Q08	4Q08	1Q09
DG-1	426.17	418.75	418.31	415.52
DG-2	426.32	418.34	418.09	415.06
DG-3	426.48	418.14	417.90	414.84
DG-4	426.70	417.89	417.83	414.72
DG-5	426.61	418.01	417.84	414.79
DG-6	426.60	418.15	417.86	414.87
DG-7	426.58	418.31	418.04	415.01
DG-8	426.53	418.44	418.12	415.10
DG-9	426.46	418.85	418.15	415.36
DG-10	426.31	418.85	418.24	415.54
DG-11	426.22	419.03	418.24	415.60
DG-12	426.07	419.44	418.40	415.90
UG-1A	427.04	419.92	419.12	416.95
UG-2	426.01	419.66	418.69	416.67
UG-3	426.14	420.25	419.19	417.15
UG-4	426.22	420.44	419.30	417.39

LEGEND

● UG-XX PIEZOMETER LOCATIONS DG-XX
☒ CONTROL POINT
• ℞ SURVEY POINT
METAL TRANSMISSION TOWER
-○- EXISTING POWER POLE
CULVERT
415.0 GROUND WATER ELEVATION (FT.)
—— 415.0 —— GROUNDWATER CONTOUR NOTE: CONTOUR INTERVAL (C.I.)=0.5 FT.
—— FO —— EXISTING FIBER OPTIC
—— OE —— EXISTING OVERHEAD ELECTRIC
PAVED ROAD
i = 0.08% HYDRAULIC GRADIENT (%)
GROUNDWATER FLOW DIRECTION
ACCESS ROAD
—— ℞ —— PROPERTY LINE (APPROX.)
CENTERLINE OF EXISTING ROAD
PROPOSED UTILITY WASTE DISPOSAL AREA FOOTPRINT
PROPOSED NPDES RECYCLE POND PERMIT
—— G —— EXISTING MISSOURI PIPELINE
—UT——UT— EXISTING UNDERGROUND UTILITIES

NOTES

1. USE OF SMALL CONTOUR INTERVAL (0.2 FT.) EXAGGERATES APPARENT "SLOPE" OF WATER TABLE SURFACE.
2. MAP REPRESENTATIVE OF GROUNDWATER CONDITIONS OCCURRING ON DATE OF MEASUREMENT: JUNE 28, 2008.
3. ELEVATION DATA FOR "SCOUR HOLE" NOT AVAILABLE FOR DATE OF GROUNDWATER MEASUREMENTS.

N

SCALE: 1" = 200'
0 100 200 400

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APPD.	J.B.F. (G.E.R.)

GROUNDWATER CONTOUR MAP
PROPOSED UTILITY WASTE DISPOSAL AREA
WATER TABLE SURFACE MAP
JUNE 28, 2008

LOCATION 001009
SIOUX PLANT
CLASS 02010

AmerenUE
ST. LOUIS, MISSOURI
FIGURE 2
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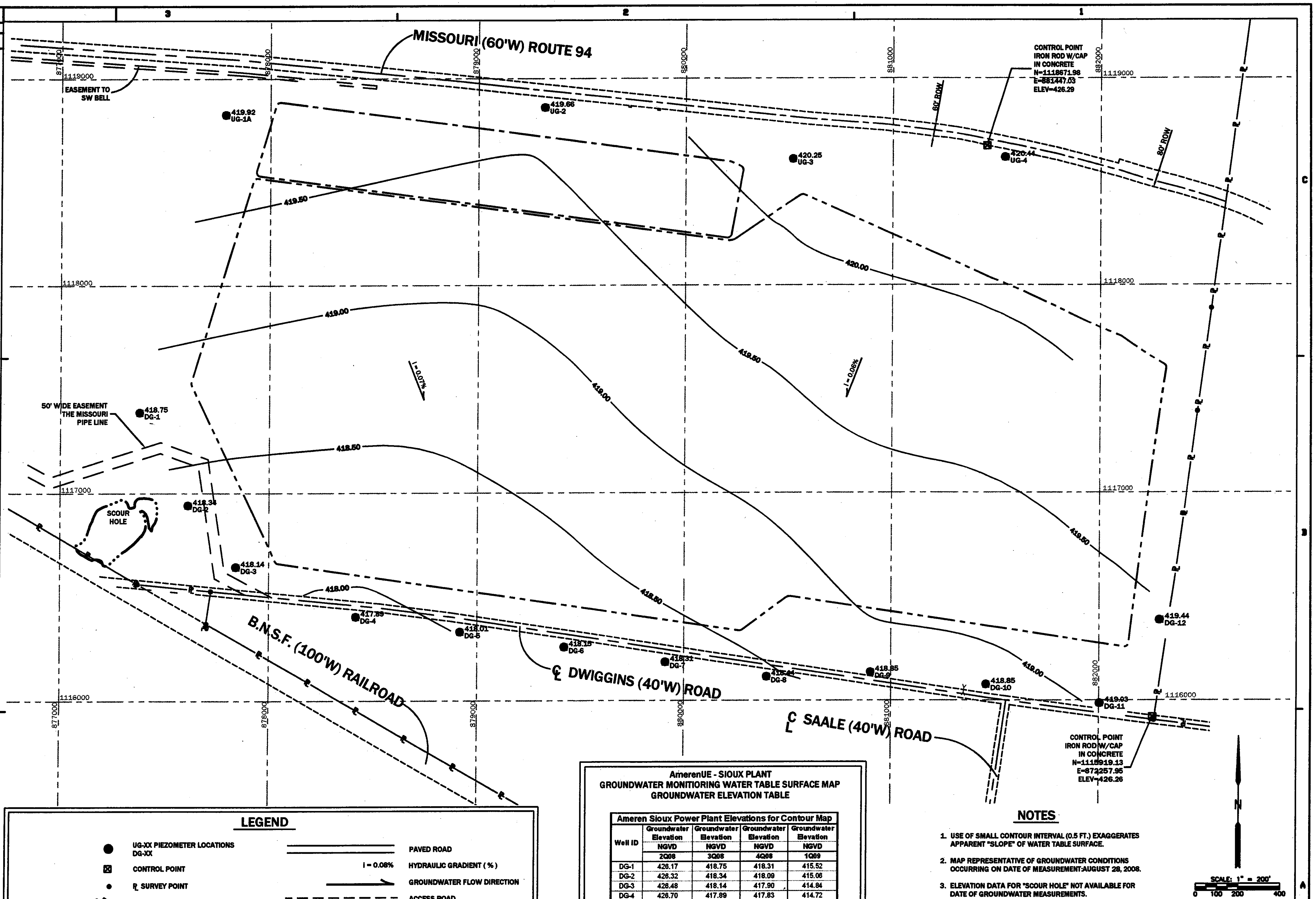

LEGEND

●	UG-XX PIEZOMETER LOCATIONS DG-XX
⊠	CONTROL POINT
•	℞ SURVEY POINT
✕	METAL TRANSMISSION TOWER
-○-	EXISTING POWER POLE
≻—≺	CULVERT
415.0	GROUND WATER ELEVATION (FT.)
—— 415.0 ——	GROUNDWATER CONTOUR NOTE: CONTOUR INTERVAL (C.I.)=0.5 FT.
——— FO ———	EXISTING FIBER OPTIC
———OE———	EXISTING OVERHEAD ELECTRIC
═══════	PAVED ROAD
i = 0.08%	HYDRAULIC GRADIENT (%)
——→	GROUNDWATER FLOW DIRECTION
= = = = = = = =	ACCESS ROAD
——— ℞ ———	PROPERTY LINE (APPROX.)
——— — ———	CENTERLINE OF EXISTING ROAD
— - - — - - —	PROPOSED UTILITY WASTE DISPOSAL AREA FOOTPRINT
—— - —— - ——	PROPOSED NPDES RECYCLE POND PERMIT
——— G ———	EXISTING MISSOURI PIPELINE
——UT——UT——	EXISTING UNDERGROUND UTILITIES

AmerenUE - SIOUX PLANT
GROUNDWATER MONITIORING WATER TABLE SURFACE MAP
GROUNDWATER ELEVATION TABLE

Ameren Sioux Power Plant Elevations for Contour Map

Well ID	Groundwater Elevation NGVD 2Q08	Groundwater Elevation NGVD 3Q08	Groundwater Elevation NGVD 4Q08	Groundwater Elevation NGVD 1Q09
DG-1	426.17	418.75	418.31	415.52
DG-2	426.32	418.34	418.09	415.06
DG-3	426.48	418.14	417.90	414.84
DG-4	426.70	417.89	417.83	414.72
DG-5	426.61	418.01	417.84	414.79
DG-6	426.60	418.15	417.86	414.87
DG-7	426.58	418.31	418.04	415.01
DG-8	426.53	418.44	418.12	415.10
DG-9	426.46	418.85	418.15	415.36
DG-10	426.31	418.85	418.24	415.54
DG-11	426.22	419.03	418.24	415.60
DG-12	426.07	419.44	418.40	415.90
UG-1A	427.04	419.92	419.12	416.95
UG-2	426.01	419.66	418.69	416.67
UG-3	426.14	420.25	419.19	417.15
UG-4	426.22	420.44	419.30	417.39

NOTES

1. USE OF SMALL CONTOUR INTERVAL (0.5 FT.) EXAGGERATES APPARENT "SLOPE" OF WATER TABLE SURFACE.
2. MAP REPRESENTATIVE OF GROUNDWATER CONDITIONS OCCURRING ON DATE OF MEASUREMENT:AUGUST 28, 2008.
3. ELEVATION DATA FOR "SCOUR HOLE" NOT AVAILABLE FOR DATE OF GROUNDWATER MEASUREMENTS.

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REITZ & JENS, INC.
CONSULTING ENGINEERS
1055 CORPORATE SQUARE DRIVE
ST. LOUIS, MISSOURI 63132
314.993.4132 (voice) 314.993.4177 (fax)

GREDELL Engineering Resources, Inc.
ENVIRONMENTAL ENGINEERING
LAND AIR WATER

PREPARED FOR AmerenUE

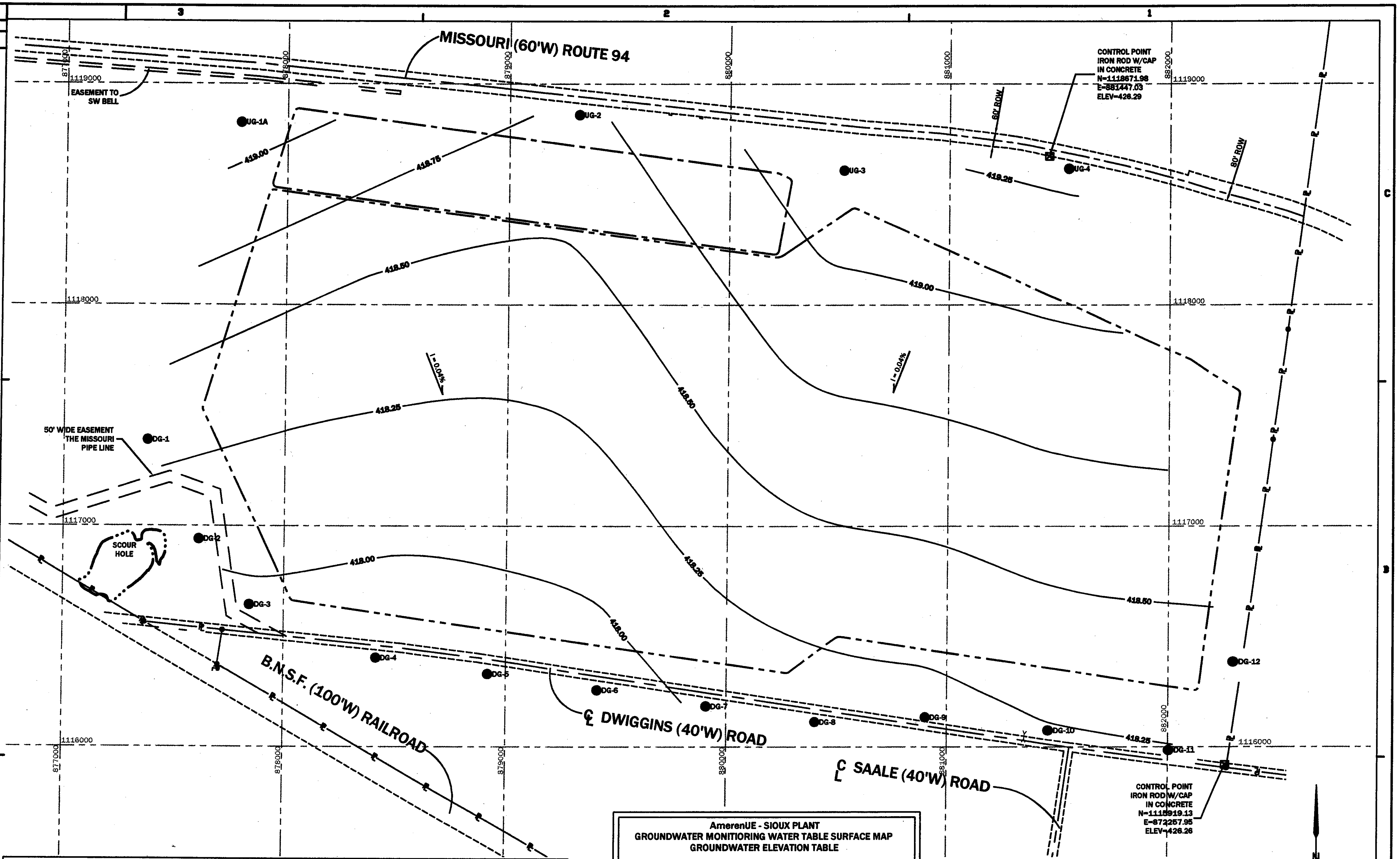
DRAWN 081308	W.J.A. (G.E.R.)
CHKD.	A.R.C. (G.E.R.)
SUPV.	J.B.F. (G.E.R.)
APPD.	J.B.F. (G.E.R.)
LOCATION	001009
CLASS	02010
REV.	

GROUNDWATER CONTOUR MAP
PROPOSED UTILITY WASTE DISPOSAL AREA
WATER TABLE SURFACE MAP
AUGUST 28, 2008

SIOUX PLANT

AmerenUE
ST. LOUIS, MISSOURI

FIGURE 3



LEGEND

- ● UG-XX PIEZOMETER LOCATIONS DG-XX
- ☒ CONTROL POINT
- • ℞ SURVEY POINT
- METAL TRANSMISSION TOWER
- -○- EXISTING POWER POLE
- CULVERT
- 415.0 GROUND WATER ELEVATION (FT.)
- —— 415.0 —— GROUNDWATER CONTOUR NOTE: CONTOUR INTERVAL (C.I.)=0.5 FT.
- —— FO —— EXISTING FIBER OPTIC
- ——OE—— EXISTING OVERHEAD ELECTRIC
- PAVED ROAD
- I = 0.08% HYDRAULIC GRADIENT (%)
- GROUNDWATER FLOW DIRECTION
- ACCESS ROAD
- —— ℞ —— PROPERTY LINE (APPROX.)
- CENTERLINE OF EXISTING ROAD
- PROPOSED UTILITY WASTE DISPOSAL AREA FOOTPRINT
- PROPOSED NPDES RECYCLE POND PERMIT
- —— G —— EXISTING MISSOURI PIPELINE
- ——UT——UT—— EXISTING UNDERGROUND UTILITIES

AmerenUE - SIOUX PLANT
GROUNDWATER MONITIORING WATER TABLE SURFACE MAP
GROUNDWATER ELEVATION TABLE

Ameren Sioux Power Plant Elevations for Contour Map

Well ID	Groundwater Elevation NGVD 2Q08	Groundwater Elevation NGVD 3Q08	Groundwater Elevation NGVD 4Q08	Groundwater Elevation NGVD 1Q09
DG-1	426.17	418.75	418.31	415.52
DG-2	426.32	418.34	418.09	415.06
DG-3	426.48	418.14	417.90	414.84
DG-4	426.70	417.89	417.83	414.72
DG-5	426.61	418.01	417.84	414.79
DG-6	426.60	418.15	417.86	414.87
DG-7	426.58	418.31	418.04	415.01
DG-8	426.53	418.44	418.12	415.10
DG-9	426.46	418.85	418.15	415.36
DG-10	426.31	418.85	418.24	415.54
DG-11	426.22	419.03	418.24	415.60
DG-12	426.07	419.44	418.40	415.90
UG-1A	427.04	419.92	419.12	416.95
UG-2	426.01	419.66	418.69	416.67
UG-3	426.14	420.25	419.19	417.15
UG-4	426.22	420.44	419.30	417.39

NOTES

1. USE OF SMALL CONTOUR INTERVAL (0.25 FT.) EXAGGERATES APPARENT "SLOPE" OF WATER TABLE SURFACE.
2. MAP REPRESENTATIVE OF GROUNDWATER CONDITIONS OCCURRING ON DATE OF MEASUREMENT: NOVEMBER 5, 2008.
3. ELEVATION DATA FOR "SCOUR HOLE" NOT AVAILABLE FOR DATE OF GROUNDWATER MEASUREMENTS.

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GREDELL Engineering Resources, Inc.
ENVIRONMENTAL ENGINEERING
LAND AIR WATER

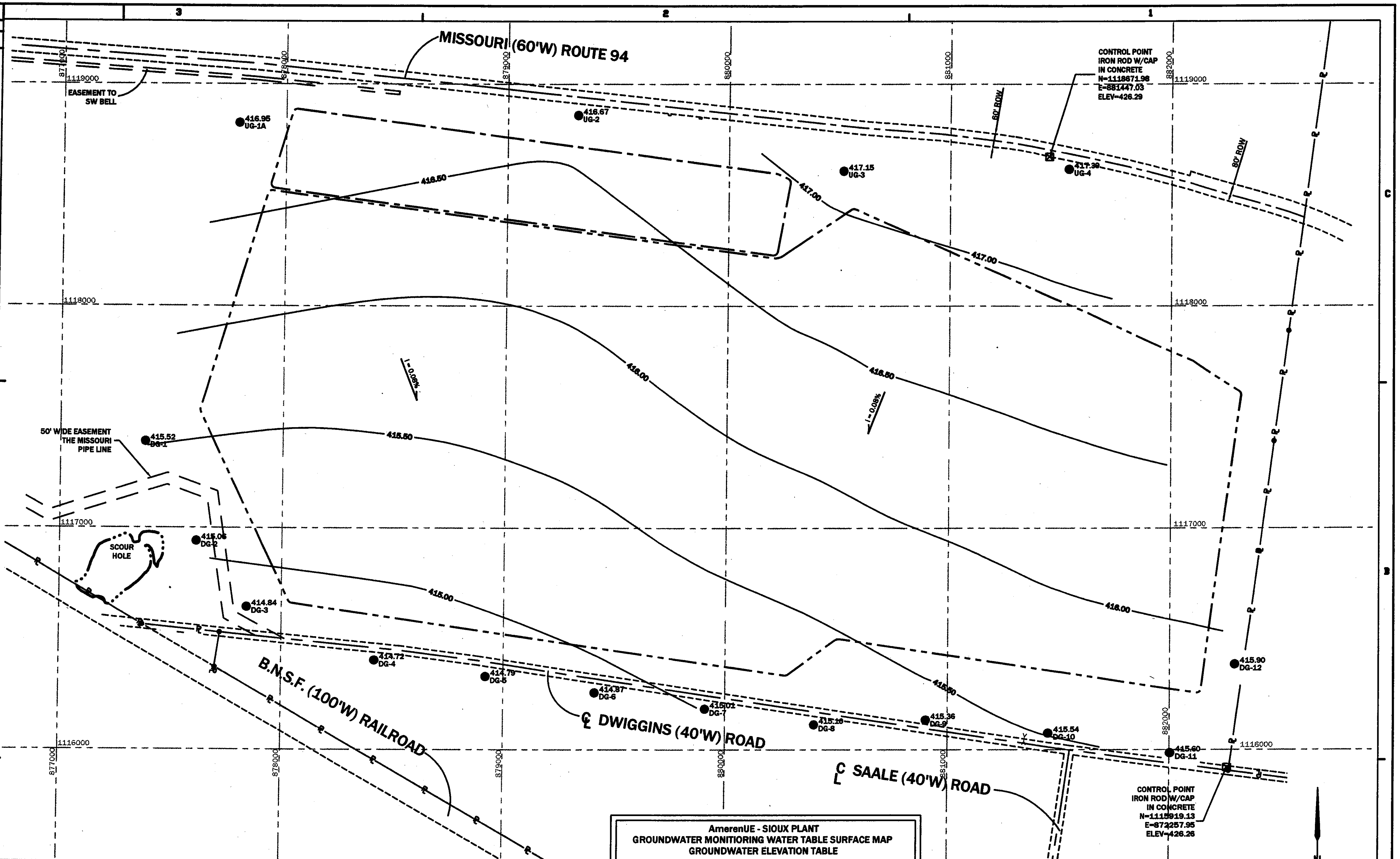
PREPARED FOR AmerenUE

DRAWN 081308 W.J.A. (G.E.R.)	GROUNDWATER CONTOUR MAP PROPOSED UTILITY WASTE DISPOSAL AREA WATER TABLE SURFACE MAP NOVEMBER 5, 2008
CHKD. A.R.C. (G.E.R.)	
SUPV. J.B.F. (G.E.R.)	
APPD. J.B.F. (G.E.R.)	LOCATION 001009 — SIOUX PLANT — CLASS 02010
AmerenUE — ST. LOUIS, MISSOURI	FIGURE 4 — REV.

PRINT DIST.

REVISIONS

REV. V.E.



LEGEND

●	UG-XX PIEZOMETER LOCATIONS DG-XX
☒	CONTROL POINT
•	℞ SURVEY POINT
✕	METAL TRANSMISSION TOWER
-○-	EXISTING POWER POLE
>—<	CULVERT
415.0	GROUND WATER ELEVATION (FT.)
—— 415.0 ——	GROUNDWATER CONTOUR NOTE: CONTOUR INTERVAL (C.I.)=0.5 FT.
—— FO ——	EXISTING FIBER OPTIC
—— OE ——	EXISTING OVERHEAD ELECTRIC
═══	PAVED ROAD
i = 0.08%	HYDRAULIC GRADIENT (%)
——→	GROUNDWATER FLOW DIRECTION
= = = = = = = =	ACCESS ROAD
—— ℞ ——	PROPERTY LINE (APPROX.)
—— — ——	CENTERLINE OF EXISTING ROAD
— - - — - - —	PROPOSED UTILITY WASTE DISPOSAL AREA FOOTPRINT
— - — - —	PROPOSED NPDES RECYCLE POND PERMIT
—— G ——	EXISTING MISSOURI PIPELINE
—UT—UT—	EXISTING UNDERGROUND UTILITIES

AmerenUE - SIOUX PLANT
GROUNDWATER MONITIORING WATER TABLE SURFACE MAP
GROUNDWATER ELEVATION TABLE

Ameren Sioux Power Plant Elevations for Contour Map				
Well ID	Groundwater Elevation NGVD	Groundwater Elevation NGVD	Groundwater Elevation NGVD	Groundwater Elevation NGVD
	2Q08	3Q08	4Q08	1Q09
DG-1	426.17	418.75	418.31	415.52
DG-2	426.32	418.34	418.09	415.06
DG-3	426.48	418.14	417.90	414.84
DG-4	426.70	417.89	417.83	414.72
DG-5	426.61	418.01	417.84	414.79
DG-6	426.60	418.15	417.86	414.87
DG-7	426.58	418.31	418.04	415.01
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UG-1A	427.04	419.92	419.12	416.95
UG-2	426.01	419.66	418.69	416.67
UG-3	426.14	420.25	419.19	417.15
UG-4	426.22	420.44	419.30	417.39

NOTES

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2. MAP REPRESENTATIVE OF GROUNDWATER CONDITIONS OCCURRING ON DATE OF MEASUREMENT: FEBRUARY 5, 2009
3. ELEVATION DATA FOR "SCOUR HOLE" NOT AVAILABLE FOR DATE OF GROUNDWATER MEASUREMENTS.

SCALE: 1" = 200'
0 100 200 400

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ST. LOUIS, MISSOURI 63132

GREDELL Engineering Resources, Inc.
ENVIRONMENTAL ENGINEERING
LAND AIR WATER

PREPARED FOR AmerenUE

DRAWN 081308 W.J.A. (G.E.R.)
CHKD. A.R.C. (G.E.R.)
SUPV. J.B.F. (G.E.R.)
APPD. J.B.F. (G.E.R.)

GROUNDWATER CONTOUR MAP
PROPOSED UTILITY WASTE DISPOSAL AREA
WATER TABLE SURFACE MAP
FEBRUARY 5, 2009

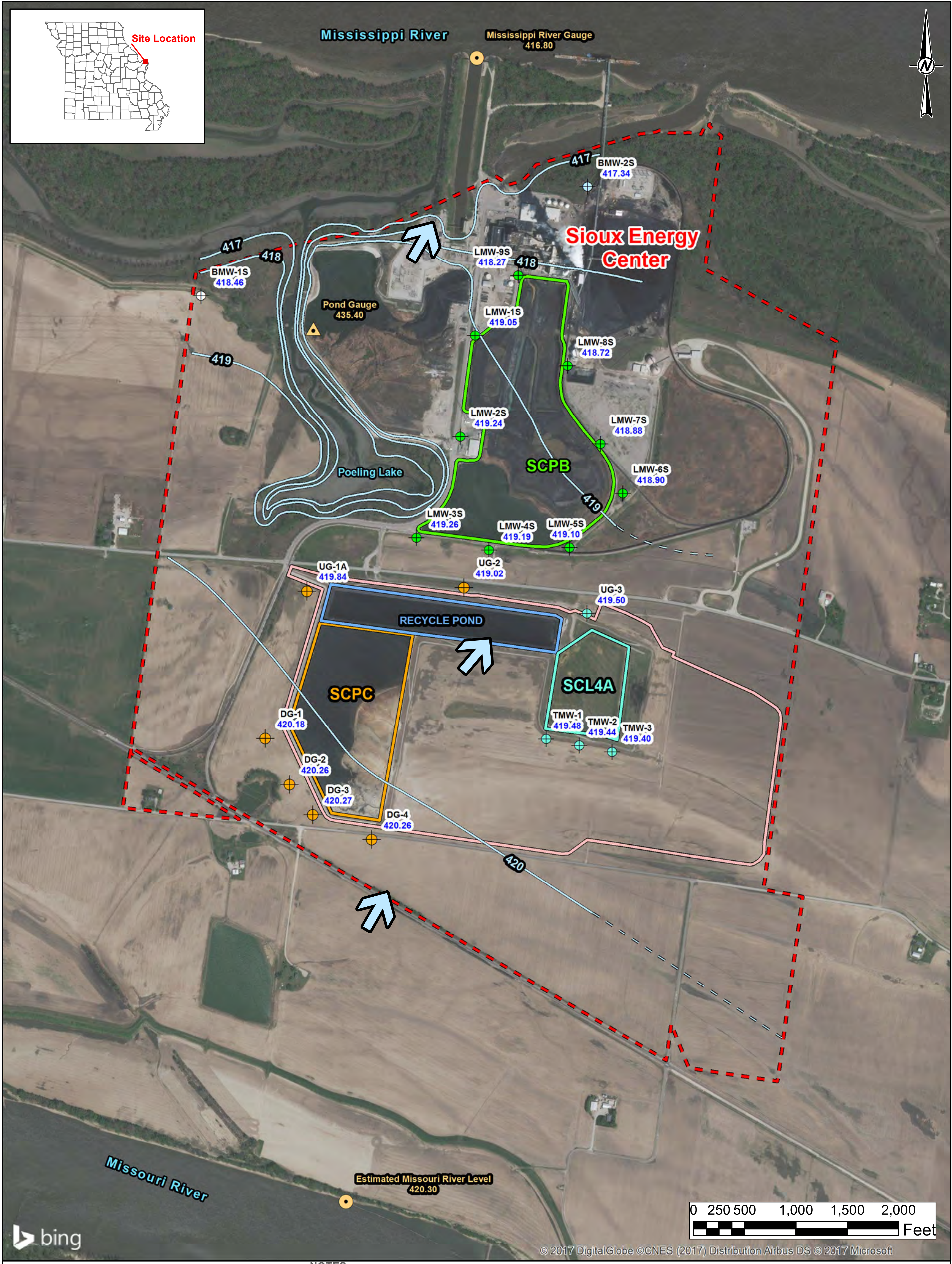
LOCATION 001009
SIOUX PLANT
CLASS 02010

AmerenUE
ST. LOUIS, MISSOURI
FIGURE 5
REV.

3
2
1

APPENDIX C
POTENTIOMETRIC SURFACE MAPS FROM BACKGROUND CCR SAMPLING EVENTS

Path: G:\Projects\150 Projects\1531406 - Ameren GW Monitoring Program - MO\Phase 0003 - Sioux Energy\800 - FIGURES-DRAWINGS\PRODUCTION\GMP\Updated Pot Maps\Final\Updated Shallow\SCPC-E1.mxd



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LEGEND

- Sioux Energy Center Property Boundary
- SCPB - Fly Ash Surface Impoundment

Ground/Surface Water Measurement Locations

- ⊕ SCL4A - UWL Cell 4A Monitoring Well
- ⊕ Groundwater Elevation Piezometer
- ⊕ Background Monitoring Well
- ⊕ SCPB - Fly Ash Surface Impoundment Monitoring Well
- ⊕ SCPC - WFGD Surface Impoundment Monitoring Well
- ▲ SPCA Pond Gauge
- ● River Elevation

Utility Waste Landfill (UWL)

- ☐ SCL4A - UWL Cell 4A
- ☐ SCPC - WFGD Surface Impoundment
- ☐ Water Recycle Pond
- ☐ UWL Future Perimeter Fence

Groundwater Elevation Contours

- Groundwater Elevation Contour (FT MSL)
- Inferred Groundwater Elevation Contour (FT MSL)
- Groundwater Flow Direction

NOTES

1.) ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2.) GOLDER GROUNDWATER MONITORING WELLS SURVEYED BY ZAHNER AND ASSOCIATES, INC. ON JANUARY 14, APRIL 29, AND DECEMBER 8, 2016.
3.) GROUNDWATER AND SURFACE WATER ELEVATIONS DISPLAYED IN FT MSL (FEET ABOVE MEAN SEA LEVEL).
4.) GROUNDWATER MEASUREMENTS OBTAINED BY GOLDER.
5.) MISSOURI RIVER ELEVATION ESTIMATED BASED ON NEARBY USGS (UNITED STATES GEOLOGICAL SURVEY) RIVER GAUGING LOCATIONS.
6.) MISSISSIPPI RIVER ELEVATION PROVIDED BY AMEREN MISSOURI.
7.) POND GAUGE LEVEL OBTAINED ONSITE BY GOLDER.
8.) UWL BOUNDARIES, DESIGNATIONS AND STATE MONITORING WELL LOCATIONS BASED ON DRAWINGS IN THE UWL PROPOSED LANDFILL PERMIT (#0918301).
9.) WFGD - WET FLUE GAS DESULFURIZATION.

REFERENCE

1.) AMEREN MISSOURI SIOUX ENERGY CENTER, SIOUX PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2,401 FEET.
3.) USGS NATIONAL WATER INFORMATION SYSTEM, USGS GAUGES 06935965 (ST. CHARLES), 07010000 (ST. LOUIS), 05587498 (ALTON), GRAFTON (05587450).
4.) AMEREN MISSOURI SIOUX POWER PLANT UTILITY WASTE LANDFILL PROPOSED CONSTRUCTION PERMIT MODIFICATION (#0918301), AUGUST 2014.

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

PROJECT
CCR GROUNDWATER MONITORING PROGRAM

TITLE
SCPC POTENTIOMETRIC SURFACE MAP
BACKGROUND EVENT 1 - MAY 9, 2016

CONSULTANT

YYYY-MM-DD	2016-05-25
PREPARED	JSI
DESIGN	JSI
REVIEW	JS
APPROVED	MNH

PROJECT No. 153-1406
PHASE 0003D
FIGURE **P1**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
1 in
0

Path: G:\Projects\150 Projects\1531406 - Ameren GW Monitoring Program - MO\Phase 0003 - Sioux Energy\800 - FIGURES-DRAWINGS\PRODUCTION\GMP\Updated Pot Maps\Final\Updated Shallow\SCPC-E2.mxd

LEGEND

- 🟥 Sioux Energy Center Property Boundary

Ground/Surface Water Measurement Locations

- ⊕ SCL4A - UWL Cell 4A
- ⊕ SCPC - WFGD Surface Impoundment
- ● River Elevation

Utility Waste Landfill (UWL)

- ▭ SCL4A - UWL Cell 4A
- ▭ SCPC - WFGD Surface Impoundment
- ▭ Water Recycle Pond
- ▭ UWL Future Perimeter Fence

Groundwater Elevation Contours

- — Groundwater Elevation Contour (FT MSL)
- - - Inferred Groundwater Elevation Contour (FT MSL)
- ⇧ Groundwater Flow Direction

NOTES

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6.) MISSISSIPPI RIVER ELEVATION PROVIDED BY AMEREN MISSOURI.
7.) UWL BOUNDARIES, DESIGNATIONS AND STATE MONITORING WELL LOCATIONS BASED ON DRAWINGS IN THE UWL PROPOSED LANDFILL PERMIT (#0918301).
8.) WFGD - WET FLUE GAS DESULFURIZATION.

REFERENCE

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4.) AMEREN MISSOURI SIOUX POWER PLANT UTILITY WASTE LANDFILL PROPOSED CONSTRUCTION PERMIT MODIFICATION (#0918301), AUGUST 2014.

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

Ameren

PROJECT
CCR GROUNDWATER MONITORING PROGRAM

TITLE
SCPC POTENTIOMETRIC SURFACE MAP
BACKGROUND EVENT 2 - JUNE 13, 2016

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-05-25
PREPARED	JSI
DESIGN	JSI
REVIEW	JS
APPROVED	MNH

PROJECT No.	PHASE	FIGURE
153-1406	0003D	P2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:

0 1 in

Path: G:\Projects\150 Projects\1531406 - Ameren GW Monitoring Program - MO\Phase 0003 - Sioux Energy\800 - FIGURES-DRAWINGS\PRODUCTION\GMP\Updated Pot Maps\Final\Updated Shallow\SCPC-E3.mxd

LEGEND

- 🟥 Sioux Energy Center Property Boundary
- ▭ SCPB - Fly Ash Surface Impoundment

Ground/Surface Water Measurement Locations

- ⊕ SCL4A - UWL Cell 4A Monitoring Well
- ⊕ Groundwater Elevation Piezometer
- ⊕ Background Monitoring Well
- ⊕ SCPB - Fly Ash Surface Impoundment Monitoring Well
- ⊕ SCPC - WFGD Surface Impoundment Monitoring Well
- ▲ SPCA Pond Gauge
- ⊙ River Elevation

Utility Waste Landfill (UWL)

- ▭ SCL4A - UWL Cell 4A
- ▭ SCPC - WFGD Surface Impoundment
- ▭ Water Recycle Pond
- ▭ UWL Future Perimeter Fence

Groundwater Elevation Contours

- — Groundwater Elevation Contour (FT MSL)
- - - Inferred Groundwater Elevation Contour (FT MSL)
- ↖ Groundwater Flow Direction

NOTES

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3.) GROUNDWATER AND SURFACE WATER ELEVATIONS DISPLAYED IN FT MSL (FEET ABOVE MEAN SEA LEVEL).
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6.) MISSISSIPPI RIVER ELEVATION PROVIDED BY AMEREN MISSOURI.
7.) POND GAUGE LEVEL OBTAINED ONSITE BY GOLDER.
8.) UWL BOUNDARIES, DESIGNATIONS AND STATE MONITORING WELL LOCATIONS BASED ON DRAWINGS IN THE UWL PROPOSED LANDFILL PERMIT (#0918301).
9.) WFGD - WET FLUE GAS DESULFURIZATION.

REFERENCE

1.) AMEREN MISSOURI SIOUX ENERGY CENTER, SIOUX PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2,401 FEET.
3.) USGS NATIONAL WATER INFORMATION SYSTEM, USGS GAUGES 06935965 (ST. CHARLES), 07010000 (ST. LOUIS), 05587498 (ALTON), GRAFTON (05587450).
4.) AMEREN MISSOURI SIOUX POWER PLANT UTILITY WASTE LANDFILL PROPOSED CONSTRUCTION PERMIT MODIFICATION (#0918301), AUGUST 2014.

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

Ameren

PROJECT
CCR GROUNDWATER MONITORING PROGRAM

TITLE
SCPC POTENTIOMETRIC SURFACE MAP
BACKGROUND EVENT 3 - JULY 5, 2016

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-08-16
PREPARED	JS
DESIGN	JS
REVIEW	JSI
APPROVED	MNH

PROJECT No.
153-1406

PHASE
0003D

FIGURE
P3

Path: G:\Projects\150 Projects\1531406 - Ameren GW Monitoring Program - MO\Phase 0003 - Sioux Energy\800 - FIGURES-DRAWINGS\PRODUCTION\GMP\Updated Pot Maps\Final\Updated Shallow\SCPC-E4.mxd

LEGEND

- ▭ Sioux Energy Center Property Boundary
- 🟩 SCPB - Fly Ash Surface Impoundment

Ground/Surface Water Measurement Locations

- ⊕ SCL4A - UWL Cell 4A Monitoring Well
- ⊕ Groundwater Elevation Piezometer
- ⊕ Background Monitoring Well
- ⊕ SCPB - Fly Ash Surface Impoundment Monitoring Well
- ⊕ SCPC - WFGD Surface Impoundment Monitoring Well
- ▲ SPCA Pond Gauge
- ⊙ River Elevation

Utility Waste Landfill (UWL)

- ▭ SCL4A - UWL Cell 4A
- 🟧 SCPC - WFGD Surface Impoundment
- 🟦 Water Recycle Pond
- ▭ UWL Future Perimeter Fence

Groundwater Elevation Contours

- — Groundwater Elevation Contour (FT MSL)
- - - Inferred Groundwater Elevation Contour (FT MSL)
- ↖ Groundwater Flow Direction

NOTES

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6.) MISSISSIPPI RIVER ELEVATION PROVIDED BY AMEREN MISSOURI.
7.) POND GAUGE LEVEL OBTAINED ONSITE BY GOLDER.
8.) UWL BOUNDARIES, DESIGNATIONS AND STATE MONITORING WELL LOCATIONS BASED ON DRAWINGS IN THE UWL PROPOSED LANDFILL PERMIT (#0918301).
9.) WFGD - WET FLUE GAS DESULFURIZATION.

REFERENCE

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2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2,401 FEET.
3.) USGS NATIONAL WATER INFORMATION SYSTEM, USGS GAUGES 06935965 (ST. CHARLES), 07010000 (ST. LOUIS), 05587498 (ALTON), GRAFTON (05587450).
4.) AMEREN MISSOURI SIOUX POWER PLANT UTILITY WASTE LANDFILL PROPOSED CONSTRUCTION PERMIT MODIFICATION (#0918301), AUGUST 2014.

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

Ameren

PROJECT
CCR GROUNDWATER MONITORING PROGRAM

TITLE
SCPC POTENTIOMETRIC SURFACE MAP
BACKGROUND EVENT 4 - SEPTEMBER 14, 2016

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-09-27
PREPARED	JSI
DESIGN	JSI
REVIEW	JS
APPROVED	MNH

PROJECT No.	PHASE	FIGURE
153-1406	0003D	P4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
0
1 in

Path: G:\Projects\150 Projects\1531406 - Ameren GW Monitoring Program - MO\Phase 0003 - Sioux Energy\800 - FIGURES-DRAWINGS\PRODUCTION\GMP\Updated Pot Maps\Final\Updated Shallow\SCPC-E5.mxd

LEGEND

Sioux Energy Center Property Boundary

SCPB - Fly Ash Surface Impoundment

Ground/Surface Water Measurement Locations

SCL4A - UWL Cell 4A Monitoring Well

Groundwater Elevation Piezometer

Background Monitoring Well

SCPB - Fly Ash Surface Impoundment Monitoring Well

SCPC - WFGD Surface Impoundment Monitoring Well

SPCA Pond Gauge

River Elevation

Utility Waste Landfill (UWL)

SCL4A - UWL Cell 4A

SCPC - WFGD Surface Impoundment

Water Recycle Pond

UWL Future Perimeter Fence

Groundwater Elevation Contours

Groundwater Elevation Contour (FT MSL)

Inferred Groundwater Elevation Contour (FT MSL)

Groundwater Flow Direction

NOTES

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6.) MISSISSIPPI RIVER ELEVATION PROVIDED BY AMEREN MISSOURI.
7.) POND GAUGE LEVEL OBTAINED ONSITE BY GOLDER.
8.) UWL BOUNDARIES, DESIGNATIONS AND STATE MONITORING WELL LOCATIONS BASED ON DRAWINGS IN THE UWL PROPOSED LANDFILL PERMIT (#0918301).
9.) WFGD - WET FLUE GAS DESULFURIZATION.

REFERENCE

1.) AMEREN MISSOURI SIOUX ENERGY CENTER, SIOUX PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2,401 FEET.
3.) USGS NATIONAL WATER INFORMATION SYSTEM, USGS GAUGES 06935965 (ST. CHARLES), 07010000 (ST. LOUIS), 05587498 (ALTON), GRAFTON (05587450).
4.) AMEREN MISSOURI SIOUX POWER PLANT UTILITY WASTE LANDFILL PROPOSED CONSTRUCTION PERMIT MODIFICATION (#0918301), AUGUST 2014.

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

Ameren

PROJECT
CCR GROUNDWATER MONITORING PROGRAM

TITLE
SCPC POTENTIOMETRIC SURFACE MAP
BACKGROUND EVENT 5 - NOVEMBER 7, 2016

CONSULTANT

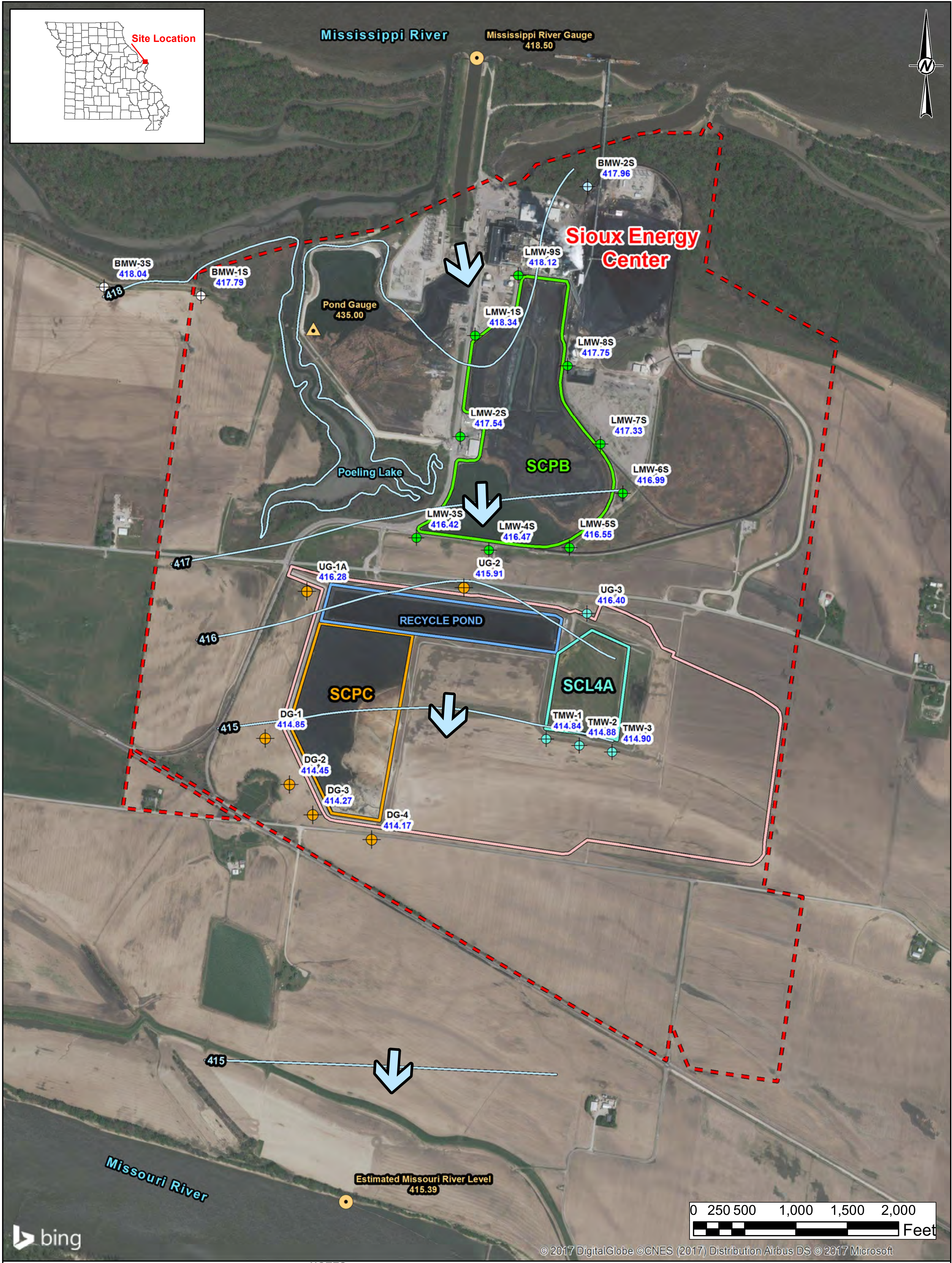
Golder Associates

YYYY-MM-DD	2016-11-07
PREPARED	JSI
DESIGN	JSI
REVIEW	MSG
APPROVED	MNH

PROJECT No.	PHASE	FIGURE
153-1406	0003D	P5

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
0
1 in

Path: G:\Projects\150 Projects\1531406 - Ameren GW Monitoring Program - MO\Phase 0003 - Sioux Energy\800 - FIGURES-DRAWINGS\PRODUCTION\GMP\Updated Pot Maps\Final\Updated Shallow\SCPC-E6.mxd



LEGEND

Sioux Energy Center Property Boundary

SCPB - Fly Ash Surface Impoundment

Ground/Surface Water Measurement Locations

SCL4A - UWL Cell 4A Monitoring Well

Groundwater Elevation Piezometer

Background Monitoring Well

SCPB - Fly Ash Surface Impoundment Monitoring Well

SCPC - WFGD Surface Impoundment Monitoring Well

SPCA Pond Gauge

River Elevation

Utility Waste Landfill (UWL)

SCL4A - UWL Cell 4A

SCPC - WFGD Surface Impoundment

Water Recycle Pond

UWL Future Perimeter Fence

Groundwater Elevation Contours

Groundwater Elevation Contour (FT MSL)

Inferred Groundwater Elevation Contour (FT MSL)

Groundwater Flow Direction

NOTES

1.) ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2.) GOLDER GROUNDWATER MONITORING WELLS SURVEYED BY ZAHNER AND ASSOCIATES, INC. ON JANUARY 14, APRIL 29, AND DECEMBER 8, 2016.
3.) GROUNDWATER AND SURFACE WATER ELEVATIONS DISPLAYED IN FT MSL (FEET ABOVE MEAN SEA LEVEL).
4.) GROUNDWATER MEASUREMENTS OBTAINED BY GOLDER.
5.) MISSOURI RIVER ELEVATION ESTIMATED BASED ON NEARBY USGS (UNITED STATES GEOLOGICAL SURVEY) RIVER GAUGING LOCATIONS.
6.) MISSISSIPPI RIVER ELEVATION PROVIDED BY AMEREN MISSOURI.
7.) POND GAUGE LEVEL OBTAINED ONSITE BY GOLDER.
8.) UWL BOUNDARIES, DESIGNATIONS AND STATE MONITORING WELL LOCATIONS BASED ON DRAWINGS IN THE UWL PROPOSED LANDFILL PERMIT (#0918301).
9.) WFGD - WET FLUE GAS DESULFURIZATION.

REFERENCE

1.) AMEREN MISSOURI SIOUX ENERGY CENTER, SIOUX PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2,401 FEET.
3.) USGS NATIONAL WATER INFORMATION SYSTEM, USGS GAUGES 06935965 (ST. CHARLES), 07010000 (ST. LOUIS), 05587498 (ALTON), GRAFTON (05587450).
4.) AMEREN MISSOURI SIOUX POWER PLANT UTILITY WASTE LANDFILL PROPOSED CONSTRUCTION PERMIT MODIFICATION (#0918301), AUGUST 2014.

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

PROJECT
CCR GROUNDWATER MONITORING PROGRAM

TITLE
SCPC POTENTIOMETRIC SURFACE MAP
BACKGROUND EVENT 6 - JANUARY 3, 2017

CONSULTANT

YYYY-MM-DD	2017-01-03
PREPARED	JS
DESIGN	JSI
REVIEW	JSI
APPROVED	MNH

PROJECT No. 153-1406
PHASE 0003D
FIGURE P6

Path: G:\Projects\150 Projects\1531406 - Ameren GW Monitoring Program - MO\Phase 0003 - Sioux Energy\800 - FIGURES-DRAWINGS\PRODUCTION\GMP\Updated Pot Maps\Final\Updated Shallow\SCPC-E7.mxd

LEGEND

- Sioux Energy Center Property Boundary
- 🟩 SCPB - Fly Ash Surface Impoundment

Ground/Surface Water Measurement Locations

- SCL4A - UWL Cell 4A Monitoring Well
- Groundwater Elevation Piezometer
- Background Monitoring Well
- SCPB - Fly Ash Surface Impoundment Monitoring Well
- SCPC - WFGD Surface Impoundment Monitoring Well
- ▲ SPCA Pond Gauge
- ● River Elevation

Utility Waste Landfill (UWL)

- SCL4A - UWL Cell 4A
- SCPC - WFGD Surface Impoundment
- Water Recycle Pond
- UWL Future Perimeter Fence

Groundwater Elevation Contours

- Groundwater Elevation Contour (FT MSL)
- Inferred Groundwater Elevation Contour (FT MSL)
- Groundwater Flow Direction

NOTES

1.) ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2.) GOLDER GROUNDWATER MONITORING WELLS SURVEYED BY ZAHNER AND ASSOCIATES, INC. ON JANUARY 14, APRIL 29, AND DECEMBER 8, 2016.
3.) GROUNDWATER AND SURFACE WATER ELEVATIONS DISPLAYED IN FT MSL (FEET ABOVE MEAN SEA LEVEL).
4.) GROUNDWATER MEASUREMENTS OBTAINED BY GOLDER.
5.) MISSOURI RIVER ELEVATION ESTIMATED BASED ON NEARBY USGS (UNITED STATES GEOLOGICAL SURVEY) RIVER GAUGING LOCATIONS.
6.) MISSISSIPPI RIVER ELEVATION PROVIDED BY AMEREN MISSOURI.
7.) POND GAUGE LEVEL OBTAINED ONSITE BY GOLDER.
8.) UWL BOUNDARIES, DESIGNATIONS AND STATE MONITORING WELL LOCATIONS BASED ON DRAWINGS IN THE UWL PROPOSED LANDFILL PERMIT (#0918301).
9.) WFGD - WET FLUE GAS DESULFURIZATION.

REFERENCE

1.) AMEREN MISSOURI SIOUX ENERGY CENTER, SIOUX PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2,401 FEET.
3.) USGS NATIONAL WATER INFORMATION SYSTEM, USGS GAUGES 06935965 (ST. CHARLES), 07010000 (ST. LOUIS), 05587498 (ALTON), GRAFTON (05587450).
4.) AMEREN MISSOURI SIOUX POWER PLANT UTILITY WASTE LANDFILL PROPOSED CONSTRUCTION PERMIT MODIFICATION (#0918301), AUGUST 2014.

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

PROJECT
CCR GROUNDWATER MONITORING PROGRAM

TITLE
SCPC POTENTIOMETRIC SURFACE MAP
BACKGROUND EVENT 7 - MARCH 8, 2017

CONSULTANT

YYYY-MM-DD	2017-03-14
PREPARED	JSI
DESIGN	JSI
REVIEW	JS
APPROVED	MNH

PROJECT No.
153-1406

PHASE
0003D

FIGURE
P7

Path: G:\Projects\150 Projects\1531406 - Ameren GW Monitoring Program - MO\Phase 0003 - Sioux Energy\800 - FIGURES-DRAWINGS\PRODUCTION\GMP\Updated Pot Maps\Final\Updated Shallow\SCPC-E8.mxd

LEGEND

🟥	Sioux Energy Center Property Boundary
🟩	SCPB - Fly Ash Surface Impoundment

Ground/Surface Water Measurement Locations

⊕	SCL4A - UWL Cell 4A Monitoring Well
⊕	Groundwater Elevation Piezometer
⊕	Background Monitoring Well
⊕	SCPB - Fly Ash Surface Impoundment Monitoring Well
⊕	SCPC - WFGD Surface Impoundment Monitoring Well
▲	SPCA Pond Gauge
●	River Elevation

Utility Waste Landfill (UWL)

▭	SCL4A - UWL Cell 4A
▭	SCPC - WFGD Surface Impoundment
▭	Water Recycle Pond
▭	UWL Future Perimeter Fence

Groundwater Elevation Contours

—	Groundwater Elevation Contour (FT MSL)
- -	Inferred Groundwater Elevation Contour (FT MSL)
↖	Groundwater Flow Direction

NOTES

1.) ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2.) GOLDER GROUNDWATER MONITORING WELLS SURVEYED BY ZAHNER AND ASSOCIATES, INC. ON JANUARY 14, APRIL 29, AND DECEMBER 8, 2016.
3.) GROUNDWATER AND SURFACE WATER ELEVATIONS DISPLAYED IN FT MSL (FEET ABOVE MEAN SEA LEVEL).
4.) GROUNDWATER MEASUREMENTS OBTAINED BY GOLDER.
5.) MISSOURI RIVER ELEVATION ESTIMATED BASED ON NEARBY USGS (UNITED STATES GEOLOGICAL SURVEY) RIVER GAUGING LOCATIONS.
6.) MISSISSIPPI RIVER ELEVATION PROVIDED BY AMEREN MISSOURI.
7.) POND GAUGE LEVEL OBTAINED ONSITE BY GOLDER.
8.) UWL BOUNDARIES, DESIGNATIONS AND STATE MONITORING WELL LOCATIONS BASED ON DRAWINGS IN THE UWL PROPOSED LANDFILL PERMIT (#0918301).
9.) WFGD - WET FLUE GAS DESULFURIZATION.

REFERENCE

1.) AMEREN MISSOURI SIOUX ENERGY CENTER, SIOUX PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2,401 FEET.
3.) USGS NATIONAL WATER INFORMATION SYSTEM, USGS GAUGES 06935965 (ST. CHARLES), 07010000 (ST. LOUIS), 05587498 (ALTON), GRAFTON (05587450).
4.) AMEREN MISSOURI SIOUX POWER PLANT UTILITY WASTE LANDFILL PROPOSED CONSTRUCTION PERMIT MODIFICATION (#0918301), AUGUST 2014.

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

PROJECT
CCR GROUNDWATER MONITORING PROGRAM

TITLE
SCPC POTENTIOMETRIC SURFACE MAP
BACKGROUND EVENT 8 - JUNE 5, 2017

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-07-05
PREPARED	JSI
DESIGN	JSI
REVIEW	RJF
APPROVED	MNH

PROJECT No.
153-1406

PHASE
0003D

FIGURE
P8

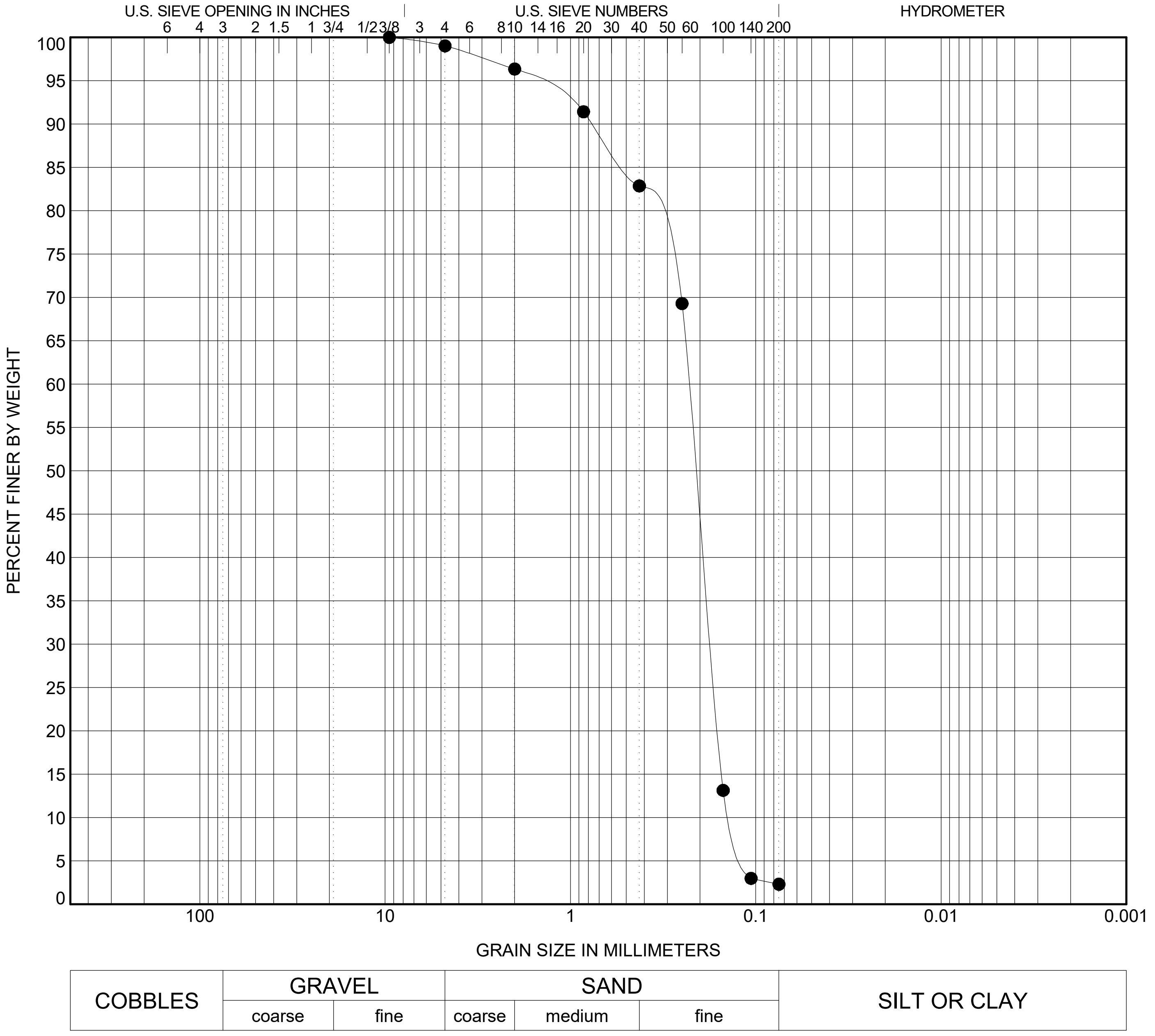
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
0 1 in

APPENDIX D
GRAIN SIZE DISTRIBUTION

Golder Associates
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

GRAIN SIZE DISTRIBUTION
ASTM D6913
Method B

CLIENT AMEREN SERVICES
PROJECT NAME Ameren/GW Monitoring Program/MO
PROJECT NUMBER 153-1406.0002
PROJECT LOCATION



	BOREHOLE	DEPTH	Classification	LL	PL	PI
●	LMW-3S	15-25 ft	POORLY GRADED SAND (SP)			

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	LMW-3S	15-25 ft	9.5	0.23	0.175	0.135	1.0	96.7	2	

Golder Associates
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

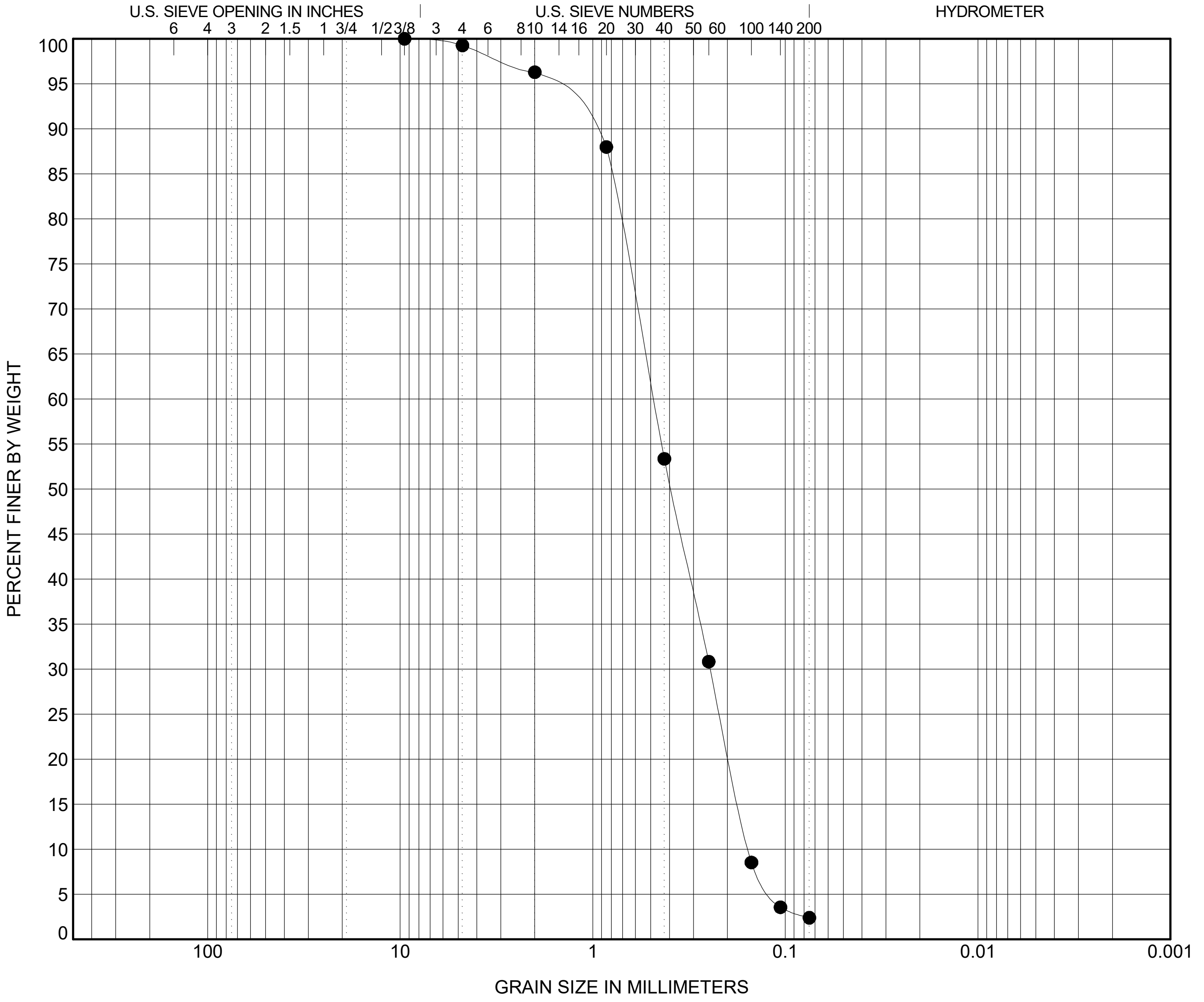
GRAIN SIZE DISTRIBUTION
ASTM D6913
Method B

CLIENT AMEREN SERVICES

PROJECT NAME Ameren/GW Monitoring Program/MO

PROJECT NUMBER 153-1406.0002

PROJECT LOCATION



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

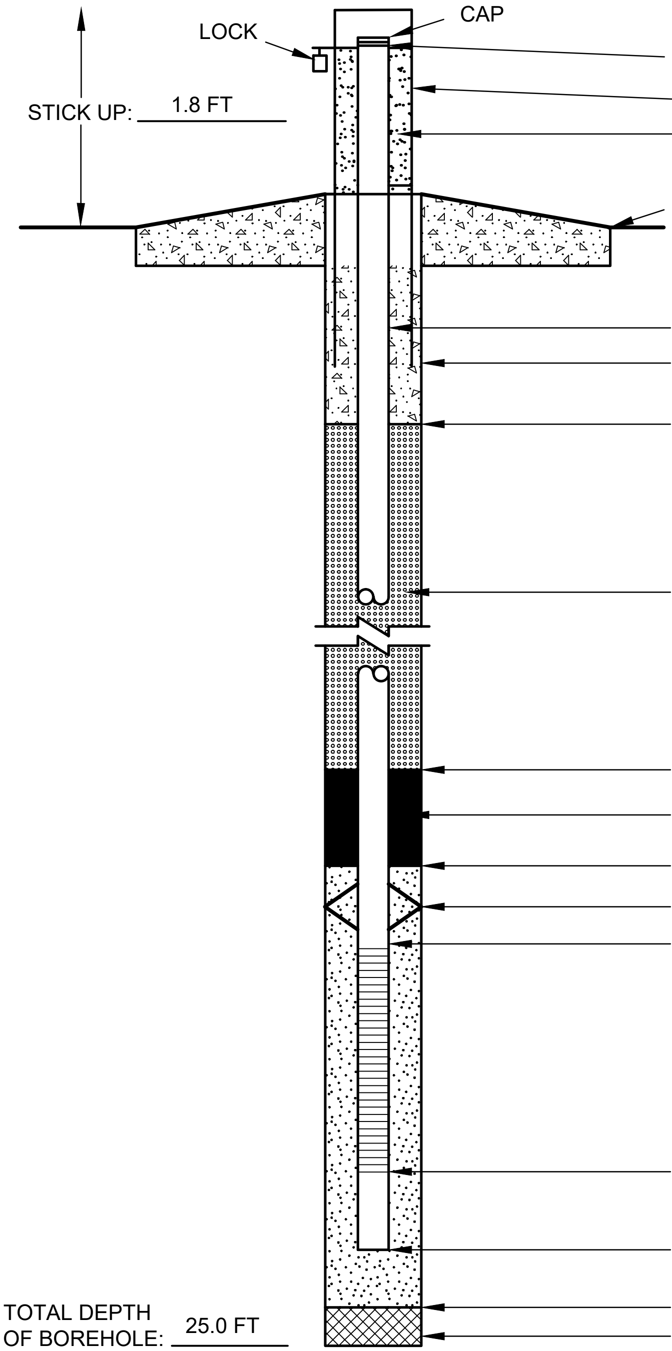
	BOREHOLE	DEPTH	Classification	LL	PL	PI
●	LMW-8S	35-45 ft	POORLY GRADED SAND (SP)			

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	LMW-8S	35-45 ft	9.5	0.485	0.245	0.155	0.7	96.9	2	

APPENDIX E
CCR MONITORING WELL CONSTRUCTION DIAGRAMS

ABOVE GROUND MONITORING WELL CONSTRUCTION LOG BMW-1S

PROJECT NAME: AMEREN CCR GW MONITORING		PROJECT NUMBER: 153-1406.0003B
SITE NAME: SIOUX ENERGY CENTER		LOCATION: BMW-1S
CLIENT: AMEREN MISSOURI		SURFACE ELEVATION: 426.0 FT MSL
GEOLOGIST: J. INGRAM	NORTHING: 1121709.2	EASTING: 876755.6
DRILLER: J. DRABEK	STATIC WATER LEVEL: 7.35 FT BTOC	COMPLETION DATE: 12/8/2015
DRILLING COMPANY: CASCADE		DRILLING METHODS: SONIC



STICK UP: 1.8 FT

TOTAL DEPTH OF BOREHOLE: 25.0 FT

TOP OF CASING ELEVATION: 427.77 FT MSL

PROTECTIVE CASING ([✓ yes] / no): 4" X 5' ALUMINUM

PEA GRAVEL OR SAND

GROUND SURFACE ELEVATION: 426.0 FT MSL

DIAMETER OF RISER PIPE (in.): 2.0

DIAMETER OF BOREHOLE (in.): 6.0

CONCRETE SEAL DEPTH (ft. bgs): 2.5

TYPE AND AMOUNT OF ANNULAR SEAL: NONE

TOP OF BENTONITE SEAL DEPTH (ft. bgs): 2.5

TYPE AND AMOUNT OF BENTONITE SEAL: $\frac{3}{8}$" BENTONITE CHIPS - 2 BAGS

TOP OF SAND PACK DEPTH (ft. bgs): COARSE: 12.5 FINE: 12.0

CENTRALIZER (yes [✓ no]) - TYPE: NONE

TOP OF SCREEN DEPTH (ft. bgs): 14.0

TYPE OF SCREEN: 2" X 9.8' SCHEDULE 40 PVC

SCREEN SLOT SIZE (in.): 0.010 IN

SIZE OF SAND PACK: COARSE: #1 FINE: #0

AMOUNT OF SAND: COARSE: 3.5 BAGS FINE: $\frac{1}{3}$ BAG

BOTTOM OF SCREEN DEPTH (ft. bgs): 23.8

BOTTOM OF WELL DEPTH (ft. bgs): 24.2

BOTTOM OF FILTER PACK (ft. bgs): 24.2

TYPE AND AMOUNT OF BACKFILL: 0.8 FT - NATURAL CAVE IN

ADDITIONAL NOTES: FT BGS = FEET BELOW GROUND SURFACE. FT MSL = FEET ABOVE MEAN SEA LEVEL. 50 GALLONS OF H2O USED DURING DRILLING. HORIZONTAL DATUM: STATE PLANE COORDINATES NAD83 US SURVEY FEET (2000) MISSOURI EAST ZONE. VERTICAL DATUM: NAVD88. WELL SURVEYED BY ZAHNER AND ASSOCIATES, INC ON JANUARY 14, 2016. FT BTOC = FEET BELOW TOP OF CASING. SAND AND BENTONITE BAGS WEIGH 50 LBS EACH.

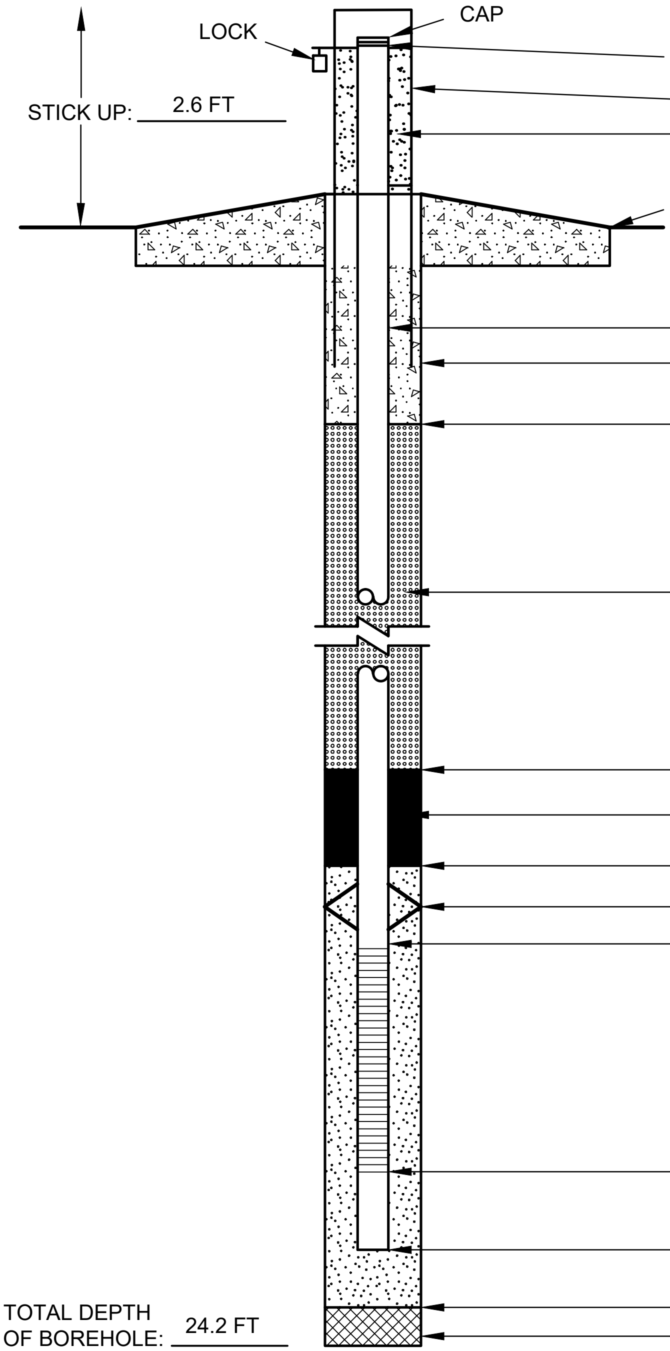
CHECKED BY: J. INGRAM

DATE CHECKED: 4/20/2016

PREPARED BY: J. SUOZZI

ABOVE GROUND MONITORING WELL CONSTRUCTION LOG BMW-3S

PROJECT NAME: AMEREN CCR GW MONITORING
PROJECT NUMBER: 153-1406.0003B
SITE NAME: SIOUX ENERGY CENTER
LOCATION: BMW-3S
CLIENT: AMEREN MISSOURI
SURFACE ELEVATION: 424.1 FT MSL
GEOLOGIST: J. INGRAM/M. GORE
NORTHING: 1121792.9
EASTING: 875809.5
DRILLER: M. RODRIGUES
STATIC WATER LEVEL: 8.65 FT BTOC
COMPLETION DATE: 11/8/2016
DRILLING COMPANY: CASCADE
DRILLING METHODS: SONIC



STICK UP: 2.6 FT

TOP OF CASING ELEVATION: 426.69 FT MSL
PROTECTIVE CASING ([✓ yes] / no): 4" X 5' ALUMINUM
PEA GRAVEL OR SAND
GROUND SURFACE ELEVATION: 424.1 FT MSL
DIAMETER OF RISER PIPE (in.): 2.0
DIAMETER OF BOREHOLE (in.): 6.0
CONCRETE SEAL DEPTH (ft. bgs): 2.5
TYPE AND AMOUNT OF ANNULAR SEAL: HIGH SOLIDS BENTONITE
TOP OF BENTONITE SEAL DEPTH (ft. bgs): 2.5
TYPE AND AMOUNT OF BENTONITE SEAL: $\frac{3}{8}$" BENTONITE CHIPS - 1 BUCKET
TOP OF SAND PACK DEPTH (ft. bgs): COARSE: 11.6 FINE: 10.8
CENTRALIZER (yes / [✓ no]) - TYPE: NONE
TOP OF SCREEN DEPTH (ft. bgs): 14.0
TYPE OF SCREEN: 2" X 9.8' SCHEDULE 40 PVC
SCREEN SLOT SIZE (in.): 0.010 IN
SIZE OF SAND PACK: COARSE: #1 (20-30) FINE: #0 (30/65)
AMOUNT OF SAND: COARSE: 4 BAGS FINE: $\frac{1}{2}$ BAG
BOTTOM OF SCREEN DEPTH (ft. bgs): 23.8
BOTTOM OF WELL DEPTH (ft. bgs): 24.2
BOTTOM OF FILTER PACK (ft. bgs): 24.2
TYPE AND AMOUNT OF BACKFILL: NONE

TOTAL DEPTH OF BOREHOLE: 24.2 FT

ADDITIONAL NOTES: FT BGS = FEET BELOW GROUND SURFACE. FT MSL = FEET ABOVE MEAN SEA LEVEL. 50 GALLONS OF H2O USED DURING DRILLING. HORIZONTAL DATUM: STATE PLANE COORDINATES NAD83 US SURVEY FEET (2000) MISSOURI EAST ZONE. VERTICAL DATUM: NAVD88. WELL SURVEYED BY ZAHNER AND ASSOCIATES, INC ON DECEMBER 8, 2016. FT BTOC = FEET BELOW TOP OF CASING. SAND AND BENTONITE BAGS WEIGH 50 LBS EACH.

CHECKED BY: J. INGRAM
DATE CHECKED: 8/3/2017
PREPARED BY: J. SUOZZI

APPENDIX F
WELL DEVELOPMENT FORMS

Sheet 1 of 2

Golder Associates WELL DEVELOPMENT/PURGING FORM

Project Ref: Ameren GW Monitoring **Project No.:** 153-1406.

Location BMW-1S

Monitored By: JSL Date 1/22/16 Time 0800

0.163

Well Piezometer Data

(circle one)

Depth of Well (from top of PVC or ground)	25.95	feet
Depth of Water (from top of PVC or ground)	7.35	feet BTOR
Radius of Casing	2.00	inches
	6.00	feet
Casing Volume	6.5x3 = 19.5	cubic feet
	+ 50 =	gallons

69.5 total gallons

Development / Purging Discharge Data

Purging Method	Watra			
Start Purging	Date	1/21/16	Time	0821
Stop Purging	Date	1/22/16	Time	1544

Monitoring

STARTED using meter – for WQ Calibr

Date	Time	Volume Discharge (gals)	Temp (°C)	pH	Spec.Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Redox Potential (+/- mV)	WL (ft BTOC)	Appearance of Water and Comments
1/22	900	55	12.84	7.21	0.804	>1000	1.61	124.4	9.30	Cloudy /Brownish – muddy up now
	930	65	13.20	~~7.45~~	0.764	>1000	1.52	153.9	9.15	
	940	80	13.12	7.45	0.763	>1000	1.47	166.0	9.20	~~[illegible]~~ Cloudy
	950	86	13.54	7.40	0.763	>1000	0.86	168.9	9.21	
	1000	95	13.54	7.39	0.765	>1000	0.83	170.3	9.22	Cloudy
	1010	104	13.29	7.38	0.766	>1000	1.06	170.5	9.23	
	1020	120	13.04	7.36	0.760	>1000	1.07	[illegible]	9.23	– less silt for 10 mins color Brown
	1040	130	13.07	7.34	0.770	>1000	0.66	171.7	9.25	
	1050	145	13.07	7.33	0.732	>1000	0.76	170.7	9.25	
	1100	155	13.01	7.33	0.744	>1000	0.65	170.4	9.25	Still less cloudy
	1110	165	13.00	[illegible]	0.744	375	0.45	170.4	9.25	Clearer
	1120	175	13.00	7.31	0.718	198	0.58	170.7	8.80	Clearer ~~s[illegible]~~
	1130	185	12.96	7.31	0.763	138	0.68	169.8	8.73	
	1140	195	13.12	7.33	0.717	98.4	0.59	168.2	8.73	– out of screen rose down. – take off Block
	1150	198	10.33	7.29	0.718	204	1.52	171.9	7.50	
	1200	200	10.40	7.33	0.726	147	1.25	173.7	7.51	Broke – Lay Hard
	1230	203	11.05	7.16	0.757	113	1.24	173.1	7.52	– Restart
	1240	206	10.84	7.36	0.757	125	1.25	166.9	7.52	
	1250	209	10.76	7.32	0.759	113	1.23	168.1	7.52	
	1300	212.	10.42	7.12	0.732	128	1.22	174.1	7.57	Stop w/ Waterra. continue by Pump.
	1310	214	10.60	7.10	0.724	132	1.23	180.5	7.46	
	1320	216	10.57	7.27	0.726	112	1.24	175.9	7.41	
	1333	220	12.48	7.87	0.756	>1000	1.46	-9.03	~~[illegible]~~	Muddy
	1345	225	12.42	7.62	0.765	374	0.99	-33.2	7.41	
	1408	230	12.31	7.74	0.762	>1000	1.08	-84.8	7.41	
	1435	235	12.37	7.71	0.756	[illegible]	1.10	-83.2	7.45	Clear
	1451	237	12.78	7.84	0.771	29.7	1.15	-91.2	7.40	Started water @ 1445 low flow
	1456	239	12.78			79.6				

Sheet 2 of 2

Golder Associates WELL DEVELOPMENT/PURGING FORM

Project Ref: Ameren GW Monitoring **Project No.:** 153-1406.

Location

BMW-15

Monitored By: JSI Date 1/22/16 Time 0800.

PASEZ

Well Piezometer Data

(circle one)

Depth of Well (from top of PVC or ground)	25.95	feet
Depth of Water (from top of PVC or ground)	7.35	feet
Radius of Casing	2.00	inches
	6.00	feet
Casing Volume	6.5x3=19.5	cubic feet
	69.5 total	gallons

SEE PAGE 1

69.5 total gals

Development / Purging Discharge Data

Purging Method: Waterra

Start Purging Date 1/22/16 Time 0821

Stop Purging Date 1/22/16 Time 1544

Monitoring

Date	Time	Volume Discharge (gals)	Temp (°C)	pH	Spec.Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Redox Potential (+/- mV)	WL (ft BTOC)	Appearance of Water and Comments
1/22	1500	239	10.39	7.44	0.761	71.6	1.26	-63.9	7.45	Clear
1/22	1510	241	10.37	7.40	0.752	27.8	1.31	-60.3	7.45	Clear
1/22	1520	243	10.32	7.41	0.743	12.6	1.33	-57.2	7.46	Clear.
1/22	1530	245	10.31	7.32	0.760	10.1	1.35	-59.2	7.46	
1/22	1540	247	10.32	7.33	0.754	4.2	1.26	-57.4	7.46	

END 23.97

Sheet 1 of 2

Golder Associates WELL DEVELOPMENT/PURGING FORM

Project Ref: Ameren GW Monitoring

Project No.: 153-1406.

Location

BMW-3S

Monitored By: M-GORE

Date: 11/10/2016 — 11/11/2016

Time: 1300 — 1700; 1030 —

Stickup 2.6'

Well Piezometer Data

(circle one)

Depth of Well (from top of PVC or ground): 26.74 feet

27.0'

Depth of Water (from top of PVC or ground): 8.65 feet

Radius of Casing: 2 inches

feet

Need to remove

Casing Volume: ~~[illegible]~~ cubic feet

6.7 gallons

40 + 6.7 = 47 gallons

Development / Purging Discharge Data

Purging Method: Watera

Start Purging Date: 11/10/2016 Time: 1300 — 11/11/16 1030

Stop Purging Date: 11/10/2016 Time: 1700 — 11/11/16

Monitoring

	Date	Time	Volume Discharge (gals)	Temp (°C)	pH	Spec.Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Redox Potential (+/- mV)	WL (ft BTOC)	Appearance of Water and Comments
		1300								8.95	START
0	11/10	1320	~~20~~ 40	17.21	7.49	0.638	>1000	4.59	-202	8.96	Cloudy
1		1330	20/60	17.30	7.39	0.744	>1000	5.37	-271	8.99	Cloudy
2		1340	20/80	17.01	7.19	0.739	>1000	3.22	-418	8.94	Cloudy
3		1350	20/100	16.73	6.96	0.725	>1000	3.03	-324	8.93	Cloudy
4		1400	20/120	16.81	7.22	~~[illegible]~~	>1000	1.90	-451	8.94	Cloudy
5		1410	20/140	16.45	7.69	0.613	>1000	3.02	-478	8.95	Cloudy
6		1420	20/160	16.75	7.54	0.613	>1000	3.31	-483	8.94	Cloudy
7		1430	20/180	16.33	7.69	0.606	>1000	3.76	-492	8.94	Cloudy
8		1440	20/200	16.39	7.51	0.603	>1000	4.75	-486	8.96	Cloudy
9		1450	20/220	16.73	7.21	0.602	>1000	2.49	-484	8.93	Cloudy
10		1500	20/240	16.48	7.70	0.595	897	3.74	-478	8.91	Cloudy
Above Screen	1550	~~[illegible]~~	10/250	16.43	7.73	0.608	776	5.30	-455	8.90	Cloudy ← ~~Deg~~ Decrease Flow rate by 1/2
		1600	10/260	14.70	7.51	0.577	478	7.02	-413	8.91	Cloudy
		1610	10/270	15.26	7.38	0.580	600	6.54	-401	8.90	Cloudy
		1620	10/280	14.49	7.36	0.569	435	6.21	-412	8.92	Cloudy
		1630	10/290	14.33	7.34	0.560	324	6.43	-406	8.91	Cloudy
		1640	10/300	13.99	7.39	0.555	264	5.93	-416	8.91	Cloudy
		1650	10/310	13.61	7.36	0.549	212	4.61	-414	8.90	Cloudy Stopped @ 1650
recalibrated equipment	11/11	~~[illegible]~~	10/320	~~18~~							Started 11/11
	1050	1030	20/340	18.43	6.75	0.718	182	4.53	-220	8.92	Cloudy
		1100	10/350	18.61	7.41	0.768	164	5.25	-237	8.91	Cloudy
		1110	10/360	18.78	7.25	0.761	139	4.66	-291	8.90	Cloudy
		1130	20/380	18.91	7.26	0.740	131	4.51	-309	8.91	Cloudy
removed surge block →		1150	20/400	18.65	7.26	0.720	132	4.80	-264	8.93	Cloudy
		1210	20/420	18.73	7.60	0.733	69	5.22	-255	8.91	Cloudy
		1230	20/440	18.93	7.21	0.714	62	4.42	-287	8.92	Cloudy

Sheet 2 of 2

Golder Associates WELL DEVELOPMENT/PURGING FORM

Project Ref: Ameren GW Monitoring **Project No.:** 153-1406.

Location
BMW-3S

Monitored By: M. GORE Date 11/10/2016 Time 1300-1700
11/11/2016 1030–

Well Piezometer Data
(circle one)

Depth of Well (from top of PVC or ground)	26.74	feet
Depth of Water (from top of PVC or ground)	8.65	feet
Radius of Casing	2	inches
	—	feet
Casing Volume	—	cubic feet
	6.7	gallons

27.0'

stickup 2.6'

Development / Purging Discharge Data

Purging Method	Watera			
Start Purging	Date 11/10/2016	Time 1300	11/11/2016	1030
Stop Purging	Date 11/10/2016	Time 1700	11/11/2016	

Monitoring

cont'd

Date	Time	Volume Discharge (gals)	Temp (°C)	pH	Spec.Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Redox Potential (+/- mV)	WL (ft BTOC)	Appearance of Water and Comments
11/11/16	1230	20/440	18.93	7.21	0.714	62	4.42	-287	8.92	Cloudy
	1250	20/460	18.67	7.25	0.703	52.3	4.56	-284	8.91	Cloudy
	1310	20/480	16.45	7.66	0.713	54.2	4.32	-327	8.92	Cloudy
	~~1330~~	~~20/~~								Pause to cool pump
	1350	20/500	17.37	7.61	0.723	46.2	5.02	-277	8.90	Cloudy
	[illegible]		16.			131			8.92	1380 – 1400 Flushed screen
										@ highest Flow rate followed
										by a 10 minute break
	1410	START AGAIN								
	1420	10/510	16.44	7.61	0.714	131	4.55	-250	8.92	Cloudy
	1440	20/530	15.94	7.56	0.711	70	5.97	-283	8.91	Cloudy
	1450	10/540	15.23	7.39	0.704	107	2.36	-316	8.90	Cloudy Slowed down rate
550	1510	[illegible]	14.10	7.46	0.694	77	4.09	-265	8.93	Cloudy
560	1530	[illegible]	13.75	6.96	0.674	50.6	3.41	-320	8.91	Cloudy
	1550	10/570	13.36	7.42	0.677	35.1	5.10	-239	8.90	Cloudy
	1620	10/580	13.24	7.52	0.682	19.7	6.22	-187	8.92	Cloudy
	1650	10/590	13.03	7.39	0.683	16.3	6.73	-151		Cloudy

APPENDIX G
CCR MDNR WELL CERTIFICATION FORMS

MISSOURI DEPARTMENT OF
NATURAL RESOURCES
DIVISION OF
GEOLOGY AND LAND SURVEY
(573) 368-2165

MONITORING WELL CERTIFICATION RECORD

REF NO 00380809	DATE RECEIVED 06/19/2008
CR NO	CHECK NO. 5127
STATE WELL NO A162746 09/16/2008	REVENUE NO. 061908

ENTERED NRSTOGD PH1 PH2 PH3 06/19/2008 06/20/2008 06/20/2008	APPROVED BY	ROUTE

INFORMATION SUPPLIED BY PRIMARY CONTRACTOR OR DRILLING CONTRACTOR

NOTE: THIS FORM IS NOT TO BE USED FOR NESTED WELLS

OWNER NAME AMEREN	CONTACT NAME PAUL PIKE			VARIANCE GRANTED BY DNR
OWNER ADDRESS 1901 CHOUTEAU AVE	CITY ST LOUIS	STATE MO	ZIP 63166	NUMBER ________________
SITE NAME AMEREN SIOUX POWER PLANT		WELL NUMBER UG 1A		COUNTY ST CHARLES
SITE ADDRESS 8501 W STATE RT 94		CITY WEST ALTON		STATIC WATER LEVEL 2.6 FT

SURFACE COMPLETION

TYPE	LENGTH AND DIAMETER OF SURFACE COMPLETION	DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED	SURFACE COMPLETION GROUT	LOCATION OF WELL
☒ ABOVE GROUND	LENGTH _0.0 FT.	DIAMETER _0.0 IN.	☐ CONCRETE	LAT. ___38 ° ___54' _21.7"
☐ FLUSH MOUNT	DIAMETER _0.0 IN.	LENGTH _0.0 FT.	☐ OTHER	LONG. ___90 ° ___17' _51.6"

SMALLEST LARGEST
_______ 1/4 _______ 1/4 _______ 1/4

SEC. LG001838 TWN. _______ NORTH
RANGE ________ Direction

☐ LOCKING CAP
☐ WEEP HOLE

ELEVATION _____425FT.

ANNULAR SEAL
LENGTH _______8.0FT.

☐ SLURRY ☐ CHIPS
☐ PELLETS ☐ GRANULAR
☐ CEMENT/SLURRY

IF CEMENT/BENTONITE MIX:

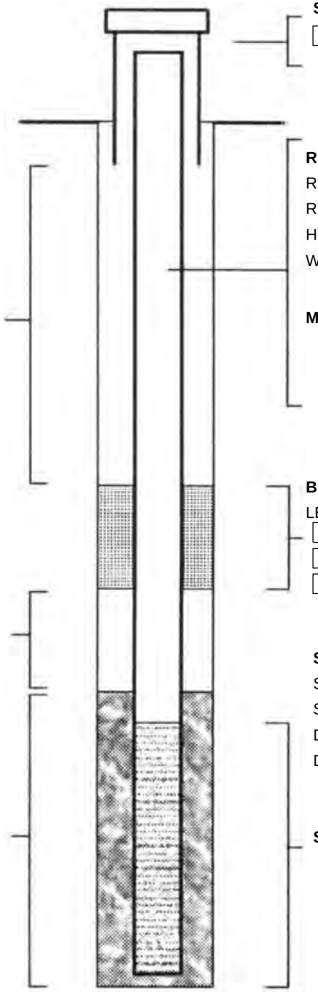
BAGS OF CEMENT USED:

%OF BENTONITE USED:
WATER USED/BAG: GAL.

SECONDARY FILTER PACK
LENGTH: _______0.0FT.

DEPTH TO TOP OF PRIMARY
FILTER PACK: ______12.0FT.

LENGTH OF PRIMARY FILTER
PACK: ______13.6FT.



SURFACE COMPLETTION
☐ STEEL ☐ ALUMINUM ☐ PLASTIC

RISER
RISER PIPE DIAMETER _______2.0IN.
RISER PIPE LENGTH ______18.1FT.
HOLE DIAMETER ______8.25IN.
WEIGHT OR SDR# _____SCH40

MATERIAL
☐ STEEL ☒ THERMOPLASTIC (PVC)
☐ OTHER _______

BENTONITE SEAL
LENGTH: ___3.0
☐ CHIPS ☐ PELLETS ☐ GRANULAR
☐ SLURRY
☐ SATURATED ZONE ☐ HYDRATED

SCREEN
SCREEN DIAMETER: _______2.0IN.
SCREEN LENGTH: ______10.0FT.
DIAMETER OF DRILL HOLE: 8.25IN.
DEPTH TO TOP ______15.6FT.

SCREEN MATERIAL
☐ STEEL ☒ THERMOPLASTIC (PVC)
☐ OTHER

MONITORING FOR:
☐ RADIONUCLIDES ☐ PETROLEUM PRODUCTS ONLY
☐ EXPLOSIVES ☐ METALS ☐ VOC
☐ SVOCS ☐ PESTICIDES/HERBICIDESS

PROPOSED USE OF WELL
☐ GAS MIGRATION WELL ☒ OBSERVATION
☐ EXTRACTION WELL ☐ OPEN HOLE
☐ PIEZOMETERS
☐ DIRECT PUSH

DEPTH		FORMATION
FROM	TO	DESCRIPTION
0.0	1.0	TS
1.0	4.0	SLTY CLY
4.0	9.0	SNDY SLTY CLY
9.0	25.0	SND FN TO MED

TOTAL DEPTH: ______25.6 FEET

FOR CASED WELLS, SUBMIT ADDITIONAL AS BUILT DIAGRAMS SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETER AND GROUT USED.

SIGNATURE (PRIMARY COUNTRACTOR) x ASHLEY COFFMAN	PERMIT NUMBER 004158____	DATE WELL DRILLING WAS COMPLETED 06/03/2008

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH MISSOURI DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS

☐ PUMP INSTALLED

SIGNATURE (WELL DRILLER) x CHRISTOPHER HEBEL	PERMIT NUMBER 002834____	SIGNATURE (APPRENTICE) x ________________________	APPRENTICE PERMIT NUMBER __________

MISSOURI DEPARTMENT OF
NATURAL RESOURCES
DIVISION OF
GEOLOGY AND LAND SURVEY
(573) 368-2165

MONITORING WELL CERTIFICATION RECORD

REF NO 00381411	DATE RECEIVED 04/23/2008
CR NO	CHECK NO.
STATE WELL NO A161852 05/01/2008	REVENUE NO. 042308

ENTERED NRSTOGD PH1 PH2 PH3 04/23/2008 04/23/2008 04/23/2008	APPROVED BY	ROUTE

INFORMATION SUPPLIED BY PRIMARY CONTRACTOR OR DRILLING CONTRACTOR

NOTE: THIS FORM IS NOT TO BE USED FOR NESTED WELLS

OWNER NAME AMEREN	CONTACT NAME PAUL PIKE			VARIANCE GRANTED BY DNR
OWNER ADDRESS 1901 CHOTCAU	CITY ST LOUIS	STATE MO	ZIP 63116	NUMBER ________
SITE NAME SIOUX POWER PLANT		WELL NUMBER UG 2		COUNTY ST CHARLES
SITE ADDRESS 8501 W STATE RT 94		CITY WEST ALTON		STATIC WATER LEVEL 12.0 FT

SURFACE COMPLETION

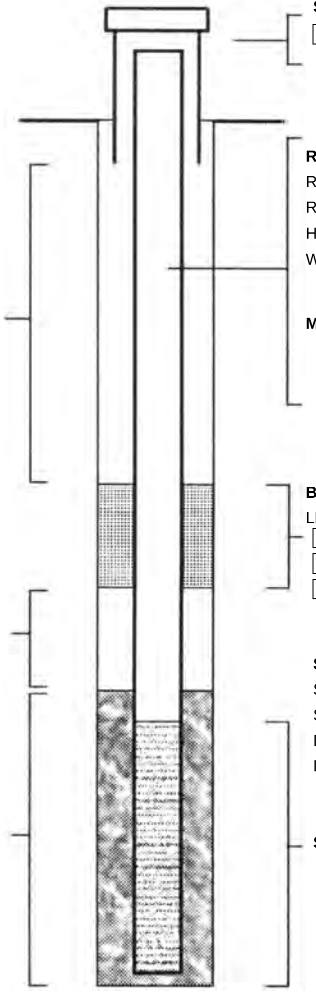
TYPE	LENGTH AND DIAMETER OF SURFACE COMPLETION	DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED	SURFACE COMPLETION GROUT
☒ ABOVE GROUND	LENGTH 0.0 FT.	DIAMETER 0.0 IN.	☐ CONCRETE
☐ FLUSH MOUNT	DIAMETER 0.0 IN.	LENGTH 0.0 FT.	☐ OTHER

LOCATION OF WELL
LAT. 38 ° 54' 24.8"
LONG. 90 ° 17' 29.4"

SMALLEST LARGEST
____ 1/4 ____ 1/4 ____ 1/4

SEC. LG001838 TWN. ____ NORTH
RANGE ____ Direction

☐ LOCKING CAP
☐ WEEP HOLE



SURFACE COMPLETTION
☐ STEEL ☐ ALUMINUM ☐ PLASTIC

ELEVATION 427FT.

ANNULAR SEAL
LENGTH 9.0FT.
☒ SLURRY ☐ CHIPS
☐ PELLETS ☐ GRANULAR
☐ CEMENT/SLURRY

IF CEMENT/BENTONITE MIX:
BAGS OF CEMENT USED:
%OF BENTONITE USED:
WATER USED/BAG: GAL.

RISER
RISER PIPE DIAMETER 2.0IN.
RISER PIPE LENGTH 18.8FT.
HOLE DIAMETER 8.25IN.
WEIGHT OR SDR# SCH40

MATERIAL
☐ STEEL ☒ THERMOPLASTIC (PVC)
☐ OTHER ____

BENTONITE SEAL
LENGTH: 3.0
☐ CHIPS ☐ PELLETS ☐ GRANULAR
☐ SLURRY
☐ SATURATED ZONE ☐ HYDRATED

SECONDARY FILTER PACK
LENGTH: 2.0FT.

SCREEN
SCREEN DIAMETER: 2.0IN.
SCREEN LENGTH: 10.0FT.
DIAMETER OF DRILL HOLE: 8.25IN.
DEPTH TO TOP 16.0FT.

DEPTH TO TOP OF PRIMARY FILTER PACK: 14.0FT.

LENGTH OF PRIMARY FILTER PACK: 12.0FT.

SCREEN MATERIAL
☐ STEEL ☒ THERMOPLASTIC (PVC)
☐ OTHER

MONITORING FOR:
☐ RADIONUCLIDES ☐ PETROLEUM PRODUCTS ONLY
☐ EXPLOSIVES ☐ METALS ☐ VOC
☐ SVOCS ☐ PESTICIDES/HERBICIDESS

PROPOSED USE OF WELL
☐ GAS MIGRATION WELL ☒ OBSERVATION
☐ EXTRACTION WELL ☐ OPEN HOLE
☐ PIEZOMETERS
☐ DIRECT PUSH

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION
0.0	10.0	CLY
10.0	26.0	SLT SND

TOTAL DEPTH: 26.0 FEET

FOR CASED WELLS, SUBMIT ADDITIONAL AS BUILT DIAGRAMS SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETER AND GROUT USED.

SIGNATURE (PRIMARY COUNTRACTOR) x ASHLEY COFFMAN	PERMIT NUMBER 004158	DATE WELL DRILLING WAS COMPLETED 12/16/2007

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH MISSOURI DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS

☐ PUMP INSTALLED

SIGNATURE (WELL DRILLER) x DAVID HUNZIKER	PERMIT NUMBER 002836	SIGNATURE (APPRENTICE) x ________	APPRENTICE PERMIT NUMBER ________

MISSOURI DEPARTMENT OF
NATURAL RESOURCES
DIVISION OF
GEOLOGY AND LAND SURVEY
(573) 368-2165

MONITORING WELL CERTIFICATION RECORD

REF NO 00381412	DATE RECEIVED 04/23/2008	
CR NO	CHECK NO.	
STATE WELL NO A161853 05/01/2008	REVENUE NO. 042308	
ENTERED NRSTOGD PH1 PH2 PH3 04/23/2008 04/23/2008 04/23/2008	APPROVED BY	ROUTE

INFORMATION SUPPLIED BY PRIMARY CONTRACTOR OR DRILLING CONTRACTOR

NOTE: THIS FORM IS NOT TO BE USED FOR NESTED WELLS

OWNER NAME AMEREN	CONTACT NAME PAUL PIKE			VARIANCE GRANTED BY DNR
OWNER ADDRESS 1901 CHOTCAU	CITY ST LOUIS	STATE MO	ZIP 63116	NUMBER ________
SITE NAME SIOUX POWER PLANT		WELL NUMBER DG1		COUNTY ST CHARLES
SITE ADDRESS 8501 W STATE RT 94		CITY WEST ALTON		STATIC WATER LEVEL 13.0 FT

SURFACE COMPLETION

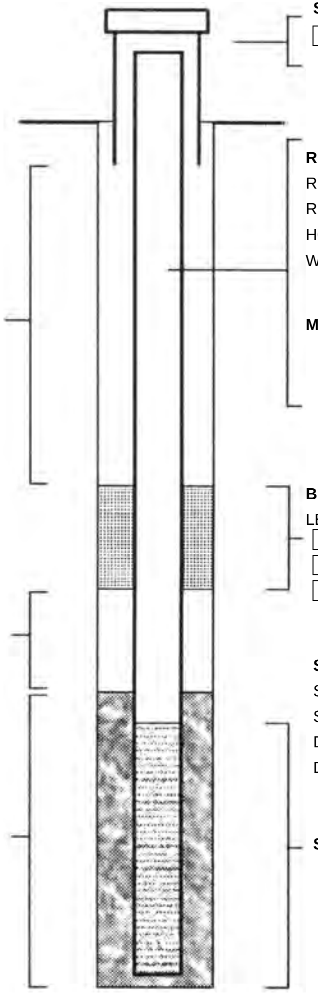
TYPE	LENGTH AND DIAMETER OF SURFACE COMPLETION	DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED	SURFACE COMPLETION GROUT
☒ ABOVE GROUND	LENGTH 0.0 FT.	DIAMETER 0.0 IN.	☐ CONCRETE
☐ FLUSH MOUNT	DIAMETER 0.0 IN.	LENGTH 0.0 FT.	☐ OTHER

LOCATION OF WELL
LAT. 38 ° 54' 10.3"
LONG. 90 ° 17' 53.9"

SMALLEST LARGEST
____ 1/4 ____ 1/4 ____ 1/4

SEC. LG001838 TWN. ____ NORTH
RANGE ____ Direction

☐ LOCKING CAP
☐ WEEP HOLE



SURFACE COMPLETTION
☐ STEEL ☐ ALUMINUM ☐ PLASTIC

ELEVATION 427FT.

ANNULAR SEAL
LENGTH 14.0FT.
☒ SLURRY ☐ CHIPS
☐ PELLETS ☐ GRANULAR
☐ CEMENT/SLURRY

IF CEMENT/BENTONITE MIX:
BAGS OF CEMENT USED:
%OF BENTONITE USED:
WATER USED/BAG: GAL.

RISER
RISER PIPE DIAMETER 2.0IN.
RISER PIPE LENGTH 23.8FT.
HOLE DIAMETER 8.25IN.
WEIGHT OR SDR# SCH40

MATERIAL
☐ STEEL ☒ THERMOPLASTIC (PVC)
☐ OTHER ____

BENTONITE SEAL
LENGTH: 3.0
☐ CHIPS ☐ PELLETS ☐ GRANULAR
☐ SLURRY
☐ SATURATED ZONE ☐ HYDRATED

SECONDARY FILTER PACK
LENGTH: 2.0FT.

DEPTH TO TOP OF PRIMARY
FILTER PACK: 19.0FT.

LENGTH OF PRIMARY FILTER
PACK: 12.0FT.

SCREEN
SCREEN DIAMETER: 2.0IN.
SCREEN LENGTH: 10.0FT.
DIAMETER OF DRILL HOLE: 8.25IN.
DEPTH TO TOP 21.0FT.

SCREEN MATERIAL
☐ STEEL ☒ THERMOPLASTIC (PVC)
☐ OTHER

MONITORING FOR:
☐ RADIONUCLIDES ☐ PETROLEUM PRODUCTS ONLY
☐ EXPLOSIVES ☐ METALS ☐ VOC
☐ SVOCS ☐ PESTICIDES/HERBICIDESS

PROPOSED USE OF WELL
☐ GAS MIGRATION WELL ☒ OBSERVATION
☐ EXTRACTION WELL ☐ OPEN HOLE
☐ PIEZOMETERS
☐ DIRECT PUSH

DEPTH		FORMATION
FROM	TO	DESCRIPTION
0.0	10.0	CLY
10.0	31.0	SLT SND
TOTAL DEPTH:		31.0 FEET

FOR CASED WELLS, SUBMIT ADDITIONAL AS BUILT DIAGRAMS SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETER AND GROUT USED.

SIGNATURE (PRIMARY COUNTRACTOR) x ASHLEY COFFMAN	PERMIT NUMBER 004158		DATE WELL DRILLING WAS COMPLETED 12/16/2007
I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH MISSOURI DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS			☐ PUMP INSTALLED
SIGNATURE (WELL DRILLER) x DAVID HUNZIKER	PERMIT NUMBER 002836	SIGNATURE (APPRENTICE) x ________	APPRENTICE PERMIT NUMBER ________

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY
(573) 368-2165

MONITORING WELL CERTIFICATION RECORD

REF NO 00381420	DATE RECEIVED 04/23/2008		
CR NO	CHECK NO. 1291232		
STATE WELL NO A161934 05/15/2008	REVENUE NO. 042308		
ENTERED NRSTOGD PH1 PH2 PH3 04/23/2008 04/23/2008 04/23/2008	APPROVED BY	ROUTE	

INFORMATION SUPPLIED BY PRIMARY CONTRACTOR OR DRILLING CONTRACTOR

NOTE: THIS FORM IS NOT TO BE USED FOR NESTED WELLS

OWNER NAME AMEREN	CONTACT NAME PAUL PIKE			VARIANCE GRANTED BY DNR
OWNER ADDRESS 1901 CHOTCAU	CITY ST LOUIS	STATE MO	ZIP 63116	NUMBER ________
SITE NAME SIOUX POWER PLANT		WELL NUMBER DG 2		COUNTY ST CHARLES
SITE ADDRESS 8501 W STATE RT 94		CITY WEST ALTON		STATIC WATER LEVEL 11.0 FT

SURFACE COMPLETION

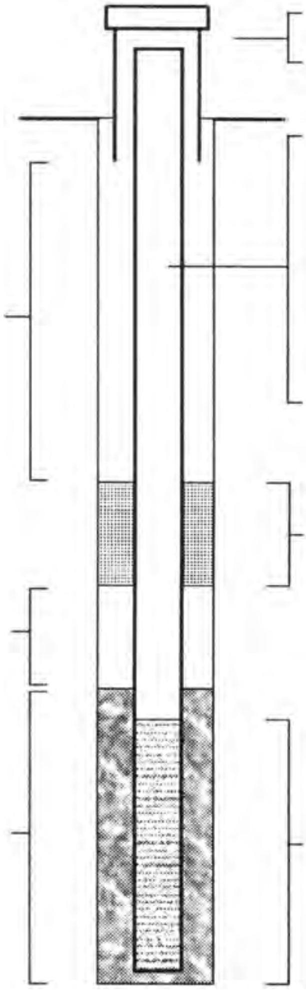
TYPE	LENGTH AND DIAMETER OF SURFACE COMPLETION	DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED	SURFACE COMPLETION GROUT
☒ ABOVE GROUND	LENGTH 0.0 FT.	DIAMETER 0.0 IN.	☐ CONCRETE
☐ FLUSH MOUNT	DIAMETER 0.0 IN.	LENGTH 0.0 FT.	☐ OTHER

LOCATION OF WELL
LAT. 38 ° 54' 5.9"
LONG. 90 ° 17' 50.9"

SMALLEST LARGEST
____ 1/4 ____ 1/4 ____ 1/4

SEC. LG001838 TWN. ____ NORTH
RANGE ____ Direction

☐ LOCKING CAP
☐ WEEP HOLE



SURFACE COMPLETTION
☐ STEEL ☐ ALUMINUM ☐ PLASTIC

MONITORING FOR:
☐ RADIONUCLIDES ☐ PETROLEUM PRODUCTS ONLY
☐ EXPLOSIVES ☐ METALS ☐ VOC
☐ SVOCS ☐ PESTICIDES/HERBICIDESS

ELEVATION 428FT.

RISER
RISER PIPE DIAMETER 2.0IN.
RISER PIPE LENGTH 21.0FT.
HOLE DIAMETER 8.25IN.
WEIGHT OR SDR# SCH40

PROPOSED USE OF WELL
☐ GAS MIGRATION WELL ☒ OBSERVATION
☐ EXTRACTION WELL ☐ OPEN HOLE
☐ PIEZOMETERS
☐ DIRECT PUSH

ANNULAR SEAL
LENGTH 17.0FT.
☒ SLURRY ☐ CHIPS
☐ PELLETS ☐ GRANULAR
☐ CEMENT/SLURRY

IF CEMENT/BENTONITE MIX:
BAGS OF CEMENT USED:
%OF BENTONITE USED:
WATER USED/BAG: GAL.

MATERIAL
☐ STEEL ☒ THERMOPLASTIC (PVC)
☐ OTHER ____

DEPTH		FORMATION
FROM	TO	DESCRIPTION
0.0	10.0	CLKY
10.0	31.0	SLT SND
TOTAL DEPTH:		31.0 FEET

BENTONITE SEAL
LENGTH: 3.0
☐ CHIPS ☐ PELLETS ☐ GRANULAR
☐ SLURRY
☐ SATURATED ZONE ☐ HYDRATED

SECONDARY FILTER PACK
LENGTH: 2.0FT.

SCREEN
SCREEN DIAMETER: 2.0IN.
SCREEN LENGTH: 10.0FT.
DIAMETER OF DRILL HOLE: 8.25IN.
DEPTH TO TOP 21.0FT.

DEPTH TO TOP OF PRIMARY
FILTER PACK: 19.0FT.

SCREEN MATERIAL
☐ STEEL ☒ THERMOPLASTIC (PVC)
☐ OTHER

LENGTH OF PRIMARY FILTER PACK: 12.0FT.

FOR CASED WELLS, SUBMIT ADDITIONAL AS BUILT DIAGRAMS SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETER AND GROUT USED.

SIGNATURE (PRIMARY COUNTRACTOR) x ASHLEY COFFMAN	PERMIT NUMBER 004158		DATE WELL DRILLING WAS COMPLETED 12/16/2007
I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH MISSOURI DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS			☐ PUMP INSTALLED
SIGNATURE (WELL DRILLER) x DAVID HUNZIKER	PERMIT NUMBER 002836	SIGNATURE (APPRENTICE) x ________	APPRENTICE PERMIT NUMBER ________

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY
(573) 368-2165

MONITORING WELL CERTIFICATION RECORD

REF NO 00381443	DATE RECEIVED 04/23/2008
CR NO	CHECK NO. 1291232
STATE WELL NO A161937 05/15/2008	REVENUE NO. 042308

ENTERED NRSTOGD PH1 PH2 PH3 04/23/2008 04/23/2008 04/23/2008	APPROVED BY	ROUTE

INFORMATION SUPPLIED BY PRIMARY CONTRACTOR OR DRILLING CONTRACTOR

NOTE: THIS FORM IS NOT TO BE USED FOR NESTED WELLS

OWNER NAME AMEREN	CONTACT NAME PAUL PIKE			VARIANCE GRANTED BY DNR
OWNER ADDRESS 1901 CHOTCAU	CITY ST LOUIS	STATE MO	ZIP 63116	NUMBER ________________
SITE NAME SIOUX POWER PLANT		WELL NUMBER DG 3		COUNTY ST CHARLES
SITE ADDRESS 8501 W STATE RT94		CITY WEST ALTON		STATIC WATER LEVEL 12.0 FT

SURFACE COMPLETION

TYPE	LENGTH AND DIAMETER OF SURFACE COMPLETION	DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED	SURFACE COMPLETION GROUT	LOCATION OF WELL
☒ ABOVE GROUND	LENGTH 0.0 FT.	DIAMETER 0.0 IN.	☐ CONCRETE	LAT. 38 ° 54' 22.3"
☐ FLUSH MOUNT	DIAMETER 0.0 IN.	LENGTH 0.0 FT.	☐ OTHER	LONG. 90 ° 17' 14.2"

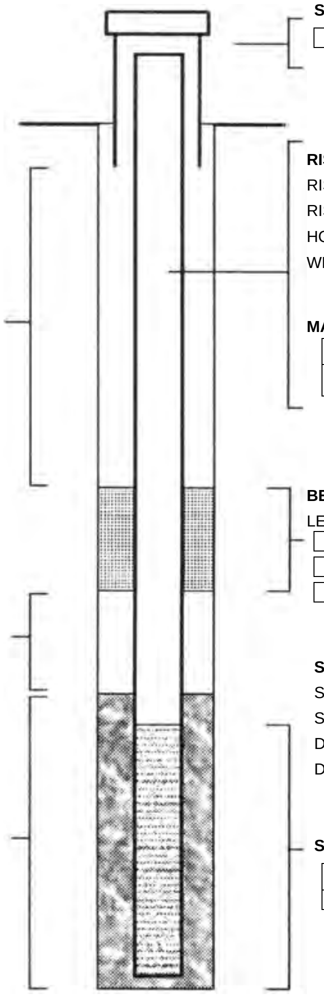
SMALLEST LARGEST
________ 1/4 ________ 1/4 ________ 1/4

SEC. LG001838 TWN. ________ NORTH
RANGE ________ Direction

MONITORING FOR:
☐ RADIONUCLIDES ☐ PETROLEUM PRODUCTS ONLY
☐ EXPLOSIVES ☐ METALS ☐ VOC
☐ SVOCS ☐ PESTICIDES/HERBICIDESS

PROPOSED USE OF WELL
☐ GAS MIGRATION WELL ☒ OBSERVATION
☐ EXTRACTION WELL ☐ OPEN HOLE
☐ PIEZOMETERS
☐ DIRECT PUSH

☐ LOCKING CAP
☐ WEEP HOLE



SURFACE COMPLETTION
☐ STEEL ☐ ALUMINUM ☐ PLASTIC

ELEVATION 427FT.

ANNULAR SEAL
LENGTH 14.0FT.
☒ SLURRY ☐ CHIPS
☐ PELLETS ☐ GRANULAR
☐ CEMENT/SLURRY

IF CEMENT/BENTONITE MIX:
BAGS OF CEMENT USED:
%OF BENTONITE USED:
WATER USED/BAG: GAL.

RISER
RISER PIPE DIAMETER 2.0IN.
RISER PIPE LENGTH 16.6FT.
HOLE DIAMETER 8.25IN.
WEIGHT OR SDR# SCH40

MATERIAL
☐ STEEL ☒ THERMOPLASTIC (PVC)
☐ OTHER ________

BENTONITE SEAL
LENGTH: 3.0
☐ CHIPS ☐ PELLETS ☐ GRANULAR
☐ SLURRY
☐ SATURATED ZONE ☐ HYDRATED

SECONDARY FILTER PACK
LENGTH: 2.0FT.

SCREEN
SCREEN DIAMETER: 2.0IN.
SCREEN LENGTH: 10.0FT.
DIAMETER OF DRILL HOLE: 8.25IN.
DEPTH TO TOP 16.5FT.

DEPTH TO TOP OF PRIMARY
FILTER PACK: 14.5FT.

SCREEN MATERIAL
☐ STEEL ☒ THERMOPLASTIC (PVC)
☐ OTHER

LENGTH OF PRIMARY FILTER
PACK: 12.0FT.

DEPTH		FORMATION
FROM	TO	DESCRIPTION
0.0	10.0	CLY
10.0	26.0	SLTY SND

TOTAL DEPTH: 26.5 FEET

FOR CASED WELLS, SUBMIT ADDITIONAL AS BUILT DIAGRAMS SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETER AND GROUT USED.

SIGNATURE (PRIMARY COUNTRACTOR) x ASHLEY COFFMAN	PERMIT NUMBER 004158	DATE WELL DRILLING WAS COMPLETED 12/16/2007

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH MISSOURI DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS

☐ PUMP INSTALLED

SIGNATURE (WELL DRILLER) x DAVID HUNZIKER	PERMIT NUMBER 002836	SIGNATURE (APPRENTICE) x ________________	APPRENTICE PERMIT NUMBER ________

MISSOURI DEPARTMENT OF
NATURAL RESOURCES
DIVISION OF
GEOLOGY AND LAND SURVEY
(573) 368-2165

MONITORING WELL CERTIFICATION RECORD

REF NO 00381422	DATE RECEIVED 04/23/2008
CR NO	CHECK NO. 1291232
STATE WELL NO A161936 05/15/2008	REVENUE NO. 042308

ENTERED NRSTOGD PH1 PH2 PH3 04/23/2008 04/23/2008 04/23/2008	APPROVED BY	ROUTE

INFORMATION SUPPLIED BY PRIMARY CONTRACTOR OR DRILLING CONTRACTOR

NOTE: THIS FORM IS NOT TO BE USED FOR NESTED WELLS

OWNER NAME AMEREN	CONTACT NAME PAUL PIKE			VARIANCE GRANTED BY DNR
OWNER ADDRESS 1901 CHOTCAU	CITY ST LOUIS	STATE MO	ZIP 63116	NUMBER ________________
SITE NAME SIOUX POWER PLANT		WELL NUMBER DG 4		COUNTY ST CHARLES
SITE ADDRESS 8501 W STATE RT 94		CITY WEST ALTON		STATIC WATER LEVEL 13.0 FT

SURFACE COMPLETION

TYPE	LENGTH AND DIAMETER OF SURFACE COMPLETION	DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED	SURFACE COMPLETION GROUT
☒ ABOVE GROUND	LENGTH 0.0 FT.	DIAMETER 0.0 IN.	☐ CONCRETE
☐ FLUSH MOUNT	DIAMETER 0.0 IN.	LENGTH 0.0 FT.	☐ OTHER

LOCATION OF WELL
LAT. 38 ° 54' 0.5"
LONG. 90 ° 17' 40.8"

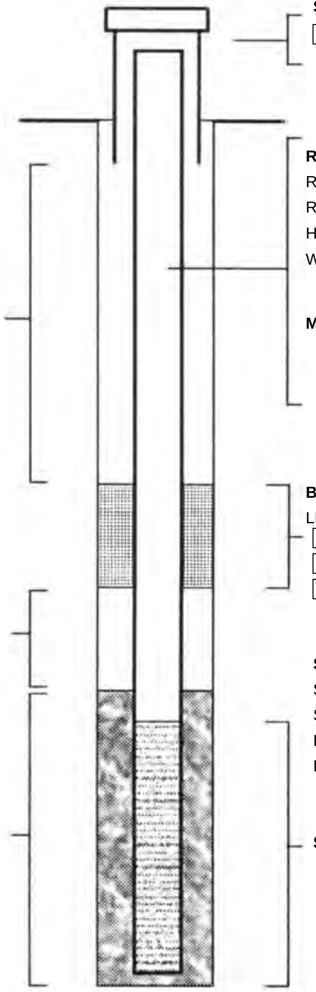
SMALLEST LARGEST
________ 1/4 ________ 1/4 ________ 1/4

SEC. LG001838 TWN. ________ NORTH
RANGE ________ Direction

MONITORING FOR:
☐ RADIONUCLIDES ☐ PETROLEUM PRODUCTS ONLY
☐ EXPLOSIVES ☐ METALS ☐ VOC
☐ SVOCS ☐ PESTICIDES/HERBICIDESS

PROPOSED USE OF WELL
☐ GAS MIGRATION WELL ☒ OBSERVATION
☐ EXTRACTION WELL ☐ OPEN HOLE
☐ PIEZOMETERS
☐ DIRECT PUSH

☐ LOCKING CAP
☐ WEEP HOLE



SURFACE COMPLETTION
☐ STEEL ☐ ALUMINUM ☐ PLASTIC

ELEVATION 427FT.

ANNULAR SEAL
LENGTH 18.0FT.
☒ SLURRY ☐ CHIPS
☐ PELLETS ☐ GRANULAR
☐ CEMENT/SLURRY

IF CEMENT/BENTONITE MIX:
BAGS OF CEMENT USED:
%OF BENTONITE USED:
WATER USED/BAG: GAL.

RISER
RISER PIPE DIAMETER 2.0IN.
RISER PIPE LENGTH 22.0FT.
HOLE DIAMETER 8.25IN.
WEIGHT OR SDR# SCH40

MATERIAL
☐ STEEL ☒ THERMOPLASTIC (PVC)
☐ OTHER ______

BENTONITE SEAL
LENGTH: 0.0
☐ CHIPS ☐ PELLETS ☐ GRANULAR
☐ SLURRY
☐ SATURATED ZONE ☐ HYDRATED

SECONDARY FILTER PACK
LENGTH: 2.0FT.

SCREEN
SCREEN DIAMETER: 2.0IN.
SCREEN LENGTH: 10.0FT.
DIAMETER OF DRILL HOLE: 8.25IN.
DEPTH TO TOP 22.0FT.

DEPTH TO TOP OF PRIMARY
FILTER PACK: 20.0FT.

SCREEN MATERIAL
☐ STEEL ☒ THERMOPLASTIC (PVC)
☐ OTHER

LENGTH OF PRIMARY FILTER
PACK: 12.0FT.

DEPTH		FORMATION
FROM	TO	DESCRIPTION
0.0	10.0	CLY
10.0	32.0	SLT SND

TOTAL DEPTH: 32.0 FEET

FOR CASED WELLS, SUBMIT ADDITIONAL AS BUILT DIAGRAMS SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETER AND GROUT USED.

SIGNATURE (PRIMARY COUNTRACTOR) x ASHLEY COFFMAN	PERMIT NUMBER 004158	DATE WELL DRILLING WAS COMPLETED 12/16/2007

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH MISSOURI DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS

☐ PUMP INSTALLED

SIGNATURE (WELL DRILLER) x DAVID HUNZIKER	PERMIT NUMBER 002836	SIGNATURE (APPRENTICE) x ________________________	APPRENTICE PERMIT NUMBER __________

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY
(573) 368-2165

MONITORING WELL CERTIFICATION RECORD

REF NO 00512903	DATE RECEIVED 02/04/2016		
CR NO	CHECK NO. 170079		
STATE WELL NO A206275 02/09/2016	REVENUE NO. 020416		
ENTERED NRBASSM PH1 PH2 PH3 02/08/2016 02/08/2016 02/08/2016	APPROVED BY	ROUTE	

INFORMATION SUPPLIED BY PRIMARY CONTRACTOR OR DRILLING CONTRACTOR

NOTE: THIS FORM IS NOT TO BE USED FOR NESTED WELLS

OWNER NAME AMEREN MISSOURI C/O BILL KUTOSKY	CONTACT NAME AMEREN MISSOURI C/O BILL KUTOSKY			VARIANCE GRANTED BY DNR
OWNER ADDRESS 3750 S LINDBERGH BLVD.	CITY ST LOUIS	STATE MO	ZIP 63127	NUMBER ________
SITE NAME SIOUX ENERGY CENTER		WELL NUMBER BMW 1S		COUNTY ST CHARLES
SITE ADDRESS 8501 N STATE ROUTE 94		CITY WEST ALTON		STATIC WATER LEVEL 7.4 FT

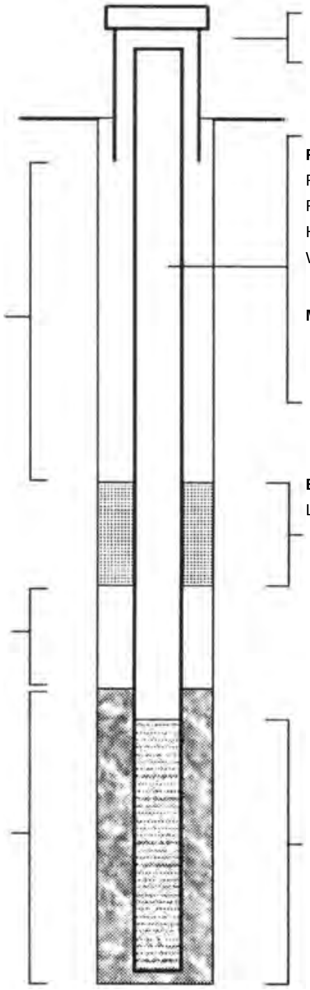
SURFACE COMPLETION

TYPE	LENGTH AND DIAMETER OF SURFACE COMPLETION	DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED	SURFACE COMPLETION GROUT	LOCATION OF WELL
☒ ABOVE GROUND	LENGTH 5.0 FT.	DIAMETER 12.0 IN.	☒ CONCRETE	LAT. 38 ° 54' 50.22"
☐ FLUSH MOUNT	DIAMETER 4.0 IN.	LENGTH 2.5 FT.	☐ OTHER	LONG. 90 ° 18' 4.54"

SMALLEST LARGEST
____ 1/4 ____ 1/4 ____ 1/4

SEC. 19 TWN. 48 NORTH
RANGE 6 Direction E

☐ LOCKING CAP
☐ WEEP HOLE



SURFACE COMPLETTION
☐ STEEL ☒ ALUMINUM ☐ PLASTIC

MONITORING FOR:
☐ RADIONUCLIDES ☐ PETROLEUM PRODUCTS ONLY
☐ EXPLOSIVES ☒ METALS ☐ VOC
☐ SVOCS ☐ PESTICIDES/HERBICIDESS

ELEVATION ____FT.

RISER
RISER PIPE DIAMETER 2.0IN.
RISER PIPE LENGTH 15.8FT.
HOLE DIAMETER 6.0IN.
WEIGHT OR SDR# SCH40

PROPOSED USE OF WELL
☐ GAS MIGRATION WELL ☒ OBSERVATION
☐ EXTRACTION WELL ☐ OPEN HOLE
☐ PIEZOMETERS
☐ DIRECT PUSH

ANNULAR SEAL
LENGTH 0.0FT.
☐ SLURRY ☐ CHIPS
☐ PELLETS ☐ GRANULAR
☐ CEMENT/SLURRY

IF CEMENT/BENTONITE MIX:
BAGS OF CEMENT USED:
%OF BENTONITE USED:
WATER USED/BAG: GAL.

MATERIAL
☐ STEEL ☒ THERMOPLASTIC (PVC)
☐ OTHER ____

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION
0.0	8.5	SDY SLT
8.5	15.6	STY CLY
15.6	17.5	SND
17.5	18.5	STY CLY
18.5	25.0	SND

TOTAL DEPTH: 25.0 FEET

BENTONITE SEAL
LENGTH: 9.5
☐ CHIPS ☐ PELLETS ☐ GRANULAR
☐ SLURRY
☐ SATURATED ZONE ☐ HYDRATED

SECONDARY FILTER PACK
LENGTH: 0.1FT.

SCREEN
SCREEN DIAMETER: 2.0IN.
SCREEN LENGTH: 9.8FT.
DIAMETER OF DRILL HOLE: 6.0IN.
DEPTH TO TOP 15.2FT.

DEPTH TO TOP OF PRIMARY
FILTER PACK: 12.5FT.

SCREEN MATERIAL
☐ STEEL ☒ THERMOPLASTIC (PVC)
☐ OTHER

LENGTH OF PRIMARY FILTER PACK: 12.5FT.

FOR CASED WELLS, SUBMIT ADDITIONAL AS BUILT DIAGRAMS SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETER AND GROUT USED.

SIGNATURE (PRIMARY COUNTRACTOR) x JOHN SUOZZI	PERMIT NUMBER 006284		DATE WELL DRILLING WAS COMPLETED 12/08/2015
I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH MISSOURI DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS			☐ PUMP INSTALLED
SIGNATURE (WELL DRILLER) x JASON DRABEK	PERMIT NUMBER 004484	SIGNATURE (APPRENTICE) x ________	APPRENTICE PERMIT NUMBER ________

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION RECORD

NOTE: This form is not to be used for nested wells

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO.		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE / /

OWNER AND SITE INFORMATION

PROPERTY OWNER NAME WHERE WELL IS LOCATED Sioux Energy Center	PRIMARY PHONE NUMBER WITH AREA CODE	WELL NUMBER BMW-3S	**WELL COMPLETION DATE** 11/08/2016
PROPERTY OWNER MAILING ADDRESS 8501 N State Rd 94	CITY West Alton	STATE MO	ZIP CODE 63386
PHYSICAL ADDRESS OF PROPERTY WHERE WELL IS LOCATED 8501 N State Rd 94	CITY West Alton	COUNTY St Charles	
NAME OF SITE OR CLEANUP PROJECT Ameren CCR GW Monitoring	DNR/EPA PROJECT NUMBER OR REGULATORY SITE ID NUMBER (IF APPLICABLE) 153-1406.0003B	VARIANCE NUMBER (IF ISSUED)	
PRIMARY CONTRACTOR NAME (PLEASE PRINT)	*PERMIT NUMBER*	*Section 256.607(3), RSMo, requires all primary contractors to comply with all rules and regulations promulgated pursuant to Sections 256.600 to 256.640 RSMo.*	

SURFACE COMPLETION

TYPE
☒ Above Ground
☐ Flush Mount

LENGTH AND DIAMETER OF SURFACE COMPLETION
Length 2.57 FT.
Diameter 4 IN.

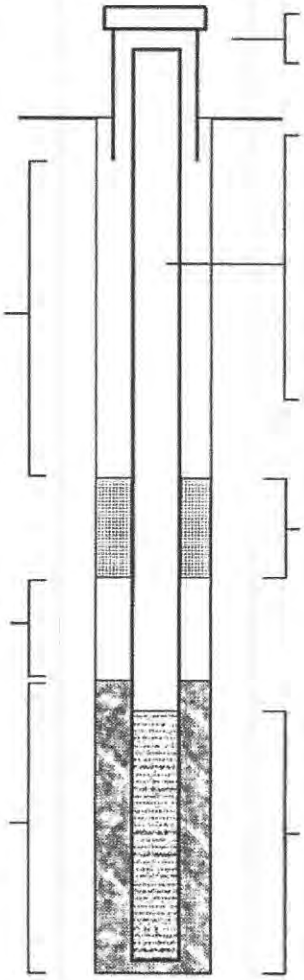
DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED
Diameter 12 IN.
Length 24.17 FT.

SURFACE COMPLETION GROUT
☒ Concrete
☐ Other

LOCATION OF WELL (D/M/S FORMAT ONLY)
Latitude 38 ° 54 ' 50.93N "
Longitude 90 ° 18 ' 16.53W "

SMALLEST ¼ ¼ LARGEST ¼
Section Township North
Range ☐ E ☐ W

☒ Locking Cap
☐ Weep Hole



SURFACE COMPLETION
☐ Steel ☒ Aluminum ☐ Plastic

Elevation 424.12 FT.

ANNULAR SEAL
Length 9 FT.
☒ Slurry ☐ Chips
☐ Pellets ☐ Granular
☐ Cement/Slurry

IF CEMENT/BENTONITE MIX:
Bags of Cement Used
% of Bentonite Used
Water Used Per Bag GAL.

RISER OR CASING (IF OPEN HOLE COMPLETION)
Riser/Casing Diameter 2 IN.
Riser/Casing Length 16.5 FT.
Diameter Of Drill Hole 6 IN.
Weight Or SDR# S40

MATERIAL
☐ Steel ☒ Thermoplastic (PVC)
☐ Other

BENTONITE SEAL
Length 2.5
☒ Chips ☐ Pellets ☐ Granular
☐ Saturated Zone ☐ Hydrated

SECONDARY FILTER PACK LENGTH
0.8 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK
11.6 FT.

LENGTH OF PRIMARY FILTER PACK
12.57 FT.

SCREEN
Screen Diameter 2 IN.
Screen Length 9.8 FT.
Diameter Of Drill Hole 6 IN.
Depth To Top 24.1 FT.

SCREEN MATERIAL
☐ Steel ☒ Thermoplastic (PVC)
☐ Other

TYPE OF WELL (CHECK ONE)
☐ Direct Push ☐ Extraction ☐ Inclinometer
☐ Gas Migration ☐ Injection Lysimeter
☒ Observation ☐ Open Hole ☐ Other (specify)
☐ Piezometer Standard

MONITORING FOR (CHECK ALL THAT APPLY)
☐ Explosives ☐ Metals
☐ Pesticides/Herbicides ☐ Petroleum
☐ Radionuclides ☐ SVOCS
☐ VOCS (non-petroleum) ☐ Geotechnical Data

DEPTH		FORMATION DESCRIPTION (OR ATTACH BORING LOG*)
FROM	TO	

TOTAL DEPTH: FT.
☐ *Boring Log Attached

STATIC WATER LEVEL 8.65 FT.
PUMP INSTALLED ☐ Yes ☒ No

For cased wells, submit additional as-built diagrams showing well construction details including type and size of all casing, hole diameter and grout used.

I hereby certify that the monitoring well herein described was constructed in accordance with Missouri Department of Natural Resources requirements.

MONITORING WELL INSTALLATION CONTRACTOR	PERMIT NUMBER 4398	DATE 8-28-17	MONITORING WELL INSTALLATION CONTRACTOR APPRENTICE (IF APPLICABLE)	PERMIT NUMBER

MO 780-1415 (8-16) **SEND COMPLETED FORM ALONG WITH $100 CERTIFICATION FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, MISSOURI GEOLOGICAL SURVEY, WELLHEAD PROTECTION SECTION, PO BOX 250, ROLLA, MO 65402 PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov RECORD (AND FEE) MAY BE SUBMITTED ONLINE: dnr.mo.gov/mowells**

APPENDIX H
STATISTICAL ANALYSIS PLAN

Statistical Analysis Plan

STATISTICAL ANALYSIS PLAN

Prepared in accordance with the United States Environmental Protection Agencies Coal Combustion Rule, part 40 CFR 257.93 for Ameren Missouri's Utility Waste Landfill Cell SCPC at the Sioux Energy Center, St. Charles County, Missouri

Submitted To: Ameren Missouri
1901 Chouteau Avenue
St. Louis, Missouri 63103

Submitted By: Golder Associates Inc.
820 S. Main Street, Suite 100
St. Charles, MO 63301 USA

Date: October 12, 2017

Project No.153-1406

EXECUTIVE SUMMARY

This Statistical Analysis Plan (SAP) was developed to meet the requirements of United States Environmental Protection Agency (USEPA) 40 CFR Part 257 “Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities; Final Rule” (the Rule or CCR Rule). The Rule requires owners or operators of an existing Coal Combustion Residuals (CCR) Surface Impoundment to install a groundwater monitoring system and develop a sampling and analysis program (§§ 257.90 - 257.94). Ameren Missouri has determined that the Utility Waste Landfill’s (UWL) SCPC Surface Impoundment at the Sioux Energy Center in St. Charles County, Missouri is subject to the requirements of the CCR Rule.

As a part of the groundwater sampling and analysis requirements of the Rule, statistical methods as described in Section §257.93(f) of the Rule need to be implemented to statistically evaluate groundwater quality. The selected statistical method must then be certified by a qualified professional engineer stating that the statistical method is appropriate for evaluating the groundwater monitoring data for the CCR Unit. Detailed descriptions of the acceptable statistical data methods are provided in the USEPA’s *Statistical Analysis of Groundwater Data at RCRA Facilities, Unified Guidance* (USEPA, 2009) (Unified Guidance). The Unified Guidance is also recommended in the CCR Rule to be used for guidance in the selection of the appropriate statistical evaluation method.

This SAP details the statistical procedures to be used to establish background conditions, to implement detection monitoring, and to implement assessment monitoring (if needed) for Ameren Missouri at the above mentioned CCR Unit. Detailed information on collection, sampling techniques, preservation, etc. are provided in the Groundwater Monitoring Plan (GMP) for the CCR Unit specified above. This SAP is a companion documents to the GMP and assumes that data analyzed by the procedures described in this SAP are from samples that were collected in accordance with the GMP.

This SAP was prepared by Golder Associates, Inc. (Golder) on behalf of Ameren in order to document appropriate method of groundwater data evaluation in compliance with CCR Rules. The methods and groundwater data evaluation techniques used in this SAP are appropriate for evaluation of the groundwater monitoring data for the above mentioned CCR Unit and are in compliance with performance standards outlined in Section §257.93(g) of the CCR Rule.

Table of Contents

List of Tables

1.0 BASELINE STATISTICS

This section discusses the procedures, methods, and processes that will be implemented as part of the Detection Monitoring statistical evaluation. Detection Monitoring will begin after eight rounds of sampling are completed at each monitoring well for each of the Appendix III and Appendix IV parameters. This background monitoring period provides baseline data for each monitoring well which can be used as the basis of the statistical evaluation. Detection monitoring will be completed on a semiannual basis unless adequate groundwater flow is not available for semiannual sampling and proper documentation as outlined in §257.94(d) is completed. Detection monitoring will analyze for Appendix III analytes as outlined in the Groundwater Monitoring Plan for this CCR Unit.

1.1 STATISTICAL DATA PREPARATION AND INITIAL REVIEW

Many of the statistical comparison tests used in detection, and assessment monitoring require various analyses to be completed prior to the data being used for the calculation of statistical limits. This section discusses the methods and procedures for completing this initial review of the data. The analyses required include testing for statistical independence, physical independence, and procedures to evaluate potential outliers.

1.1.1 Physical and Statistical Independence of Groundwater Samples

Detection, and Assessment Monitoring statistical evaluations assume that background and downgradient sampling results are statistically independent. The Unified Guidance states that *"Physical independence of samples does not guarantee statistical independence, but it increases the likelihood of statistical independence."* (Section 14.1, Unified Guidance). Physical independence is most likely achieved when consecutive groundwater samples are collected from independent volumes of water within a given aquifer zone. Using the Darcy Equation, minimum time intervals between sampling events can be calculated in order to confirm the minimum time interval for groundwater to travel through the borehole is less than the time between sampling events (**Table 1, Physical Independence**). This minimum time can be calculated as displayed in Section *14.3.2* of the Unified Guidance.

Table 1: Physical Independence

Well ID	Hydraulic Conductivity	Average Hydraulic Gradient	Effective Porosity	Well Bore Volume	Minimum Time
Symbol	K	I	n	D	T_{min}
Units	Feet/Day	Feet/Foot	%	Feet	Days
UG-1A	51	0.0003	0.35	0.5	11.4
UG-2	51	0.0003	0.35	0.5	11.4
DG-1	51	0.0003	0.35	0.5	11.4
DG-2	51	0.0003	0.35	0.5	11.4
DG-3	51	0.0003	0.35	0.5	11.4
DG-4	51	0.0003	0.35	0.5	11.4
BMW-1S	16	0.0003	0.35	0.5	37.2
BMW-3S	53	0.0003	0.35	0.5	11.0

Notes:
1. Average hydraulic gradient and effective porosity taken from table 2 in the Groundwater Monitoring Plan (GMP)
2. Hydraulic Conductivity taken from table 3 of the Groundwater Monitoring Plan (GMP)
3. Calculation completed using the Darcy Equation as outlined in section 14.3.2 of the Unified Guidance.

1.1.2 Data Review – Testing For Outliers

Careful review of the data is critical for verifying that there is an accurate representation of the groundwater conditions. Early identification of anomalous data (outliers) helps play a key role in a successful SAP. Possible causes for outliers include:

- Sampling error or field contamination;
- Analytical errors or laboratory contamination;
- Recording or transcription errors;
- Faulty sample preparation, preservation, or shelf-life exceedance; or
- Extreme, but accurately detected environmental conditions (e.g., spills, migration from the facility).

The following sections outline a few graphical and statistical tests that should be completed prior to the data being used to calculate statistical limits.

1.1.2.1 Time Series Plots

Time Series plots are a quick and simple method to check for possible outliers. Time series plots should be generated with the concentration of the analyte on the Y-axis and the sample date (time) on the X-axis. If any data points look to be potential outliers, the data should be flagged and further evaluated as described in Section 1.1.2.2 below.

1.1.2.2 Dixon’s and Rosner’s Tests

If graphical methods demonstrate that potential outliers exist, further investigation of these data points can be completed using Dixon’s test for datasets with fewer than 25 samples and Rosner’s test with datasets greater than 20 samples. Formal testing should only be performed if an observation seems particularly high compared to the rest of the dataset. If statistical testing is to be completed to whether an outlier exists, it should be cautioned that these outlier tests assume that the rest of the data (other than the outlier) are normally distributed. Additionally, because log-normally distributed data often contain one or more values that appear high relative to the rest, it is recommended that the outlier test be run on the transformed values instead of their original observations. This way, one can avoid classifying a high log-normal measurement as an outlier just because the test assumptions were violated. Most groundwater statistical packages can complete Dixon’s and Rosner’s tests and more information about Dixon’s and Rosner’s tests is provided in Sections 12.3 and 12.4 of the Unified Guidance. If the test designates an observation as a statistical outlier, the source of the abnormal measurement should be investigated. In general, if a data point is found to be a statistical outlier, it should not be used for statistical evaluation. However, outlier removal should be performed carefully, and typically only when a specific cause for the outlier can be identified.

In some cases where a specific cause for an outlier cannot be identified, professional judgment can be used to determine whether the outlier significantly affects the statistical results to the extent that removal is deemed necessary. If an outlier value with much higher concentration than other background observations is not removed from background prior to statistical testing, it will tend to increase both the background sample mean and standard deviation. In turn, this may substantially raise the magnitude of the prediction limit or control limit calculated from that data set. Thus, experience shows that it is a good practice to remove obvious outliers from the database even when independent evidence of the source of the outlier does not exist. The removal of outliers tends to normalize the data and therefore produce a more robust statistical limit. Outlier removal also tends to produces a more conservative statistical limit, since the data variability is decreased, thereby decreasing the standard deviation.

1.2 Upgradient Monitoring Wells

Following the identification and removal of outliers, the upgradient data are further reviewed to determine appropriate methods for statistical evaluation to maintain adequate statistical power while minimizing the chance of false positives. The following sections describe the procedures and methods that should be used, based on the background dataset, to compare the background datasets, to calculate the data distribution, to handle non-detect (ND) data, and to select appropriate statistical evaluation methods (interwell vs intrawell).

1.2.1 Calculate for Mean and Standard Deviation

Following outlier removal, initial summary statistics including mean and standard deviation should be calculated for the background monitoring well datasets. While these summary statistics are easily completed in many groundwater statistical software packages, it is important to account for values that have low or zero values as described below.

1.2.1.1 Reporting of Low and Zero Values

1.2.1.1.1 Estimated Values (J Flag)

Estimated values are values that have a concentration between the method detection limit (MDL[1]) and the practical quantitation limit (PQL[2]) for any given compound. These values are typically displayed with a J flag in laboratory report packages and are often referred to as "J-values". In most cases, The Unified Guidance recommends using the estimated value provided for statistical evaluation. Estimated values are typically used because the accuracy and power of most statistical evaluations lose power as the percentage of non-detects increases. While they are below the PQL, estimated values are considered detectable concentrations for statistical calculations, which has the effect of lowering the percentage of non-detects.

This "rule" should be applied with care, as there is an exception. Estimated values are not considered detectable concentrations if all values for a single constituent are less than the PQL. This is discussed in more detail in Section 1.3.5 of this document.

1.2.1.1.2 Non-Detects Values (ND)

Non-Detect Values (ND) are concentrations that were not detected at a concentration above the MDL. ND values are typically displayed with a "U" or "ND" flag in laboratory data report packages. The following approaches for managing ND values are based on recommendations in the Unified Guidance and are applicable for use with the statistical evaluation procedures that will be further discussed and used in this SAP (prediction intervals, confidence intervals, and tolerance intervals):

- If <15% ND, substitute ½ the PQL;
- If between 15% to 50% ND, use the Kaplan-Meier or robust regression on ordered statistics to estimate the mean and standard deviation;
- If >50% but less than 100% ND, use a non-parametric test; or
- If 100% of values are less than the PQL, use the Double Quantification Rule.

1.2.2 Data Distribution

Statistical evaluations of groundwater data require an understanding of the data distribution for each analyte in each monitoring well. Data typically fall into one of the following distributions:

---

[1] MDL = lowest level of an analyte (substance) that the laboratory can reliably detect with calibrated instrumentation; generally based on results of an annual "MDL study" performed in accordance with 40 CFR Part 136, Appendix B; MDLs are generally set using laboratory grade deionized water spiked with a known concentration and thus do not account for effects of matrix interference inherent in typical groundwaters.

[2] PQL = minimum concentration of an analyte (substance) that can be measured with a high degree of confidence that the analyte is present at or above that concentration (typically 5-10x higher than the MDL).

- Normal distribution – Sometimes referred to as Gaussian distribution, a normal distribution is a common continuous distribution where data form a symmetrical bell-shaped curve around a mean. Normally distributed data are tested using parametric methods.
- Transformed-normal distribution – Similar to a normal distribution, however, data are asymmetrical until transformation is applied to all data which then causes it to form a bell-curve. Transformed-normal data distributions are also tested use parametric methods.
- Non-Normal Distribution – When the data are not or cannot be transformed into a symmetrical distribution. Non-normal data distributions are tested using Non-parametric methods.

Testing for data distributions can be completed in several different ways including the skewness coefficient, probability plots with Filliben's test, or the Shapiro-Wilk/Shapiro-Francia Test. All of these methods may be employed, however, the Shapiro-Wilk and Shapiro-Francia tests are generally considered the best method according to the Unified Guidance. The Shapiro-Wilk test is best for sample sizes under 50 while the Shapiro-Francia test is best with larger datasets of 50 or more observations. Most groundwater statistical software packages can complete both Shapiro-Wilk and Shapiro-Francia tests and a detailed discussion of the testing procedures is provided in Section *10.5.1* of the Unified Guidance.

Based on the outcome of the data distribution testing, data will use either Parametric or Non-parametric tests. It is important to note that non-parametric testing usually requires larger datasets in order to minimize the Site Wide False Positive Rate (SWFPR) therefore when the raw data are not normally distributed, a transformed-normal distribution is preferred when possible.

1.2.3 Temporal Trend

Most statistical tests assume that the sample data are statistically independent and identically distributed. Therefore, samples collected over a period of time should not exhibit a time dependence. A time dependence could include the presence of trends or cyclical patterns when observations are graphed on a time series plot. Trend analysis methodologies test to see whether the dataset displays an increasing, decreasing, or seasonal trend. A statistically significant increasing or decreasing trend could indicate a release from the CCR unit (or alternative source) and further investigation of the cause of the trend may be necessary.

If a trend is suspected, a Theil-Sen trend line should be used to estimate slope and the Mann-Kendall Trend Test should be used to evaluate the slope significance (Chapter 14, Unified Guidance). If a statistically significant trend is reported, based on a Sen's slope/Mann-Kendall trend test, the source of the trend should be investigated. If the trend can be shown to be a result of an upgradient or off-site source, the data can be de-trended and used to calculated statistical limits. De-trending can be accomplished by computing a linear regression on the data (see Section 17.3.1 of the Unified Guidance) and then using the regression residuals instead of the original measurements in subsequent statistical analysis.

1.2.4 *Comparing Background Datasets (Spatial Variation)*

After physical independence, outlier, trend, and summary statistical testing is completed, the datasets from the background monitoring wells should be compared to one another for each individual constituent. The comparison of these background datasets is useful for determining whether spatial variability exists in the background dataset, and can also be used to decide whether an interwell or intrawell approach is more appropriate for statistical evaluation.

Box and whisker plots can be used to perform side by side comparison for each well and can be completed for each individual analyte to determine if the variance is equal across the background datasets. If the box plots appear to be staggered and do not appear to be from the same population (same variance) then a Lavene’s test using an α of 0.01 should be used as a check to determine if the background datasets have spatial variation. Testing methods and procedures are provided in Section 11.2 of the Unified Guidance.

The preferred method for comparing background datasets is a Mann-Whitney (or Wilcoxon Rank Sum) Test, which evaluates the ranked medians of both the historical and new dataset populations. An α of 0.05 should be used for this evaluation. After calculation, if the Mann-Whitney statistic does not exceed the critical point, the test assumes that the two data populations have equal medians, and therefore are likely from the same statistical distribution. The testing methods and procedures for this analysis are provided in Section 16.2 of the Unified Guidance.

If spatial variability is identified within the background dataset, an additional investigation may be needed in order to confirm that the variability is not caused by impacts from the CCR unit. If there is spatial variability and it is not caused by impacts from the CCR Unit, then an intrawell approach to statistical evaluation may be appropriate.

1.3 Compliance Monitoring Wells and Statistically Significant Increases

After completing the previously described analyses of the background data, a statistical evaluation of the compliance monitoring data should be completed to determine if there are any Statistically Significant Increases[3] (SSIs) that could trigger assessment monitoring. Section §257.93(F) of the CCR Rule specifies the list of methods that can be used for statistical evaluation. These specific methods to be used for statistical evaluation of data from the RMSGS are detailed below. Further, the Unified Guidance is recommended in the CCR Rule to be used for guidance in the selection of the appropriate statistical evaluation method. This section provides a guide to choosing the correct statistical evaluation to analyze the compliance wells for SSIs, the basic principles of each method, and response activities for identified SSIs.

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[3] SSI = a verified statistical exceedance; under compliance monitoring programs, the first time an exceedance is reported it is an initial statistical exceedance and is only considered an SSI if a confirmatory result verifies the initial exceedance.

1.3.1 Interwell vs Intrawell Statistical Analysis

1.3.1.1 Interwell Statistical Analysis

An interwell statistical evaluation compares the groundwater results from the compliance (downgradient) monitoring wells to a pool of background (typically upgradient) monitoring well results. If results from the downgradient wells are statistically higher (or significant) than the background dataset then an exceedance is triggered. This upgradient verses downgradient method typically assumes that:

- Naturally, un-impacted groundwater characteristics in the compliance monitoring wells is comparable and equal on average to the background monitoring wells.
- Upgradient and downgradient monitoring well samples are drawn from the same aquifer and are screened in essentially the same hydrostratigraphic position.
- The aquifer unit is homogeneous and isotropic.
- Groundwater flow is in a definable pathway from upgradient to downgradient wells beneath the CCR Unit.

An interwell approach is preferable for statistical evaluation because it compares data to a background dataset that is not influenced by the CCR Unit. Interwell methods should be used with two exceptions: (1) there are significant differences in the datasets of the background wells (as indicated by methods described in Section 1.2.4) or (2) it can be demonstrated that groundwater geochemistry at all wells (background and compliance) is not impacted by the SCPC.

1.3.1.2 Intrawell Statistical Analysis

An intrawell statistical evaluation compares the groundwater results from a compliance monitoring well to historical data collected from that same compliance monitoring well. This method can be used for CCR monitoring when groundwater data from the background monitoring wells is statistically different than that of the compliance monitoring wells or when it can be shown that there is no impact from the SCPC in either upgradient or downgradient/compliance wells.

1.3.2 Statistical Power

As discussed above, one of the primary goals of the selection of a proper statistical evaluation method is to limit the potential for results to falsely trigger a SSI while also maintaining sufficient statistical power to detect a true SSI. Falsely triggering a SSI when no release from the CCR unit has occurred is referred to as a false positive. The False Positive Rate (FPR), typically denoted by the Greek letter α, is also known as the "significance level". The FPR is the probability that a future compliance observation will be declared to be from a different statistical distribution than the background data. If the FPR is set too high, it can lead to the conclusion that there is evidence of impact when none exists. Conversely, if the FPR is set too low, it can lead to a false conclusion that no contamination exists, when it actually does exist (also known as a "false negative"). Ultimately, the ability to accurately identify SSIs depends on the selection of an appropriate FPR, which is referred to as the statistical power. FPRs are set for each parameter (or for each parameter in each well for intrawell analysis). However, statistical analysis programs and the resulting decision making do not depend on each individual measurement/comparison error rates, but are dependent on the collective error rate from all of the individual comparisons. When the individual FPRs are integrated over the entire statistical monitoring program, it is referred to as the site-wide false positive rate (SWFPR), which is a better measure of the ability of the entire statistical program to detect false positive observations.

1.3.2.1 Site-Wide False Positive Rate

For CCR monitoring, detection monitoring events are based on multiple comparisons, which include the seven (7) Appendix III parameters, at each compliance monitoring well. The SWFPR can be calculated based on several input parameters, including the assumed FPR, the number of downgradient monitoring wells (n), the number of parameters, and the number of statistical comparisons events in a given year for the CCR Unit. The Unified Guidance recommends that a statistical evaluation program be designed with an annual, cumulative SWFPR of approximately 10%.

The Unified Guidance recommends measuring statistical power using power curves which display the probability that an individual comparison will detect a concentration increase relative to background results. After determining the statistical method based on the background data, a power curve can be generated in order to determine the statistical power of the compliance monitoring program. The methods and procedures for calculating the SWFPR are described in Section 6.2.2 of the Unified Guidance.

1.3.2.2 Verification Sampling

Verification Sampling is an important aspect of the SAP as it improves statistical power while maintaining the SWFPR. Most statistical evaluations incorporate verification sampling mathematically into their determination of the SWFPR. Verification sampling is typically completed at a 1 of 2 pass strategy. As described above if an initial statistical exceedance is reported, then verification sampling will be performed to confirm the initial exceedance. Verification samples should be collected on a schedule that allows for physical independence of the samples. In a 1 of 2 pass strategy, if the concentration of the verification sample is less than the calculated compliance limit, then no SSI is triggered. If the initial and subsequent verification observation are above the calculated compliance limit, a SSI is triggered.

Due to the time constraints for reporting put forth in the CCR rule, it is suggested that verification sampling not be completed at the next regularly scheduled sampling event, but instead be collected prior to the next sampling event. Verification sampling within 90 days (assuming a 1 of 2 pass verification sampling strategy) will typically allow sufficient time to complete laboratory and statistical analysis in accordance with the timeframes set forth in the CCR Rules.

1.3.3 Statistical Evaluation Methods

As outlined above, the CCR rule list 5 possible methods for statistical evaluation. The different methods that can be employed for CCR monitoring as outlined in §257.93(F) are:

- ***§257.93(F)(1)*** *"A parametric analysis of variance followed by multiple comparison procedures to identify statistically significant evidence of contamination. The method must include estimation and testing of the contrasts between each compliance well's mean and the background mean levels for each constituent."*
- ***§257.93(F)(2)*** *"An analysis of variance based on ranks followed by multiple comparison procedures to identify statistically significant evidence of contamination. The method must include estimation and testing of the contrasts between each compliance well's median and the background median levels for each constituent."*
- ***§257.93(F)(3)*** *"A tolerance or prediction interval procedure, in which an interval for each constituent is established from the distribution of the background data and the level of each constituent in each compliance well is compared to the upper tolerance or prediction limit."*
- ***§257.93(F)(4)*** *"A control chart approach that gives control limits for each constituent."*
- ***§257.93(F)(5)*** *"Another statistical test method that meets the performance standards of paragraph (g) of this section."*

1.3.4 Prediction Intervals

Section §257.93(F)(3) outlines using prediction intervals or tolerance intervals for statistical evaluation. Based on recommendation from the Unified Guidance, prediction limits are the preferred method for calculating detection monitoring compliance limits and will be used to calculate compliance limits for the seven Appendix III constituents. In addition, the Unified Guidance suggests using prediction limits with verification sampling (Chapter 19 of the Unified Guidance), because prediction limits help to maintain low SWFPR while still providing high statistical power. Tolerance intervals, which are a backward looking procedure, should not be used for detection monitoring, but will likely be used in assessment monitoring, as further described in Section 2.0 below. If, at any point in the future, a different statistical method becomes more applicable to the site conditions, this document may be modified to include that method as recommended by the Unified Guidance.

Prediction interval methods can be used for parametric and non-parametric datasets as well as for intrawell or interwell statistical analysis. Prediction limits use background data from either background monitoring wells for interwell analysis or from historical data for intrawell analysis calculate a concentration that represents an upper limit of expected future concentrations for a particular population. In contrast to tolerance limits, prediction intervals are a forward looking, predictive analysis, which incorporate uncertainty in future measurements, and are thus the most appropriate method for detection monitoring programs. Typically, a one-sided upper prediction limit is used to evaluate detection monitoring observations. Observations must be lower than the prediction limit (or within the upper and lower prediction limits for pH) to be considered "in control". Parametric methods are generally preferred over non-parametric methods, because they result in lower SWFPRs and higher statistical power.

For detection monitoring, if parametric testing is required, the procedures outlined in Section 19.3.1 of the Unified Guidance should be used to calculate prediction limits for the statistical analysis. If non-parametric testing is required, the procedures outlined in Section 19.4.1 of the Unified Guidance should be used to calculate prediction limits. Most groundwater statistical software includes algorithms for calculating either parametric or non-parametric prediction limits.

1.3.5 Double Quantification Rule

In situations where the entire background dataset is reported as ND or Estimated (J-flag), the Double Quantification Rule (DQR) will be used to supplement the prediction limit analyses. Generally, the Appendix III constituents occur at detectable concentrations in natural groundwater; however, if ND results are encountered for a given constituent, the DQR can be implemented. A demonstration that this statistical evaluation is as least as effective as any other test and results as described in §257.93(f)(5) can be made. The DQR is recommended by the Unified Guidance as a supplement to prediction limits because it reduces the number of non-detects used for statistical analysis and provides a lower SWFPR while maintaining statistical power.

Under the DQR, a SSI is triggered if a compliance well observation is higher than the reporting limit (RL)/PQL in either (1) both a detection monitoring sample and its verification resample, or (2) two consecutive sampling events in a program were resampling is not utilized.

1.4 Responding to SSIs

If the statistical evaluation for an Appendix III analyte triggers a SSI, the data must be evaluated to determine if the cause of the SSI is due to a release from the CCR Unit or from an alternative source. Possible alternative sources may include laboratory causes, sampling causes, statistical evaluation causes, or natural variation. If the SSI can be attributed to one of these sources and the SSI was not caused by the CCR Unit, an alternate source demonstration (ASD) can be completed. An ASD must be certified by a qualified professional engineer and completed in writing within 90 days of completing the statistical evaluation for a particular sampling event. If the SSI cannot be attributed to an alternative source and is from the CCR Unit, then Assessment Monitoring is triggered.

1.5 Updating Background Values

The Unified Guidance suggests that updating statistical limits should only be completed after a minimum of 4 to 8 new measurements are available (i.e., every 2 to 4 years of semiannual monitoring, assuming no verification sampling). The periodic update of background, during which additional data are incorporated into the background, improves statistical power and accuracy by providing a more conservative estimate of the true background population. Prior to incorporating new data into the background dataset, a test should be performed to demonstrate that the "new data" are from the same statistical population as the existing background results. Below are three methods that can be used in determining if the “new” data should be included in the background:

- Time Series Graphs – As described in Section 1.1.2.1, time series graphs can be used as a qualitative test to assist with the determination whether a new group of data match the historical data or if there is a concentration trend that could be indicative of a release or evolving groundwater conditions.
- Box-Whisker plots can also be used to determine whether or not the datasets are similar.
- Mann-Whitney (or Wilcoxon Rank) Test – Used to evaluate the ranked medians of both the historical and new dataset populations. An α of 0.05 should be used for this evaluation. After calculation, if the Mann-Whitney statistic does not exceed the critical point, the test assumes that the two data populations have equal medians, and therefore are likely similar.

Ultimately, the Mann-Whitney (Wilcoxon Rank Sum) Test is the statistical test that is used to determine whether new observations should be included in the background dataset. It is important to note that a difference in background datasets does not automatically prevent the new data from being used; however, if differences are noted, a review of the new data will be conducted to determine if the noted difference is a result of a change in the natural conditions of the groundwater or if it is the result of a potential release from the CCR Unit. If the new data are included in the background dataset, the prediction limits will be recalculated, as described in Section 1.3.4 above.

2.0 ASSESSMENT MONITORING STATISTICAL EVALUATION

This section discusses the procedures, methods, and processes that will be implemented as part of the assessment monitoring statistical evaluation, if required. Assessment monitoring will be initiated if a SSI is triggered during detection monitoring. As per the CCR Rule in Section §257.95(b), assessment monitoring must be initiated within 90 days of identifying an SSI (not the sample event which provided the data that resulted in the SSI). This 90-day period includes sampling the groundwater monitoring network for the Appendix IV constituents. Following the initial sampling event for all Appendix IV constituents, the monitoring network is then sampled again within 90 days of receiving the results from the initial Appendix IV sampling event. Following these initial assessment monitoring events, assessment monitoring is performed on a semiannual basis. During one of the two semiannual events, the full list of Appendix IV constituents must be tested. During the second assessment monitoring event of each year, only the Appendix IV constituents that are detected during the previous semiannual event are required to be monitored. Assessment monitoring is terminated if concentrations for all Appendix III and Appendix IV constituents in all compliance wells are statistically lower than background for two consecutive sampling events (§257.95(e)). The following sections discuss the procedures, methods, and processes that will be implemented as part of the assessment monitoring statistical evaluation. As discussed in Section 1.1 of this document, many of the statistical comparisons used in assessment monitoring require various analyses to be completed prior to the data being accepted into the statistical evaluation. Before using the results from assessment monitoring, the steps outlined in Sections 1.1 and 1.2 will be completed. Please refer to those sections for descriptions on the methods and techniques required to complete these analyses.

2.1 Establishing a Ground Water Protection Standard (GWPS)

Following the removal of outliers and the performance of general statistics described in Sections 1.1 and 1.2, GWPS will be developed for use in the assessment monitoring program. The GWPS is a key element to the assessment monitoring process. GWPS must be generated for each of the detected Appendix IV analytes. If interwell methods are utilized (preferred method), a site-wide GWPS will be generated for each analyte based on Appendix IV results reported for background/hydraulically upgradient wells. If intrawell methods are utilized, a well specific GWPS will be generated for each analyte.

For Appendix IV parameters that have a maximum contaminant level (MCL), as established by the United States Environmental Protection Agency, the GWPS is set equal to the MCL. For those constituents whose background concentration are greater than the MCL, the GWPS will be calculated from the background data. Finally, for those constituents that do not have an established MCL, the GWPS will be calculated. Several analytes (cobalt, lead, lithium, and molybdenum) do not have MCLs established and therefore the GWPS must be calculated based on their background concentrations.

2.1.1 Maximum Contaminant Level (MCL) Based GWPS

Many of the Appendix IV analytes have USEPA MCL levels. As specified in the CCR Rule in Section §257.95(b), the GWPS must either be the MCL, or a limit based on background data, whichever is greater. This section describes the methods to be used for statistical analysis when the MCL is to be used as the GWPS.

For Assessment Monitoring, the Unified Guidance recommends the confidence interval method to evaluate for potential exceedances, which are referred to as "statistically significant levels" (SSLs) (Chapter 21, Unified Guidance). Using confidence intervals, SSLs are identified by comparing the calculated confidence interval against the GWPS. A confidence interval statistically defines the upper and lower bounds of a specified population within a stipulated level of significance. Confidence intervals are required to be calculated based on a minimum of 4 independent observations, but a more representative confidence interval can be developed when all of the available data are utilized.

The specific type of confidence interval should be based the attributes of the data being analyzed, including: (1) the data distribution, (2) the detection frequency, and (3) potential trends in the data. Table 1 below is based on Table 4-4 from the Electric Power Research Institute's *Groundwater Monitoring Guidance for the Coal Combustion Residual Rule* (2015), which displays the criteria for selecting an appropriate confidence interval. The method and procedure for calculating the Upper Confidence Limit (UCL) and Lower Confidence Limit (LCL) is provided in the section reference from the Unified Guidance, which is listed in the last column of Table 1, below.

Table 2- Confidence Interval Method Selection

Data Distribution	Non-detect Frequency	Data Trend	Confidence Interval Method
Normal	Low	Stable	Confidence Interval Around Normal Mean (Section 21.1.1)
Transformed Normal (Log-Normal)	Low	Stable	Confidence Interval Around Lognormal Arithmetic Mean (Section 21.1.3)
Non-normal	N/A	Stable	Nonparametric Confidence Interval Around Median (Section 21.2)
Cannot Be Determined	High	Stable	Nonparametric Confidence Interval Around Median (Section 21.2)
Residuals After Subtracting Trend are Normal (with equal variance)	Low	Trend	Confidence Band Around Linear Regression (Section 21.3.1)
Residuals after Subtracting Trend are Non-Normal	Low	Trend	Confidence Band Around Theil-Sen Line (Section 21.3.2)

In an assessment monitoring program the LCL is of prime interest. If the LCL exceeds the GWPS, there is statistical evidence that a SSL has been triggered. An initial SSL should be confirmed by verification sampling. If only the UCL exceeds the GWPS while the LCL is below the GWPS, the test is considered inconclusive and the Unified Guidance recommends that this situation be interpreted as ”in compliance”. If both the UCL and the LCL are below the GPWS, the data are also “in compliance” with the GWPS.

It is important to note that a slightly different set of criteria are used to determine whether assessment monitoring can be terminated. Additional discussion of the criteria used for exiting assessment monitoring and returning to detection monitoring is provided below in Section 2.2.

During Assessment Monitoring, a per test FPR (α) of 0.05 will be used as an initial error level for calculating the two-tailed confidence intervals for the compliance wells (which actually means 2.5% FPR per tail). In some cases based on recommendations from the Unified Guidance, it is appropriate to adjust the FPR of the confidence interval based on the number of data points available as well as the distribution of the data being evaluated. If deemed necessary based on recommendations from the Unified Guidance, an approach is provided in Section 22 of the Unified Guidance for determining an appropriate per test FPR based on the data characteristics.

When performing assessment monitoring statistical evaluations, it is important to evaluate the compliance data for shifts. If no shifts have occurred, then all of the available Appendix IV data for a particular constituent can be used in the statistical evaluation. If shifts are noted (typically based on qualitative evaluation of a time series plot), only the data collected after the shift should be used in the statistical evaluation.

2.1.2 Non-MCL Based GWPS

Background or historical concentration limits should be assessed using the following techniques for all Appendix IV analytes. These concentration limits should then be compared with the MCL, if available, and the higher of these two values will be used as the GWPS.

The Unified Guidance provides two acceptable approaches for establishing a non-MCL based GWPS (unless all values are ND, in which case the Double Quantification Rule as described above in Section 1.3.5 should be used). The two methods include the tolerance interval approach or the prediction interval approach.

2.1.2.1 Tolerance Interval Approach

If the background dataset is normally or transformed normally distributed, the Unified Guidance recommends Tolerance Intervals over the Prediction Intervals for establishing a GWPS. The GWPS should be based on a 95 percent coverage/95 percent confidence tolerance interval. If the background data are non-normal (even after transformation), then a large number of background observations are required to calculate a non-parametric tolerance interval (typically a minimum of 60 background observations are required to meet these requirements). If there is an insufficient number of background observations to calculate a non-parametric tolerance interval, then a non-parametric Prediction Interval approach should be used, as described in Section 2.1.2.2 below.

The Upper Tolerance Limit (UTL) is calculated for each detected Appendix VI constituent. Tolerance Limits, as outlined in the Unified Guidance (Section 17.2), are a concentration limit that is designed to contain a pre-specified percentage of the dataset population. Two coefficients associated tolerance intervals are (1) the specified population proportion and (2) the statistical confidence. The coverage coefficient (γ), which is used to contain the population portion, and the tolerance coefficient (or confidence level ($1-\alpha$)), which is used to set the confidence of the test. Typically, the UTL is calculated to have a coverage and confidence of 95%. When an MCL does not exist or the background concentrations are greater than the MCL, the calculated UTL for each constituent is used as the GWPS. The confidence interval for each compliance well is then compared with the GWPS.

In order to calculate a valid confidence interval, a minimum of four data points are necessary for each of the detected Appendix IV constituents in each compliance monitoring well (or four “new” assessment monitoring observations in each well when intrawell statistical methods are employed). Using the Tolerance Interval Approach, a statistically significant level (SSL) is triggered when calculated lower confidence limit (LCL) for each compliance well is greater than the GWPS.

Tolerance limits can be completed using both parametric (Section 17.2.1 of Unified Guidance) or non-parametric methods (Section 17.2.2 of Unified Guidance). However, as described above, the non-parametric method requires at least 60 background (or historical) measurements in order to achieve 95% confidence with 95% coverage. Tolerance Intervals can be calculated using most groundwater statistical software packages.

2.1.2.2 Prediction Interval Approach

If Tolerance Intervals cannot be used to calculate the GWPS (based on recommendation from the Unified Guidance, such as non-parametric datasets, ect.), then a Prediction Interval method should be used. This method is very similar to Section 1.3.4 of this document, however, for assessment monitoring, the Unified Guidance suggests using a prediction interval about a future mean for normally/transfomred-normally distributed datasets or a prediction interval about a future median for datasets with a high percent of ND or non-normally distributed data.

When using prediction intervals to calculate for a GWPS, a one-sided prediction interval is calculated using background (or historical) datasets based on a specified number of future comparisons - four future comparisons is typical. The Upper Prediction Limit that is calculated as a product of this method then becomes the GWPS, and is compared against the confidence interval for the compliance data, as described in Section 2.1.2.1, above. As also described above, if the LCL is greater than the calculated prediction limit then an SSL is triggered.

2.2 Returning to Background Detection Monitoring

As specified in 257.95(e) of the CCR Rule, in order to return to detection monitoring, the concentration of all constituents listed in Appendix III and Appendix IV must be shown to be at or below calculated “background (or historical) values” for two consecutive semiannual sampling events. This determination of background values is based on the statistical evaluation procedure established for detection monitoring. Therefore, if prediction limits (with the double quantification rule for analytes with all non-detects) are used for detection monitoring, prediction limits should be calculated and used for all Appendix III and IV analytes to determine when the monitoring program can return to Detection Monitoring. It is important to remember that Appendix IV constituents are only required to be sampled annually with only those Appendix IV constituents that are detected during the previous semiannual event being required to be analyzed during the second semiannual event of a given year. If statistical results demonstrate that concentrations for all constituents are below background levels for a particular event, all Appendix IV constituents should be sampled during the next event in order to achieve this goal of returning to Detection Monitoring. If this statistical evaluation demonstrates that any of the Appendix III or Appendix IV are at a concentration above background levels, but no SSLs have been triggered, then the CCR unit will remain in assessment monitoring (257.95(f)).

2.3 Response to a SSL

If the assessment monitoring statistical evaluation demonstrates that a SSL has been triggered, then the owner/operator of the CCR unit must complete the following four actions as described in 257.95(g):

1. Prepare a notification identifying the constituents in Appendix IV that have exceeded a CCR Unit specific GWPS. This notification must be placed in the facilities operating record within 30 days of identifying the SSL
2. Define the nature and extent of the release and any relevant site conditions that may affect the corrective action remedy that is ultimately selected. The characterization must be sufficient to support a complete and accurate assessment of the corrective measures necessary to effectively clean up releases from the CCR Unit and must include at least the following;
   A. Installation of additional monitoring wells that are necessary to define the contaminant plume,
   B. Collect data on the nature and estimated quantity of the material released,
   C. Install and sample at least one additional monitoring well at the facility boundary in the direction of the contaminant plume migration,
3. Notify off-site property owners if the contamination plume has migrated offsite on to their property, and
4. If possible, provide an alternative source demonstration that determines that the SSL is not caused by a release at the facility within 90 days of completing the statistical evaluation. If no alternative source demonstration can be made and the plume is determined to have come from the CCR Unit then initiate corrective action.

Actions 1-3 must be completed regardless of whether or not an alternate source demonstration can be made.

2.4 Updating Background Values

The background for Assessment Monitoring Parameters should be updated using the same methods and techniques described in Section 1.5 for updating detection monitoring background data.

3.0 REFERENCES

EPRI. 2015. Groundwater Monitoring Guidance for the Coal Combustion Residual Rule. Electric Power Research Institute. November.

USEPA. 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance. Office of Resource Conservation and Recovery – Program Implementation and Information Division. March

USEPA. 2015. Federal Register. Volume 80. No. 74. Friday April 17, 2015. Part II. Environmental Protection Agency. 40 CFR Parts 257 and 261. Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule/ [EPA-HQ-RCRA-2009-0640; FRL-9919-44-OSWER]. RIN-2050-AE81. April.

APPENDIX I
EXAMPLE FIELD FORMS

Sheet ___ of ___

Golder Associates WELL DEVELOPMENT/PURGING FORM

Project Ref: ____________________

Project No.: ____________________

Location

Monitored By: ☐ Date ☐ Time ☐

Well Piezometer Data

(*circle one*)

Depth of Well (from top of PVC or ground)		feet
Depth of Water (from top of PVC or ground)		feet
Radius of Casing		inches
		feet
Casing Volume		cubic feet
		gallons

Development / Purging Discharge Data

Purging Method

Start Purging Date ☐ Time ☐

Stop Purging Date ☐ Time ☐

Monitoring

Date	Time	Volume Discharge (gals)	Temp (°__)	pH	Spec.Cond. (__S/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Redox Potential (+/- mV)	WL (ft TOC)	Appearance of Water and Comments

Golder Associates

GROUNDWATER SAMPLE COLLECTION FORM

Project Ref: ___ ______________________________ **Project No. :**________________

WEATHER CONDITIONS

Temperature __________________ Weather ______________________________

SAMPLE INFORMATION

Sample Location ______________________________ Sample No. ____________________
Sample Date ________________ Time ____________ Sample By______________________
Sample Method ______________________________ Sample Type____________________

Water Level Before Purging: ______________________________
Well Volume: ______________________________
Volume Water Removed Before Sampling: ____________________
Water Level Before Sampling: ______________________________
Water Level After Sampling: ______________________________
Appearance of Sample: ______________________________

FIELD MEASUREMENTS

Parameter	Units	Measurement	Measurement	Measurement	Measurement	Sample
Time	hhmm					
Volume Discharge	gals					
pH	Standard					
Spec. Cond.	___S/CM					
Turbidity	NTU					
Temperature	°___					
Dissolved Oxygen	mg/l					
Redox Potential	+/- mV					

LABORATORY CONTAINERS

Sub-Sample	**Analysis Requested**	**Type and Size of Sample Container**	**Filtered (Yes or No)**	**Type of Preservative**
1				
2				
3				
4				
5				
6				
7				
8				

REMARKS: ____

NA = Not applicable

SAMPLING METHODS:

Bailer: PVC/PE
Stainless Steel
Teflon

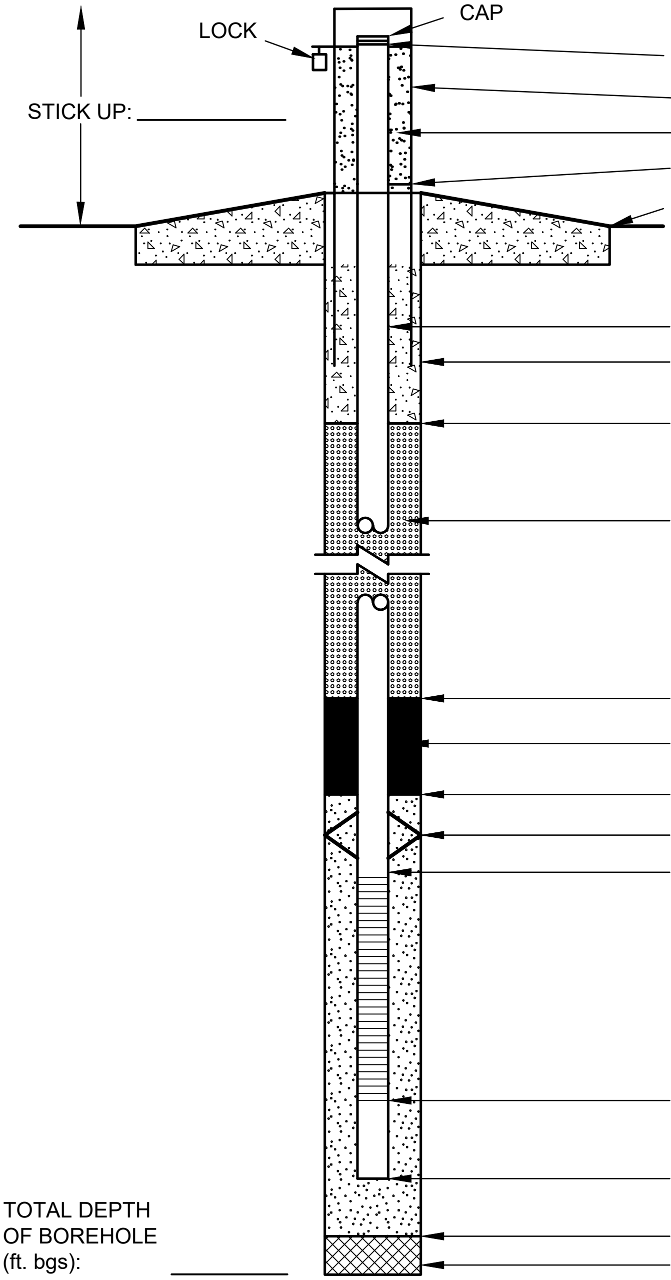
Peristaltic Pump
Submersible Pump
Hand Pump

Air-Lift Pump
Other___________

Golder Associates

ABOVE GROUND MONITORING WELL CONSTRUCTION LOG

PROJECT NAME:
PROJECT NUMBER:
SITE NAME:
LOCATION:
CLIENT:
SURFACE ELEVATION:
GEOLOGIST:
NORTHING:
EASTING:
DRILLER:
STATIC WATER LEVEL:
COMPLETION DATE:
DRILLING COMPANY:
DRILLING METHODS:



STICK UP:
TOP OF CASING ELEVATION:
PROTECTIVE CASING (yes / no):
PEA GRAVEL OR SAND
WEEP HOLE
GROUND SURFACE ELEVATION:
DIAMETER OF RISER PIPE (in.):
DIAMETER OF BOREHOLE (in.):
CONCRETE SEAL DEPTH (ft. bgs):
TYPE AND AMOUNT OF ANNULAR SEAL:
TOP OF BENTONITE SEAL DEPTH (ft. bgs):
TYPE AND AMOUNT OF BENTONITE SEAL:
TOP OF SAND PACK DEPTH (ft. bgs):
CENTRALIZER (yes / no) - TYPE:
TOP OF SCREEN DEPTH (ft. bgs):
TYPE OF SCREEN:
SCREEN SLOT SIZE (in.):
SIZE OF SAND PACK:
AMOUNT OF SAND:
BOTTOM OF SCREEN DEPTH (ft. bgs):
BOTTOM OF WELL DEPTH (ft. bgs):
TOTAL DEPTH OF BOREHOLE (ft. bgs):
BOTTOM OF FILTER PACK (ft. bgs):
TYPE AND AMOUNT OF BACKFILL:

ADDITIONAL NOTES:

CHECKED BY:
DATE CHECKED:
PREPARED BY:

Golder Associates

RECORD OF WATER LEVEL READINGS

Project Name: ___________________________ **Location:** ___________________________________ **Project No.:** _____________________________

Borehole No.	Date	Time	Measuring Device / Serial No.	Measurement Point (M.P)	Water Level Below M.P.	Correction To Survey Mark	Survey Mark Elevation	Water Level Elevation	By	Comments

Sheet ___ of ___

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INSTRUMENT CALIBRATION FORM

Project Name: ____________________________ **Project No:** ______________________

Calibration By: ☐

Instrument Details

Instrument Name	
Serial No.	
Model No.	

Calibration Details

Required Calibration Frequency/Last Calibration	
Calibration Standard	
Calibration Standard(s) Expiration Date	

Calibration:

Date	Time	**Calibration Standard** Units: ___________	**Instrument Reading** Units: _________

Comments:

>>> Select a Laboratory <<<

Chain of Custody Record

#N/A
#N/A
#N/A
#N/A

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact	**Project Manager:**	**Site Contact:**	**Date:**	COC No:
Your Company Name here	**Tel/Fax:**	**Lab Contact:**	**Carrier:**	_______ of ______ COCs
Address	**Analysis Turnaround Time**			Sampler:
City/State/Zip	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(xxx) xxx-xxxx Phone	TAT if different from Below _________			Walk-in Client:
(xxx) xxx-xxxx FAX	☐ 2 weeks			Lab Sampling:
Project Name:	☐ 1 week			
Site:	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)																		Sample Specific Notes:

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other _____________

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for__________ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No

Custody Seal No.:

Cooler Temp. (^{o}C): Obs'd:_________ Corr'd:__________ Therm ID No.:____________

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

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Field Boring Log

DEPTH HOLE ______________ **PROJ. NO.** ______________ **PROJECT** ______________ **BORING NO.** ______________

DEPTH SOIL DRILL ________ **GA INSP.** ______________ **DRILLING METHOD** ______________ **SHEET** ________ **OF** ________

DEPTH ROCK CORE ________ **WEATHER** ______________ **DRILLING COMPANY** ______________ **SURFACE ELEV.** ______________

ABANDONMENT ______________ **DRILL RIG** ______________ **DRILLER** ______________ **DATUM** ______________

DEPTHS ________/________/________/________ (WATER LEVEL / CAVE-IN / DATE-TIME / NOTE) **SAMPLER HAMMER TYPE** ______________ **WT.** ________ **DROP** ________ **STARTED** ________/________ (TIME / DATE)

DEPTHS ________/________/________/________ ((DELAYED) WATER LEVEL / CAVE-IN / DATE-TIME / NOTE) **HOLE LOCATION** ______________ **COMPLETED** ________/________ (TIME / DATE)

SAMPLE TYPES

A.S.	AUGER SAMPLE
C.S.	CHUNK SAMPLE
* D.O.	DRIVE OPEN (SPT)
D.S.	DENISON SAMPLE
F.S.	FOIL SAMPLE
P.S.	PITCHER SAMPLE
S.C.	SOIL CORE
* T.O.	THIN-WALLED, OPEN
* T.P.	THIN-WALLED, PISTON
W.S.	WASH SAMPLE
* ____	________________
* ____	________________
* ____	________________

* NOTE SIZE

ABBREVIATIONS

ANG	ANGULAR	GR	GRAY	R	RED
BL	BLACK	HE	HETEROGENEOUS	RES	RESIDUAL
BR	BROWN	HO	HOMOGENEOUS	RX	ROCK
C	COARSE	LYD	LAYERED	RND	ROUNDED
CIN	CAVE-IN	M	MEDIUM	SAT	SATURATED
CO	COHESIVE	MIC	MICACEOUS	SD	SAND
CL	CLAY	MOT	MOTTLED	SI	SILT
CLY	CLAYEY	MST	MOIST	SIY	SILTY
D	DRY	NC	NON-COHESIVE	SM	SOME
EL	ELONGATED	NP	NON-PLASTIC	TR	TRACE
F	FINE	OG	ORANGE	WL	WATER LEVEL
FL	FLAT	ORG	ORGANIC	WH	WEIGHT OF HAMMER
FRAG	FRAGMENTS	PP	POCKET PEN.	WR	WEIGHT OF RODS
GL	GRAVEL	PL	PLASTIC LIMIT	Y	YELLOW

ORDER OF DESCRIPTION

CONSTITUENTS
1) GROUP SYMBOL
2) SOIL GROUP NAME
3) PRIMARY COMPONENTS
4) SECONDARY COMPONENTS
5) MINOR COMPONENTS ;

PLUS DESCRIPTION:
CL/SI: PLASTICITY
SD: SIZE, GRADING
GL: SIZE, GRADING, SHAPE, ROCK TYPE

GENERAL
6) COLOR
7) WEATHERING
8) STRUCTURE
9) SENSITIVITY
10) CONTAMINATION
11) MINEROLOGY
12) ORIGIN ;

BEHAVIOR
13) BEHAVIOR (CO/NC)
14) MOISTURE/WATER CONTENT
15) DENSITY/CONSISTENCY

PROPORTIONS

"TRACE"	0 – 5%
"SOME"	5 – 12%
PREFIX "-Y"	12 – 35%
"AND"	35 – 50%

NON-COHESIVE SOILS

RELATIVE DENSITY		BLOWS
VERY LOOSE	VLS	0 – 4
LOOSE	LS	4 – 10
COMPACT	CP	10 – 30
DENSE	DN	30 – 50
VERY DENSE	VDN	>50

MOISTURE CONDITION

DRY	SOIL FLOWS
MOIST	FEELS COOL
WET	WITH FREE WATER

COHESIVE SOILS

CONSISTENCY		PP(TSF)	FINGER PRESSURE
VERY SOFT	VS	<0.25	EXTRUDES
SOFT	S	0.25 - 0.5	MOLDS EASILY
FIRM	FM	0.5 – 1	MOLDS
STIFF	ST	1 – 2	THUMB INDENTS
VERY STIFF	VST	2 – 4	THUMBNAIL INDENTS
HARD	H	>4	RESISTS THUMBNAIL

WATER CONTENT - W

W < PL	CANNOT ROLL 4 mm THREAD
W ~ PL	CAN ROLL THREAD 2 – 4 mm
W > PL	CAN ROLL THREAD <2 mm

ELEV. / DEPTH	LITHOLOGY	SAMPLES						CONSTITUENTS			BEHAVIOR			USCS	SAMPLE DESCRIPTION AND DRILLING NOTES
		NO.	TYPE	DEPTH	SPT N / PP(TSF)	BLOWS PER 6 IN	REC / ATT	GL	SD	CL/SI	CO or NC	MOIST. or W	DENS./ CONS.		
								PROPORTION; SIZE, SHAPE, GRADING; PLASTICITY							

Dec 2012

Established in 1960, Golder Associates is a global, employee-owned organization that helps clients find sustainable solutions to the challenges of finite resources, energy and water supply and management, waste management, urbanization, and climate change. We provide a wide range of independent consulting, design, and construction services in our specialist areas of earth, environment, and energy. By building strong relationships and meeting the needs of clients, our people have created one of the most trusted professional services organizations in the world.

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Golder Associates

Engineering Earth's Development, Preserving Earth's Integrity

Attachment 5

Groundwater Monitoring Results

Table 4
November 2019 Detection Monitoring Results
SCPC Surface Impoundment
Sioux Energy Center, St. Charles County, MO

ANALYTE	UNITS	BACKGROUND		GROUNDWATER MONITORING WELLS					
		BMW-1S	BMW-3S	UG-1A	UG-2	DG-1	DG-2	DG-3	DG-4
November 2019 Detection Monitoring Event									
DATE	NA	11/13/2019	11/13/2019	11/14/2019	11/14/2019	11/14/2019	11/14/2019	11/14/2019	11/15/2019
pH	SU	6.88	7.13	6.85	7.09	7.06	6.61	6.88	6.97
BORON, TOTAL	µg/L	118	80.1 J	239	144	111	100	93.1 J	71.0 J
CALCIUM, TOTAL	µg/L	143,000 J	102,000	166,000	115,000	135,000	133,000	144,000	138,000
CHLORIDE, TOTAL	mg/L	6.4	7.6	118	27.8	6.0	7.4	5.4	96.9 J
FLUORIDE, TOTAL	mg/L	0.28	0.23	0.29	0.24	0.33	0.39	0.42	0.30
SULFATE, TOTAL	mg/L	26.5	34.4	53	43.8	38.4	37.8	51.1	33.9
TOTAL DISSOLVED SOLIDS	mg/L	551	418	739	480	524	512	576	628

NOTES:

1. Unit Abbreviations: µg/L - micrograms per liter, mg/L - milligrams per liter, SU - standard units.
2. J - Result is an estimated value.
3. NA - Not applicable.

Prepared By: TJG
Checked By: KAB
Reviewed By: CMR

Table 3
August 2019 Detection Monitoring Results
SCPC Surface Impoundment
Sioux Energy Center, St. Charles County, MO

ANALYTE	UNITS	BACKGROUND		GROUNDWATER MONITORING WELLS											
		BMW-1S	BMW-3S	Prediction Limit UG-1A	UG-1A	Prediction Limit UG-2	UG-2	Prediction Limit DG-1	DG-1	Prediction Limit DG-2	DG-2	Prediction Limit DG-3	DG-3	Prediction Limit DG-4	DG-4
August 2019 Detection Monitoring Event															
DATE	NA	8/2/2019	8/2/2019	NA	8/19/2019	NA	8/19/2019	NA	8/19/2019	NA	8/19/2019	NA	8/19/2019	NA	8/19/2019
pH	SU	6.9	7.5	6.294-7.616	6.55	6.031-7.969	6.65	6.759-7.323	6.77	6.73-7.482	6.83	6.156-7.702	6.76	6.291-7.62	6.64
BORON, TOTAL	µg/L	ND	ND	362.5	270	234.6	144	122.5	106	119.3	104	115.1	95.1 J	DQR	61.1 J
CALCIUM, TOTAL	µg/L	149,000	122,000	164,715	177,000	133,251	116,000	146,584	135,000	142,779	133,000	159,563	148,000	147,361	136,000
CHLORIDE, TOTAL	mg/L	8.8	10.6	131.6	145	125.3	30.0	9.962	6.2	9.817	8.2	16.08	4.8	115.1	103.0
FLUORIDE, TOTAL	mg/L	0.31	0.35	0.3822	0.28	0.24	0.25	0.3844	0.34	0.4365	0.38	0.4619	0.37	0.37	0.32
SULFATE, TOTAL	mg/L	34.1	25.3	103.2	57.7	101.6	45.2	66.1	41.7	47.44	37.1	61.41	49.5	57.15	31.5
TOTAL DISSOLVED SOLIDS	mg/L	548	452	818.8	785	613.7	519	569.1	503	521.6	511	580	624	698.9	671
October 2019 Verification Sampling Event															
DATE	NA				10/2/2019		10/2/2019						10/2/2019		
pH	SU				6.82		6.83						6.82		
BORON, TOTAL	µg/L														
CALCIUM, TOTAL	µg/L				166,600										
CHLORIDE, TOTAL	mg/L				140										
FLUORIDE, TOTAL	mg/L						0.30								
SULFATE, TOTAL	mg/L														
TOTAL DISSOLVED SOLIDS	mg/L												569		

NOTES:

1. Unit Abbreviations: µg/L - micrograms per liter, mg/L - milligrams per liter, SU - standard units.
2. J - Result is an estimated value.
3. ND - Constituent was analyzed for, but was not detected above the Method Detection Limit (MDL) and is considered a non-detect. Values displayed as ND.
4. NA - Not applicable.
5. Prediction Limits calculated using Sanitas Software.
6. If all background values are less than the Practical Quantitation Limit (PQL) then the Double Quantification Rule (DQR) is used.
7. Values highlighted in yellow indicate a Statistically Significant Increase (SSI).
8. Values highlighted in green indicate an initial exceedance above the prediction limit that was not confirmed by Verification Sampling (not an SSI).
9. Only analytes/wells that were detected above the prediction limit were tested during Verification Sampling.

Prepared By: RJF
Checked By: KAB
Reviewed By: CMR

Table 2
November 2018 Detection Monitoring Results
SCPC Surface Impoundment
Sioux Energy Center, St. Charles County, MO

ANALYTE	UNITS	BACKGROUND		GROUNDWATER MONITORING WELLS											
		BMW-1S	BMW-3S	Prediction Limit UG-1A	UG-1A	Prediction Limit UG-2	UG-2	Prediction Limit DG-1	DG-1	Prediction Limit DG-2	DG-2	Prediction Limit DG-3	DG-3	Prediction Limit DG-4	DG-4
November 2018 Detection Monitoring Event															
DATE	NA	11/12/2018	11/12/2018	NA	11/13/2018	NA	11/13/2018	NA	11/13/2018	NA	11/13/2018	NA	11/13/2018	NA	11/13/2018
pH	SU	7.46	7.49	6.294-7.616	7.00	6.031-7.969	6.76	6.759-7.323	6.11	6.73-7.482	6.20	6.156-7.702	6.12	6.291-7.62	7.05
BORON, TOTAL	µg/L	72.9 J	61.5 J	362.5	145	234.6	145	122.5	125	119.3	114	115.1	108	DQR	73.2 J
CALCIUM, TOTAL	µg/L	157,000	124,000	164,715	116,000	133,251	105,000	146,584	129,000	142,779	122,000	159,563	137,000	147,361	121,000
CHLORIDE, TOTAL	mg/L	6.7	10.1	131.6	65.4	125.3	24.4	9.962	8.6	9.817	6.9	16.08	9.1	115.1	80.2
FLUORIDE, TOTAL	mg/L	0.34	0.36	0.3822	ND	0.24	ND	0.3844	ND	0.4365	ND	0.4619	ND	0.37	ND
SULFATE, TOTAL	mg/L	28.8	25.6	103.2	65.9	101.6	17.7	66.1	27.1	47.44	29.0	61.41	64.7	57.15	39.3
TOTAL DISSOLVED SOLIDS	mg/L	556	436	818.8	549	613.7	607 J	569.1	511	521.6	470	580	545	698.9	611
January 2019 Verification Sampling															
DATE	NA								1/8/2019		1/8/2019		1/8/2019		
pH	SU								6.97		7.00		7.14		
BORON, TOTAL	µg/L								99.7 J						
CALCIUM, TOTAL	µg/L														
CHLORIDE, TOTAL	mg/L														
FLUORIDE, TOTAL	mg/L														
SULFATE, TOTAL	mg/L												29.7		
TOTAL DISSOLVED SOLIDS	mg/L														

NOTES:

1. Unit Abbreviations: µg/L - micrograms per liter, mg/L - milligrams per liter, SU - standard units.
2. J - Result is an estimated value.
3. ND - Constituent was analyzed for, but was not detected above the Method Detection Limit (MDL) and is considered a non-detect. Values displayed as ND.
4. NA - Not applicable.
5. Prediction Limits calculated using Sanitas Software.
6. If all background values are less than the Practical Quantitation Limit (PQL) then the Double Quantification Rule (DQR) is used.
7. Values highlighted in yellow indicate a Statistically Significant Increase (SSI).
8. Values highlighted in green indicate an initial exceedance above the prediction limit that was not confirmed by Verification Sampling (not an SSI).
9. Only analytes/wells that were detected above the prediction limit were tested during Verification Sampling.

Prepared By: RJF
Checked By: KAB
Reviewed By: CMR

Intended for
Ameren Missouri

Date
June 30, 2020

Project No.
74842

2020 1ST SEMI-ANNUAL REPORT

SIOUX ENERGY CENTER UTILITY WASTE LANDFILL

Bright ideas. Sustainable change.

2020 1ST SEMI-ANNUAL REPORT
SIOUX ENERGY CENTER UTILITY WASTE LANDFILL

Project name	**2020 Semi-Annual Reporting**
Project no.	**74842**
Recipient	**Ameren Missouri**
Document type	**2020 1st Semi-Annual Report**
Revision	**0**
Version	**FINAL**
Date	**6/30/2020**
Prepared by	**Rachel Banoff, EIT**
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CONTENTS

TABLES

FIGURES

APPENDICES

ACRONYMS AND ABBREVIATIONS

ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
CSR	Missouri Code of State Regulations
EPRI	Electric Power Research Institute, Inc.
fpd	Feet per Day
ft	Feet
Golder	Golder Associates Inc.
HDPE	High Density Polyethylene
MANAGES	MANAGES Groundwater Data Management and Evaluation Software™
MANAGES 3.4	MANAGES version 3.4
MANAGES 4.0	MANAGES version 4.0.2
MANAGES 4.1	MANAGES version 4.1
MDL	Method Detection Limit
MDNR	Missouri Department of Natural Resources
MS/MSD	Matrix Spike/Matrix Spike Duplicate
mg/L	Milligrams per Liter
NAVD 88	North American Vertical Datum of 1988
NTU	Nephelometric Turbidity Units
ug/L	Micrograms per Liter
micromhos/cm	Micromhos per Centimeter
RL	Reporting Limit
RPD	Relative Percent Difference
SSI	Statistically Significant Increase
s.u.	Standard Units
TDS	Total Dissolved Solids
TOC	Top of Well Casing Elevation or total organic carbon
TOX	Total Organic Halogens
UWL	Utility Waste Landfill
V	Velocity, groundwater flow

1. INTRODUCTION

Ameren Missouri has constructed a Utility Waste Landfill (UWL) at the Sioux Energy Center in St. Charles County, Missouri. The facility was constructed in compliance with requirements contained in Solid Waste Disposal Area Construction Permit No. 0918301. The UWL first accepted Sioux Energy Center waste on November 18, 2010 and has been operated in accordance with the requirements of Missouri Code of State Regulations (CSR): 10 CSR 80-11. The focus of this report is the analysis of trends, discussion of error analysis, detection limits, and associated prediction limit exceedances for the 1st semi-annual 2020 reporting period, which includes the May 2020 sampling event data. Additionally, all data has been electronically submitted to the Missouri Department of Natural Resources (MDNR) in the required electronic format.

2. FACILITY LOCATION

The UWL is located on an alluvial floodplain in northeastern St. Charles County, in the southeastern part of Township 46 North, Range 6 and 7 East, approximately 2 miles east of Portage des Sioux, Missouri. The facility is bounded on the north by State Highway 94, on the south by Dwiggins Road, on the west by the Sioux Energy Center railroad spur, and on the east by the Sioux Energy Center property line. The site lies between two major river systems, the Mississippi River, less than 1 mile north of the UWL, and the Missouri River, less than ¾ of a mile south of the UWL.

3. GROUNDWATER MONITORING SYSTEM

Ameren Missouri has installed a series of 16 monitoring wells at the UWL to monitor groundwater quality underlying the facility (see Figure 1). The groundwater monitoring system was originally designed to include a series of up-gradient and down-gradient monitoring wells screened in the uppermost water-bearing zone of colluvium-alluvium deposits underlying the facility. The monitored alluvial aquifer is described by Miller, et al., as a calcium-magnesium-bicarbonate type that may locally contain significant quantities of sulfate (Miller et al., 1974). The groundwater monitoring wells in the groundwater monitoring system at the UWL, are as follows:

Up-gradient Monitoring Wells	**Down-gradient Monitoring Wells**
UG-01A, UG-02, UG-03, UG-04	DG-01, DG-02, DG-03, DG-04, DG-05, DG-06, DG-07, DG-08, DG-09, DG-10, DG-11, DG-12

The October 2011 Background Report confirmed that intra-well monitoring of the UWL would be the most appropriate groundwater monitoring approach since the underlying aquifer is prone to flow reversals. Therefore, data from April 1, 2008 through March 31, 2011 (12 quarters of data), were designated as the original background data for intra-well monitoring. The updated background data set covers the range April 1, 2008 to January 1, 2017.

The May 2020 sampling event data were first checked for outliers, utilizing a Grubbs’ outlier test. Five potential outliers were identified by the outlier test in (Appendix A). In accordance with Appendix S of the revised “Groundwater Sampling and Analysis Plan” (Gredell Engineering Resources, Inc., 2007), and since there was insufficient evidence indicating that the samples did not represent field conditions, none of the potential outliers identified in the May 2020 sampling event were excluded from the database and statistical calculations. Regarding data that has been previously flagged as outliers and excluded from statistical calculations, all flagged data remains archived in the database. The Appendix B list of flagged data is current for any and all excluded data, as of this report.

Since analysis of the flue gas desulfurization waste being placed into the landfill suggests calcium and sulfate to be appropriate indicator parameters for potential releases from the containment system, calcium and sulfate will continue to be used as the prime indicator parameters in monitoring the UWL.

4. SEMI-ANNUAL GROUNDWATER MONITORING REPORTING

As required in Solid Waste Disposal Area Construction Permit No. 0918301, semi-annual groundwater monitoring shall be conducted at the UWL. The original 12 quarters of background data prior to the UWL's operation were collected, statistically analyzed, and evaluated for flow characteristics. Results of data evaluation indicated intra-well monitoring to be most appropriate for monitoring of the UWL.

Groundwater monitoring data is analyzed using Electric Power Research Institute's Inc. (EPRI) MANAGES Groundwater Data Management and Evaluation Software™ (MANAGES). For the 2020 1st Semi-Annual Groundwater Monitoring report, MANAGES 4.1 was used for statistical analyses. See Appendix C for further discussion on the differences between MANAGES 3.4, MANAGES 4.0, and MANAGES 4.1.

Quality controlled and assessed data is used for statistical evaluation and reporting. MANAGES performs the following tasks in generating a groundwater monitoring summary report for each well-parameter sampling event:

- Displays sample date
- Displays laboratory identification
- Displays the number of verification samples, if any
- Selects appropriate statistical testing for generation of prediction limits, parametric (Shapiro-Wilk) for normally distributed data, non-parametric (Kruskal-Wallace) for non-normal distributed data, method detection limit (MDL) for high percentage non-detection data, and Cohen's Adjustment for normally distributed data with 15% - 50% non-detections
- Calculates and displays the parameter-specific prediction limit and a lower limit if applicable (e.g., pH)
- Displays the current sampling event's analytical (compliance) result
- Determines whether the prediction limit has been exceeded
- If an exceedance has occurred, evaluates trending for the compliance date range via Mann-Kendall trend analysis

.

5. DISCUSSION OF RESULTS, ERROR ANALYSIS, DETECTION LIMITS, AND OBSERVED TRENDS

The analytical data for the 1st semi-annual 2020 groundwater monitoring event were visually checked for increasing and decreasing trending, obvious outliers, change in detection limits, and for transcriptional errors. Analyses of the May 2020 field blanks indicate residual contamination for barium, boron, calcium, copper, magnesium, and sodium. Ameren intends to contact both field collection personnel and the laboratory to evaluate ways to minimize the potential for field equipment contamination in the future. These analytes are likely from laboratory instrument carry-over or the source water used to collect the field blanks. A trip blank for total organic halogens (TOX) is also included to determine if some form of halogenated solvent contamination was present during May 2020 sample transportation. The trip blank indicates no TOX contamination.

Review of 1st semi-annual 2020 data revealed the following:

- Laboratory reporting limits (RLs) were acceptable.
- No recognizable or correctable errors, such as transcription errors, were found to be present in the reporting of groundwater monitoring results.
- Many analytes were qualified estimated with a “J” qualifier because the concentrations were greater than the laboratory MDL but less than the laboratory RL. Estimated results were reported correctly and are acceptable for use.
- Data quality qualifiers associated with the May 2020 analytical results were added due to quality assurance analysis:
  - Calcium in samples DG-01 and DG-11 were qualified with the laboratory qualifier "S". This indicates the sample matrix spike / matrix spike duplicate percent recovery was outside the expected statistical control range. However, because the sample concentration was greater than 4 times the spike concentration, the calcium MS/MSD recoveries were not evaluated.
- Field duplicate comparison in Table 4 indicates acceptable Relative Percent Difference (RPD<15%) for field duplicate pairs UG-02 / Dup 1 and DG-08 / Dup 2 with the exception of iron for UG-02 / Dup 1 (RPD = 30.8%). Because some of the containers for samples collected from DG-08 were damaged during processing, no RPDs were calculated for chloride, sulfate, fluoride, total dissolved solids (TDS), total organic carbon (TOC), and TOX for field duplicate pair DG-08 / Dup 2.

Further details regarding data review and qualification of data for May 2020 sampling event are listed in Appendix D.

Following the above review, all May 2020 data are acceptable for groundwater evaluation. Thus, data were compared with the appropriate intra-well prediction limits, utilizing MANAGES to determine if intra-well prediction limit exceedances [i.e., statistically significant increases (SSIs)] were present (see Table 2). Intra-well prediction limits were calculated using April 1, 2008 through January 1, 2017 background data as documented in Table 1 (Detection Monitoring Procedure – MANAGES). A listing of background data outliers excluded from prediction limit calculation and graphing is included in Appendix B.

It is also noted that some laboratory-estimated analytical results (estimated below the RL) were used in prediction limit calculations, potentially resulting in more error than targeted for the calculation and an overestimated number of SSIs. SSIs that may be affected by this factor have been identified below, in cases where non-detected results (represented by the RL) exceed background (or prediction limit).

Observed SSIs are listed in Table 2 (Statistically Significant Increases). For informational purposes, SSIs associated with statistically significant upward trending according to a 95% confidence Mann-Kendall test are highlighted in yellow.

Higher RLs for some analytical data in this report, combined with low background values (e.g., cadmium, lead, mercury, and thallium), seem to have contributed to the occurrence of SSIs. As a conservative approach, the RL value is used for non-detects in the Table 2 Statistically Significant Increases. An update of the statistical analysis plan and background data set is planned for 2020. As part of the background update, upper prediction limits for parameters that have been affected by analytical method RL changes will be reassessed, and recent data that is representative of current site conditions may be incorporated. The statistical analysis plan is required to be approved by the MDNR before updating the background and was submitted to the MDNR for approval on June 30, 2020.

The following groundwater parameters had SSIs at more than half of the well locations during May 2020:

- Cadmium, total – Fifteen SSIs were identified. SSIs were identified at all wells except for well UG-03.
- Mercury, total – Eleven SSIs were identified at wells DG-01, DG-03, DG-04, DG-06, DG-07, DG-10, DG-11, and DG-12 and at wells UG-01A, UG-02, and UG-04.
- Thallium, total – Fifteen SSIs were identified. SSIs were identified at all wells except for well DG-03.

Mann-Kendall trend test at the 95% confidence level was performed on all parameters and is listed in Tables 3a and 3b (Data Trending). SSIs are highlighted in peach. For informational purposes, upward trends are underlined and bolded in Table 3b.

Figure 2 contains time series plots for all 10 CSR 80-11 Appendix I parameters plotted from the beginning of groundwater monitoring in 2nd quarter 2008 through May 2020. Non-detect values are circled in red.

None of the SSIs listed above have true upward trends when the data is reviewed in a time series plot. All the SSIs listed above are non-detect results that exceed the prediction limit (discussed above in this section).

SSIs with upward trending are discussed below. Figure 3 contains time-series plots discussed below.

- Barium, total (UG-03) – During sampling events in 2017 and in 2018, SSIs in barium were identified at UG-03 indicating a consistency in higher concentrations of barium at this well location, but similar in magnitude to the other nearby wells (UG-01A, UG-02, UG-04). During the May 2020 sampling event, the barium concentration of 257 ug/L barely exceeded the upper prediction limit of 249 ug/L and is likely the result of natural variation of barium at this well location.

- Barium, total (DG-10) – During the November 2018 and 2019 sampling events, no SSIs were identified. In the August 2019 and May 2020 sampling events, an SSI of barium was identified at this well indicating a possible seasonal effect. During the May 2020 sampling event, the barium concentration of 261 micrograms per liter (ug/L) barely exceeded the upper prediction limit of 255 ug/L and is likely the result of natural variation of barium at this well location.
- Boron, total (UG-03) – During sampling events in 2017 and in 2018, SSIs in boron were identified indicating a consistency in higher concentrations of boron at this well location. This well is possibly impacted by the nearby coal handling operations. The boron concentrations in this well decreased during the May 2020 sampling event, which would be expected based upon observed groundwater flow (reverse of what it was through most of 2017 and 2018).
- Chloride, total (UG-03) – The upward trend for chloride at this well may be as a result of a long-term temporal variation in groundwater quality. During sampling events in 2017 and in 2018, SSIs of chloride were identified at UG-03 indicating a consistency in higher concentrations of chloride at this well location. Higher concentrations in sodium could be explained by the use of road salt on which is commonly used for road de-icing purposes on Missouri State Highway 94 (Golder Associates Inc., 2018). During the May 2020 sampling event, the chloride concentration of 77 mg/L barely exceeded the upper prediction limit of 69 ug/L.
- Manganese, total (UG-02) – An upward trend in manganese concentrations was identified at this well after the May 2020 sampling event, but the observed concentration was at a magnitude similar to that historically observed at well UG-03. The analytical result during the May 2020 sampling event was identified as a potential outlier and may have influenced the upward trending outcome. No SSI for manganese was identified at this well prior to the May 2020 sampling event.
- Nickel, total (UG-02) – An upward trend in nickel concentrations was identified at this well after the May 2020 sampling event, but the observed concentration was at a magnitude similar to that historically observed at wells UG-01A and UG-03. The analytical result during the May 2020 sampling event was identified as a potential outlier and may have influenced the upward trending outcome. No SSI for nickel was identified at this well prior to the May 2020 sampling event.
- Nickel, total (DG-09) – SSIs of nickel were identified at this well both during the August 2019 and May 2020 sampling events. Between the August 2017 and August 2019, no SSIs for nickel were identified. By looking at the time series, one can see that nickel concentrations experience possible natural seasonal variation. Another observation made from the time series is that the RLs for nickel during the August 2010, May 2012, May 2014, February 2016, and May 2016 (10 ug/L) sampling events were all higher than detected concentrations.
- Sodium, total (DG-05) – Higher concentrations in sodium could be explained by the use of road salt on Dwiggins Road. The observed sodium concentrations of the May 2020 sampling event fall between the maximum sodium concentration [224 milligrams per Liter (mg/L)] and the minimum sodium concentration (1.1 mg/L) published in Water Resources of the St. Louis Area Missouri (Miller, et al., 1974). Thus, the upward trend may be as a result of a long-term temporal variation in groundwater quality. Additionally, the sodium concentration at DG-05 (9.03 mg/L) barely exceeded the upper prediction limit of 9.02 mg/L.
- Specific Conductance (DG-12) – SSIs of specific conductance were identified at this well during the November 2018, November 2019, and May 2020 sampling events. Prior to the

November 2018 sampling event, no SSIs of specific conductance were identified at DG-12. The field result of 844 micromhos per centimeter (micromhos/cm) barely exceeded the upper prediction limit of 836 micromhos/cm during the May 2020 sampling event.

6. GROUNDWATER FLOW EVALUATION

Semi-annual depth to water and groundwater elevation data for May 2020 are summarized in Table 5. Included in Table 5 are ground surface elevations at each well, top of well casing (TOC) elevation, depth to water from TOC and groundwater surface elevation for November 2019 and May 2020, and changes in water levels between November 2019 and May 2020.

Groundwater elevations ranged from 421.78 feet above the North American Vertical Datum of 1988 (ft NAVD 88) to 422.92 feet NAVD 88 in May 2020. The minimum measured change in groundwater elevation was a 0.01-foot increase in wells DG-03, DG-08, and DG-09. The maximum measured change in groundwater elevation was a 0.23-foot increase in wells DG-11 and DG-12.

The 1st Semi-Annual Potentiometric Surface Map for May 2020 was prepared by data interpolation using SURFER®, by Golden Software, LLC (2019), and manual adjustment of the resulting contours to create a reasonable representation of groundwater flow beneath the UWL (Figure 3). The groundwater flow in May 2020 was generally to the northeast at a shallow gradient (average gradient of 0.0001 feet/foot).

Groundwater flow velocities beneath the UWL in May 2020 were estimated using Darcy's Law in the form:

$$V = \frac{ki}{n}$$

where:

V = Velocity, in feet per day (fpd)
k = hydraulic conductivity = 5.1 x 10 fpd (Ameren Missouri, 2019)
i = hydraulic gradient, in feet/foot
n = effective porosity = 0.25 (Ameren Missouri, 2019)

Minimum and maximum values of hydraulic gradient, i, beneath the UWL were computed utilizing SURFER and are tabulated, along with calculated minimum and maximum groundwater flow velocities in Table 6. The calculated values of hydraulic gradient ranged from 2×10^{-5} feet/foot to 1×10^{-3} feet/foot beneath the Utility Waste Landfill. The calculated flow velocities ranged from 4.1×10^{-3} fpd to 2.0×10^{-1} fpd.

7. CONCLUSIONS

The observed groundwater flow direction during the May 2020 sampling event was southwest to northeast.

Statistical analyses of parameter concentrations observed in groundwater samples collected in May 2020 at the Sioux UWL identified 58 cases of SSIs (42 non-detected and 16 detected SSIs). None of these SSIs were for calcium or sulfate which were identified as indicator parameters for the Sioux UWL.

Additional concluding observations for the current sampling event include:

- A total of 42 of the identified SSI cases (72% of all cases) are from non-detect results of total cadmium, total mercury, total thallium, and total lead. Due to the fact that some laboratory-estimated analytical results (estimated below the RL) were used in background (or prediction limit) calculations, the number of these SSIs may be overestimated. A background update is planned in 2020 that will address this issue and improve the accuracy of the representation of site conditions as well as SSI identification for the UWL.
- Mann-Kendall trend test at the 95% confidence level was performed on all parameters and is listed in Tables 3a and 3b (Data Trending). SSIs are highlighted in peach. For informational purposes, upward trends are underlined and bolded in Table 3b.
- The nine upward trending detected SSIs were:
    - Barium: DG-10, UG-03
    - Boron: UG-03
    - Chloride: UG-03
    - Manganese: UG-02
    - Nickel: DG-09, UG-02
    - Sodium: DG-05
    - Specific conductance: DG-12

Multiple lines of evidence indicate that the number of observed SSIs may be artificially inflated:

- Some laboratory-estimated analytical results (estimated below the RL) were used in background (prediction limit) calculations, resulting in more uncertain and less representative background values and the potential for an overestimated number of SSIs.
- Out of the 16 detected SSIs, 13 SSIs are only slightly greater than the background (prediction limit) and may be attributable to natural variability in the data set.
- An alternative source demonstration (ASD) was performed on the same unit in 2018 (Golder Associates Inc., 2018) as a part of the groundwater monitoring for federal Coal Combustion Residuals (CCR) Rule. The ASD concluded that factors such as pre-existing low-level CCR impacts; a relatively small background data set that does not fully represent the natural variability of the system; and the presence of a high-density polyethylene (HDPE) liner underlain with 2 feet of clay at the UWL indicate the likelihood of an SSI source other than the UWL.

As discussed, both a background update and an update of the statistical analysis plan are planned in 2020 that will improve the accuracy of the representation of site conditions as well SSI identification for the UWL. The background update will increase statistical power and accuracy of statistical analysis; and the revised statistical analysis plan will incorporate and document current best practices for use at the UWL. The statistical analysis plan is required to be approved by the MDNR before updating the background and was submitted to the MDNR for approval on June 30, 2020.

8. KEY ACTIVITIES PLANNED FOR THE 2ND HALF OF 2020

The following key activities are planned for the 2nd half of 2020:

- An update to the background evaluation and statistical analysis plan are anticipated in 2020. These updates that will improve the accuracy of the representation of site conditions as well SSI identification. The statistical analysis plan is required to be approved by the MDNR before updating the background and was submitted to the MDNR for approval on June 30, 2020.
- Continuation of the Detection Monitoring Program with semi-annual sampling scheduled for November of 2020.
- Complete evaluation of analytical data from all wells, using calculated intra-well prediction limits to determine whether an SSI of Appendix I parameters has occurred.

9. REFERENCES

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Attachment 6

Annual Groundwater Monitoring and Corrective Action Report

2019 Annual Groundwater Monitoring and Corrective Action Report

SCPC Surface Impoundment, Sioux Energy Center, St. Charles County, Missouri, USA

Submitted to:

Ameren Missouri
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Submitted by:

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Project No. 153-140601

January 31, 2020

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APPENDICES

1.0 INTRODUCTION

This annual report was developed to meet the requirements of United States Environmental Protection Agency (USEPA) 40 CFR Part 257 “Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities; Final Rule” (the CCR Rule). The CCR Rule requires owners or operators of existing CCR units to produce an Annual Groundwater Monitoring and Corrective Action Report (Annual Report) each year (§§ 257.90(e)). Ameren Missouri (Ameren) has determined that the Utility Waste Landfill (UWL) SCPC Surface Impoundment at the Sioux Energy Center (SEC) is subject to the requirements of the CCR Rule. This Annual Report for the SCPC describes CCR Rule groundwater monitoring activities from January 1, 2019 through December 31, 2019.

2.0 INSTALLATION OR DECOMMISSIONING OF MONITORING WELLS

In accordance with the CCR Rule, a groundwater monitoring system has been installed to monitor the SCPC. The groundwater monitoring system consists of eight (8) groundwater monitoring wells screened in the uppermost aquifer and is displayed in **Figure 1**. No new monitoring wells were installed or decommissioned in 2019 as a part of the CCR Rule monitoring program for the SCPC. For more information on the groundwater monitoring network, details are provided in the 2017 Annual Groundwater Monitoring Report for the SCPC.

3.0 GROUNDWATER SAMPLING RESULTS AND DISCUSSION

The following sections review the sampling events completed for the SCPC CCR Unit in 2019. **Table 1** below provides a summary of the groundwater samples collected in 2019 including the number of samples, the date of sample collection, and the monitoring program.

Table 1 – Summary of Groundwater Sampling Dates

Sampling Event	Groundwater Monitoring Wells								Monitoring Program
	BMW-1S	BMW-3S	UG-1A	UG-2	DG-1	DG-2	DG-3	DG-4	
	Date of Sample Collection								
January 2019 Verification Sampling	-	-	-	-	1/8/2019	1/8/2019	1/8/2019	-	Detection
August 2019 Detection Monitoring Sampling	8/2/2019	8/2/2019	8/19/2019	8/19/2019	8/19/2019	8/19/2019	8/19/2019	8/19/2019	Detection
October 2019 Verification Sampling	-	-	10/2/2019	10/2/2019	-	-	10/2/2019	-	Detection
November 2019 Detection Monitoring Sampling	11/13/2019	11/13/2019	11/14/2019	11/14/2019	11/14/2019	11/14/2019	11/14/2019	11/15/2019	Detection
Total Number of Samples Collected	2	2	3	3	3	3	4	2	NA

Notes:
1.) Detection Monitoring Events tested for Appendix III Parameters.
2.) Verification Sampling Events tested for Appendix III Parameters with initial exceedances.
3.) "-" No sample collected.
4.) NA - Not applicable.

3.1 Detection Monitoring Program

A Detection Monitoring event was completed November 12-13, 2018. Verification Sampling and the Statistical Analysis to evaluate for Statistically Significant Increases (SSIs) for the November 2018 event were not completed until 2019 and are, therefore, included in this report. Detections of Appendix III analytes triggered a verification sampling event, which was completed on January 8, 2019 and did not verify any SSIs. **Table 2** summarizes the results of the statistical analysis of the November 2018 Detection Monitoring event and laboratory analytical data are provided in **Appendix A**.

A Detection Monitoring sampling event was scheduled for May 2019, however due to flooding the event was completed August 2-19, 2019, and testing was completed for all Appendix III analytes. Statistical analysis of the data determined that there were SSIs. **Table 3** summarizes the results of the statistical analysis of the August 2019 Detection Monitoring event and laboratory analytical data are provided in **Appendix A**.

As outlined in section 257.94(e)(2) of the CCR Rule, the owner or operator may demonstrate that a source other than the CCR Unit has caused an SSI and that the apparent SSI was the result of an alternative source or resulted from errors in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. An Alternative Source Demonstration (ASD) was completed for these SSIs and is provided in **Appendix B**. This ASD demonstrates that SSIs are not caused by the SCPC CCR Unit and the SCPC CCR Unit remains in Detection Monitoring.

As outlined in the Statistical Analysis Plan for this site, updates to the statistical limits are completed once four (4) to eight (8) new sample results are available. After the statistical analysis of the August 2019 sampling event, the statistical limits used to determine an SSI were updated according to the Statistical Analysis Plan. These updated limits will be used for November 2019 and subsequent statistical analyses.

A Detection Monitoring event was completed November 13-15, 2019, and testing was performed for all Appendix III analytes. Statistical analyses to evaluate for SSIs in the November 2019 data were not completed in 2019 and the results will be provided in the 2020 Annual Report. **Table 4** summarizes the results of the November 2019 Detection Monitoring event and laboratory analytical data are provided in **Appendix A**.

3.2 Groundwater Elevation, Flow Rate and Direction

To meet the requirements of §257.93(c), water level measurements were taken at all monitoring wells prior to the start of groundwater purging and sampling. Static water levels were measured within a 24-hour period in each monitoring well using an electronic water level indicator.

Groundwater elevations were used to generate potentiometric surface maps found in **Appendix C**. As shown on the potentiometric surface maps, groundwater flow direction within the uppermost aquifer is dynamic and influenced by seasonal changes in the water level in the adjacent Mississippi and Missouri Rivers, since the alluvial aquifer is hydraulically connected to these water bodies. Groundwater in the alluvial aquifer will generally flow from the higher of the two rivers toward the lower elevation river. The SCPA Surface Impoundment and Poeling Lake also locally affect water levels and flow directions. Water flows into and out of the alluvial aquifer as a result of fluctuating river water levels that produce “bank recharge” and “bank discharge” conditions. At this facility, groundwater can flow north and south toward the Mississippi and Missouri Rivers, depending on river levels.

Groundwater flow direction and hydraulic gradient were estimated for the alluvial aquifer wells at the SEC using commercially available software. Results from this assessment indicate that while groundwater flow direction is variable, the overall net groundwater flow at the SEC was toward the northeast but ranged from north to south. Horizontal gradients calculated by the program range from 0.0001 to 0.001 feet/foot with an estimated net annual groundwater velocity of approximately four (4) feet per year.

4.0 STATUS OF THE GROUNDWATER MONITORING PROGRAM

The SCPC remains in Detection Monitoring. Section 5.0 provides a discussion of the activities planned for 2020.

4.1 Sampling Issues

Detection Monitoring for the SEC was planned for May 2019. However, from approximately March to July 2019, some of the monitoring wells at the SEC were under water due flooding of the Mississippi and Missouri Rivers. This caused a delay in the planned sampling dates for the SCPC. On July 15-17, 2019, Golder performed post-flood monitoring well inspections at the SEC and found that at the SCPC BMW-1S, BMW-3S, DG-4 and UG-1A had been impacted by the flood. On July 23, 2019, Golder re-developed BMW-1S and BMW-3S to remove floodwater impacts to the wells prior to any future groundwater elevation measurements or groundwater samples being collected. After successful re-development, BMW-1S and BMW-3S were returned to service. Gredell Engineering Resources re-developed wells used for the UWL permitting at the SEC August 12-16, 2019. After successful re-development DG-4 and UG-1A were returned to service.

No other notable sampling issues were encountered in 2019.

5.0 ACTIVITIES PLANNED FOR 2020

Detection Monitoring is scheduled to continue on a semi-annual basis in the second and fourth quarters of 2020. Statistical analysis of the November 2019 Detection Monitoring data will be completed in 2020 and included in the 2020 Annual Report.

Tables

Table 2
November 2018 Detection Monitoring Results
SCPC Surface Impoundment
Sioux Energy Center, St. Charles County, MO

ANALYTE	UNITS	BACKGROUND		GROUNDWATER MONITORING WELLS											
		BMW-1S	BMW-3S	Prediction Limit UG-1A	UG-1A	Prediction Limit UG-2	UG-2	Prediction Limit DG-1	DG-1	Prediction Limit DG-2	DG-2	Prediction Limit DG-3	DG-3	Prediction Limit DG-4	DG-4
November 2018 Detection Monitoring Event															
DATE	NA	11/12/2018	11/12/2018	NA	11/13/2018	NA	11/13/2018	NA	11/13/2018	NA	11/13/2018	NA	11/13/2018	NA	11/13/2018
pH	SU	7.46	7.49	6.294-7.616	7.00	6.031-7.969	6.76	6.759-7.323	6.11	6.73-7.482	6.20	6.156-7.702	6.12	6.291-7.62	7.05
BORON, TOTAL	µg/L	72.9 J	61.5 J	362.5	145	234.6	145	122.5	125	119.3	114	115.1	108	DQR	73.2 J
CALCIUM, TOTAL	µg/L	157,000	124,000	164,715	116,000	133,251	105,000	146,584	129,000	142,779	122,000	159,563	137,000	147,361	121,000
CHLORIDE, TOTAL	mg/L	6.7	10.1	131.6	65.4	125.3	24.4	9.962	8.6	9.817	6.9	16.08	9.1	115.1	80.2
FLUORIDE, TOTAL	mg/L	0.34	0.36	0.3822	ND	0.24	ND	0.3844	ND	0.4365	ND	0.4619	ND	0.37	ND
SULFATE, TOTAL	mg/L	28.8	25.6	103.2	65.9	101.6	17.7	66.1	27.1	47.44	29.0	61.41	64.7	57.15	39.3
TOTAL DISSOLVED SOLIDS	mg/L	556	436	818.8	549	613.7	607 J	569.1	511	521.6	470	580	545	698.9	611
January 2019 Verification Sampling															
DATE	NA								1/8/2019		1/8/2019		1/8/2019		
pH	SU								6.97		7.00		7.14		
BORON, TOTAL	µg/L								99.7 J						
CALCIUM, TOTAL	µg/L														
CHLORIDE, TOTAL	mg/L														
FLUORIDE, TOTAL	mg/L														
SULFATE, TOTAL	mg/L												29.7		
TOTAL DISSOLVED SOLIDS	mg/L														

NOTES:
1. Unit Abbreviations: µg/L - micrograms per liter, mg/L - milligrams per liter, SU - standard units.
2. J - Result is an estimated value.
3. ND - Constituent was analyzed for, but was not detected above the Method Detection Limit (MDL) and is considered a non-detect. Values displayed as ND.
4. NA - Not applicable.
5. Prediction Limits calculated using Sanitas Software.
6. If all background values are less than the Practical Quantitation Limit (PQL) then the Double Quantification Rule (DQR) is used.
7. Values highlighted in yellow indicate a Statistically Significant Increase (SSI).
8. Values highlighted in green indicate an initial exceedance above the prediction limit that was not confirmed by Verification Sampling (not an SSI).
9. Only analytes/wells that were detected above the prediction limit were tested during Verification Sampling.

Prepared By: RJF
Checked By: KAB
Reviewed By: CMR

Table 3
August 2019 Detection Monitoring Results
SCPC Surface Impoundment
Sioux Energy Center, St. Charles County, MO

ANALYTE	UNITS	BACKGROUND		GROUNDWATER MONITORING WELLS											
		BMW-1S	BMW-3S	Prediction Limit UG-1A	UG-1A	Prediction Limit UG-2	UG-2	Prediction Limit DG-1	DG-1	Prediction Limit DG-2	DG-2	Prediction Limit DG-3	DG-3	Prediction Limit DG-4	DG-4
August 2019 Detection Monitoring Event															
DATE	NA	8/2/2019	8/2/2019	NA	8/19/2019	NA	8/19/2019	NA	8/19/2019	NA	8/19/2019	NA	8/19/2019	NA	8/19/2019
pH	SU	6.9	7.5	6.294-7.616	6.55	6.031-7.969	6.65	6.759-7.323	6.77	6.73-7.482	6.83	6.156-7.702	6.76	6.291-7.62	6.64
BORON, TOTAL	µg/L	ND	ND	362.5	270	234.6	144	122.5	106	119.3	104	115.1	95.1 J	DQR	61.1 J
CALCIUM, TOTAL	µg/L	149,000	122,000	164,715	177,000	133,251	116,000	146,584	135,000	142,779	133,000	159,563	148,000	147,361	136,000
CHLORIDE, TOTAL	mg/L	8.8	10.6	131.6	145	125.3	30.0	9.962	6.2	9.817	8.2	16.08	4.8	115.1	103.0
FLUORIDE, TOTAL	mg/L	0.31	0.35	0.3822	0.28	0.24	0.25	0.3844	0.34	0.4365	0.38	0.4619	0.37	0.37	0.32
SULFATE, TOTAL	mg/L	34.1	25.3	103.2	57.7	101.6	45.2	66.1	41.7	47.44	37.1	61.41	49.5	57.15	31.5
TOTAL DISSOLVED SOLIDS	mg/L	548	452	818.8	785	613.7	519	569.1	503	521.6	511	580	624	698.9	671
October 2019 Verification Sampling Event															
DATE	NA				10/2/2019		10/2/2019						10/2/2019		
pH	SU				6.82		6.83						6.82		
BORON, TOTAL	µg/L														
CALCIUM, TOTAL	µg/L				166,600										
CHLORIDE, TOTAL	mg/L				140										
FLUORIDE, TOTAL	mg/L						0.30								
SULFATE, TOTAL	mg/L														
TOTAL DISSOLVED SOLIDS	mg/L												569		

NOTES:

1. Unit Abbreviations: µg/L - micrograms per liter, mg/L - milligrams per liter, SU - standard units.
2. J - Result is an estimated value.
3. ND - Constituent was analyzed for, but was not detected above the Method Detection Limit (MDL) and is considered a non-detect. Values displayed as ND.
4. NA - Not applicable.
5. Prediction Limits calculated using Sanitas Software.
6. If all background values are less than the Practical Quantitation Limit (PQL) then the Double Quantification Rule (DQR) is used.
7. Values highlighted in yellow indicate a Statistically Significant Increase (SSI).
8. Values highlighted in green indicate an initial exceedance above the prediction limit that was not confirmed by Verification Sampling (not an SSI).
9. Only analytes/wells that were detected above the prediction limit were tested during Verification Sampling.

Prepared By: RJF
Checked By: KAB
Reviewed By: CMR

Table 4
November 2019 Detection Monitoring Results
SCPC Surface Impoundment
Sioux Energy Center, St. Charles County, MO

ANALYTE	UNITS	BACKGROUND		GROUNDWATER MONITORING WELLS					
		BMW-1S	BMW-3S	UG-1A	UG-2	DG-1	DG-2	DG-3	DG-4
November 2019 Detection Monitoring Event									
DATE	NA	11/13/2019	11/13/2019	11/14/2019	11/14/2019	11/14/2019	11/14/2019	11/14/2019	11/15/2019
pH	SU	6.88	7.13	6.85	7.09	7.06	6.61	6.88	6.97
BORON, TOTAL	µg/L	118	80.1 J	239	144	111	100	93.1 J	71.0 J
CALCIUM, TOTAL	µg/L	143,000 J	102,000	166,000	115,000	135,000	133,000	144,000	138,000
CHLORIDE, TOTAL	mg/L	6.4	7.6	118	27.8	6.0	7.4	5.4	96.9 J
FLUORIDE, TOTAL	mg/L	0.28	0.23	0.29	0.24	0.33	0.39	0.42	0.30
SULFATE, TOTAL	mg/L	26.5	34.4	53	43.8	38.4	37.8	51.1	33.9
TOTAL DISSOLVED SOLIDS	mg/L	551	418	739	480	524	512	576	628

NOTES:

1. Unit Abbreviations: µg/L - micrograms per liter, mg/L - milligrams per liter, SU - standard units.
2. J - Result is an estimated value.
3. NA - Not applicable.

Prepared By: TJG
Checked By: KAB
Reviewed By: CMR

Figures

LEGEND

🟥	Sioux Energy Center Property Boundary
▭	UWL Perimeter Fence
▭	SCPC - WFGD Disposal Area
▭	Water Recycle Pond

Groundwater Monitoring Wells Used for SCPC CCR Rule Monitoring

⌖	SCPC Monitoring Well
⌖	Background Monitoring Well

0 1,000 2,000 3,000
Feet

NOTE(S)

1.) ALL BOUNDARIES AND LOCATIONS ARE APPROXIMATE.
2.) UWL - UTILITY WASTE LANDFILL.
3.) WFGD - WET FLUE GAS DESULFURIZATION.

REFERENCE(S)

1.) AMEREN MISSOURI SIOUX ENERGY CENTER, SIOUX PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2,401 FEET.

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

PROJECT
GROUNDWATER MONITORING PROGRAM

TITLE
SITE LOCATION AERIAL MAP AND MONITORING WELL LOCATIONS

CONSULTANT

YYYY-MM-DD	2020-01-15
DESIGNED	JSI
PREPARED	RJF
REVIEWED	EMS
APPROVED	CMR

PROJECT NO.	CONTROL	REV.	FIGURE
153140601	1240	0	1

PATH: G:\Projects\150 Projects\1531406 - Ameren GW Monitoring Program - MO\Phase 0003 - Sioux Energy\800 - FIGURES-DRAWINGS\PRODUCTION\2019 Annual Report\Figure 1 - SCPC_v2.mxd PRINTED ON: 2020-01-24 AT: 10:47:32 AM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 1 in

APPENDIX A

Laboratory Analytical Data

Pace Analytical Services, LLC
9608 Loiret Blvd.
Lenexa, KS 66219
(913)599-5665

January 10, 2019

Mark Haddock
Golder Associates
820 S. Main St
Suite 100
Saint Charles, MO 63301

RE: Project: SCPC GW SAMPLING
Pace Project No.: 60291371

Dear Mark Haddock:

Enclosed are the analytical results for sample(s) received by the laboratory on January 09, 2019. The results relate only to the samples included in this report. Results reported herein conform to the most current, applicable TNI/NELAC standards and the laboratory's Quality Assurance Manual, where applicable, unless otherwise noted in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Jamie Church

Jamie Church
jamie.church@pacelabs.com
314-838-7223
Project Manager

Enclosures

cc: Ryan Feldmann, Golder
Jeffrey Ingram, Golder Associates
Eric Schneider, Golder Associates

CERTIFICATIONS

Project:	SCPC GW SAMPLING
Pace Project No.:	60291371

Kansas Certification IDs

9608 Loiret Boulevard, Lenexa, KS 66219
Missouri Certification Number: 10090
Arkansas Drinking Water
WY STR Certification #: 2456.01
Arkansas Certification #: 18-016-0
Arkansas Drinking Water
Illinois Certification #: 004455
Iowa Certification #: 118
Kansas/NELAP Certification #: E-10116 / E10426
Louisiana Certification #: 03055
Nevada Certification #: KS000212018-1
Oklahoma Certification #: 9205/9935
Texas Certification #: T104704407-18-11
Utah Certification #: KS000212018-8
Kansas Field Laboratory Accreditation: # E-92587
Missouri Certification: 10070
Missouri Certification Number: 10090

SAMPLE SUMMARY

Project: SCPC GW SAMPLING
Pace Project No.: 60291371

Lab ID	Sample ID	Matrix	Date Collected	Date Received
60291371001	**S-D6-1**	Water	01/08/19 09:45	01/09/19 03:00
60291371002	**S-D6-3**	Water	01/08/19 09:50	01/09/19 03:00

SAMPLE ANALYTE COUNT

Project: SCPC GW SAMPLING
Pace Project No.: 60291371

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
60291371001	**S-D6-1**	EPA 200.7	CTR	1	PASI-K
60291371002	**S-D6-3**	EPA 300.0	MGS	1	PASI-K

ANALYTICAL RESULTS

Project: SCPC GW SAMPLING
Pace Project No.: 60291371

Sample: S-D6-1 **Lab ID: 60291371001** Collected: 01/08/19 09:45 Received: 01/09/19 03:00 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
200.7 Metals, Total	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7								
Boron	**99.7J**	ug/L	100	12.5	1	01/09/19 15:16	01/10/19 10:42	7440-42-8	

ANALYTICAL RESULTS

Project: SCPC GW SAMPLING
Pace Project No.: 60291371

Sample: S-D6-3 **Lab ID: 60291371002** Collected: 01/08/19 09:50 Received: 01/09/19 03:00 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Sulfate	**29.7**	mg/L	5.0	1.2	5		01/10/19 11:31	14808-79-8	M1

QUALITY CONTROL DATA

Project: SCPC GW SAMPLING
Pace Project No.: 60291371

QC Batch: 563906
QC Batch Method: EPA 200.7
Analysis Method: EPA 200.7
Analysis Description: 200.7 Metals, Total
Associated Lab Samples: 60291371001

METHOD BLANK: 2313489
Matrix: Water
Associated Lab Samples: 60291371001

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Boron	ug/L	<12.5	100	12.5	01/10/19 10:39	

LABORATORY CONTROL SAMPLE: 2313490

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Boron	ug/L	1000	944	94	85-115	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2313491 2313492

Parameter	Units	60291374003 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Boron	ug/L	382	1000	1000	1350	1330	97	95	70-130	1	20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: SCPC GW SAMPLING
Pace Project No.: 60291371

QC Batch: 564071
QC Batch Method: EPA 300.0
Analysis Method: EPA 300.0
Analysis Description: 300.0 IC Anions
Associated Lab Samples: 60291371002

METHOD BLANK: 2314235
Matrix: Water
Associated Lab Samples: 60291371002

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Sulfate	mg/L	<0.24	1.0	0.24	01/10/19 09:48	

LABORATORY CONTROL SAMPLE: 2314236

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Sulfate	mg/L	5	4.9	98	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2314237 2314238

Parameter	Units	60291371002 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Sulfate	mg/L	29.7	25	25	57.6	53.6	112	96	90-110	7	15	M1

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALIFIERS

Project: SCPC GW SAMPLING
Pace Project No.: 60291371

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.

ND - Not Detected at or above adjusted reporting limit.

TNTC - Too Numerous To Count

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PQL - Practical Quantitation Limit.

RL - Reporting Limit - The lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix.

S - Surrogate

1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

LABORATORIES

PASI-K	Pace Analytical Services - Kansas City

ANALYTE QUALIFIERS

M1	Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery.

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project:	SCPC GW SAMPLING
Pace Project No.:	60291371

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
60291371001	**S-D6-1**	EPA 200.7	563906	EPA 200.7	563987
60291371002	**S-D6-3**	EPA 300.0	564071		

JLS

WO# : 60291371

60291371

Pace Analytical®
www.pacelabs.com

Sample Condition Upon Receipt

Client Name: Golder Associates

Courier: FedEx ☐ UPS ☐ VIA ☐ Clay ☐ PEX ☐ ECI ☐ Pace ☐ Xroads ☒ Client ☐ Other ☐

Tracking #: ______ Pace Shipping Label Used? Yes ☐ No ☒

Custody Seal on Cooler/Box Present: Yes ☒ No ☐ Seals intact: Yes ☒ No ☐

Packing Material: Bubble Wrap ☐ Bubble Bags ☒ Foam ☐ None ☐ Other ☐

Thermometer Used: T-301 **Type of Ice:** [✓ Wet] Blue None

Cooler Temperature (°C): **As-read** 0.9 **Corr. Factor** 0.0 **Corrected** 0.9

Date and initials of person examining contents: 1/9/19 RK

Temperature should be above freezing to 6°C

Chain of Custody present:	☒Yes ☐No ☐N/A	
Chain of Custody relinquished:	☒Yes ☐No ☐N/A	
Samples arrived within holding time:	☒Yes ☐No ☐N/A	
Short Hold Time analyses (<72hr):	☐Yes ☒No ☐N/A	
Rush Turn Around Time requested:	☒Yes ☐No ☐N/A	
Sufficient volume:	☒Yes ☐No ☐N/A	
Correct containers used:	☒Yes ☐No ☐N/A	
Pace containers used:	☒Yes ☐No ☐N/A	
Containers intact:	☒Yes ☐No ☐N/A	
Unpreserved 5035A / TX1005/1006 soils frozen in 48hrs?	☐Yes ☐No ☒N/A	
Filtered volume received for dissolved tests?	☐Yes ☒No ☐N/A	
Sample labels match COC: Date / time / ID / analyses	☒Yes ☐No ☐N/A	
Samples contain multiple phases? Matrix: WT	☐Yes ☒No ☐N/A	
Containers requiring pH preservation in compliance? (HNO_3, H_2SO_4, HCl<2; NaOH>9 Sulfide, NaOH>10 Cyanide) (Exceptions: VOA, Micro, O&G, KS TPH, OK-DRO)	☒Yes ☐No ☐N/A	List sample IDs, volumes, lot #'s of preservative and the date/time added.
Cyanide water sample checks: Lead acetate strip turns dark? (Record only) Potassium iodide test strip turns blue/purple? (Preserve)	 ☐Yes ☒No ☐Yes ☒No	
Trip Blank present:	☐Yes ☐No ☒N/A	
Headspace in VOA vials (>6mm):	☐Yes ☐No ☒N/A	
Samples from USDA Regulated Area: State:	☐Yes ☐No ☒N/A	
Additional labels attached to 5035A / TX1005 vials in the field?	☐Yes ☐No ☒N/A	

Client Notification/ Resolution: Copy COC to Client? Y / N Field Data Required? Y / N

Person Contacted: ______ Date/Time: ______

Comments/ Resolution: ______

Project Manager Review: Jamie Church Date: 1/9/19

Pace Analytical
www.pacelabs.com

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately

Page: 1 of 1

Section A
Required Client Information:

Company: Golder Associates
Address: 820 South Main Street, Suite 100
St Charles, MO 63301
Email To: maddock@golder.com
Phone: 636-724-9191
Fax: 636-724-9323
Requested Due Date/TAT: Standard

Section B
Required Project Information:

Report To: Mark Haddock (mhaddock@golder.com)
Copy To: Jeffrey Ingram
Purchase Order No.:
Project Name: SCPC GW Sampling
Project Number: 153i406.0003

Section C
Invoice Information:

Attention:
Company Name:
Address:
Pace Quote Reference:
Pace Project Manager: Jamie Church
Pace Profile #: 9285

REGULATORY AGENCY

☐ NPDES ☑ GROUND WATER ☐ DRINKING WATER
☐ UST ☐ RCRA ☐ OTHER

Site Location STATE: MO

Section D
Required Client Information

Valid Matrix Codes

MATRIX	CODE
DRINKING WATER	DW
WATER	WT
WASTE WATER	WW
PRODUCT	P
SOIL/SOLID	SL
OIL	OL
	WP
	AR
	OT
	TS

SAMPLE ID
(A-Z, 0-9 / ,-)
Sample IDs MUST BE UNIQUE

Requested Analysis Filtered (Y/N)

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED COMPOSITE START DATE	COLLECTED COMPOSITE START TIME	COLLECTED COMPOSITE END/GRAB DATE	COLLECTED COMPOSITE END/GRAB TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	↓Analysis Test↓ Y/N	Boron	Calcium	Chloride	Fluoride	Sulfate	TDS							Residual Chlorine (Y/N)	60291371 Pace Project No./ Lab I.D.
																			N	N	N	N	N	N								
1	S-DG-1	WT	G			1/8/19	0945		2	1		1							✓						BP2U, BP3N							001
2	S-DG-3	WT	G			1	0950		1	1		1											✓			✓			✓			002
3		WT	G																													
4		WT	G																													
5		WT	G																													
6		WT	G																													
7		WT	G																													
8		WT	G																													
9		WT	G																													
10		WT	G																													
11		WT	G																													
12		WT	G																													

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS			
	/ Golder	1/08/19		/ Pace	1/9/19	0830	0.9	Y	Y	Y
							Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Eric Schneider
SIGNATURE of SAMPLER:
DATE Signed (MM/DD/YY): 01/08/19

*Important Note: By signing this form you are accepting Pace's NET 30 day payment terms and agreeing to late charges of 1.5% per month for any invoices not paid within 30 days

F-ALL-Q-020rev.08, 12-Oct-2007

GOLDER

MEMORANDUM

DATE January 10, 2019 **Project No.** 1531406

TO Project File
Golder Associates

CC

FROM Tommy Goodwin **EMAIL tgoodwin@golder.com**

DATA VALIDATION SUMMARY: AMEREN – SIOUX ENERGY CENTER – VERIFICATION SAMPLING – DATA PACKAGE 60291371

The following is a summary of instances where quality control criteria in the functional guidelines were not met and data qualification was required:

- When analytes exceeded the recovery criteria for MS/MSD of a sample, the sample result was not qualified on MS/MSD data alone.
- When a compound was detected in a sample result between the MDL and the PQL the results were recorded at the detection value and qualified as estimates (J).

Golder Associates Inc.
13515 Barrett Parkway Drive, Suite 260,
Ballwin, Missouri, USA 63021

T: +1 314 984-8800 F: +1 314 984-8770

QA LEVEL II - INORGANIC DATA EVALUATION CHECKLIST

Company Name: Golder Associates
Project Name: Ameren - SCPC - VS - Jan 2019
Reviewer: T Goodwin

Project Manager: J Ingram
Project Number: 1531406
Validation Date: ~~60291371~~ Ⓣ 1/10/19

Laboratory: Pace Analytical
SDG #: 60291371
Analytical Method (type and no.): Metals (200.7~~&200.8), Hg (7470), Alk (SM 2320B), TDS (SM 2540C), Fe (SM 3500-Fe B#4), Anions (300.0), P (365.4), Ra (903.1&904.0)~~ (TG)
Anions (300.0)
Matrix: ☐ Air ☐ Soil/Sed. ☒ Water ☐ Waste ☐
Sample Names S-D6-1, S-D6-3

NOTE: Please provide calculation in Comment areas or on the back (if on the back please indicate in comment areas).

Field Information	**YES**	**NO**	**NA**	**COMMENTS**
a) Sampling dates noted?	☒	☐	☐	
b) Sampling team indicated?	☒	☐	☐	
c) Sample location noted?	☒	☐	☐	
d) Sample depth indicated (Soils)?	☐	☐	☒	
e) Sample type indicated (grab/composite)?	☒	☐	☐	Grab
f) Field QC noted?	☒	☐	☐	
g) Field parameters collected (note types)?	☒	☐	☐	pH, Cond, Turb, Temp, DO, ORP, Q, DTW
h) Field Calibration within control limits?	☒	☐	☐	
i) Notations of unacceptable field conditions/performances from field logs or field notes?	☐	☒	☐	
j) Does the laboratory narrative indicate deficiencies?	☐	☐	☒	

Note Deficiencies:

Chain-of-Custody (COC)	**YES**	**NO**	**NA**	**COMMENTS**
a) Was the COC properly completed?	☒	☐	☐	
b) Was the COC signed by both field and laboratory personnel?	☒	☐	☐	
c) Were samples received in good condition?	☒	☐	☐	

General (reference QAPP or Method)	**YES**	**NO**	**NA**	**COMMENTS**
a) Were hold times met for sample pretreatment?	☐	☐	☒	
b) Were hold times met for sample analysis?	☐	☐	☐	
c) Were the correct preservatives used?	☒	☐	☐	
d) Was the correct method used?	☒	☐	☐	
e) Were appropriate reporting limits achieved?	☒	☐	☐	
f) Were any sample dilutions noted?	☒	☐	☐	
g) Were any matrix problems noted?	☒	☐	☐	

QA LEVEL II - INORGANIC DATA EVALUATION CHECKLIST

Blanks	**YES**	**NO**	**NA**	**COMMENTS**
a) Were analytes detected in the method blank(s)?	☐	☑	☐	
b) Were analytes detected in the field blank(s)?	☐	☐	☑	
c) Were analytes detected in the equipment blank(s)?	☐	☐	☒	
d) Were analytes detected in the trip blank(s)?	☐	☐	☒	

Laboratory Control Sample (LCS)	**YES**	**NO**	**NA**	**COMMENTS**
a) Was a LCS analyzed once per SDG?	☒	☐	☐	
b) Were the proper analytes included in the LCS?	☒	☐	☐	
c) Was the LCS accuracy criteria met?	☑	☐	☐	

Duplicates	**YES**	**NO**	**NA**	**COMMENTS**
a) Were field duplicates collected (note original and duplicate sample names)?	☐	☑	☐	Dup-1@ N/A FB-1@ N/A
b) Were field dup. precision criteria met (note RPD)?	☐	☐	☑	
c) Were lab duplicates analyzed (note original and duplicate samples)?	☒	☐	☐	
d) Were lab dup. precision criteria met (note RPD)?	☑	☐	☐	

Blind Standards	**YES**	**NO**	**NA**	**COMMENTS**
a) Was a blind standard used (indicate name, analytes included and concentrations)?	☐	☐	☒	
b) Was the %D within control limits?	☐	☐	☒	

Matrix Spike/Matrix Spike Duplicate (MS/MSD)	**YES**	**NO**	**NA**	**COMMENTS**
a) Was MS accuracy criteria met?	☐	☑	☐	SO_4^{2-}
Recovery could not be calculated since sample contained high concentration of analyte?	☐	☐	☒	
b) Was MSD accuracy criteria met?	☑	☐	☐	
Recovery could not be calculated since sample contained high concentration of analyte?	☐	☐	☒	
c) Were MS/MSD precision criteria met?	☑	☐	☐	

Comments/Notes:

QA LEVEL II - INORGANIC DATA EVALUATION CHECKLIST

Data Qualification:

Sample Name	Constituent(s)	Result	Qualifier	Reason
None				

Signature: Tommy J Goodall

Date: 1/10/19

Pace Analytical Services, LLC
9608 Loiret Blvd.
Lenexa, KS 66219
(913)599-5665

October 17, 2019

Jeffrey Ingram
Golder Associates
13515 Barrett Parkway Drive
Suite 260
Ballwin, MO 63021

RE: Project: AMEREN SIOUX ENERGY CTR
Pace Project No.: 60312389

Dear Jeffrey Ingram:

Enclosed are the analytical results for sample(s) received by the laboratory between August 03, 2019 and August 20, 2019. The results relate only to the samples included in this report. Results reported herein conform to the most current, applicable TNI/NELAC standards and the laboratory's Quality Assurance Manual, where applicable, unless otherwise noted in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Jamie Church

Jamie Church
jamie.church@pacelabs.com
314-838-7223
Project Manager

Enclosures

cc: Ryan Feldmann, Golder
Mark Haddock, Golder Associates
Eric Schneider, Golder Associates

CERTIFICATIONS

Project:	AMEREN SIOUX ENERGY CTR
Pace Project No.:	60312389

Kansas Certification IDs

9608 Loiret Boulevard, Lenexa, KS 66219
Missouri Inorganic Drinking Water Certification #: 10090
Arkansas Drinking Water
Arkansas Certification #: 19-016-0
Arkansas Drinking Water
Illinois Certification #: 004455
Iowa Certification #: 118
Kansas/NELAP Certification #: E-10116
Louisiana Certification #: 03055

Nevada Certification #: KS000212018-1
Oklahoma Certification #: 9205/9935
Florida: Cert E871149 SEKS WET
Texas Certification #: T104704407-18-11
Utah Certification #: KS000212018-8
Illinois Certification #: 004592
Kansas Field Laboratory Accreditation: # E-92587
Missouri SEKS Micro Certification: 10070

SAMPLE SUMMARY

Project: AMEREN SIOUX ENERGY CTR
Pace Project No.: 60312389

Lab ID	Sample ID	Matrix	Date Collected	Date Received
60312389001	**S-UG-1A**	Water	08/19/19 09:35	08/20/19 02:45
60312389002	**S-UG-2**	Water	08/19/19 09:20	08/20/19 02:45
60312389003	**S-DG-1**	Water	08/19/19 10:30	08/20/19 02:45
60312389004	**S-DG-2**	Water	08/19/19 11:15	08/20/19 02:45
60312389005	**S-DG-3**	Water	08/19/19 12:05	08/20/19 02:45
60312389006	**S-DG-4**	Water	08/19/19 11:20	08/20/19 02:45
60312389007	**S-SCPC-DUP-1**	Water	08/19/19 08:00	08/20/19 02:45
60312389008	**S-SCPC-FB-1**	Water	08/19/19 09:12	08/20/19 02:45
60310790002	**S-BMW-1S**	Water	08/01/19 10:55	08/03/19 02:50
60310790003	**S-BMW-3S**	Water	08/01/19 11:45	08/03/19 02:50

SAMPLE ANALYTE COUNT

Project: AMEREN SIOUX ENERGY CTR
Pace Project No.: 60312389

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
60312389001	**S-UG-1A**	EPA 200.7	EMR	7	PASI-K
		SM 2320B	MJK	1	PASI-K
		SM 2540C	BLA	1	PASI-K
		EPA 300.0	JDS	3	PASI-K
60312389002	**S-UG-2**	EPA 200.7	EMR	7	PASI-K
		SM 2320B	MJK	1	PASI-K
		SM 2540C	BLA	1	PASI-K
		EPA 300.0	JDS	3	PASI-K
60312389003	**S-DG-1**	EPA 200.7	EMR	7	PASI-K
		SM 2320B	MJK	1	PASI-K
		SM 2540C	BLA	1	PASI-K
		EPA 300.0	JDS	3	PASI-K
60312389004	**S-DG-2**	EPA 200.7	EMR	7	PASI-K
		SM 2320B	MJK	1	PASI-K
		SM 2540C	BLA	1	PASI-K
		EPA 300.0	JDS	3	PASI-K
60312389005	**S-DG-3**	EPA 200.7	EMR	7	PASI-K
		SM 2320B	MJK	1	PASI-K
		SM 2540C	BLA	1	PASI-K
		EPA 300.0	JDS	3	PASI-K
60312389006	**S-DG-4**	EPA 200.7	EMR	7	PASI-K
		SM 2320B	MJK	1	PASI-K
		SM 2540C	BLA	1	PASI-K
		EPA 300.0	JDS	3	PASI-K
60312389007	**S-SCPC-DUP-1**	EPA 200.7	EMR	7	PASI-K
		SM 2320B	MJK	1	PASI-K
		SM 2540C	BLA	1	PASI-K
		EPA 300.0	JDS	3	PASI-K
60312389008	**S-SCPC-FB-1**	EPA 200.7	EMR	7	PASI-K
		SM 2320B	MJK	1	PASI-K
		SM 2540C	BLA	1	PASI-K
		EPA 300.0	JDS	3	PASI-K
60310790002	**S-BMW-1S**	EPA 200.7	HKC	7	PASI-K
		SM 2320B	MJK	1	PASI-K
		SM 2540C	BLA	1	PASI-K
		EPA 300.0	JDS	3	PASI-K
60310790003	**S-BMW-3S**	EPA 200.7	HKC	7	PASI-K

SAMPLE ANALYTE COUNT

Project: AMEREN SIOUX ENERGY CTR
Pace Project No.: 60312389

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
		SM 2320B	MJK	1	PASI-K
		SM 2540C	BLA	1	PASI-K
		EPA 300.0	JDS	3	PASI-K

ANALYTICAL RESULTS

Project: AMEREN SIOUX ENERGY CTR
Pace Project No.: 60312389

Sample: S-UG-1A **Lab ID: 60312389001** Collected: 08/19/19 09:35 Received: 08/20/19 02:45 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
200.7 Metals, Total	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7								
Boron	**270**	ug/L	100	10.7	1	08/22/19 08:30	08/22/19 18:43	7440-42-8	
Calcium	**177000**	ug/L	200	50.0	1	08/22/19 08:30	08/22/19 18:43	7440-70-2	
Iron	**<14.0**	ug/L	50.0	14.0	1	08/22/19 08:30	08/22/19 18:43	7439-89-6	
Magnesium	**42000**	ug/L	50.0	13.0	1	08/22/19 08:30	08/22/19 18:43	7439-95-4	
Manganese	**1080**	ug/L	5.0	2.1	1	08/22/19 08:30	08/22/19 18:43	7439-96-5	
Potassium	**9530**	ug/L	500	79.0	1	08/22/19 08:30	08/22/19 18:43	7440-09-7	
Sodium	**39100**	ug/L	500	144	1	08/22/19 08:30	08/22/19 18:43	7440-23-5	
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**437**	mg/L	20.0	6.5	1		09/02/19 13:30		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**785**	mg/L	10.0	10.0	1		08/26/19 13:50		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Chloride	**145**	mg/L	20.0	4.4	20		09/04/19 11:11	16887-00-6	
Fluoride	**0.28**	mg/L	0.20	0.085	1		09/03/19 23:38	16984-48-8	
Sulfate	**57.7**	mg/L	5.0	1.2	5		09/03/19 23:53	14808-79-8	

ANALYTICAL RESULTS

Project: AMEREN SIOUX ENERGY CTR
Pace Project No.: 60312389

Sample: S-UG-2 **Lab ID: 60312389002** Collected: 08/19/19 09:20 Received: 08/20/19 02:45 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
200.7 Metals, Total	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7								
Boron	**144**	ug/L	100	10.7	1	08/22/19 08:30	08/22/19 18:45	7440-42-8	
Calcium	**116000**	ug/L	200	50.0	1	08/22/19 08:30	08/22/19 18:45	7440-70-2	
Iron	**<14.0**	ug/L	50.0	14.0	1	08/22/19 08:30	08/22/19 18:45	7439-89-6	
Magnesium	**24600**	ug/L	50.0	13.0	1	08/22/19 08:30	08/22/19 18:45	7439-95-4	
Manganese	**285**	ug/L	5.0	2.1	1	08/22/19 08:30	08/22/19 18:45	7439-96-5	
Potassium	**4700**	ug/L	500	79.0	1	08/22/19 08:30	08/22/19 18:45	7440-09-7	
Sodium	**30400**	ug/L	500	144	1	08/22/19 08:30	08/22/19 18:45	7440-23-5	
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**362**	mg/L	20.0	6.5	1		09/02/19 13:36		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**519**	mg/L	10.0	10.0	1		08/26/19 13:50		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Chloride	**30.0**	mg/L	5.0	1.1	5		09/04/19 00:23	16887-00-6	
Fluoride	**0.25**	mg/L	0.20	0.085	1		09/04/19 00:08	16984-48-8	
Sulfate	**45.2**	mg/L	5.0	1.2	5		09/04/19 00:23	14808-79-8	

ANALYTICAL RESULTS

Project: AMEREN SIOUX ENERGY CTR
Pace Project No.: 60312389

Sample: S-DG-1 **Lab ID: 60312389003** Collected: 08/19/19 10:30 Received: 08/20/19 02:45 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
200.7 Metals, Total	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7								
Boron	**106**	ug/L	100	10.7	1	08/22/19 08:30	08/22/19 18:52	7440-42-8	
Calcium	**135000**	ug/L	200	50.0	1	08/22/19 08:30	08/22/19 18:52	7440-70-2	
Iron	**1230**	ug/L	50.0	14.0	1	08/22/19 08:30	08/22/19 18:52	7439-89-6	
Magnesium	**32300**	ug/L	50.0	13.0	1	08/22/19 08:30	08/22/19 18:52	7439-95-4	
Manganese	**275**	ug/L	5.0	2.1	1	08/22/19 08:30	08/22/19 18:52	7439-96-5	
Potassium	**4010**	ug/L	500	79.0	1	08/22/19 08:30	08/22/19 18:52	7440-09-7	
Sodium	**4230**	ug/L	500	144	1	08/22/19 08:30	08/22/19 18:52	7440-23-5	
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**411**	mg/L	20.0	6.5	1		09/02/19 13:42		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**503**	mg/L	10.0	10.0	1		08/26/19 13:50		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Chloride	**6.2**	mg/L	1.0	0.22	1		09/04/19 01:08	16887-00-6	
Fluoride	**0.34**	mg/L	0.20	0.085	1		09/04/19 01:08	16984-48-8	
Sulfate	**41.7**	mg/L	5.0	1.2	5		09/04/19 01:23	14808-79-8	

ANALYTICAL RESULTS

Project: AMEREN SIOUX ENERGY CTR
Pace Project No.: 60312389

Sample: S-DG-2 **Lab ID: 60312389004** Collected: 08/19/19 11:15 Received: 08/20/19 02:45 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
200.7 Metals, Total	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7								
Boron	**104**	ug/L	100	10.7	1	08/22/19 08:30	08/22/19 18:54	7440-42-8	
Calcium	**133000**	ug/L	200	50.0	1	08/22/19 08:30	08/22/19 18:54	7440-70-2	
Iron	**691**	ug/L	50.0	14.0	1	08/22/19 08:30	08/22/19 18:54	7439-89-6	
Magnesium	**33300**	ug/L	50.0	13.0	1	08/22/19 08:30	08/22/19 18:54	7439-95-4	
Manganese	**693**	ug/L	5.0	2.1	1	08/22/19 08:30	08/22/19 18:54	7439-96-5	
Potassium	**5140**	ug/L	500	79.0	1	08/22/19 08:30	08/22/19 18:54	7440-09-7	
Sodium	**4760**	ug/L	500	144	1	08/22/19 08:30	08/22/19 18:54	7440-23-5	
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**425**	mg/L	20.0	6.5	1		09/02/19 13:48		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**511**	mg/L	10.0	10.0	1		08/26/19 15:06		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Chloride	**8.2**	mg/L	1.0	0.22	1		09/04/19 01:38	16887-00-6	
Fluoride	**0.38**	mg/L	0.20	0.085	1		09/04/19 01:38	16984-48-8	
Sulfate	**37.1**	mg/L	5.0	1.2	5		09/04/19 01:52	14808-79-8	

ANALYTICAL RESULTS

Project: AMEREN SIOUX ENERGY CTR
Pace Project No.: 60312389

Sample: S-DG-3 **Lab ID: 60312389005** Collected: 08/19/19 12:05 Received: 08/20/19 02:45 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
200.7 Metals, Total	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7								
Boron	**95.1J**	ug/L	100	10.7	1	08/22/19 08:30	08/22/19 18:56	7440-42-8	
Calcium	**148000**	ug/L	200	50.0	1	08/22/19 08:30	08/22/19 18:56	7440-70-2	
Iron	**480**	ug/L	50.0	14.0	1	08/22/19 08:30	08/22/19 18:56	7439-89-6	
Magnesium	**39100**	ug/L	50.0	13.0	1	08/22/19 08:30	08/22/19 18:56	7439-95-4	
Manganese	**722**	ug/L	5.0	2.1	1	08/22/19 08:30	08/22/19 18:56	7439-96-5	
Potassium	**6470**	ug/L	500	79.0	1	08/22/19 08:30	08/22/19 18:56	7440-09-7	
Sodium	**4680**	ug/L	500	144	1	08/22/19 08:30	08/22/19 18:56	7440-23-5	
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**450**	mg/L	20.0	6.5	1		09/02/19 13:54		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**624**	mg/L	10.0	10.0	1		08/26/19 15:06		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Chloride	**4.8**	mg/L	1.0	0.22	1		09/04/19 02:07	16887-00-6	
Fluoride	**0.37**	mg/L	0.20	0.085	1		09/04/19 02:07	16984-48-8	
Sulfate	**49.5**	mg/L	5.0	1.2	5		09/04/19 02:22	14808-79-8	

ANALYTICAL RESULTS

Project: AMEREN SIOUX ENERGY CTR
Pace Project No.: 60312389

Sample: S-DG-4 **Lab ID: 60312389006** Collected: 08/19/19 11:20 Received: 08/20/19 02:45 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
200.7 Metals, Total	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7								
Boron	**61.1J**	ug/L	100	10.7	1	08/22/19 08:30	08/22/19 18:59	7440-42-8	
Calcium	**136000**	ug/L	200	50.0	1	08/22/19 08:30	08/22/19 18:59	7440-70-2	
Iron	**115**	ug/L	50.0	14.0	1	08/22/19 08:30	08/22/19 18:59	7439-89-6	
Magnesium	**39500**	ug/L	50.0	13.0	1	08/22/19 08:30	08/22/19 18:59	7439-95-4	
Manganese	**499**	ug/L	5.0	2.1	1	08/22/19 08:30	08/22/19 18:59	7439-96-5	
Potassium	**7570**	ug/L	500	79.0	1	08/22/19 08:30	08/22/19 18:59	7440-09-7	
Sodium	**44600**	ug/L	500	144	1	08/22/19 08:30	08/22/19 18:59	7440-23-5	
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**403**	mg/L	20.0	6.5	1		09/02/19 14:09		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**671**	mg/L	10.0	10.0	1		08/26/19 15:06		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Chloride	**103**	mg/L	10.0	2.2	10		09/04/19 14:21	16887-00-6	
Fluoride	**0.32**	mg/L	0.20	0.085	1		09/04/19 02:37	16984-48-8	
Sulfate	**31.5**	mg/L	5.0	1.2	5		09/04/19 03:22	14808-79-8	

ANALYTICAL RESULTS

Project: AMEREN SIOUX ENERGY CTR
Pace Project No.: 60312389

Sample: S-SCPC-DUP-1 **Lab ID: 60312389007** Collected: 08/19/19 08:00 Received: 08/20/19 02:45 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
200.7 Metals, Total	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7								
Boron	**96.4J**	ug/L	100	10.7	1	08/22/19 08:30	08/22/19 19:05	7440-42-8	
Calcium	**149000**	ug/L	200	50.0	1	08/22/19 08:30	08/22/19 19:05	7440-70-2	
Iron	**544**	ug/L	50.0	14.0	1	08/22/19 08:30	08/22/19 19:05	7439-89-6	
Magnesium	**39100**	ug/L	50.0	13.0	1	08/22/19 08:30	08/22/19 19:05	7439-95-4	
Manganese	**734**	ug/L	5.0	2.1	1	08/22/19 08:30	08/22/19 19:05	7439-96-5	
Potassium	**6560**	ug/L	500	79.0	1	08/22/19 08:30	08/22/19 19:05	7440-09-7	
Sodium	**4740**	ug/L	500	144	1	08/22/19 08:30	08/22/19 19:05	7440-23-5	
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**438**	mg/L	20.0	6.5	1		09/02/19 14:21		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**597**	mg/L	10.0	10.0	1		08/26/19 15:06		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Chloride	**4.8**	mg/L	1.0	0.22	1		09/04/19 04:37	16887-00-6	
Fluoride	**0.37**	mg/L	0.20	0.085	1		09/04/19 04:37	16984-48-8	
Sulfate	**50.1**	mg/L	5.0	1.2	5		09/04/19 04:52	14808-79-8	

ANALYTICAL RESULTS

Project: AMEREN SIOUX ENERGY CTR
Pace Project No.: 60312389

Sample: S-SCPC-FB-1 **Lab ID: 60312389008** Collected: 08/19/19 09:12 Received: 08/20/19 02:45 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
200.7 Metals, Total	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7								
Boron	**<10.7**	ug/L	100	10.7	1	08/22/19 08:30	08/22/19 19:07	7440-42-8	
Calcium	**51.9J**	ug/L	200	50.0	1	08/22/19 08:30	08/22/19 19:07	7440-70-2	B
Iron	**<14.0**	ug/L	50.0	14.0	1	08/22/19 08:30	08/22/19 19:07	7439-89-6	
Magnesium	**14.1J**	ug/L	50.0	13.0	1	08/22/19 08:30	08/22/19 19:07	7439-95-4	
Manganese	**<2.1**	ug/L	5.0	2.1	1	08/22/19 08:30	08/22/19 19:07	7439-96-5	
Potassium	**<79.0**	ug/L	500	79.0	1	08/22/19 08:30	08/22/19 19:07	7440-09-7	
Sodium	**<144**	ug/L	500	144	1	08/22/19 08:30	08/22/19 19:07	7440-23-5	
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**<6.5**	mg/L	20.0	6.5	1		09/02/19 14:25		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**16.0**	mg/L	5.0	5.0	1		08/26/19 15:06		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Chloride	**<0.22**	mg/L	1.0	0.22	1		09/04/19 05:07	16887-00-6	
Fluoride	**<0.085**	mg/L	0.20	0.085	1		09/04/19 05:07	16984-48-8	
Sulfate	**<0.23**	mg/L	1.0	0.23	1		09/04/19 05:07	14808-79-8	

ANALYTICAL RESULTS

Project:	AMEREN SIOUX ENERGY CTR
Pace Project No.:	60312389

Sample: S-BMW-1S **Lab ID: 60310790002** Collected: 08/01/19 10:55 Received: 08/03/19 02:50 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
200.7 Metals, Total	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7								
Boron	**70.8J**	ug/L	100	10.7	1	08/07/19 14:31	08/09/19 12:51	7440-42-8	B
Calcium	**149000**	ug/L	200	50.0	1	08/07/19 14:31	08/08/19 16:36	7440-70-2	
Iron	**<14.0**	ug/L	50.0	14.0	1	08/07/19 14:31	08/08/19 16:36	7439-89-6	
Magnesium	**28400**	ug/L	50.0	13.0	1	08/07/19 14:31	08/08/19 16:36	7439-95-4	
Manganese	**472**	ug/L	5.0	2.1	1	08/07/19 14:31	08/08/19 16:36	7439-96-5	
Potassium	**383J**	ug/L	500	79.0	1	08/07/19 14:31	08/08/19 16:36	7440-09-7	
Sodium	**5350**	ug/L	500	144	1	08/07/19 14:31	08/08/19 16:36	7440-23-5	
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**432**	mg/L	20.0	6.5	1		08/15/19 11:20		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**548**	mg/L	10.0	10.0	1		08/07/19 13:13		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Chloride	**8.8**	mg/L	1.0	0.22	1		08/15/19 04:53	16887-00-6	
Fluoride	**0.31**	mg/L	0.20	0.085	1		08/15/19 04:53	16984-48-8	
Sulfate	**34.1**	mg/L	2.0	0.46	2		08/15/19 05:44	14808-79-8	

ANALYTICAL RESULTS

Project: AMEREN SIOUX ENERGY CTR
Pace Project No.: 60312389

Sample: S-BMW-3S **Lab ID: 60310790003** Collected: 08/01/19 11:45 Received: 08/03/19 02:50 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
200.7 Metals, Total	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7								
Boron	**73.9J**	ug/L	100	10.7	1	08/07/19 14:31	08/09/19 12:53	7440-42-8	B
Calcium	**122000**	ug/L	200	50.0	1	08/07/19 14:31	08/08/19 16:38	7440-70-2	
Iron	**44.3J**	ug/L	50.0	14.0	1	08/07/19 14:31	08/08/19 16:38	7439-89-6	
Magnesium	**22400**	ug/L	50.0	13.0	1	08/07/19 14:31	08/08/19 16:38	7439-95-4	
Manganese	**298**	ug/L	5.0	2.1	1	08/07/19 14:31	08/08/19 16:38	7439-96-5	
Potassium	**648**	ug/L	500	79.0	1	08/07/19 14:31	08/08/19 16:38	7440-09-7	
Sodium	**5280**	ug/L	500	144	1	08/07/19 14:31	08/08/19 16:38	7440-23-5	
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**358**	mg/L	20.0	6.5	1		08/15/19 11:25		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**452**	mg/L	10.0	10.0	1		08/07/19 13:14		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Chloride	**10.6**	mg/L	1.0	0.22	1		08/15/19 06:01	16887-00-6	
Fluoride	**0.35**	mg/L	0.20	0.085	1		08/15/19 06:01	16984-48-8	
Sulfate	**25.3**	mg/L	2.0	0.46	2		08/15/19 06:17	14808-79-8	

QUALITY CONTROL DATA

Project: AMEREN SIOUX ENERGY CTR
Pace Project No.: 60312389

QC Batch: 601714
Analysis Method: EPA 200.7
QC Batch Method: EPA 200.7
Analysis Description: 200.7 Metals, Total
Associated Lab Samples: 60310790002, 60310790003

METHOD BLANK: 2461467
Matrix: Water
Associated Lab Samples: 60310790002, 60310790003

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Boron	ug/L	11.8J	100	10.7	08/09/19 12:44	
Calcium	ug/L	<50.0	200	50.0	08/08/19 16:31	
Iron	ug/L	<14.0	50.0	14.0	08/08/19 16:31	
Magnesium	ug/L	<13.0	50.0	13.0	08/08/19 16:31	
Manganese	ug/L	<2.1	5.0	2.1	08/08/19 16:31	
Potassium	ug/L	<79.0	500	79.0	08/08/19 16:31	
Sodium	ug/L	<144	500	144	08/08/19 16:31	

LABORATORY CONTROL SAMPLE: 2461468

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Boron	ug/L	1000	987	99	85-115	
Calcium	ug/L	10000	9780	98	85-115	
Iron	ug/L	10000	9860	99	85-115	
Magnesium	ug/L	10000	9530	95	85-115	
Manganese	ug/L	1000	988	99	85-115	
Potassium	ug/L	10000	9940	99	85-115	
Sodium	ug/L	10000	10300	103	85-115	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2461469 2461470

Parameter	Units	60310791001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Boron	ug/L	217	1000	1000	1230	1210	101	100	70-130	1	20	
Calcium	ug/L	58100	10000	10000	70000	68700	119	106	70-130	2	20	
Iron	ug/L	1010	10000	10000	10700	10800	97	97	70-130	1	20	
Magnesium	ug/L	16700	10000	10000	26800	26400	101	97	70-130	1	20	
Manganese	ug/L	113	1000	1000	1100	1100	98	99	70-130	0	20	
Potassium	ug/L	4210	10000	10000	14400	14300	102	101	70-130	0	20	
Sodium	ug/L	14000	10000	10000	24700	24300	107	103	70-130	2	20	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2461471 2461472

Parameter	Units	60310791002 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Boron	ug/L	12400	1000	1000	13200	13600	84	116	70-130	2	20	
Calcium	ug/L	171000	10000	10000	180000	184000	94	127	70-130	2	20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: AMEREN SIOUX ENERGY CTR
Pace Project No.: 60312389

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2461471 2461472

Parameter	Units	60310791002 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Iron	ug/L	416	10000	10000	10100	10200	97	98	70-130	0	20	
Magnesium	ug/L	5320	10000	10000	14500	14700	92	94	70-130	1	20	
Manganese	ug/L	168	1000	1000	1140	1160	97	99	70-130	1	20	
Potassium	ug/L	22900	10000	10000	33000	33600	101	107	70-130	2	20	
Sodium	ug/L	46500	10000	10000	56500	57800	100	113	70-130	2	20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: AMEREN SIOUX ENERGY CTR
Pace Project No.: 60312389

QC Batch: 604815
Analysis Method: EPA 200.7
QC Batch Method: EPA 200.7
Analysis Description: 200.7 Metals, Total
Associated Lab Samples: 60312389001, 60312389002, 60312389003, 60312389004, 60312389005, 60312389006, 60312389007, 60312389008

METHOD BLANK: 2472448
Matrix: Water
Associated Lab Samples: 60312389001, 60312389002, 60312389003, 60312389004, 60312389005, 60312389006, 60312389007, 60312389008

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Boron	ug/L	<10.7	100	10.7	08/22/19 18:41	
Calcium	ug/L	50.1J	200	50.0	08/22/19 18:41	
Iron	ug/L	<14.0	50.0	14.0	08/22/19 18:41	
Magnesium	ug/L	<13.0	50.0	13.0	08/22/19 18:41	
Manganese	ug/L	<2.1	5.0	2.1	08/22/19 18:41	
Potassium	ug/L	<79.0	500	79.0	08/22/19 18:41	
Sodium	ug/L	<144	500	144	08/22/19 18:41	

LABORATORY CONTROL SAMPLE: 2472449

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Boron	ug/L	1000	980	98	85-115	
Calcium	ug/L	10000	10400	104	85-115	
Iron	ug/L	10000	10200	102	85-115	
Magnesium	ug/L	10000	10200	102	85-115	
Manganese	ug/L	1000	1030	103	85-115	
Potassium	ug/L	10000	9760	98	85-115	
Sodium	ug/L	10000	9830	98	85-115	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2472450 2472451

Parameter	Units	60312389006 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Boron	ug/L	61.1J	1000	1000	1060	1070	100	101	70-130	2	20	
Calcium	ug/L	136000	10000	10000	146000	148000	98	121	70-130	2	20	
Iron	ug/L	115	10000	10000	9830	10000	97	99	70-130	2	20	
Magnesium	ug/L	39500	10000	10000	49400	49900	100	104	70-130	1	20	
Manganese	ug/L	499	1000	1000	1490	1520	99	102	70-130	2	20	
Potassium	ug/L	7570	10000	10000	17100	17400	95	98	70-130	2	20	
Sodium	ug/L	44600	10000	10000	54600	55100	100	106	70-130	1	20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: AMEREN SIOUX ENERGY CTR
Pace Project No.: 60312389

QC Batch: 603364 Analysis Method: SM 2320B
QC Batch Method: SM 2320B Analysis Description: 2320B Alkalinity
Associated Lab Samples: 60310790002, 60310790003

METHOD BLANK: 2467297 Matrix: Water
Associated Lab Samples: 60310790002, 60310790003

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Alkalinity, Total as CaCO3	mg/L	<6.5	20.0	6.5	08/15/19 10:55	

LABORATORY CONTROL SAMPLE: 2467298

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Alkalinity, Total as CaCO3	mg/L	500	486	97	90-110	

SAMPLE DUPLICATE: 2467299

Parameter	Units	60310412023 Result	Dup Result	RPD	Max RPD	Qualifiers
Alkalinity, Total as CaCO3	mg/L	277	296	7	10	

SAMPLE DUPLICATE: 2467300

Parameter	Units	60310791002 Result	Dup Result	RPD	Max RPD	Qualifiers
Alkalinity, Total as CaCO3	mg/L	186	187	0	10	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: AMEREN SIOUX ENERGY CTR
Pace Project No.: 60312389

QC Batch: 606629
Analysis Method: SM 2320B
QC Batch Method: SM 2320B
Analysis Description: 2320B Alkalinity
Associated Lab Samples: 60312389001, 60312389002, 60312389003, 60312389004, 60312389005, 60312389006, 60312389007, 60312389008

METHOD BLANK: 2479208
Matrix: Water
Associated Lab Samples: 60312389001, 60312389002, 60312389003, 60312389004, 60312389005, 60312389006, 60312389007, 60312389008

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Alkalinity, Total as CaCO3	mg/L	<6.5	20.0	6.5	09/02/19 11:48	

LABORATORY CONTROL SAMPLE: 2479209

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Alkalinity, Total as CaCO3	mg/L	500	487	97	90-110	

SAMPLE DUPLICATE: 2479210

Parameter	Units	60312275001 Result	Dup Result	RPD	Max RPD	Qualifiers
Alkalinity, Total as CaCO3	mg/L	96.5	154	46	10	D6

SAMPLE DUPLICATE: 2479211

Parameter	Units	60312389006 Result	Dup Result	RPD	Max RPD	Qualifiers
Alkalinity, Total as CaCO3	mg/L	403	404	0	10	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: AMEREN SIOUX ENERGY CTR
Pace Project No.: 60312389

QC Batch: 601524
QC Batch Method: SM 2540C
Analysis Method: SM 2540C
Analysis Description: 2540C Total Dissolved Solids
Associated Lab Samples: 60310790002, 60310790003

METHOD BLANK: 2460999
Matrix: Water
Associated Lab Samples: 60310790002, 60310790003

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Total Dissolved Solids	mg/L	<5.0	5.0	5.0	08/07/19 13:10	

LABORATORY CONTROL SAMPLE: 2461000

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Total Dissolved Solids	mg/L	1000	982	98	80-120	

SAMPLE DUPLICATE: 2461001

Parameter	Units	60310791002 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Dissolved Solids	mg/L	822	809	2	10	

SAMPLE DUPLICATE: 2461002

Parameter	Units	60310412023 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Dissolved Solids	mg/L	545	600	10	10	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: AMEREN SIOUX ENERGY CTR
Pace Project No.: 60312389

QC Batch:	605419	Analysis Method:	SM 2540C
QC Batch Method:	SM 2540C	Analysis Description:	2540C Total Dissolved Solids

Associated Lab Samples: 60312389001, 60312389002, 60312389003

METHOD BLANK: 2475117 Matrix: Water

Associated Lab Samples: 60312389001, 60312389002, 60312389003

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Total Dissolved Solids	mg/L	<5.0	5.0	5.0	08/26/19 13:47	

LABORATORY CONTROL SAMPLE: 2475118

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Total Dissolved Solids	mg/L	1000	997	100	80-120	

SAMPLE DUPLICATE: 2475119

Parameter	Units	60312240001 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Dissolved Solids	mg/L	861	857	0	10	

SAMPLE DUPLICATE: 2475120

Parameter	Units	60312291003 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Dissolved Solids	mg/L	433	415	4	10	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project:	AMEREN SIOUX ENERGY CTR
Pace Project No.:	60312389

QC Batch:	605420	Analysis Method:	SM 2540C
QC Batch Method:	SM 2540C	Analysis Description:	2540C Total Dissolved Solids

Associated Lab Samples: 60312389004, 60312389005, 60312389006, 60312389007, 60312389008

METHOD BLANK: 2475121 Matrix: Water

Associated Lab Samples: 60312389004, 60312389005, 60312389006, 60312389007, 60312389008

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Total Dissolved Solids	mg/L	<5.0	5.0	5.0	08/26/19 15:05	

LABORATORY CONTROL SAMPLE: 2475122

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Total Dissolved Solids	mg/L	1000	1020	102	80-120	

SAMPLE DUPLICATE: 2475123

Parameter	Units	60312389006 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Dissolved Solids	mg/L	671	705	5	10	

SAMPLE DUPLICATE: 2475124

Parameter	Units	60312546001 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Dissolved Solids	mg/L	3010	2780	8	10	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: AMEREN SIOUX ENERGY CTR
Pace Project No.: 60312389

QC Batch: 603127 Analysis Method: EPA 300.0
QC Batch Method: EPA 300.0 Analysis Description: 300.0 IC Anions
Associated Lab Samples: 60310790002, 60310790003

METHOD BLANK: 2466421 Matrix: Water
Associated Lab Samples: 60310790002, 60310790003

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Chloride	mg/L	<0.22	1.0	0.22	08/14/19 11:57	
Fluoride	mg/L	<0.085	0.20	0.085	08/14/19 11:57	
Sulfate	mg/L	<0.23	1.0	0.23	08/14/19 11:57	

LABORATORY CONTROL SAMPLE: 2466422

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Chloride	mg/L	5	4.7	94	90-110	
Fluoride	mg/L	2.5	2.4	97	90-110	
Sulfate	mg/L	5	4.7	95	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2466423 2466424

Parameter	Units	60310412023 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Chloride	mg/L	25.5	25	25	50.0	49.4	98	96	80-120	1	15	
Fluoride	mg/L	2.1	2.5	2.5	4.6	4.7	101	102	80-120	1	15	
Sulfate	mg/L	96.6	25	25	122	120	100	94	80-120	1	15	E

MATRIX SPIKE SAMPLE: 2466425

Parameter	Units	60310952001 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Chloride	mg/L	46500	50000	99400	106	80-120	
Fluoride	mg/L	ND	25000	24700	99	80-120	
Sulfate	mg/L	21700	50000	73700	104	80-120	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: AMEREN SIOUX ENERGY CTR
Pace Project No.: 60312389

QC Batch: 607014
Analysis Method: EPA 300.0
QC Batch Method: EPA 300.0
Analysis Description: 300.0 IC Anions
Associated Lab Samples: 60312389001, 60312389002, 60312389003, 60312389004, 60312389005, 60312389006, 60312389007, 60312389008

METHOD BLANK: 2480852
Matrix: Water
Associated Lab Samples: 60312389001, 60312389002, 60312389003, 60312389004, 60312389005, 60312389006, 60312389007, 60312389008

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Chloride	mg/L	<0.22	1.0	0.22	09/03/19 19:09	
Fluoride	mg/L	<0.085	0.20	0.085	09/03/19 19:09	
Sulfate	mg/L	<0.23	1.0	0.23	09/03/19 19:09	

LABORATORY CONTROL SAMPLE: 2480853

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Chloride	mg/L	5	4.6	93	90-110	
Fluoride	mg/L	2.5	2.4	97	90-110	
Sulfate	mg/L	5	5.0	100	90-110	

MATRIX SPIKE SAMPLE: 2480854

Parameter	Units	60312388004 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Chloride	mg/L		50	134	109	80-120	H5
Fluoride	mg/L		25	25.1	96	80-120	H5
Sulfate	mg/L		50	193	110	80-120	H5

MATRIX SPIKE SAMPLE: 2480855

Parameter	Units	60312389006 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Fluoride	mg/L	<0.85	2.5	2.8	101	80-120	
Sulfate	mg/L	31.5	25	58.6	109	80-120	

QUALITY CONTROL DATA

Project: AMEREN SIOUX ENERGY CTR
Pace Project No.: 60312389

QC Batch: 607229
Analysis Method: EPA 300.0
QC Batch Method: EPA 300.0
Analysis Description: 300.0 IC Anions
Associated Lab Samples: 60312389001, 60312389006

METHOD BLANK: 2481446
Matrix: Water
Associated Lab Samples: 60312389001, 60312389006

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Chloride	mg/L	<0.22	1.0	0.22	09/04/19 09:29	

LABORATORY CONTROL SAMPLE: 2481447

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Chloride	mg/L	5	4.7	95	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2481448 2481449

Parameter	Units	60312389006 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Chloride	mg/L	103	50	50	160	154	114	101	80-120	4	15	

MATRIX SPIKE SAMPLE: 2481452

Parameter	Units	60312725002 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Chloride	mg/L	3140	2500	5760	105	80-120	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALIFIERS

Project:	AMEREN SIOUX ENERGY CTR
Pace Project No.:	60312389

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.

ND - Not Detected at or above adjusted reporting limit.

TNTC - Too Numerous To Count

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PQL - Practical Quantitation Limit.

RL - Reporting Limit - The lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix.

S - Surrogate

1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

LABORATORIES

PASI-K	Pace Analytical Services - Kansas City

ANALYTE QUALIFIERS

B	Analyte was detected in the associated method blank.
D6	The precision between the sample and sample duplicate exceeded laboratory control limits.
E	Analyte concentration exceeded the calibration range. The reported result is estimated.
H5	Reanalysis conducted in excess of EPA method holding time. Results confirm original analysis performed in hold time.

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project:	AMEREN SIOUX ENERGY CTR
Pace Project No.:	60312389

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
60310790002	**S-BMW-1S**	EPA 200.7	601714	EPA 200.7	601738
60310790003	**S-BMW-3S**	EPA 200.7	601714	EPA 200.7	601738
60312389001	**S-UG-1A**	EPA 200.7	604815	EPA 200.7	604890
60312389002	**S-UG-2**	EPA 200.7	604815	EPA 200.7	604890
60312389003	**S-DG-1**	EPA 200.7	604815	EPA 200.7	604890
60312389004	**S-DG-2**	EPA 200.7	604815	EPA 200.7	604890
60312389005	**S-DG-3**	EPA 200.7	604815	EPA 200.7	604890
60312389006	**S-DG-4**	EPA 200.7	604815	EPA 200.7	604890
60312389007	**S-SCPC-DUP-1**	EPA 200.7	604815	EPA 200.7	604890
60312389008	**S-SCPC-FB-1**	EPA 200.7	604815	EPA 200.7	604890
60310790002	**S-BMW-1S**	SM 2320B	603364		
60310790003	**S-BMW-3S**	SM 2320B	603364		
60312389001	**S-UG-1A**	SM 2320B	606629		
60312389002	**S-UG-2**	SM 2320B	606629		
60312389003	**S-DG-1**	SM 2320B	606629		
60312389004	**S-DG-2**	SM 2320B	606629		
60312389005	**S-DG-3**	SM 2320B	606629		
60312389006	**S-DG-4**	SM 2320B	606629		
60312389007	**S-SCPC-DUP-1**	SM 2320B	606629		
60312389008	**S-SCPC-FB-1**	SM 2320B	606629		
60310790002	**S-BMW-1S**	SM 2540C	601524		
60310790003	**S-BMW-3S**	SM 2540C	601524		
60312389001	**S-UG-1A**	SM 2540C	605419		
60312389002	**S-UG-2**	SM 2540C	605419		
60312389003	**S-DG-1**	SM 2540C	605419		
60312389004	**S-DG-2**	SM 2540C	605420		
60312389005	**S-DG-3**	SM 2540C	605420		
60312389006	**S-DG-4**	SM 2540C	605420		
60312389007	**S-SCPC-DUP-1**	SM 2540C	605420		
60312389008	**S-SCPC-FB-1**	SM 2540C	605420		
60310790002	**S-BMW-1S**	EPA 300.0	603127		
60310790003	**S-BMW-3S**	EPA 300.0	603127		
60312389001	**S-UG-1A**	EPA 300.0	607014		
60312389001	**S-UG-1A**	EPA 300.0	607229		
60312389002	**S-UG-2**	EPA 300.0	607014		
60312389003	**S-DG-1**	EPA 300.0	607014		
60312389004	**S-DG-2**	EPA 300.0	607014		
60312389005	**S-DG-3**	EPA 300.0	607014		
60312389006	**S-DG-4**	EPA 300.0	607014		
60312389006	**S-DG-4**	EPA 300.0	607229		
60312389007	**S-SCPC-DUP-1**	EPA 300.0	607014		
60312389008	**S-SCPC-FB-1**	EPA 300.0	607014		

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Sample Condition Upon Receipt

WO#:60312389

60312389

Client Name: Golder Associates

Courier: FedEx ☐ UPS ☐ VIA ☐ Clay ☐ PEX ☐ ECI ☐ Pace ☐ Xroads ☑ Client ☐ Other ☐

Tracking #: ______ Pace Shipping Label Used? Yes ☐ No ☐

Custody Seal on Cooler/Box Present: Yes ☑ No ☐ Seals intact: Yes ☑ No ☐

Packing Material: Bubble Wrap ☐ Bubble Bags ☐ Foam ☐ None ☐ Other ☑ ZPIC

Thermometer Used: T295 **Type of Ice:** [✓ Wet] Blue None

Cooler Temperature (°C): **As-read** 1.4, 0.4, 4.3 **Corr. Factor** 0.2 **Corrected** 1.2, 0.2, 4.1

Date and initials of person examining contents: VB 8/20/19

Temperature should be above freezing to 6°C

Chain of Custody present:	☑ Yes ☐ No ☐ N/A	
Chain of Custody relinquished:	☑ Yes ☐ No ☐ N/A	
Samples arrived within holding time:	☑ Yes ☐ No ☐ N/A	
Short Hold Time analyses (<72hr):	☐ Yes ☑ No ☐ N/A	
Rush Turn Around Time requested:	☐ Yes ☑ No ☐ N/A	
Sufficient volume:	☑ Yes ☐ No ☐ N/A	
Correct containers used:	☑ Yes ☐ No ☐ N/A	
Pace containers used:	☑ Yes ☐ No ☐ N/A	
Containers intact:	☑ Yes ☐ No ☐ N/A	
Unpreserved 5035A / TX1005/1006 soils frozen in 48hrs?	☐ Yes ☐ No ☑ N/A	
Filtered volume received for dissolved tests?	☐ Yes ☐ No ☑ N/A	
Sample labels match COC: Date / time / ID / analyses	☑ Yes ☐ No ☐ N/A	
Samples contain multiple phases? Matrix: WT	☐ Yes ☑ No ☐ N/A	
Containers requiring pH preservation in compliance? (HNO$_3$, H$_2$SO$_4$, HCl<2; NaOH>9 Sulfide, NaOH>10 Cyanide) (Exceptions: VOA, Micro, O&G, KS TPH, OK-DRO)	☑ Yes ☐ No ☐ N/A	List sample IDs, volumes, lot #'s of preservative and the date/time added.
Cyanide water sample checks: Lead acetate strip turns dark? (Record only) Potassium iodide test strip turns blue/purple? (Preserve)	 ☐ Yes ☐ No ☐ Yes ☐ No	
Trip Blank present:	☐ Yes ☐ No ☑ N/A	
Headspace in VOA vials (>6mm):	☐ Yes ☐ No ☑ N/A	
Samples from USDA Regulated Area: State:	☐ Yes ☐ No ☑ N/A	
Additional labels attached to 5035A / TX1005 vials in the field?	☐ Yes ☐ No ☑ N/A	

Client Notification/ Resolution: Copy COC to Client? Y / N Field Data Required? Y / N

Person Contacted: ______ Date/Time: ______

Comments/ Resolution: ______

Project Manager Review: Jami Church Date: 8/21/19

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CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately

Page: of

Section A Required Client Information:		Section B Required Project Information:		Section C Invoice Information:	
Company:	Golder Associates	Report To:	Jeffrey Ingram	Attention:	
Address:	13515 Barrett Parkway Drive, Ste 260	Copy To:	Ryan Feldmann/Eric Schneider	Company Name:	
	Ballwin, MO 63021			Address:	
Email To:	jeffrey_ingram@golder.com	Purchase Order No.:		Pace Quote Reference	
Phone: 636-724-9191	Fax: 636-724-9323	Project Name:	Ameren Sioux Energy Center	Pace Project Manager:	Jamie Church
Requested Due Date/TAT:	Standard	Project Number:	153-1406-01.0003C (COC#7)	Pace Profile #	9285

REGULATORY AGENCY

NPDES	GROUND WATER	DRINKING WATER
UST	RCRA	OTHER ______

Site Location STATE: MO

Section D Required Client Information

SAMPLE ID (A-Z, 0-9 / ,-) Sample IDs MUST BE UNIQUE

Valid Matrix Codes MATRIX	CODE
DRINKING WATER	DW
WATER	WT
WASTE WATER	WW
PRODUCT	P
SOIL/SOLID	SL
OIL	OL
	WP
	AR
	OT
	TS

60312389

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED COMPOSITE START DATE	COLLECTED COMPOSITE START TIME	COLLECTED COMPOSITE END/GRAB DATE	COLLECTED COMPOSITE END/GRAB TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS
1 2	S-UG-1A	WT	G	8/19/19	0935				3
2 1	S-UG-2	WT	G		1120				
3 2	S-DG-1	WT	G		1030				
4 2	S-DG-2	WT	G		1115				
5 2	S-DG-3	WT	G		1205				
6 1	S-DG-4	WT	G		1120				
7 2	S-SCPC-DUP-1	WT	G		—				
8 1	S-SCPC-FB-1	WT	G		0912				
9	S-BMW-1S	WT	G						
10	S-BMW-3S	WT	G		—				
11 1	S-DG-4-MS	WT	G		1120				3
12 1	S-DG-4-MSD	WT	G		1120				3

ITEM #	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test Y/N	Requested Analysis Filtered (Y/N): Metals* (N)	Chloride/Fluoride/Sulfate (N)	TDS (N)	Alkalinity (N)	Total Phosphorus (N)			Residual Chlorine (Y/N)	Pace Project No./ Lab I.D.
1	2		1							1	1	1	1	Bp2U	Bp3U	BP3N		001
2																		002
3																		003
4																		004
5																		005
6														3Bp2U	3Bp3U	3Bp3N		006
7														Bp2U	Bp3U	Bp3N		
8																		
9																		
10																		
11	2		1							1	1	1	1					
12	2		1							1	1	1	1					

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS: Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)
*EPA 200.7: B, Ca, Fe, Mg, Mn, K, Na	Jeff Ingram/Golder	8/19/19	1345	Angela Mu	8/19/19	15:50				
	Angela Mu	8/19/19	13:51	Walton Brown/Pace	8/20/19	0245	1.2 0.2 4.1	Y	Y	Y

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Jeff Ingram

SIGNATURE of SAMPLER:

DATE Signed (MM/DD/YY): 8/19/19

WO# : 60310790

60310790

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Sample Condition Upon Receipt

Client Name: Golder

Courier: FedEx ☐ UPS ☐ VIA ☐ Clay ☐ PEX ☐ ECI ☐ Pace ☐ Xroads ☒ Client ☐ Other ☐

Tracking #: ______ Pace Shipping Label Used? Yes ☐ No ☒

Custody Seal on Cooler/Box Present: Yes ☒ No ☐ Seals intact: Yes ☒ No ☐

Packing Material: Bubble Wrap ☐ Bubble Bags ☒ Foam ☐ None ☐ Other ☐

Thermometer Used: T-294 **Type of Ice:** [✓ Wet] Blue None

Cooler Temperature (°C): **As-read** 1.5, 2.0 **Corr. Factor** -1.0 **Corrected** 0.5, 1.0

Date and initials of person examining contents: 8/3/19

Temperature should be above freezing to 6°C

Chain of Custody present:	☒Yes ☐No ☐N/A	
Chain of Custody relinquished:	☒Yes ☐No ☐N/A	
Samples arrived within holding time:	☒Yes ☐No ☐N/A	
Short Hold Time analyses (<72hr):	☐Yes ☒No ☐N/A	
Rush Turn Around Time requested:	☐Yes ☒No ☐N/A	
Sufficient volume:	☒Yes ☐No ☐N/A	
Correct containers used:	☒Yes ☐No ☐N/A	
Pace containers used:	☒Yes ☐No ☐N/A	
Containers intact:	☒Yes ☐No ☐N/A	
Unpreserved 5035A / TX1005/1006 soils frozen in 48hrs?	☐Yes ☐No ☒N/A	
Filtered volume received for dissolved tests?	☐Yes ☐No ☒N/A	No volume for analysis
Sample labels match COC: Date / time / ID / analyses	☒Yes ☒No ☐N/A	total phosphorus.
Samples contain multiple phases? Matrix: WT	☐Yes ☒No ☐N/A	
Containers requiring pH preservation in compliance? (HNO_3, H_2SO_4, HCl<2; NaOH>9 Sulfide, NaOH>10 Cyanide) (Exceptions: VOA, Micro, O&G, KS TPH, OK-DRO)	☒Yes ☐No ☐N/A	List sample IDs, volumes, lot #'s of preservative and the date/time added.
Cyanide water sample checks:		
Lead acetate strip turns dark? (Record only)	☐Yes ☐No	
Potassium iodide test strip turns blue/purple? (Preserve)	☐Yes ☐No	
Trip Blank present:	☐Yes ☐No ☒N/A	
Headspace in VOA vials (>6mm):	☐Yes ☐No ☒N/A	
Samples from USDA Regulated Area: State:	☐Yes ☐No ☒N/A	
Additional labels attached to 5035A / TX1005 vials in the field?	☐Yes ☐No ☒N/A	

Client Notification/ Resolution: Copy COC to Client? Y / N Field Data Required? Y / N

Person Contacted: ______ Date/Time: ______

Comments/ Resolution: ______

Project Manager Review: Jamie Church Date: 8/8/19

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CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT All relevant fields must be completed accurately

Page: 1 of 1

Section A
Required Client Information:

Company:	Golder Associates
Address:	13515 Barrett Parkway Drive, Ste 260 Ballwin, MO 63021
Email To:	jeffrey_ingram@golder.com
Phone:	636-724-9191
Fax:	636-724-9323
Requested Due Date/TAT:	Standard

Section B
Required Project Information:

Report To:	Jeffrey Ingram
Copy To:	Ryan Feldmann/Eric Schneider
Purchase Order No.:	
Project Name:	Ameren Sioux Energy Center
Project Number:	153-1406-01.0003B (COC#6)

Section C
Invoice Information:

Attention:	
Company Name:	
Address:	
Pace Quote Reference:	
Pace Project Manager:	Jamie Church
Pace Profile #:	9285

REGULATORY AGENCY

NPDES [✓ GROUND WATER] DRINKING WATER
UST RCRA OTHER

Site Location STATE: MO

Section D
Required Client Information

Valid Matrix Codes

MATRIX	CODE
DRINKING WATER	DW
WATER	WT
WASTE WATER	WW
PRODUCT	P
SOIL/SOLID	SL
OIL	OL
	WP
	AR
	OT
	TS

SAMPLE ID
(A-Z, 0-9 / ,-)
Sample IDs MUST BE UNIQUE

Requested Analysis Filtered (Y/N): Y/N ➡ N N N N N

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED COMPOSITE START DATE	COLLECTED COMPOSITE START TIME	COLLECTED COMPOSITE END/GRAB DATE	COLLECTED COMPOSITE END/GRAB TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	⬇Analysis Test⬇	Metals*	Chloride/Fluoride/Sulfate	TDS	Alkalinity	Total Phosphorus		Residual Chlorine (Y/N)	Pace Project No./ Lab I.D. L1310790
1	S-LMW-1S	WT	G	8/2/19	1500				5	2		3							1	1	1	1	1	BP2n, BP3n,		BP3N 001
2	S-LMW-2S	WT	G																							
3	S-LMW-3S	WT	G																							
4	S-LMW-4S	WT	G																							
5	S-LWM-5S	WT	G																							
6	S-LWM-6S	WT	G																							
7	S-LMW-7S	WT	G																							
8	S-LMW-8S	WT	G																							
9	S-LMW-9S	WT	G																							
10	S-BMW-1S	WT	G	8/1/19	1055				5	2		3							1	1	1	1		BP2n, BP3n,		BP3N1 002
11	S-BMW-3S	WT	G	↓	1145				5	2		3							1	1	1	1		↓ ↓		↓ 003
12	S-LMW-DUP-1	WT	G																							

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS			
*EPA 200.7: B, Ca, Fe, Mg, Mn, K, Na	/Golder	8/2/19	1635		8/3/19	0250	1.5 2.0	Y	Y	Y
							Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)

SAMPLER NAME AND SIGNATURE
PRINT Name of SAMPLER: Ryan Feldmann
SIGNATURE of SAMPLER:
DATE Signed (MM/DD/YY): 8/2/19

WO# : 60310790

60310790

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Sample Condition Upon Receipt

Client Name: Golder Assoc.

Courier: FedEx ☐ UPS ☐ VIA ☐ Clay ☐ PEX ☐ ECI ☐ Pace ☐ Xroads ☒ Client ☐ Other ☐

Tracking #: Pace Shipping Label Used? Yes ☐ No ☒

Custody Seal on Cooler/Box Present: Yes ☒ No ☐ Seals intact: Yes ☒ No ☐

Packing Material: Bubble Wrap ☐ Bubble Bags ☐ Foam ☐ None ☐ Other ☒ zplc

Thermometer Used: T100 **Type of Ice:** [✓ Wet] Blue None

Cooler Temperature (°C): **As-read** 0.2 **Corr. Factor** +0.0 **Corrected** 0.2, 0.6, 1.0, 0.3

Date and initials of person examining contents: 8-7-19

Temperature should be above freezing to 6°C 0.6, 1.0, 0.3

Chain of Custody present:	☒Yes ☐No ☐N/A	
Chain of Custody relinquished:	☒Yes ☐No ☐N/A	
Samples arrived within holding time:	☒Yes ☐No ☐N/A	
Short Hold Time analyses (<72hr):	☐Yes ☒No ☐N/A	
Rush Turn Around Time requested:	☐Yes ☒No ☐N/A	
Sufficient volume:	☒Yes ☐No ☐N/A	
Correct containers used:	☒Yes ☐No ☐N/A	
Pace containers used:	☒Yes ☐No ☐N/A	
Containers intact:	☒Yes ☐No ☐N/A	
Unpreserved 5035A / TX1005/1006 soils frozen in 48hrs?	☐Yes ☐No ☒N/A	
Filtered volume received for dissolved tests?	☐Yes ☐No ☒N/A	
Sample labels match COC: Date / time / ID / analyses	☒Yes ☐No ☐N/A	
Samples contain multiple phases? Matrix: WT	☐Yes ☒No ☐N/A	
Containers requiring pH preservation in compliance? (HNO_3, H_2SO_4, HCl<2; NaOH>9 Sulfide, NaOH>10 Cyanide) (Exceptions: VOA, Micro, O&G, KS TPH, OK-DRO)	☒Yes ☐No ☐N/A	List sample IDs, volumes, lot #'s of preservative and the date/time added.
Cyanide water sample checks: Lead acetate strip turns dark? (Record only) Potassium iodide test strip turns blue/purple? (Preserve)	 ☐Yes ☐No ☐Yes ☐No	
Trip Blank present:	☐Yes ☐No ☒N/A	
Headspace in VOA vials (>6mm):	☐Yes ☐No ☒N/A	
Samples from USDA Regulated Area: State:	☐Yes ☐No ☒N/A	
Additional labels attached to 5035A / TX1005 vials in the field?	☐Yes ☐No ☒N/A	

Client Notification/ Resolution: Copy COC to Client? Y / N Field Data Required? Y / N

Person Contacted: Date/Time:

Comments/ Resolution:

Project Manager Review: Jamie Church Date: 8/8/19

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CHAIN-OF-CUSTODY / Analytical Request Document

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Page: 1 of 2

Section A
Required Client Information:

Company:	Golder Associates
Address:	13515 Barrett Parkway Drive, Ste 260 Ballwin, MO 63021
Email To:	jeffrey_ingram@golder.com
Phone:	636-724-9191
Fax:	636-724-9323
Requested Due Date/TAT:	Standard

Section B
Required Project Information:

Report To:	Jeffrey Ingram
Copy To:	Ryan Feldmann/Eric Schneider
Purchase Order No.:	
Project Name:	Ameren Sioux Energy Center
Project Number:	153-1406-01.0003B (COC#6)

Section C
Invoice Information:

Attention:	
Company Name:	
Address:	
Pace Quote Reference:	
Pace Project Manager:	Jamie Church
Pace Profile #:	9285

REGULATORY AGENCY

NPDES [✓ GROUND WATER] DRINKING WATER
UST RCRA OTHER ______

Site Location STATE: MO

Section D
Required Client Information

SAMPLE ID
(A-Z, 0-9 / ,-)
Sample IDs MUST BE UNIQUE

Valid Matrix Codes MATRIX	CODE
DRINKING WATER	DW
WATER	WT
WASTE WATER	WW
PRODUCT	P
SOIL/SOLID	SL
OIL	OL
	WP
	AR
	OT
	TS

Requested Analysis Filtered (Y/N)

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED COMPOSITE START DATE	COMPOSITE START TIME	COMPOSITE END/GRAB DATE	COMPOSITE END/GRAB TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test	Metals*	Chloride/Fluoride/Sulfate	TDS	Alkalinity	~~Total Phosphorus~~		Residual Chlorine (Y/N)	Pace Project No./ Lab I.D. 60310790
																		Y/N	N	N	N	N	N			
1	S-LMW-1S	WT	G																							
2	S-LMW-2S	WT	G			8/6/19	1030		3	2		1							/	/	/	/		BP2U, BP3N, BP3U		004
3	S-LMW-3S	WT	G			8/5/19	1620		3	2		1							/	/	/	/				005
4	S-LMW-4S	WT	G			8/5/19	1450		3	2		1							/	/	/	/				006
5	S-LWM-5S	WT	G			8/5/19	1030		9	6		3							/	/	/	/		3BP2U, 3BP3N, 3BP3U		007
6	S-LWM-6S	WT	G			8/5/19	1135		3	2		1							/	/	/	/		BP2U, BP3N, BP3U		008
7	S-LMW-7S	WT	G			8/5/19	1255		3	2		1							/	/	/	/				009
8	S-LMW-8S	WT	G			8/6/19	0925		3	2		1							/	/	/	/				010
9	S-LMW-9S	WT	G																							
10	S-BMW-1S	WT	G																							
11	S-BMW-3S	WT	G																							
12	S-LMW-DUP-1	WT	G			8/5/19	—		3	2		1							/	/	/	/		BP2U, BP3N, BP3U		011

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS			
*EPA 200.7: B, Ca, Fe, Mg, Mn, K, Na	/Golder	8/6/19	1700	UZ/H / Pcs	8-7-19	0255	0.2	Y	Y	Y
							0.6			
							1.0			
							0.3			
							Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Lucas Swindle

SIGNATURE of SAMPLER:

DATE Signed (MM/DD/YY): 8/6/19

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CHAIN-OF-CUSTODY / Analytical Request Document

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Page: 2 of 2

Section A
Required Client Information:

Company:	Golder Associates
Address:	13515 Barrett Parkway Drive, Ste 260 Ballwin, MO 63021
Email To:	jeffrey_ingram@golder.com
Phone:	636-724-9191
Fax:	636-724-9323
Requested Due Date/TAT:	Standard

Section B
Required Project Information:

Report To:	Jeffrey Ingram
Copy To:	Ryan Feldmann/Eric Schneider
Purchase Order No.:	
Project Name:	Ameren Sioux Energy Center
Project Number:	153-1406-01.0003B (COC #6)

Section C
Invoice Information:

Attention:	
Company Name:	
Address:	
Pace Quote Reference	
Pace Project Manager	Jamie Church
Pace Profile #:	9285

REGULATORY AGENCY

NPDES [✓ GROUND WATER] DRINKING WATER
UST RCRA OTHER ______

Site Location STATE: MO

Section D
Required Client Information

Valid Matrix Codes

MATRIX	CODE
DRINKING WATER	DW
WATER	WT
WASTE WATER	WW
PRODUCT	P
SOIL/SOLID	SL
OIL	OL
	WP
	AR
	OT
	TS

SAMPLE ID
(A-Z, 0-9 / ,-)
Sample IDs MUST BE UNIQUE

Requested Analysis Filtered (Y/N)

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED COMPOSITE START DATE	COLLECTED COMPOSITE START TIME	COLLECTED COMPOSITE END/GRAB DATE	COLLECTED COMPOSITE END/GRAB TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test Y/N	Metals*	Chloride/Fluoride/Sulfate	TDS	Alkalinity	Total Phosphorus		Residual Chlorine (Y/N)	Pace Project No./ Lab I.D. 60310790
																			N	N	N	N	N			
1	S-LMW-DUP-2	WT	G			8/6/19	—		3	2		1							/	/	/	/		BP2U, BP3N, BP3U		012
2	S-LMW-FB-1	WT	G			8/5/19	1408		3	2		1							/	/	/	/				013
3	S-LMW-FB-2	WT	G			8/6/19	0812		3	2		1							/	/	/	/				014
4		WT	G																							
5		WT	G																							
6		WT	G																							
7		WT	G																							
8		WT	G																							
9		WT	G																							
10		WT	G																							
11		WT	G																							
12		WT	G																							

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)
*EPA 200.7: B, Ca, Fe, Mg, Mn, K, Na	/Golder	8/6/19	1700		8.7.19	0255	0.2	Y	Y	Y
							0.6			
							1.0			
							0.3			

SAMPLE CONDITIONS

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Lucas Swindle
SIGNATURE of SAMPLER:
DATE Signed (MM/DD/YY): 8/6/19

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Sample Condition Upon Receipt

WO# : 60310790
60310790

Client Name: Golder

Courier: FedEx ☐ UPS ☐ VIA ☐ Clay ☐ PEX ☐ ECI ☐ Pace ☐ Xroads ☑ Client ☐ Other ☐

Tracking #: ____________ Pace Shipping Label Used? Yes ☐ No ☑

Custody Seal on Cooler/Box Present: Yes ☑ No ☐ Seals intact: Yes ☑ No ☐

Packing Material: Bubble Wrap ☐ Bubble Bags ☑ Foam ☐ None ☐ Other ☐

Thermometer Used: T-294 **Type of Ice:** [✓ Wet] Blue None

Cooler Temperature (°C): **As-read** 2.2 **Corr. Factor** -1.0 **Corrected** 1.2

Date and initials of person examining contents: 8/10/19

Temperature should be above freezing to 6°C

Chain of Custody present:	☑Yes ☐No ☐N/A	
Chain of Custody relinquished:	☑Yes ☐No ☐N/A	
Samples arrived within holding time:	☑Yes ☐No ☐N/A	
Short Hold Time analyses (<72hr):	☐Yes ☑No ☐N/A	
Rush Turn Around Time requested:	☐Yes ☑No ☐N/A	
Sufficient volume:	☑Yes ☐No ☐N/A	
Correct containers used:	☑Yes ☐No ☐N/A	
Pace containers used:	☑Yes ☐No ☐N/A	
Containers intact:	☑Yes ☐No ☐N/A	
Unpreserved 5035A / TX1005/1006 soils frozen in 48hrs?	☐Yes ☐No ☑N/A	
Filtered volume received for dissolved tests?	☐Yes ☐No ☑N/A	
Sample labels match COC: Date / time / ID / analyses	☑Yes ☐No ☐N/A	
Samples contain multiple phases? Matrix: WT	☐Yes ☑No ☐N/A	
Containers requiring pH preservation in compliance? (HNO_3, H_2SO_4, HCl<2; NaOH>9 Sulfide, NaOH>10 Cyanide) (Exceptions: VOA, Micro, O&G, KS TPH, OK-DRO)	☑Yes ☐No ☐N/A	List sample IDs, volumes, lot #'s of preservative and the date/time added.
Cyanide water sample checks: Lead acetate strip turns dark? (Record only) Potassium iodide test strip turns blue/purple? (Preserve)	 ☐Yes ☐No ☐Yes ☐No	
Trip Blank present:	☐Yes ☐No ☑N/A	
Headspace in VOA vials (>6mm):	☐Yes ☐No ☑N/A	
Samples from USDA Regulated Area: State:	☐Yes ☐No ☑N/A	
Additional labels attached to 5035A / TX1005 vials in the field?	☐Yes ☐No ☑N/A	

Client Notification/ Resolution: Copy COC to Client? Y / N Field Data Required? Y / N

Person Contacted: ____________ Date/Time: ____________

Comments/ Resolution: ____________

Project Manager Review: Jamie Church Date: 8/13/19

Pace Analytical®
www.pacelabs.com

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Page: of

2013245

Section A
Required Client Information:

Company: Golder Associates
Address: 13515 Barrett Parkway Dr. Ste 260
Ballwin, MO 63021
Email To: jeffrey_ingram@golder.com
Phone: 636-724-9191 Fax: 636-724-9323
Requested Due Date/TAT: Standard

Section B
Required Project Information:

Report To: Jeffrey Ingram
Copy To: Ryan Feldmann / Eric Schneider
Purchase Order No.:
Project Name: Ameren Sioux Energy Center
Project Number: 153-140601.0003B

Section C
Invoice Information:

Attention:
Company Name:
Address:
Pace Quote Reference:
Pace Project Manager: Jamie Church
Pace Profile #: 9285

REGULATORY AGENCY

☐ NPDES ☑ GROUND WATER ☐ DRINKING WATER
☐ UST ☐ RCRA ☐ OTHER

Site Location
STATE:

Section D
Required Client Information

SAMPLE ID
(A-Z, 0-9 / ,-)
Sample IDs MUST BE UNIQUE

Matrix Codes MATRIX / CODE	
Drinking Water	DW
Water	WT
Waste Water	WW
Product	P
Soil/Solid	SL
Oil	OL
Wipe	WP
Air	AR
Tissue	TS
Other	OT

Collected: COMPOSITE START; COMPOSITE END/[✓ GRAB]

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COMPOSITE START DATE	COMPOSITE START TIME	COMPOSITE END/GRAB DATE	COMPOSITE END/GRAB TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test	Metals*	Chloride/Fluoride/Sulfate	TDS	Alkalinity									Residual Chlorine (Y/N)	Pace Project No./ Lab I.D.
																		Y/N	N	N	N	N										60310790
1	S-LMW-95	WT	G			8/9/19	0935		3	2		1							/	/	/	/										05
2																																
3																																
4																																
5																																
6																																
7																																
8																																
9																																
10																																
11																																
12																																

Requested Analysis Filtered (Y/N)

BP2N, BP3N, BP2U

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS			
*EPA 200.7: B, Ca, Fe, Mg, Mn, K, Na	/Golder	8/9/19	1311	/PACE	8/9/19	1317				
	/PACE	8/9/19	1700		8/10/19	0845	1.2	Y	Y	Y
							Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)

ORIGINAL

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Lucas Swindle
SIGNATURE of SAMPLER: L. Swindle
DATE Signed (MM/DD/YY): 8/9/19

*Important Note: By signing this form you are accepting Pace's NET 30 day payment terms and agreeing to late charges of 1.5% per month for any invoices not paid within 30 days.

F-ALL-Q-020rev.07, 15-May-2007

MEMORANDUM

DATE October 17, 2019 **Project No.** 1531406

TO Project File
Golder Associates

CC Amanda Derhake, Jeff Ingram

FROM Tommy Goodwin **EMAIL Tommy_Goodwin@golder.com**

DATA VALIDATION SUMMARY, SIOUX ENERGY CENTER – SCPC – DATA PACKAGE 60312389

The following is a summary of instances where quality control criteria in the functional guidelines were not met and data qualification was required:

- When a compound was detected in a sample result between the MDL and the PQL the results were recorded at the detection value and qualified as estimates (J).
- When a compound was detected in a blank (i.e. method, field), and the blank comparison criterion was not met, associated sample results were qualified as estimates (J) or non-detects (U).

Golder Associates Inc.
13515 Barrett Parkway Drive, Suite 260,
Ballwin, Missouri, USA 63021
T: +1 314 984-8800 F: +1 314 984-8770

QA LEVEL II - INORGANIC DATA EVALUATION CHECKLIST

Company Name: Golder Associates
Project Manager: J Ingram
Project Name: Ameren - Sioux - SCPC
Project Number: 1531406
Reviewer: T Goodwin
Validation Date: 10/17/2019

Laboratory: Pace Analytical - KS
SDG #: 60312389
Analytical Method (type and no.): EPA 200.7 (Metals); SM 2320B (Alk); SM 2540C (TDS); EPA 300.0 (Anions)
Matrix: ☐ Air ☐ Soil/Sed. ■ Water ☐ Waste ☐
Sample Names S-UG-1A, S-UG-2, S-DG-1, S-DG-2, S-DG-3, S-DG-4, S-SCPC-DUP-1, S-SCPC-FB-1, S-BMW-1S, S-BMW-3S

NOTE: Please provide calculation in Comment areas or on the back (if on the back please indicate in comment areas).

Field Information	**YES**	**NO**	**NA**	**COMMENTS**
a) Sampling dates noted?	☒	☐	☐	8/1 and 8/19/2019
b) Sampling team indicated?	☒	☐	☐	
c) Sample location noted?	☒	☐	☐	
d) Sample depth indicated (Soils)?	☐	☐	☒	
e) Sample type indicated ([✓ grab]/composite)?	☒	☐	☐	
f) Field QC noted?	☒	☐	☐	
g) Field parameters collected (note types)?	☒	☐	☐	pH, Sp.Cond, ORP, Temp, DO, Turb
h) Field Calibration within control limits?	☒	☐	☐	
i) Notations of unacceptable field conditions/performances from field logs or field notes?	☐	☒	☐	
j) Does the laboratory narrative indicate deficiencies?	☐	☐	☒	

Note Deficiencies:

Chain-of-Custody (COC)	**YES**	**NO**	**NA**	**COMMENTS**
a) Was the COC properly completed?	☒	☐	☐	
b) Was the COC signed by both field and laboratory personnel?	☒	☐	☐	
c) Were samples received in good condition?	☒	☐	☐	

General (reference QAPP or Method)	**YES**	**NO**	**NA**	**COMMENTS**
a) Were hold times met for sample pretreatment?	☒	☐	☐	
b) Were hold times met for sample analysis?	☒	☐	☐	
c) Were the correct preservatives used?	☒	☐	☐	
d) Was the correct method used?	☒	☐	☐	
e) Were appropriate reporting limits achieved?	☒	☐	☐	
f) Were any sample dilutions noted?	☒	☐	☐	See Notes
g) Were any matrix problems noted?	☐	☒	☐	

QA LEVEL II - INORGANIC DATA EVALUATION CHECKLIST

Blanks	**YES**	**NO**	**NA**	**COMMENTS**
a) Were analytes detected in the method blank(s)?	☒	☐	☐	See Notes
b) Were analytes detected in the field blank(s)?	☒	☐	☐	See Notes
c) Were analytes detected in the equipment blank(s)?	☐	☐	☒	
d) Were analytes detected in the trip blank(s)?	☐	☐	☒	

Laboratory Control Sample (LCS)	**YES**	**NO**	**NA**	**COMMENTS**
a) Was a LCS analyzed once per SDG?	☒	☐	☐	
b) Were the proper analytes included in the LCS?	☒	☐	☐	
c) Was the LCS accuracy criteria met?	☒	☐	☐	

Duplicates	**YES**	**NO**	**NA**	**COMMENTS**
a) Were field duplicates collected (note original and duplicate sample names)?	☒	☐	☐	DUP-1 @ S-DG-3 FB-1 @ S-UG-2
b) Were field dup. precision criteria met (note RPD)?	☒	☐	☐	See Notes
c) Were lab duplicates analyzed (note original and duplicate samples)?	☒	☐	☐	-89006: Alk, TDS
d) Were lab dup. precision criteria met (note RPD)?	☒	☐	☐	See Notes

Blind Standards	**YES**	**NO**	**NA**	**COMMENTS**
a) Was a blind standard used (indicate name, analytes included and concentrations)?	☐	☒	☐	
b) Was the %D within control limits?	☐	☐	☒	

Matrix Spike/Matrix Spike Duplicate (MS/MSD)	**YES**	**NO**	**NA**	**COMMENTS**
a) Was MS accuracy criteria met?	☒	☐	☐	
Recovery could not be calculated since sample contained high concentration of analyte?	☐	☐	☒	
b) Was MSD accuracy criteria met?	☒	☐	☐	
Recovery could not be calculated since sample contained high concentration of analyte?	☐	☐	☒	
c) Were MS/MSD precision criteria met?	☒	☐	☐	

Comments/Notes:

MB: -90002-03: B (11.8); -89001-08: Ca (50.1)

FB-1: Ca (51.9), Mg (14.1), TDS (16.0)

Max analyzed Field Duplicate RPD: 4.4% (Limit: 20%)

Max analyzed Lab Duplicate RPD: 5% (Limit: 10%)

Dilution: Chloride and Sulfate were diluted in several samples; no qualification is necessary.

QA LEVEL II - INORGANIC DATA EVALUATION CHECKLIST

Data Qualification:

Sample Name	Constituent(s)	Result	Qualifier	Reason
S-SCPC-FB-1	Calcium (Ca)	200	U	Analyte Detected in Method Blank (MB); PQL>Result>MDL
S-BMW-1S	Boron (B)	100	U	"
S-BMW-3S	"	100	U	"

Signature: ______________________ Date: 10/17/2019

Pace Analytical Services, LLC
9608 Loiret Blvd.
Lenexa, KS 66219
(913)599-5665

October 17, 2019

Jeffrey Ingram
Golder Associates
13515 Barrett Parkway Drive
Suite 260
Ballwin, MO 63021

RE: Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60317027

Dear Jeffrey Ingram:

Enclosed are the analytical results for sample(s) received by the laboratory on October 04, 2019. The results relate only to the samples included in this report. Results reported herein conform to the most current, applicable TNI/NELAC standards and the laboratory's Quality Assurance Manual, where applicable, unless otherwise noted in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Jamie Church

Jamie Church
jamie.church@pacelabs.com
314-838-7223
Project Manager

Enclosures

cc: Ryan Feldmann, Golder
Mark Haddock, Golder Associates
Eric Schneider, Golder Associates

CERTIFICATIONS

Project:	AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.:	60317027

Kansas Certification IDs

9608 Loiret Boulevard, Lenexa, KS 66219
Missouri Inorganic Drinking Water Certification #: 10090
Arkansas Drinking Water
Arkansas Certification #: 19-016-0
Arkansas Drinking Water
Illinois Certification #: 004455
Iowa Certification #: 118
Kansas/NELAP Certification #: E-10116
Louisiana Certification #: 03055
Nevada Certification #: KS000212018-1
Oklahoma Certification #: 9205/9935
Florida: Cert E871149 SEKS WET
Texas Certification #: T104704407-18-11
Utah Certification #: KS000212018-8
Illinois Certification #: 004592
Kansas Field Laboratory Accreditation: # E-92587
Missouri SEKS Micro Certification: 10070

SAMPLE SUMMARY

Project:	AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.:	60317027

Lab ID	Sample ID	Matrix	Date Collected	Date Received
60317027001	**S-UG1A**	Water	10/02/19 12:45	10/04/19 02:55
60317027002	**S-SCPC-DUP-1**	Water	10/02/19 12:45	10/04/19 02:55
60317027003	**S-UG-2**	Water	10/02/19 11:15	10/04/19 02:55
60317027004	**SCPC-FB-1**	Water	10/02/19 11:25	10/04/19 02:55
60317027005	**S-DG-3**	Water	10/02/19 12:45	10/04/19 02:55

SAMPLE ANALYTE COUNT

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60317027

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
60317027001	**S-UG1A**	EPA 200.7	LRS	1	PASI-K
		EPA 300.0	MGS	1	PASI-K
60317027002	**S-SCPC-DUP-1**	EPA 200.7	LRS	1	PASI-K
		EPA 300.0	MGS	1	PASI-K
60317027003	**S-UG-2**	EPA 300.0	MGS	1	PASI-K
60317027004	**SCPC-FB-1**	EPA 200.7	LRS	1	PASI-K
		SM 2540C	MAP	1	PASI-K
		EPA 300.0	MGS	2	PASI-K
60317027005	**S-DG-3**	SM 2540C	MAP	1	PASI-K

ANALYTICAL RESULTS

Project:	AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.:	60317027

Sample: S-UG1A **Lab ID: 60317027001** Collected: 10/02/19 12:45 Received: 10/04/19 02:55 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
200.7 Metals, Total	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7								
Calcium	**166000**	ug/L	200	50.0	1	10/11/19 14:00	10/14/19 14:54	7440-70-2	
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Chloride	**140**	mg/L	10.0	2.2	10		10/16/19 11:02	16887-00-6	

ANALYTICAL RESULTS

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60317027

Sample: S-SCPC-DUP-1 **Lab ID: 60317027002** Collected: 10/02/19 12:45 Received: 10/04/19 02:55 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
200.7 Metals, Total	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7								
Calcium	**164000**	ug/L	200	50.0	1	10/11/19 14:00	10/14/19 15:02	7440-70-2	
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Chloride	**139**	mg/L	10.0	2.2	10		10/16/19 11:19	16887-00-6	

ANALYTICAL RESULTS

Project:	AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.:	60317027

Sample: S-UG-2 **Lab ID: 60317027003** Collected: 10/02/19 11:15 Received: 10/04/19 02:55 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Fluoride	**0.30**	mg/L	0.20	0.085	1		10/15/19 18:36	16984-48-8	

ANALYTICAL RESULTS

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60317027

Sample: SCPC-FB-1 **Lab ID: 60317027004** Collected: 10/02/19 11:25 Received: 10/04/19 02:55 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
200.7 Metals, Total	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7								
Calcium	**<50.0**	ug/L	200	50.0	1	10/11/19 14:00	10/14/19 15:04	7440-70-2	
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**<5.0**	mg/L	5.0	5.0	1		10/08/19 15:19		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Chloride	**<0.22**	mg/L	1.0	0.22	1		10/15/19 18:53	16887-00-6	
Fluoride	**<0.085**	mg/L	0.20	0.085	1		10/15/19 18:53	16984-48-8	

ANALYTICAL RESULTS

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60317027

Sample: S-DG-3 **Lab ID: 60317027005** Collected: 10/02/19 12:45 Received: 10/04/19 02:55 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**569**	mg/L	10.0	10.0	1		10/08/19 15:20		

REPORT OF LABORATORY ANALYSIS

QUALITY CONTROL DATA

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60317027

QC Batch: 615188
Analysis Method: EPA 200.7
QC Batch Method: EPA 200.7
Analysis Description: 200.7 Metals, Total
Associated Lab Samples: 60317027001, 60317027002, 60317027004

METHOD BLANK: 2511571
Matrix: Water
Associated Lab Samples: 60317027001, 60317027002, 60317027004

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Calcium	ug/L	<50.0	200	50.0	10/14/19 14:47	

LABORATORY CONTROL SAMPLE: 2511572

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Calcium	ug/L	10000	10100	101	85-115	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2511573 2511574

Parameter	Units	60317027001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Calcium	ug/L	166000	10000	10000	176000	176000	99	92	70-130	0	20	

MATRIX SPIKE SAMPLE: 2511575

Parameter	Units	60317068001 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Calcium	ug/L	138000	10000	145000	69	70-130	M1

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60317027

QC Batch: 614091
QC Batch Method: SM 2540C
Analysis Method: SM 2540C
Analysis Description: 2540C Total Dissolved Solids
Associated Lab Samples: 60317027004, 60317027005

METHOD BLANK: 2507725
Matrix: Water
Associated Lab Samples: 60317027004, 60317027005

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Total Dissolved Solids	mg/L	<5.0	5.0	5.0	10/08/19 15:18	

LABORATORY CONTROL SAMPLE: 2507726

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Total Dissolved Solids	mg/L	1000	982	98	80-120	

SAMPLE DUPLICATE: 2507728

Parameter	Units	60317050012 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Dissolved Solids	mg/L	47100	45400	4	10	

SAMPLE DUPLICATE: 2507743

Parameter	Units	60317050008 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Dissolved Solids	mg/L	947	957	1	10	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60317027

QC Batch: 614196
Analysis Method: EPA 300.0
QC Batch Method: EPA 300.0
Analysis Description: 300.0 IC Anions
Associated Lab Samples: 60317027001, 60317027002, 60317027003, 60317027004

METHOD BLANK: 2508100
Matrix: Water
Associated Lab Samples: 60317027001, 60317027002, 60317027003, 60317027004

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Chloride	mg/L	<0.22	1.0	0.22	10/15/19 15:08	
Fluoride	mg/L	<0.085	0.20	0.085	10/15/19 15:08	

LABORATORY CONTROL SAMPLE: 2508101

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Chloride	mg/L	5	4.6	92	90-110	
Fluoride	mg/L	2.5	2.4	97	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2508102 2508103

Parameter	Units	60317026001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Chloride	mg/L	22.1	10	10	34.2	32.5	121	105	80-120	5	15	M1
Fluoride	mg/L	0.26	2.5	2.5	2.8	2.9	103	106	80-120	3	15	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALIFIERS

Project:	AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.:	60317027

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.

ND - Not Detected at or above adjusted reporting limit.

TNTC - Too Numerous To Count

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PQL - Practical Quantitation Limit.

RL - Reporting Limit - The lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix.

S - Surrogate

1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

LABORATORIES

PASI-K	Pace Analytical Services - Kansas City

ANALYTE QUALIFIERS

M1	Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery.

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60317027

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
60317027001	**S-UG1A**	EPA 200.7	615188	EPA 200.7	615295
60317027002	**S-SCPC-DUP-1**	EPA 200.7	615188	EPA 200.7	615295
60317027004	**SCPC-FB-1**	EPA 200.7	615188	EPA 200.7	615295
60317027004	**SCPC-FB-1**	SM 2540C	614091		
60317027005	**S-DG-3**	SM 2540C	614091		
60317027001	**S-UG1A**	EPA 300.0	614196		
60317027002	**S-SCPC-DUP-1**	EPA 300.0	614196		
60317027003	**S-UG-2**	EPA 300.0	614196		
60317027004	**SCPC-FB-1**	EPA 300.0	614196		

Pace Analytical
www.pacelabs.com

Sample Condition Upon Receipt

WO# : 60317027

60317027

Client Name: Golder Associates

Courier: FedEx ☐ UPS ☐ VIA ☐ Clay ☐ PEX ☐ ECI ☐ Pace ☐ Xroads ☑ Client ☐ Other ☐

Tracking #: ______ Pace Shipping Label Used? Yes ☐ No ☑

Custody Seal on Cooler/Box Present: Yes ☑ No ☐ Seals intact: Yes ☑ No ☐

Packing Material: Bubble Wrap ☐ Bubble Bags ☐ Foam ☐ None ☐ Other ☑ Ziplc

Thermometer Used: T-301 **Type of Ice:** [✓ Wet] Blue None

Cooler Temperature (°C): **As-read** 0.1 **Corr. Factor** +0.0 **Corrected** 0.1

Date and initials of person examining contents: HS 10.4.19

Temperature should be above freezing to 6°C

Chain of Custody present:	☑Yes ☐No ☐N/A	
Chain of Custody relinquished:	☑Yes ☐No ☐N/A	
Samples arrived within holding time:	☑Yes ☐No ☐N/A	
Short Hold Time analyses (<72hr):	☐Yes ☑No ☐N/A	
Rush Turn Around Time requested:	☐Yes ☑No ☐N/A	
Sufficient volume:	☑Yes ☐No ☐N/A	
Correct containers used:	☑Yes ☐No ☐N/A	
Pace containers used:	☑Yes ☐No ☐N/A	
Containers intact:	☑Yes ☐No ☐N/A	
Unpreserved 5035A / TX1005/1006 soils frozen in 48hrs?	☐Yes ☐No ☑N/A	
Filtered volume received for dissolved tests?	☐Yes ☐No ☑N/A	
Sample labels match COC: Date / time / ID / analyses	☑Yes ☐No ☐N/A	
Samples contain multiple phases? Matrix: WT	☐Yes ☑No ☐N/A	
Containers requiring pH preservation in compliance? (HNO_3, H_2SO_4, HCl<2; NaOH>9 Sulfide, NaOH>10 Cyanide) (Exceptions: VOA, Micro, O&G, KS TPH, OK-DRO)	☑Yes ☐No ☐N/A	List sample IDs, volumes, lot #'s of preservative and the date/time added.
Cyanide water sample checks: Lead acetate strip turns dark? (Record only) Potassium iodide test strip turns blue/purple? (Preserve)	 ☐Yes ☐No ☐Yes ☐No	
Trip Blank present:	☐Yes ☑No ☐N/A	
Headspace in VOA vials (>6mm):	☐Yes ☐No ☑N/A	
Samples from USDA Regulated Area: State:	☐Yes ☐No ☑N/A	
Additional labels attached to 5035A / TX1005 vials in the field?	☐Yes ☐No ☑N/A	

Client Notification/ Resolution: Copy COC to Client? Y / N Field Data Required? Y / N

Person Contacted: ______ Date/Time: ______

Comments/ Resolution: ______

Project Manager Review: Jami Church Date: 10/8/19

Pace Analytical
www.pacelabs.com

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Page: 1 of 1

Section A
Required Client Information:

Company:	Golder Associates
Address:	13515 Barrett Parkway Drive, Ste 260 Ballwin, MO 63021
Email To:	jeffrey_ingram@golder.com
Phone:	636-724-9191
Fax:	636-724-9323
Requested Due Date/TAT:	Standard

Section B
Required Project Information:

Report To:	Jeffrey Ingram
Copy To:	Ryan Feldmann/Eric Schneider
Purchase Order No.:	
Project Name:	Ameren SCPC
Project Number:	153140601.0003

Section C
Invoice Information:

Attention:	
Company Name:	
Address:	
Pace Quote Reference:	
Pace Project Manager:	Jamie Church
Pace Profile #:	9285

REGULATORY AGENCY

NPDES [✓ GROUND WATER] DRINKING WATER
UST RCRA OTHER ______

Site Location STATE: MO

Section D
Required Client Information

Valid Matrix Codes

MATRIX	CODE
DRINKING WATER	DW
WATER	WT
WASTE WATER	WW
PRODUCT	P
SOIL/SOLID	SL
OIL	OL
	WP
	AR
	OT
	TS

SAMPLE ID (A-Z, 0-9 / ,-) Sample IDs MUST BE UNIQUE

Requested Analysis Filtered (Y/N)

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED COMPOSITE START DATE	COLLECTED COMPOSITE START TIME	COLLECTED COMPOSITE END/GRAB DATE	COLLECTED COMPOSITE END/GRAB TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test Y/N	200.7 Boron (N)	200.7 Calcium (N)	Chloride (N)	Fluoride (N)	Sulfate (N)	TDS (N)	Residual Chlorine (Y/N)	Pace Project No./ Lab I.D. 60317027
1	S-UG-1A	WT	G			10/2/19	1245		2	/		/								/	/					001
2	S-SCPC-DUP-1	WT	G			|	–		2	/		/								/	/					002
3	S-UG-2	WT	G			|	1115		1	/												/				003
4	SCPC-FB-1	WT	G			|	1125		2	/		/								/	/	/		/		004
5	S-DG-3	WT	G			|	~~1100~~ 1245		1	/														/		005
6		WT	G																							
7		WT	G																							
8		WT	G																							
9		WT	G																							
10		WT	G																							
11		WT	G																							
12		WT	G																							

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)
	Annie Muehlfarth/Golder	~~10/2/19~~ 10/3/19	1333	Angela Mc	10/3/19	13:35				
	Angela McManus	10/3/19	13:36	E Brackett/Pace	10/4/19	0255	0.1	Y	Y	Y

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Annie Muehlfarth
SIGNATURE of SAMPLER: Annie Muehlfarth
DATE Signed (MM/DD/YY): 10/2/19

MEMORANDUM

DATE November 12, 2019

Project No. 1531406

TO Project File
Golder Associates

CC Amanda Derhake, Jeff Ingram

FROM Tommy Goodwin

EMAIL Tommy_Goodwin@golder.com

DATA VALIDATION SUMMARY, SIOUX ENERGY CENTER – SCPC – VERIFICATION SAMPLING - DATA PACKAGE 60317027

The following is a summary of instances where quality control criteria in the functional guidelines were not met and data qualification was required:

- None.

QA LEVEL II - INORGANIC DATA EVALUATION CHECKLIST

Company Name: Golder Associates
Project Name: Ameren - Sioux - SCPC
Reviewer: T Goodwin

Project Manager: J Ingram
Project Number: 1531406
Validation Date: 11/12/2019

Laboratory: Pace Analytical - KS
SDG #: 60317027
Analytical Method (type and no.): EPA 200.7 (Metals); SM 2540C (TDS); EPA 300.0 (Anions)
Matrix: ☐ Air ☐ Soil/Sed. ■ Water ☐ Waste ☐
Sample Names S-UG-1A, S-SCPC-DUP-1, S-UG-2, SCPC-FB-1, S-DG-3

NOTE: Please provide calculation in Comment areas or on the back (if on the back please indicate in comment areas).

Field Information	**YES**	**NO**	**NA**	**COMMENTS**
a) Sampling dates noted?	☒	☐	☐	10/2/2019
b) Sampling team indicated?	☒	☐	☐	
c) Sample location noted?	☒	☐	☐	
d) Sample depth indicated (Soils)?	☐	☐	☒	
e) Sample type indicated ([✓ grab]/composite)?	☒	☐	☐	
f) Field QC noted?	☒	☐	☐	
g) Field parameters collected (note types)?	☒	☐	☐	pH, Sp.Cond, ORP, Temp, DO, Turb
h) Field Calibration within control limits?	☒	☐	☐	
i) Notations of unacceptable field conditions/performances from field logs or field notes?	☐	☒	☐	
j) Does the laboratory narrative indicate deficiencies?	☐	☐	☒	

Note Deficiencies:

Chain-of-Custody (COC)	**YES**	**NO**	**NA**	**COMMENTS**
a) Was the COC properly completed?	☒	☐	☐	
b) Was the COC signed by both field and laboratory personnel?	☒	☐	☐	
c) Were samples received in good condition?	☒	☐	☐	

General (reference QAPP or Method)	**YES**	**NO**	**NA**	**COMMENTS**
a) Were hold times met for sample pretreatment?	☒	☐	☐	
b) Were hold times met for sample analysis?	☒	☐	☐	
c) Were the correct preservatives used?	☒	☐	☐	
d) Was the correct method used?	☒	☐	☐	
e) Were appropriate reporting limits achieved?	☒	☐	☐	
f) Were any sample dilutions noted?	☒	☐	☐	See Notes
g) Were any matrix problems noted?	☐	☒	☐	

QA LEVEL II - INORGANIC DATA EVALUATION CHECKLIST

Blanks	**YES**	**NO**	**NA**	**COMMENTS**
a) Were analytes detected in the method blank(s)?	☐	☒	☐	
b) Were analytes detected in the field blank(s)?	☐	☒	☐	
c) Were analytes detected in the equipment blank(s)?	☐	☐	☒	
d) Were analytes detected in the trip blank(s)?	☐	☐	☒	

Laboratory Control Sample (LCS)	**YES**	**NO**	**NA**	**COMMENTS**
a) Was a LCS analyzed once per SDG?	☒	☐	☐	
b) Were the proper analytes included in the LCS?	☒	☐	☐	
c) Was the LCS accuracy criteria met?	☒	☐	☐	

Duplicates	**YES**	**NO**	**NA**	**COMMENTS**
a) Were field duplicates collected (note original and duplicate sample names)?	☒	☐	☐	DUP-1 @ S-UG1A FB-1 @ S-UG-2
b) Were field dup. precision criteria met (note RPD)?	☒	☐	☐	See Notes
c) Were lab duplicates analyzed (note original and duplicate samples)?	☐	☒	☐	
d) Were lab dup. precision criteria met (note RPD)?	☐	☐	☒	

Blind Standards	**YES**	**NO**	**NA**	**COMMENTS**
a) Was a blind standard used (indicate name, analytes included and concentrations)?	☐	☒	☐	
b) Was the %D within control limits?	☐	☐	☒	

Matrix Spike/Matrix Spike Duplicate (MS/MSD)	**YES**	**NO**	**NA**	**COMMENTS**
a) Was MS accuracy criteria met?	☒	☐	☐	
Recovery could not be calculated since sample contained high concentration of analyte?	☐	☐	☒	
b) Was MSD accuracy criteria met?	☒	☐	☐	
Recovery could not be calculated since sample contained high concentration of analyte?	☐	☐	☒	
c) Were MS/MSD precision criteria met?	☒	☐	☐	

Comments/Notes:

Max Field Duplicate RPD: 1.2% (Limit: 20%)

Dilution: Chloride diluted in some samples; no qualification is necessary.

QA LEVEL II - INORGANIC DATA EVALUATION CHECKLIST

Data Qualification:

Sample Name	Constituent(s)	Result	Qualifier	Reason
None				

Signature: Tommy J Good Jr

Date: 11/12/2019

Pace Analytical Services, LLC
9608 Loiret Blvd.
Lenexa, KS 66219
(913)599-5665

December 09, 2019

Jeffrey Ingram
Golder Associates
13515 Barrett Parkway Drive
Suite 260
Ballwin, MO 63021

RE: Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60321518

Dear Jeffrey Ingram:

Enclosed are the analytical results for sample(s) received by the laboratory on November 16, 2019. The results relate only to the samples included in this report. Results reported herein conform to the most current, applicable TNI/NELAC standards and the laboratory's Quality Assurance Manual, where applicable, unless otherwise noted in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Jamie Church

Jamie Church
jamie.church@pacelabs.com
314-838-7223
Project Manager

Enclosures

cc: Ryan Feldmann, Golder
Tommy Goodwin, Golder Associates
Mark Haddock, Golder Associates
Eric Schneider, Golder Associates

CERTIFICATIONS

Project:	AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.:	60321518

Pace Analytical Services Kansas

9608 Loiret Boulevard, Lenexa, KS 66219
Missouri Inorganic Drinking Water Certification #: 10090
Arkansas Drinking Water
Arkansas Certification #: 19-016-0
Arkansas Drinking Water
Illinois Certification #: 004455
Iowa Certification #: 118
Kansas/NELAP Certification #: E-10116
Louisiana Certification #: 03055
Nevada Certification #: KS000212020-2
Oklahoma Certification #: 9205/9935
Florida: Cert E871149 SEKS WET
Texas Certification #: T104704407-19-12
Utah Certification #: KS000212018-8
Illinois Certification #: 004592
Kansas Field Laboratory Accreditation: # E-92587
Missouri SEKS Micro Certification: 10070

SAMPLE SUMMARY

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60321518

Lab ID	Sample ID	Matrix	Date Collected	Date Received
60321518001	**S-UG-1A**	Water	11/14/19 09:20	11/16/19 02:35
60321518002	**S-UG-2**	Water	11/14/19 16:03	11/16/19 02:35
60321518003	**S-DG-1**	Water	11/14/19 10:36	11/16/19 02:35
60321518004	**S-DG-2**	Water	11/14/19 12:15	11/16/19 02:35
60321518005	**S-DG-3**	Water	11/14/19 14:13	11/16/19 02:35
60321518006	**S-DG-4**	Water	11/15/19 09:50	11/16/19 02:35
60321518007	**S-SCPC-DUP-1**	Water	11/14/19 09:50	11/16/19 02:35
60321518008	**S-SCPC-FB-1**	Water	11/14/19 09:50	11/16/19 02:35
60321513010	**S-BMW-1S**	Water	11/15/19 14:43	11/16/19 02:35
60321513011	**S-BMW-3S**	Water	11/15/19 12:18	11/16/19 02:35

SAMPLE ANALYTE COUNT

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60321518

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
60321518001	**S-UG-1A**	EPA 200.7	HKC	7	PASI-K
		SM 2320B	AJS2	1	PASI-K
		SM 2540C	MAP	1	PASI-K
		EPA 300.0	CNB	3	PASI-K
60321518002	**S-UG-2**	EPA 200.7	HKC	7	PASI-K
		SM 2320B	AJS2	1	PASI-K
		SM 2540C	MAP	1	PASI-K
		EPA 300.0	CNB	3	PASI-K
60321518003	**S-DG-1**	EPA 200.7	HKC	7	PASI-K
		SM 2320B	AJS2	1	PASI-K
		SM 2540C	MAP	1	PASI-K
		EPA 300.0	CNB	3	PASI-K
60321518004	**S-DG-2**	EPA 200.7	HKC	7	PASI-K
		SM 2320B	AJS2	1	PASI-K
		SM 2540C	MAP	1	PASI-K
		EPA 300.0	CNB, MJK	3	PASI-K
60321518005	**S-DG-3**	EPA 200.7	HKC	7	PASI-K
		SM 2320B	AJS2	1	PASI-K
		SM 2540C	MAP	1	PASI-K
		EPA 300.0	MGS	3	PASI-K
60321518006	**S-DG-4**	EPA 200.7	HKC	7	PASI-K
		SM 2320B	AJS2	1	PASI-K
		SM 2540C	BLA	1	PASI-K
		EPA 300.0	MGS	3	PASI-K
60321518007	**S-SCPC-DUP-1**	EPA 200.7	HKC	7	PASI-K
		SM 2320B	AJS2	1	PASI-K
		SM 2540C	MAP	1	PASI-K
		EPA 300.0	MGS	3	PASI-K
60321518008	**S-SCPC-FB-1**	EPA 200.7	HKC	7	PASI-K
		SM 2320B	AJS2	1	PASI-K
		SM 2540C	MAP	1	PASI-K
		EPA 300.0	MGS	3	PASI-K
60321513010	**S-BMW-1S**	EPA 200.7	HKC	7	PASI-K
		SM 2320B	AJS2	1	PASI-K
		SM 2540C	BLA	1	PASI-K
		EPA 300.0	CNB	3	PASI-K
60321513011	**S-BMW-3S**	EPA 200.7	HKC	7	PASI-K

SAMPLE ANALYTE COUNT

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60321518

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
		SM 2320B	AJS2	1	PASI-K
		SM 2540C	BLA	1	PASI-K
		EPA 300.0	CNB	3	PASI-K

ANALYTICAL RESULTS

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60321518

Sample: S-UG-1A **Lab ID: 60321518001** Collected: 11/14/19 09:20 Received: 11/16/19 02:35 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
200.7 Metals, Total	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7								
Boron	**239**	ug/L	100	10.7	1	11/27/19 07:57	11/27/19 13:28	7440-42-8	
Calcium	**166000**	ug/L	200	50.0	1	11/27/19 07:57	11/27/19 13:28	7440-70-2	
Iron	**<14.0**	ug/L	50.0	14.0	1	11/27/19 07:57	11/27/19 13:28	7439-89-6	
Magnesium	**39800**	ug/L	50.0	13.0	1	11/27/19 07:57	11/27/19 13:28	7439-95-4	
Manganese	**465**	ug/L	5.0	2.1	1	11/27/19 07:57	11/27/19 13:28	7439-96-5	
Potassium	**9530**	ug/L	500	79.0	1	11/27/19 07:57	11/27/19 13:28	7440-09-7	
Sodium	**37900**	ug/L	500	144	1	11/27/19 07:57	11/27/19 13:28	7440-23-5	
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**430**	mg/L	20.0	6.5	1		11/22/19 17:59		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**739**	mg/L	10.0	10.0	1		11/21/19 16:04		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Chloride	**118**	mg/L	10.0	2.2	10		11/27/19 22:15	16887-00-6	
Fluoride	**0.29**	mg/L	0.20	0.085	1		11/27/19 21:59	16984-48-8	
Sulfate	**53.0**	mg/L	10.0	2.3	10		11/27/19 22:15	14808-79-8	

ANALYTICAL RESULTS

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60321518

Sample: S-UG-2 **Lab ID: 60321518002** Collected: 11/14/19 16:03 Received: 11/16/19 02:35 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
200.7 Metals, Total	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7								
Boron	**144**	ug/L	100	10.7	1	11/27/19 07:57	11/27/19 13:30	7440-42-8	
Calcium	**115000**	ug/L	200	50.0	1	11/27/19 07:57	11/27/19 13:30	7440-70-2	
Iron	**<14.0**	ug/L	50.0	14.0	1	11/27/19 07:57	11/27/19 13:30	7439-89-6	
Magnesium	**24100**	ug/L	50.0	13.0	1	11/27/19 07:57	11/27/19 13:30	7439-95-4	
Manganese	**196**	ug/L	5.0	2.1	1	11/27/19 07:57	11/27/19 13:30	7439-96-5	
Potassium	**5090**	ug/L	500	79.0	1	11/27/19 07:57	11/27/19 13:30	7440-09-7	
Sodium	**32500**	ug/L	500	144	1	11/27/19 07:57	11/27/19 13:30	7440-23-5	
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**355**	mg/L	20.0	6.5	1		11/22/19 18:05		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**480**	mg/L	10.0	10.0	1		11/21/19 16:04		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Chloride	**27.8**	mg/L	5.0	1.1	5		11/27/19 22:47	16887-00-6	
Fluoride	**0.24**	mg/L	0.20	0.085	1		11/27/19 22:31	16984-48-8	
Sulfate	**43.8**	mg/L	5.0	1.2	5		11/27/19 22:47	14808-79-8	

ANALYTICAL RESULTS

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60321518

Sample: S-DG-1 **Lab ID: 60321518003** Collected: 11/14/19 10:36 Received: 11/16/19 02:35 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
200.7 Metals, Total	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7								
Boron	**111**	ug/L	100	10.7	1	11/27/19 07:57	11/27/19 13:33	7440-42-8	
Calcium	**135000**	ug/L	200	50.0	1	11/27/19 07:57	11/27/19 13:33	7440-70-2	
Iron	**386**	ug/L	50.0	14.0	1	11/27/19 07:57	11/27/19 13:33	7439-89-6	
Magnesium	**31200**	ug/L	50.0	13.0	1	11/27/19 07:57	11/27/19 13:33	7439-95-4	
Manganese	**297**	ug/L	5.0	2.1	1	11/27/19 07:57	11/27/19 13:33	7439-96-5	
Potassium	**4480**	ug/L	500	79.0	1	11/27/19 07:57	11/27/19 13:33	7440-09-7	
Sodium	**4440**	ug/L	500	144	1	11/27/19 07:57	11/27/19 13:33	7440-23-5	
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**409**	mg/L	20.0	6.5	1		11/22/19 18:11		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**524**	mg/L	10.0	10.0	1		11/21/19 16:04		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Chloride	**6.0**	mg/L	1.0	0.22	1		11/27/19 23:03	16887-00-6	
Fluoride	**0.33**	mg/L	0.20	0.085	1		11/27/19 23:03	16984-48-8	
Sulfate	**38.4**	mg/L	5.0	1.2	5		11/27/19 23:19	14808-79-8	

ANALYTICAL RESULTS

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60321518

Sample: S-DG-2 **Lab ID: 60321518004** Collected: 11/14/19 12:15 Received: 11/16/19 02:35 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
200.7 Metals, Total	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7								
Boron	**100**	ug/L	100	10.7	1	11/27/19 07:57	11/27/19 13:35	7440-42-8	
Calcium	**133000**	ug/L	200	50.0	1	11/27/19 07:57	11/27/19 13:35	7440-70-2	
Iron	**82.0**	ug/L	50.0	14.0	1	11/27/19 07:57	11/27/19 13:35	7439-89-6	
Magnesium	**31300**	ug/L	50.0	13.0	1	11/27/19 07:57	11/27/19 13:35	7439-95-4	
Manganese	**464**	ug/L	5.0	2.1	1	11/27/19 07:57	11/27/19 13:35	7439-96-5	
Potassium	**5780**	ug/L	500	79.0	1	11/27/19 07:57	11/27/19 13:35	7440-09-7	
Sodium	**4800**	ug/L	500	144	1	11/27/19 07:57	11/27/19 13:35	7440-23-5	
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**403**	mg/L	20.0	6.5	1		11/22/19 18:17		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**512**	mg/L	10.0	10.0	1		11/21/19 16:04		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Chloride	**7.4**	mg/L	1.0	0.22	1		11/27/19 23:35	16887-00-6	
Fluoride	**0.39**	mg/L	0.20	0.085	1		11/27/19 23:35	16984-48-8	
Sulfate	**37.8**	mg/L	5.0	1.2	5		12/03/19 13:38	14808-79-8	

ANALYTICAL RESULTS

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60321518

Sample: S-DG-3 **Lab ID: 60321518005** Collected: 11/14/19 14:13 Received: 11/16/19 02:35 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
200.7 Metals, Total	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7								
Boron	**93.1J**	ug/L	100	10.7	1	11/27/19 07:57	11/27/19 13:38	7440-42-8	
Calcium	**144000**	ug/L	200	50.0	1	11/27/19 07:57	11/27/19 13:38	7440-70-2	
Iron	**171**	ug/L	50.0	14.0	1	11/27/19 07:57	11/27/19 13:38	7439-89-6	
Magnesium	**38100**	ug/L	50.0	13.0	1	11/27/19 07:57	11/27/19 13:38	7439-95-4	
Manganese	**700**	ug/L	5.0	2.1	1	11/27/19 07:57	11/27/19 13:38	7439-96-5	
Potassium	**6700**	ug/L	500	79.0	1	11/27/19 07:57	11/27/19 13:38	7440-09-7	
Sodium	**4780**	ug/L	500	144	1	11/27/19 07:57	11/27/19 13:38	7440-23-5	
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**447**	mg/L	20.0	6.5	1		11/22/19 18:24		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**576**	mg/L	10.0	10.0	1		11/21/19 16:04		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Chloride	**5.4**	mg/L	1.0	0.22	1		12/02/19 11:10	16887-00-6	
Fluoride	**0.42**	mg/L	0.20	0.085	1		12/02/19 11:10	16984-48-8	
Sulfate	**51.1**	mg/L	5.0	1.2	5		12/02/19 11:59	14808-79-8	

ANALYTICAL RESULTS

Project:	AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.:	60321518

Sample: S-DG-4 **Lab ID: 60321518006** Collected: 11/15/19 09:50 Received: 11/16/19 02:35 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
200.7 Metals, Total	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7								
Boron	**71.0J**	ug/L	100	10.7	1	11/27/19 07:57	11/27/19 13:40	7440-42-8	
Calcium	**138000**	ug/L	200	50.0	1	11/27/19 07:57	11/27/19 13:40	7440-70-2	
Iron	**14.5J**	ug/L	50.0	14.0	1	11/27/19 07:57	11/27/19 13:40	7439-89-6	
Magnesium	**38900**	ug/L	50.0	13.0	1	11/27/19 07:57	11/27/19 13:40	7439-95-4	
Manganese	**138**	ug/L	5.0	2.1	1	11/27/19 07:57	11/27/19 13:40	7439-96-5	
Potassium	**7580**	ug/L	500	79.0	1	11/27/19 07:57	11/27/19 13:40	7440-09-7	
Sodium	**40300**	ug/L	500	144	1	11/27/19 07:57	11/27/19 13:40	7440-23-5	
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**381**	mg/L	20.0	6.5	1		11/25/19 16:17		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**628**	mg/L	10.0	10.0	1		11/22/19 11:15		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Chloride	**96.9**	mg/L	5.0	1.1	5		12/02/19 10:45	16887-00-6	M1
Fluoride	**0.30**	mg/L	0.20	0.085	1		12/02/19 09:58	16984-48-8	
Sulfate	**33.9**	mg/L	5.0	1.2	5		12/02/19 10:45	14808-79-8	

ANALYTICAL RESULTS

Project:	AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.:	60321518

Sample: S-SCPC-DUP-1 **Lab ID: 60321518007** Collected: 11/14/19 09:50 Received: 11/16/19 02:35 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
200.7 Metals, Total	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7								
Boron	**98.6J**	ug/L	100	10.7	1	11/27/19 07:57	11/27/19 13:53	7440-42-8	
Calcium	**132000**	ug/L	200	50.0	1	11/27/19 07:57	11/27/19 13:53	7440-70-2	
Iron	**76.8**	ug/L	50.0	14.0	1	11/27/19 07:57	11/27/19 13:53	7439-89-6	
Magnesium	**30800**	ug/L	50.0	13.0	1	11/27/19 07:57	11/27/19 13:53	7439-95-4	
Manganese	**460**	ug/L	5.0	2.1	1	11/27/19 07:57	11/27/19 13:53	7439-96-5	
Potassium	**5720**	ug/L	500	79.0	1	11/27/19 07:57	11/27/19 13:53	7440-09-7	
Sodium	**4670**	ug/L	500	144	1	11/27/19 07:57	11/27/19 13:53	7440-23-5	
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**409**	mg/L	20.0	6.5	1		11/22/19 18:40		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**489**	mg/L	10.0	10.0	1		11/21/19 16:05		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Chloride	**7.6**	mg/L	1.0	0.22	1		12/02/19 12:16	16887-00-6	
Fluoride	**0.42**	mg/L	0.20	0.085	1		12/02/19 12:16	16984-48-8	
Sulfate	**36.6**	mg/L	5.0	1.2	5		12/02/19 12:33	14808-79-8	

ANALYTICAL RESULTS

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60321518

Sample: S-SCPC-FB-1 **Lab ID: 60321518008** Collected: 11/14/19 09:50 Received: 11/16/19 02:35 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
200.7 Metals, Total	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7								
Boron	**<10.7**	ug/L	100	10.7	1	11/27/19 07:57	11/27/19 13:55	7440-42-8	
Calcium	**<50.0**	ug/L	200	50.0	1	11/27/19 07:57	11/27/19 13:55	7440-70-2	
Iron	**<14.0**	ug/L	50.0	14.0	1	11/27/19 07:57	11/27/19 13:55	7439-89-6	
Magnesium	**<13.0**	ug/L	50.0	13.0	1	11/27/19 07:57	11/27/19 13:55	7439-95-4	
Manganese	**<2.1**	ug/L	5.0	2.1	1	11/27/19 07:57	11/27/19 13:55	7439-96-5	
Potassium	**<79.0**	ug/L	500	79.0	1	11/27/19 07:57	11/27/19 13:55	7440-09-7	
Sodium	**<144**	ug/L	500	144	1	11/27/19 07:57	11/27/19 13:55	7440-23-5	
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**<6.5**	mg/L	20.0	6.5	1		11/22/19 18:44		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**5.0**	mg/L	5.0	5.0	1		11/21/19 16:05		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Chloride	**0.45J**	mg/L	1.0	0.22	1		12/02/19 12:50	16887-00-6	
Fluoride	**<0.085**	mg/L	0.20	0.085	1		12/02/19 12:50	16984-48-8	
Sulfate	**<0.23**	mg/L	1.0	0.23	1		12/02/19 12:50	14808-79-8	

ANALYTICAL RESULTS

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60321518

Sample: S-BMW-1S **Lab ID: 60321513010** Collected: 11/15/19 14:43 Received: 11/16/19 02:35 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
200.7 Metals, Total	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7								
Boron	**118**	ug/L	100	10.7	1	11/26/19 09:12	11/26/19 18:13	7440-42-8	
Calcium	**143000**	ug/L	200	50.0	1	11/26/19 09:12	11/26/19 18:13	7440-70-2	M1
Iron	**<14.0**	ug/L	50.0	14.0	1	11/26/19 09:12	11/26/19 18:13	7439-89-6	
Magnesium	**29700**	ug/L	50.0	13.0	1	11/26/19 09:12	11/26/19 18:13	7439-95-4	
Manganese	**426**	ug/L	5.0	2.1	1	11/26/19 09:12	11/26/19 18:13	7439-96-5	
Potassium	**424J**	ug/L	500	79.0	1	11/26/19 09:12	11/26/19 18:13	7440-09-7	
Sodium	**5360**	ug/L	500	144	1	11/26/19 09:12	11/26/19 18:13	7440-23-5	
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**428**	mg/L	20.0	6.5	1		11/25/19 15:41		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**551**	mg/L	10.0	10.0	1		11/22/19 08:54		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Chloride	**6.4**	mg/L	1.0	0.22	1		11/27/19 19:32	16887-00-6	
Fluoride	**0.28**	mg/L	0.20	0.085	1		11/27/19 19:32	16984-48-8	
Sulfate	**26.5**	mg/L	2.0	0.46	2		11/30/19 01:38	14808-79-8	

ANALYTICAL RESULTS

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60321518

Sample: S-BMW-3S **Lab ID: 60321513011** Collected: 11/15/19 12:18 Received: 11/16/19 02:35 Matrix: Water

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
200.7 Metals, Total	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7								
Boron	**80.1J**	ug/L	100	10.7	1	11/26/19 09:12	11/26/19 18:17	7440-42-8	
Calcium	**102000**	ug/L	200	50.0	1	11/26/19 09:12	11/26/19 18:17	7440-70-2	
Iron	**6800**	ug/L	50.0	14.0	1	11/26/19 09:12	11/26/19 18:17	7439-89-6	
Magnesium	**25600**	ug/L	50.0	13.0	1	11/26/19 09:12	11/26/19 18:17	7439-95-4	
Manganese	**519**	ug/L	5.0	2.1	1	11/26/19 09:12	11/26/19 18:17	7439-96-5	
Potassium	**3840**	ug/L	500	79.0	1	11/26/19 09:12	11/26/19 18:17	7440-09-7	
Sodium	**6610**	ug/L	500	144	1	11/26/19 09:12	11/26/19 18:17	7440-23-5	
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**342**	mg/L	20.0	6.5	1		11/25/19 15:52		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**418**	mg/L	5.0	5.0	1		11/22/19 08:54		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Chloride	**7.6**	mg/L	1.0	0.22	1		11/27/19 21:07	16887-00-6	
Fluoride	**0.23**	mg/L	0.20	0.085	1		11/27/19 21:07	16984-48-8	
Sulfate	**34.4**	mg/L	2.0	0.46	2		11/27/19 21:23	14808-79-8	

QUALITY CONTROL DATA

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60321518

QC Batch: 624736 Analysis Method: EPA 200.7
QC Batch Method: EPA 200.7 Analysis Description: 200.7 Metals, Total
Associated Lab Samples: 60321513010, 60321513011

METHOD BLANK: 2547231 Matrix: Water
Associated Lab Samples: 60321513010, 60321513011

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Boron	ug/L	<10.7	100	10.7	11/26/19 17:42	
Calcium	ug/L	<50.0	200	50.0	11/26/19 17:42	
Iron	ug/L	21.5J	50.0	14.0	11/26/19 17:42	
Magnesium	ug/L	<13.0	50.0	13.0	11/26/19 17:42	
Manganese	ug/L	<2.1	5.0	2.1	11/26/19 17:42	
Potassium	ug/L	<79.0	500	79.0	11/26/19 17:42	
Sodium	ug/L	<144	500	144	11/26/19 17:42	

LABORATORY CONTROL SAMPLE: 2547232

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Boron	ug/L	1000	1030	103	85-115	
Calcium	ug/L	10000	9320	93	85-115	
Iron	ug/L	10000	9140	91	85-115	
Magnesium	ug/L	10000	9890	99	85-115	
Manganese	ug/L	1000	1000	100	85-115	
Potassium	ug/L	10000	9900	99	85-115	
Sodium	ug/L	10000	9950	100	85-115	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2547233 2547234

Parameter	Units	60321513002 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Boron	ug/L	11200	1000	1000	12600	12700	132	144	70-130	1	20	M1
Calcium	ug/L	170000	10000	10000	182000	184000	127	140	70-130	1	20	M1
Iron	ug/L	69.8	10000	10000	9170	9330	91	93	70-130	2	20	
Magnesium	ug/L	29800	10000	10000	40000	40200	102	104	70-130	0	20	
Manganese	ug/L	404	1000	1000	1410	1430	101	102	70-130	1	20	
Potassium	ug/L	7710	10000	10000	17900	18000	102	103	70-130	1	20	
Sodium	ug/L	67100	10000	10000	78300	78700	112	116	70-130	1	20	

MATRIX SPIKE SAMPLE: 2547235

Parameter	Units	60321513010 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Boron	ug/L	118	1000	1140	102	70-130	
Calcium	ug/L	143000	10000	146000	26	70-130	M1
Iron	ug/L	<14.0	10000	8880	89	70-130	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60321518

MATRIX SPIKE SAMPLE: 2547235

Parameter	Units	60321513010 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Magnesium	ug/L	29700	10000	38000	83	70-130	
Manganese	ug/L	426	1000	1400	97	70-130	
Potassium	ug/L	424J	10000	10200	98	70-130	
Sodium	ug/L	5360	10000	14900	96	70-130	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60321518

QC Batch: 625027
Analysis Method: EPA 200.7
QC Batch Method: EPA 200.7
Analysis Description: 200.7 Metals, Total
Associated Lab Samples: 60321518001, 60321518002, 60321518003, 60321518004, 60321518005, 60321518006, 60321518007, 60321518008

METHOD BLANK: 2548362
Matrix: Water
Associated Lab Samples: 60321518001, 60321518002, 60321518003, 60321518004, 60321518005, 60321518006, 60321518007, 60321518008

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Boron	ug/L	<10.7	100	10.7	11/27/19 13:25	
Calcium	ug/L	<50.0	200	50.0	11/27/19 13:25	
Iron	ug/L	<14.0	50.0	14.0	11/27/19 13:25	
Magnesium	ug/L	<13.0	50.0	13.0	11/27/19 13:25	
Manganese	ug/L	<2.1	5.0	2.1	11/27/19 13:25	
Potassium	ug/L	<79.0	500	79.0	11/27/19 13:25	
Sodium	ug/L	<144	500	144	11/27/19 13:25	

LABORATORY CONTROL SAMPLE: 2548363

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Boron	ug/L	1000	1020	102	85-115	
Calcium	ug/L	10000	10200	102	85-115	
Iron	ug/L	10000	9980	100	85-115	
Magnesium	ug/L	10000	10000	100	85-115	
Manganese	ug/L	1000	1020	102	85-115	
Potassium	ug/L	10000	10000	100	85-115	
Sodium	ug/L	10000	10100	101	85-115	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2548364 2548365

Parameter	Units	60321518006 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Boron	ug/L	71.0J	1000	1000	1120	1140	104	107	70-130	2	20	
Calcium	ug/L	138000	10000	10000	146000	150000	76	112	70-130	2	20	
Iron	ug/L	14.5J	10000	10000	9800	9990	98	100	70-130	2	20	
Magnesium	ug/L	38900	10000	10000	48800	49600	99	107	70-130	2	20	
Manganese	ug/L	138	1000	1000	1140	1160	101	103	70-130	2	20	
Potassium	ug/L	7580	10000	10000	17600	17900	100	103	70-130	2	20	
Sodium	ug/L	40300	10000	10000	49400	50300	91	100	70-130	2	20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60321518

QC Batch: 624293
Analysis Method: SM 2320B
QC Batch Method: SM 2320B
Analysis Description: 2320B Alkalinity
Associated Lab Samples: 60321518001, 60321518002, 60321518003, 60321518004, 60321518005, 60321518007, 60321518008

METHOD BLANK: 2545462
Matrix: Water
Associated Lab Samples: 60321518001, 60321518002, 60321518003, 60321518004, 60321518005, 60321518007, 60321518008

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Alkalinity, Total as CaCO3	mg/L	<6.5	20.0	6.5	11/22/19 16:12	

LABORATORY CONTROL SAMPLE: 2545463

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Alkalinity, Total as CaCO3	mg/L	500	510	102	90-110	

SAMPLE DUPLICATE: 2545464

Parameter	Units	60321303002 Result	Dup Result	RPD	Max RPD	Qualifiers
Alkalinity, Total as CaCO3	mg/L	1500	1510	0	10	

SAMPLE DUPLICATE: 2545466

Parameter	Units	60321516004 Result	Dup Result	RPD	Max RPD	Qualifiers
Alkalinity, Total as CaCO3	mg/L	360	355	1	10	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60321518

QC Batch: 624580 Analysis Method: SM 2320B
QC Batch Method: SM 2320B Analysis Description: 2320B Alkalinity
Associated Lab Samples: 60321513010, 60321513011, 60321518006

METHOD BLANK: 2546893 Matrix: Water
Associated Lab Samples: 60321513010, 60321513011, 60321518006

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Alkalinity, Total as CaCO3	mg/L	<6.5	20.0	6.5	11/25/19 15:29	

LABORATORY CONTROL SAMPLE: 2546894

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Alkalinity, Total as CaCO3	mg/L	500	488	98	90-110	

SAMPLE DUPLICATE: 2546895

Parameter	Units	60321513010 Result	Dup Result	RPD	Max RPD	Qualifiers
Alkalinity, Total as CaCO3	mg/L	428	429	0	10	

SAMPLE DUPLICATE: 2546897

Parameter	Units	60321518006 Result	Dup Result	RPD	Max RPD	Qualifiers
Alkalinity, Total as CaCO3	mg/L	381	406	6	10	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60321518

QC Batch: 624015 Analysis Method: SM 2540C
QC Batch Method: SM 2540C Analysis Description: 2540C Total Dissolved Solids
Associated Lab Samples: 60321518001, 60321518002, 60321518003, 60321518004, 60321518005, 60321518007, 60321518008

METHOD BLANK: 2544577 Matrix: Water
Associated Lab Samples: 60321518001, 60321518002, 60321518003, 60321518004, 60321518005, 60321518007, 60321518008

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Total Dissolved Solids	mg/L	<5.0	5.0	5.0	11/21/19 16:08	

LABORATORY CONTROL SAMPLE: 2544578

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Total Dissolved Solids	mg/L	1000	1010	101	80-120	

SAMPLE DUPLICATE: 2544579

Parameter	Units	60321516004 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Dissolved Solids	mg/L	721	724	0	10	

SAMPLE DUPLICATE: 2544580

Parameter	Units	60321518004 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Dissolved Solids	mg/L	512	521	2	10	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60321518

QC Batch: 624081 Analysis Method: SM 2540C
QC Batch Method: SM 2540C Analysis Description: 2540C Total Dissolved Solids
Associated Lab Samples: 60321513010, 60321513011

METHOD BLANK: 2544812 Matrix: Water
Associated Lab Samples: 60321513010, 60321513011

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Total Dissolved Solids	mg/L	<5.0	5.0	5.0	11/22/19 08:51	

LABORATORY CONTROL SAMPLE: 2544813

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Total Dissolved Solids	mg/L	1000	990	99	80-120	

SAMPLE DUPLICATE: 2544814

Parameter	Units	60321433002 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Dissolved Solids	mg/L	2440	2470	1	10	

SAMPLE DUPLICATE: 2544815

Parameter	Units	60321513002 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Dissolved Solids	mg/L	927	959	3	10	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60321518

QC Batch: 624082
QC Batch Method: SM 2540C
Analysis Method: SM 2540C
Analysis Description: 2540C Total Dissolved Solids
Associated Lab Samples: 60321518006

METHOD BLANK: 2544816
Matrix: Water
Associated Lab Samples: 60321518006

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Total Dissolved Solids	mg/L	<5.0	5.0	5.0	11/22/19 11:13	

LABORATORY CONTROL SAMPLE: 2544817

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Total Dissolved Solids	mg/L	1000	964	96	80-120	

SAMPLE DUPLICATE: 2544818

Parameter	Units	60321513012 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Dissolved Solids	mg/L	779	854	9	10	

SAMPLE DUPLICATE: 2544819

Parameter	Units	60321518006 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Dissolved Solids	mg/L	628	643	2	10	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60321518

QC Batch: 625047
Analysis Method: EPA 300.0
QC Batch Method: EPA 300.0
Analysis Description: 300.0 IC Anions
Associated Lab Samples: 60321513010, 60321513011

METHOD BLANK: 2548479 Matrix: Water
Associated Lab Samples: 60321513010, 60321513011

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Chloride	mg/L	<0.22	1.0	0.22	11/27/19 10:18	
Fluoride	mg/L	<0.085	0.20	0.085	11/27/19 10:18	
Sulfate	mg/L	<0.23	1.0	0.23	11/27/19 10:18	

METHOD BLANK: 2550027 Matrix: Water
Associated Lab Samples: 60321513010, 60321513011

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Chloride	mg/L	<0.22	1.0	0.22	11/29/19 20:37	
Fluoride	mg/L	<0.085	0.20	0.085	11/29/19 20:37	
Sulfate	mg/L	<0.23	1.0	0.23	11/29/19 20:37	

METHOD BLANK: 2550207 Matrix: Water
Associated Lab Samples: 60321513010, 60321513011

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Chloride	mg/L	<0.22	1.0	0.22	12/02/19 09:31	
Fluoride	mg/L	<0.085	0.20	0.085	12/02/19 09:31	
Sulfate	mg/L	<0.23	1.0	0.23	12/02/19 09:31	

LABORATORY CONTROL SAMPLE: 2548480

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Chloride	mg/L	5	4.8	96	90-110	
Fluoride	mg/L	2.5	2.5	99	90-110	
Sulfate	mg/L	5	4.5	90	90-110	

LABORATORY CONTROL SAMPLE: 2550028

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Chloride	mg/L	5	4.8	96	90-110	
Fluoride	mg/L	2.5	2.4	95	90-110	
Sulfate	mg/L	5	4.9	99	90-110	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60321518

LABORATORY CONTROL SAMPLE: 2550208

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Chloride	mg/L	5	5.0	99	90-110	
Fluoride	mg/L	2.5	2.5	99	90-110	
Sulfate	mg/L	5	4.9	99	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2548481 2548482

Parameter	Units	60321513002 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Chloride	mg/L	102	100	100	218	210	116	108	80-120	4	15	
Fluoride	mg/L	0.31	2.5	2.5	3.1	3.1	110	112	80-120	1	15	
Sulfate	mg/L	317	250	250	568	565	100	99	80-120	0	15	

MATRIX SPIKE SAMPLE: 2548483

Parameter	Units	60321513010 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Chloride	mg/L	6.4	5	11.6	103	80-120	
Fluoride	mg/L	0.28	2.5	3.0	110	80-120	
Sulfate	mg/L	26.5	10	37.2	107	80-120	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project:	AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.:	60321518

QC Batch:	625048	Analysis Method:	EPA 300.0
QC Batch Method:	EPA 300.0	Analysis Description:	300.0 IC Anions

Associated Lab Samples: 60321518001, 60321518002, 60321518003, 60321518004, 60321518005, 60321518007, 60321518008

METHOD BLANK: 2548493 Matrix: Water

Associated Lab Samples: 60321518001, 60321518002, 60321518003, 60321518004, 60321518005, 60321518007, 60321518008

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Chloride	mg/L	<0.22	1.0	0.22	11/27/19 10:45	
Fluoride	mg/L	<0.085	0.20	0.085	11/27/19 10:45	
Sulfate	mg/L	<0.23	1.0	0.23	11/27/19 10:45	

METHOD BLANK: 2550023 Matrix: Water

Associated Lab Samples: 60321518001, 60321518002, 60321518003, 60321518004, 60321518005, 60321518007, 60321518008

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Chloride	mg/L	<0.22	1.0	0.22	12/02/19 09:31	
Fluoride	mg/L	<0.085	0.20	0.085	12/02/19 09:31	
Sulfate	mg/L	<0.23	1.0	0.23	12/02/19 09:31	

METHOD BLANK: 2551117 Matrix: Water

Associated Lab Samples: 60321518001, 60321518002, 60321518003, 60321518004, 60321518005, 60321518007, 60321518008

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Chloride	mg/L	<0.22	1.0	0.22	12/03/19 09:27	
Fluoride	mg/L	<0.085	0.20	0.085	12/03/19 09:27	
Sulfate	mg/L	<0.23	1.0	0.23	12/03/19 09:27	

LABORATORY CONTROL SAMPLE: 2548494

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Chloride	mg/L	5	4.7	94	90-110	
Fluoride	mg/L	2.5	2.7	108	90-110	
Sulfate	mg/L	5	4.7	94	90-110	

LABORATORY CONTROL SAMPLE: 2550024

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Chloride	mg/L	5	5.0	99	90-110	
Fluoride	mg/L	2.5	2.5	99	90-110	
Sulfate	mg/L	5	4.9	99	90-110	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60321518

LABORATORY CONTROL SAMPLE: 2551118

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Chloride	mg/L	5	5.1	101	90-110	
Fluoride	mg/L	2.5	2.6	104	90-110	
Sulfate	mg/L	5	5.0	101	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2548495 2548496

Parameter	Units	60321515006 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Chloride	mg/L	12.5	5	5	17.9	17.8	108	107	80-120	0	15	
Fluoride	mg/L	0.45	2.5	2.5	3.1	3.1	105	104	80-120	0	15	
Sulfate	mg/L	71.8	25	25	102	102	123	119	80-120	1	15	E,M1

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2548497 2548498

Parameter	Units	60321516004 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Chloride	mg/L	83.5	25	25	113	112	117	116	80-120	0	15	E
Fluoride	mg/L	0.33	2.5	2.5	3.0	2.9	105	104	80-120	1	15	
Sulfate	mg/L	185	100	100	229	251	44	65	80-120	9	15	M1

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60321518

QC Batch: 625468
Analysis Method: EPA 300.0
QC Batch Method: EPA 300.0
Analysis Description: 300.0 IC Anions
Associated Lab Samples: 60321518006

METHOD BLANK: 2550404
Matrix: Water
Associated Lab Samples: 60321518006

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Chloride	mg/L	<0.22	1.0	0.22	12/02/19 09:11	
Fluoride	mg/L	<0.085	0.20	0.085	12/02/19 09:11	
Sulfate	mg/L	<0.23	1.0	0.23	12/02/19 09:11	

METHOD BLANK: 2551173
Matrix: Water
Associated Lab Samples: 60321518006

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Chloride	mg/L	<0.22	1.0	0.22	12/03/19 11:31	
Fluoride	mg/L	<0.085	0.20	0.085	12/03/19 11:31	
Sulfate	mg/L	<0.23	1.0	0.23	12/03/19 11:31	

LABORATORY CONTROL SAMPLE: 2550405

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Chloride	mg/L	5	4.8	95	90-110	
Fluoride	mg/L	2.5	2.3	94	90-110	
Sulfate	mg/L	5	4.9	98	90-110	

LABORATORY CONTROL SAMPLE: 2551174

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Chloride	mg/L	5	4.8	96	90-110	
Fluoride	mg/L	2.5	2.3	93	90-110	
Sulfate	mg/L	5	4.9	98	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2550406 2550407

Parameter	Units	60321518006 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Chloride	mg/L	96.9	25	25	124	128	109	123	80-120	3	15	E,M1
Fluoride	mg/L	0.30	2.5	2.5	2.7	2.7	95	95	80-120	0	15	
Sulfate	mg/L	33.9	25	25	58.4	59.3	98	102	80-120	2	15	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60321518

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2550408 2550409

Parameter	Units	60321509010 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Chloride	mg/L	2.7	5	5	7.4	7.5	93	95	80-120	1	15	
Fluoride	mg/L	2.0	2.5	2.5	4.4	4.5	95	98	80-120	1	15	
Sulfate	mg/L	556	250	250	800	803	97	99	80-120	0	15	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALIFIERS

Project:	AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.:	60321518

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.

ND - Not Detected at or above adjusted reporting limit.

TNTC - Too Numerous To Count

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PQL - Practical Quantitation Limit.

RL - Reporting Limit - The lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix.

S - Surrogate

1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

LABORATORIES

PASI-K	Pace Analytical Services - Kansas City

ANALYTE QUALIFIERS

E	Analyte concentration exceeded the calibration range. The reported result is estimated.
M1	Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery.

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: AMEREN SIOUX ENERGY CTR SCPC
Pace Project No.: 60321518

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
60321513010	**S-BMW-1S**	EPA 200.7	624736	EPA 200.7	624858
60321513011	**S-BMW-3S**	EPA 200.7	624736	EPA 200.7	624858
60321518001	**S-UG-1A**	EPA 200.7	625027	EPA 200.7	625177
60321518002	**S-UG-2**	EPA 200.7	625027	EPA 200.7	625177
60321518003	**S-DG-1**	EPA 200.7	625027	EPA 200.7	625177
60321518004	**S-DG-2**	EPA 200.7	625027	EPA 200.7	625177
60321518005	**S-DG-3**	EPA 200.7	625027	EPA 200.7	625177
60321518006	**S-DG-4**	EPA 200.7	625027	EPA 200.7	625177
60321518007	**S-SCPC-DUP-1**	EPA 200.7	625027	EPA 200.7	625177
60321518008	**S-SCPC-FB-1**	EPA 200.7	625027	EPA 200.7	625177
60321513010	**S-BMW-1S**	SM 2320B	624580		
60321513011	**S-BMW-3S**	SM 2320B	624580		
60321518001	**S-UG-1A**	SM 2320B	624293		
60321518002	**S-UG-2**	SM 2320B	624293		
60321518003	**S-DG-1**	SM 2320B	624293		
60321518004	**S-DG-2**	SM 2320B	624293		
60321518005	**S-DG-3**	SM 2320B	624293		
60321518006	**S-DG-4**	SM 2320B	624580		
60321518007	**S-SCPC-DUP-1**	SM 2320B	624293		
60321518008	**S-SCPC-FB-1**	SM 2320B	624293		
60321513010	**S-BMW-1S**	SM 2540C	624081		
60321513011	**S-BMW-3S**	SM 2540C	624081		
60321518001	**S-UG-1A**	SM 2540C	624015		
60321518002	**S-UG-2**	SM 2540C	624015		
60321518003	**S-DG-1**	SM 2540C	624015		
60321518004	**S-DG-2**	SM 2540C	624015		
60321518005	**S-DG-3**	SM 2540C	624015		
60321518006	**S-DG-4**	SM 2540C	624082		
60321518007	**S-SCPC-DUP-1**	SM 2540C	624015		
60321518008	**S-SCPC-FB-1**	SM 2540C	624015		
60321513010	**S-BMW-1S**	EPA 300.0	625047		
60321513011	**S-BMW-3S**	EPA 300.0	625047		
60321518001	**S-UG-1A**	EPA 300.0	625048		
60321518002	**S-UG-2**	EPA 300.0	625048		
60321518003	**S-DG-1**	EPA 300.0	625048		
60321518004	**S-DG-2**	EPA 300.0	625048		
60321518005	**S-DG-3**	EPA 300.0	625048		
60321518006	**S-DG-4**	EPA 300.0	625468		
60321518007	**S-SCPC-DUP-1**	EPA 300.0	625048		
60321518008	**S-SCPC-FB-1**	EPA 300.0	625048		

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www.pacelabs.com

Sample Condition Upon Receipt

WO# : 60321518

60321518

Client Name: Golder

Courier: FedEx ☐ UPS ☐ VIA ☐ Clay ☐ PEX ☐ ECI ☐ Pace ☐ Xroads ☒ Client ☐ Other ☐

Tracking #: ______ Pace Shipping Label Used? Yes ☐ No ☒

Custody Seal on Cooler/Box Present: Yes ☒ No ☐ Seals intact: Yes ☒ No ☐

Packing Material: Bubble Wrap ☐ Bubble Bags ☒ Foam ☐ None ☐ Other ☐

Thermometer Used: T-299 **Type of Ice:** [✓ Wet] Blue None

Cooler Temperature (°C): **As-read** 1.8 **Corr. Factor** 0.2 **Corrected** 2.0

Date and initials of person examining contents: 11/15/19

Temperature should be above freezing to 6°C

Chain of Custody present:	☒Yes ☐No ☐N/A	
Chain of Custody relinquished:	☒Yes ☐No ☐N/A	
Samples arrived within holding time:	☒Yes ☐No ☐N/A	
Short Hold Time analyses (<72hr):	☐Yes ☒No ☐N/A	
Rush Turn Around Time requested:	☐Yes ☒No ☐N/A	
Sufficient volume:	☒Yes ☐No ☐N/A	
Correct containers used:	☒Yes ☐No ☐N/A	
Pace containers used:	☒Yes ☐No ☐N/A	
Containers intact:	☒Yes ☐No ☐N/A	
Unpreserved 5035A / TX1005/1006 soils frozen in 48hrs?	☐Yes ☐No ☒N/A	
Filtered volume received for dissolved tests?	☐Yes ☐No ☒N/A	
Sample labels match COC: Date / time / ID / analyses	☒Yes ☐No ☐N/A	
Samples contain multiple phases? Matrix: WT	☐Yes ☒No ☐N/A	
Containers requiring pH preservation in compliance? (HNO_3, H_2SO_4, HCl<2; NaOH>9 Sulfide, NaOH>10 Cyanide) (Exceptions: VOA, Micro, O&G, KS TPH, OK-DRO)	☒Yes ☐No ☐N/A	List sample IDs, volumes, lot #'s of preservative and the date/time added.
Cyanide water sample checks: Lead acetate strip turns dark? (Record only) Potassium iodide test strip turns blue/purple? (Preserve)	 ☐Yes ☐No ☐Yes ☐No	
Trip Blank present:	☐Yes ☐No ☒N/A	
Headspace in VOA vials (>6mm):	☐Yes ☐No ☒N/A	
Samples from USDA Regulated Area: State:	☐Yes ☐No ☒N/A	
Additional labels attached to 5035A / TX1005 vials in the field?	☐Yes ☐No ☒N/A	

Client Notification/ Resolution: Copy COC to Client? Y / N Field Data Required? Y / N

Person Contacted: ______ Date/Time: ______

Comments/ Resolution: ______

Project Manager Review: Jamie Church Date: 11/20/19

F-KS-C-003-Rev.11, February 28, 2018

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CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Page: 1 of 1

Section A
Required Client Information:

Company:	Golder Associates
Address:	13515 Barrett Parkway Dr., Ste 260 Ballwin, MO 63021
Email To:	jeffrey_ingram@golder.com
Phone:	636-724-9191
Fax:	636-724-9323
Requested Due Date/TAT:	**Standard**

Section B
Required Project Information:

Report To:	Jeffrey Ingram
Copy To:	
Purchase Order No.:	
Project Name:	Ameren Sioux Energy Center SCPC
Project Number:	

Section C
Invoice Information:

Attention:	
Company Name:	
Address:	
Pace Quote Reference:	
Pace Project Manager:	Jamie Church
Pace Profile #:	9285

REGULATORY AGENCY

☐ NPDES ☐ GROUND WATER ☐ DRINKING WATER
☐ UST ☐ RCRA ☐ OTHER ______

Site Location STATE: MO

Section D
Required Client Information

SAMPLE ID
(A-Z, 0-9 / ,-)
Sample IDs MUST BE UNIQUE

Valid Matrix Codes

MATRIX	CODE
DRINKING WATER	DW
WATER	WT
WASTE WATER	WW
PRODUCT	P
SOIL/SOLID	SL
OIL	OL
	WP
	AR
	OT
	TS

Requested Analysis Filtered (Y/N)

Pace Project No./ Lab I.D.: 60321518

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED COMPOSITE START DATE	COLLECTED COMPOSITE START TIME	COLLECTED COMPOSITE END/GRAB DATE	COLLECTED COMPOSITE END/GRAB TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H₂SO₄	HNO₃	HCl	NaOH	Na₂S₂O₃	Methanol	Other	Analysis Test (Y/N)	Metals* (N)	Chloride/Fluoride/Sulfate (N)	TDS (N)	Alkalinity (N)	Residual Chlorine (Y/N)	Pace Project No./ Lab I.D.
1	S-UG-1A	WT	G			11-14-19	0920		2	1		1							✓	✓	✓	✓		001
2	S-UG-2	WT	G			|	1603		2	1		1							✓	✓	✓	✓		002
3	S-DG-1	WT	G			|	1036		2	1		1							✓	✓	✓	✓		003
4	S-DG-2	WT	G			|	1215		2	1		1							✓	✓	✓	✓		004
5	S-DG-3	WT	G			|	1413		2	1		1							✓	✓	✓	✓		005
6	S-DG-4	WT	G			11-15-19	0950		2	1		1							✓	✓	✓	✓		006
7	S-SCPC-DUP-1	WT	G			11-14-19	—		2	1		1							✓	✓	✓	✓		007
8	S-SCPC-FB-1	WT	G			|	0950		2	1		1							✓	✓	✓	✓		008
9	MS	WT	G			11-15-19	0950		2	1		1							✓	✓	✓	✓		009
10	MSD	WT	G			|	0950		2	1		1							✓	✓	✓	✓		
11		WT	G																					
12		WT	G																					

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS: Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)
*EPA 200.7: B, Ca, Fe, Mn, Mg, K, Na	Annie Muehlfarth / Golder	11-15-19	1640	Angela McManus	11/15	1545				
	Angelo McManus	11/15	1545		11/16/19	0235	2.0	Y	Y	Y

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Annie Muehlfarth
SIGNATURE of SAMPLER: Annie Muehlfarth
DATE Signed (MM/DD/YY): 11-15-19

*Important Note: By signing this form you are accepting Pace's NET 30 day payment terms and agreeing to late charges of 1.5% per month for any invoices not paid within 30 days

F-ALL-Q-020rev.08, 12-Oct-2007

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Sample Condition Upon Receipt

WO# : 60321513
60321513

Client Name: Golder

Courier: FedEx ☐ UPS ☐ VIA ☐ Clay ☐ PEX ☐ ECI ☐ Pace ☐ Xroads ☑ Client ☐ Other ☐

Tracking #: ______ Pace Shipping Label Used? Yes ☐ No ☑

Custody Seal on Cooler/Box Present: Yes ☑ No ☐ Seals intact: Yes ☑ No ☐

Packing Material: Bubble Wrap ☐ Bubble Bags ☑ Foam ☐ None ☐ Other ☐

Thermometer Used: T-299 **Type of Ice:** [✓ Wet] Blue None

Cooler Temperature (°C): **As-read** 2.8, 2.3 **Corr. Factor** 0.2 **Corrected** 3.0, 2.5

Date and initials of person examining contents: 11/14/19

Temperature should be above freezing to 6°C

Chain of Custody present:	☑Yes ☐No ☐N/A	
Chain of Custody relinquished:	☑Yes ☐No ☐N/A	
Samples arrived within holding time:	☑Yes ☐No ☐N/A	
Short Hold Time analyses (<72hr):	☐Yes ☑No ☐N/A	
Rush Turn Around Time requested:	☐Yes ☑No ☐N/A	
Sufficient volume:	☑Yes ☐No ☐N/A	
Correct containers used:	☑Yes ☐No ☐N/A	
Pace containers used:	☑Yes ☐No ☐N/A	
Containers intact:	☑Yes ☐No ☐N/A	
Unpreserved 5035A / TX1005/1006 soils frozen in 48hrs?	☐Yes ☐No ☑N/A	
Filtered volume received for dissolved tests?	☐Yes ☐No ☑N/A	
Sample labels match COC: Date / time / ID / analyses	☑Yes ☐No ☐N/A	
Samples contain multiple phases? Matrix: WT	☐Yes ☑No ☐N/A	
Containers requiring pH preservation in compliance? (HNO$_3$, H$_2$SO$_4$, HCl<2; NaOH>9 Sulfide, NaOH>10 Cyanide) (Exceptions: VOA, Micro, O&G, KS TPH, OK-DRO)	☑Yes ☐No ☐N/A	List sample IDs, volumes, lot #'s of preservative and the date/time added.
Cyanide water sample checks: Lead acetate strip turns dark? (Record only) Potassium iodide test strip turns blue/purple? (Preserve)	 ☐Yes ☐No ☐Yes ☐No	
Trip Blank present:	☐Yes ☐No ☑N/A	
Headspace in VOA vials (>6mm):	☐Yes ☐No ☑N/A	
Samples from USDA Regulated Area: State:	☐Yes ☐No ☑N/A	
Additional labels attached to 5035A / TX1005 vials in the field?	☐Yes ☐No ☑N/A	

Client Notification/ Resolution: Copy COC to Client? Y / N Field Data Required? Y / N

Person Contacted: ______ Date/Time: ______

Comments/ Resolution: ______

Project Manager Review: Jamie Church Date: 11/20/19

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CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Page: 1 of 2

Section A
Required Client Information:

Company: Golder Associates
Address: 13515 Barrett Parkway Dr., Ste 260
Ballwin, MO 63021
Email To: jeffrey_ingram@golder.com
Phone: 636-724-9191 Fax: 636-724-9323
Requested Due Date/TAT: Standard

Section B
Required Project Information:

Report To: Jeffrey Ingram
Copy To:
Purchase Order No.:
Project Name: Ameren Sioux Energy Center SCPB
Project Number:

Section C
Invoice Information:

Attention:
Company Name:
Address:
Pace Quote Reference:
Pace Project Manager: Jamie Church
Pace Profile #: 9285

REGULATORY AGENCY

☐ NPDES ☑ GROUND WATER ☐ DRINKING WATER
☐ UST ☐ RCRA ☐ OTHER

Site Location MO
STATE:

Section D
Required Client Information

SAMPLE ID
(A-Z, 0-9 / ,-)
Sample IDs MUST BE UNIQUE

Valid Matrix Codes

MATRIX	CODE
DRINKING WATER	DW
WATER	WT
WASTE WATER	WW
PRODUCT	P
SOIL/SOLID	SL
OIL	OL
	WP
	AR
	OT
	TS

Requested Analysis Filtered (Y/N): Metals* N; Chloride/Fluoride/Sulfate N; TDS N; Alkalinity N

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED COMPOSITE START DATE	COLLECTED COMPOSITE START TIME	COLLECTED COMPOSITE END/GRAB DATE	COLLECTED COMPOSITE END/GRAB TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test	Metals*	Chloride/Fluoride/Sulfate	TDS	Alkalinity	Residual Chlorine (Y/N)	Pace Project No./ Lab I.D.
1	S-LMW-1S	WT	G			11-15-19	1314		2	1		1							✓	✓	✓	✓		001
2	S-LMW-2S	WT	G				1405		2	1		1							✓	✓	✓	✓		002
3	S-LMW-3S	WT	G				1105		2	1		1							✓	✓	✓	✓		003
4	S-LMW-4S	WT	G				1204		2	1		1							✓	✓	✓	✓		004
5	S-LMW-5S	WT	G				1052		2	1		1							✓	✓	✓	✓		005
6	S-LMW-6S	WT	G				1148		2	1		1							✓	✓	✓	✓		006
7	S-LMW-7S	WT	G				1231		2	1		1							✓	✓	✓	✓		007
8	S-LMW-8S	WT	G				1331		2	1		1							✓	✓	✓	✓		008
9	S-LMW-9S	WT	G				1418		2	1		1							✓	✓	✓	✓		009
10	S-BMW-1S	WT	G			11-13-19	1443		2	1		1							✓	✓	✓	✓		010
11	S-BMW-3S	WT	G			11-13-19	1218		2	1		1							✓	✓	✓	✓		011
12	S-LMW-DUP-1	WT	G				—		2	1		1							✓	✓	✓	✓		012

Pace Project No.: 60321513

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)
*EPA 200.7: B, Ca, Fe, Mn, Mg, K, Na	Annie Muehlfarth / Golder	11-15-19	1540	Angela McMaw	11-15-19	15:45				
	Angela McMaw	11-15-19	15:45		11/21/19	0735	3.0	Y	Y	Y
							2.5			

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Annie Muehlfarth
SIGNATURE of SAMPLER: Annie Muehlfarth
DATE Signed (MM/DD/YY): 11-15-19

*Important Note: By signing this form you are accepting Pace's NET 30 day payment terms and agreeing to late charges of 1.5% per month for any invoices not paid within 30 days.

F-ALL-Q-020rev.08, 12-Oct-2007

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CHAIN-OF-CUSTODY / Analytical Request Document

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Page: 2 of 2

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Phone: 636-724-9191
Fax: 636-724-9323
Requested Due Date/TAT: Standard

Section B
Required Project Information:

Report To: Jeffrey Ingram
Copy To:
Purchase Order No.:
Project Name: Ameren Sioux Energy Center SCPB
Project Number:

Section C
Invoice Information:

Attention:
Company Name:
Address:
Pace Quote Reference:
Pace Project Manager: Jamie Church
Pace Profile #: 9285

REGULATORY AGENCY

NPDES [✓ GROUND WATER] DRINKING WATER
UST RCRA OTHER ______

Site Location STATE: MO

Section D
Required Client Information

Valid Matrix Codes

MATRIX	CODE
DRINKING WATER	DW
WATER	WT
WASTE WATER	WW
PRODUCT	P
SOIL/SOLID	SL
OIL	OL
	WP
	AR
	OT
	TS

SAMPLE ID
(A-Z, 0-9 / ,-)
Sample IDs MUST BE UNIQUE

Requested Analysis Filtered (Y/N)

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED COMPOSITE START DATE	COLLECTED COMPOSITE START TIME	COLLECTED COMPOSITE END/GRAB DATE	COLLECTED COMPOSITE END/GRAB TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test Y/N	Metals*	Chloride/Fluoride/Sulfate	TDS	Alkalinity	Residual Chlorine (Y/N)	Pace Project No./ Lab I.D.
																			N	N	N	N		
1	S-LMW-DUP-2	WT	G			11-15-19	—		2	1		1							✓	✓	✓	✓		013
2	S-LMW-FB-1	WT	G			|	1140		2	1		1							✓	✓	✓	✓		014
3	S-LMW-FB-2	WT	G			|	1320		2	1		1							✓	✓	✓	✓		015
4		WT	G																					
5		WT	G																					
6		WT	G																					
7		WT	G																					
8		WT	G																					
9		WT	G																					
10		WT	G																					
11		WT	G																					
12		WT	G																					

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)
*EPA 200.7: B, Ca, Fe, Mn, Mg, K, Na	Angela Mun	11/15/19	1545		11.17.19	0235	3.6 2.5	Y	Y	Y

SAMPLE CONDITIONS

SAMPLER NAME AND SIGNATURE
PRINT Name of SAMPLER:
SIGNATURE of SAMPLER:
DATE Signed (MM/DD/YY):

MEMORANDUM

DATE January 10, 2020 **Project No.** 153140601

TO Project File
Golder Associates

CC Amanda Derhake, Jeff Ingram

FROM Tommy Goodwin **EMAIL Tommy_Goodwin@golder.com**

DATA VALIDATION SUMMARY, SIOUX ENERGY CENTER – SCPC – DATA PACKAGE 60321518

The following is a summary of instances where quality control criteria in the functional guidelines were not met and data qualification was required:

- When a compound was detected in a sample result between the MDL and the PQL the results were recorded at the detection value and qualified as estimates (J).
- When MS/MSD recovery exceeded the QC limits, the associated sample result was qualified as an estimate (J).

QA LEVEL II - INORGANIC DATA EVALUATION CHECKLIST

Company Name: Golder Associates
Project Name: Ameren - Sioux - SCPC
Reviewer: T Goodwin

Project Manager: J Ingram
Project Number: 153140601
Validation Date: 1/9/2020

Laboratory: Pace Analytical - KS
SDG #: 60321518
Analytical Method (type and no.): EPA 200.7 (Metals); SM 2320B (Alk); SM 2540C (TDS); EPA 300.0 (Anions)
Matrix: ☐ Air ☐ Soil/Sed. ☒ Water ☐ Waste ☐
Sample Names S-UG-1A, S-UG-2, S-DG-1, S-DG-2, S-DG-3, S-DG-4, S-SCPC-DUP-1, S-SCPC-FB-1, S-BMW-1S, S-BMW-3S

NOTE: Please provide calculation in Comment areas or on the back (if on the back please indicate in comment areas).

Field Information	**YES**	**NO**	**NA**	**COMMENTS**
a) Sampling dates noted?	☒	☐	☐	11/14-15/2019
b) Sampling team indicated?	☒	☐	☐	
c) Sample location noted?	☒	☐	☐	
d) Sample depth indicated (Soils)?	☐	☐	☒	
e) Sample type indicated ([✓ grab]/composite)?	☒	☐	☐	
f) Field QC noted?	☒	☐	☐	
g) Field parameters collected (note types)?	☒	☐	☐	pH, Sp.Cond, ORP, Temp, DO, Turb
h) Field Calibration within control limits?	☒	☐	☐	
i) Notations of unacceptable field conditions/performances from field logs or field notes?	☐	☒	☐	
j) Does the laboratory narrative indicate deficiencies?	☐	☐	☒	

Note Deficiencies:

Chain-of-Custody (COC)	**YES**	**NO**	**NA**	**COMMENTS**
a) Was the COC properly completed?	☒	☐	☐	
b) Was the COC signed by both field and laboratory personnel?	☐	☒	☐	Page 2 of COC not completed/signed by field staff
c) Were samples received in good condition?	☒	☐	☐	

General (reference QAPP or Method)	**YES**	**NO**	**NA**	**COMMENTS**
a) Were hold times met for sample pretreatment?	☒	☐	☐	
b) Were hold times met for sample analysis?	☒	☐	☐	
c) Were the correct preservatives used?	☒	☐	☐	
d) Was the correct method used?	☒	☐	☐	
e) Were appropriate reporting limits achieved?	☒	☐	☐	
f) Were any sample dilutions noted?	☒	☐	☐	See Notes
g) Were any matrix problems noted?	☐	☒	☐	

QA LEVEL II - INORGANIC DATA EVALUATION CHECKLIST

Blanks	**YES**	**NO**	**NA**	**COMMENTS**
a) Were analytes detected in the method blank(s)?	☒	☐	☐	See Notes
b) Were analytes detected in the field blank(s)?	☒	☐	☐	See Notes
c) Were analytes detected in the equipment blank(s)?	☐	☐	☒	
d) Were analytes detected in the trip blank(s)?	☐	☐	☒	

Laboratory Control Sample (LCS)	**YES**	**NO**	**NA**	**COMMENTS**
a) Was a LCS analyzed once per SDG?	☒	☐	☐	
b) Were the proper analytes included in the LCS?	☒	☐	☐	
c) Was the LCS accuracy criteria met?	☒	☐	☐	

Duplicates	**YES**	**NO**	**NA**	**COMMENTS**
a) Were field duplicates collected (note original and duplicate sample names)?	☒	☐	☐	DUP-1 @ S-DG-2 FB-1 @ S-UG-1A
b) Were field dup. precision criteria met (note RPD)?	☒	☐	☐	See Notes
c) Were lab duplicates analyzed (note original and duplicate samples)?	☒	☐	☐	-13010 (Alk); -18006 (Alk, TDS); -18004 (TDS)
d) Were lab dup. precision criteria met (note RPD)?	☒	☐	☐	See Notes

Blind Standards	**YES**	**NO**	**NA**	**COMMENTS**
a) Was a blind standard used (indicate name, analytes included and concentrations)?	☐	☒	☐	
b) Was the %D within control limits?	☐	☐	☒	

Matrix Spike/Matrix Spike Duplicate (MS/MSD)	**YES**	**NO**	**NA**	**COMMENTS**
a) Was MS accuracy criteria met?	☐	☒	☐	See Notes
Recovery could not be calculated since sample contained high concentration of analyte?	☐	☐	☒	
b) Was MSD accuracy criteria met?	☐	☒	☐	See Notes
Recovery could not be calculated since sample contained high concentration of analyte?	☐	☐	☒	
c) Were MS/MSD precision criteria met?	☒	☐	☐	

Comments/Notes:

FB-1: TDS (5.0), Cl (0.45)

MB: -13010-11: Fe (21.5)

MS/MSD: -18006: Cl_MSD-H (123% of 80-120%); -13010: Ca_MS-L (26% of 70-130%)

Max Field Duplicate RPD: 7.4% (Limit 20%)

Max Lab Duplicated RPD: 6% (Limit 10%)

Dilution: Chloride and Sulfate diluted in several samples; no qualification is required.

QA LEVEL II - INORGANIC DATA EVALUATION CHECKLIST

Data Qualification:

Sample Name	Constituent(s)	Result	Qualifier	Reason
S-DG-4	Chloride (Cl)	96.9	J	MSD Exceeded QC Range
S-BMW-1S	Calcium (Ca)	149,000	J	MS Exceeded QC Range

Signature: Tommy J Good Jr

Date: 1/09/2020

APPENDIX B

Alternative Source Demonstration-August 2019 Sampling Event

SCPC - Alternative Source Demonstration

Sioux Energy Center, St. Charles County, Missouri, USA

Submitted to:

Ameren Missouri
1901 Chouteau Ave, St. Louis, MO 63103

Submitted by:

Golder Associates Inc.
13515 Barrett Parkway Drive, Suite 260, Ballwin, Missouri, USA 63021

+1 314 984-8800

January 2020

Distribution List

1 Electronic Copy - Ameren Missouri

1 Hard Copy - Golder

Table of Contents

Tables

FIGURES

1.0 CERTIFICATION STATEMENT

This *SCPC – Alternative Source Demonstration, Sioux Energy Center, St. Charles County, Missouri, USA* has been prepared to comply with the United States Environmental Protection Agency (EPA) coal combustion residual (CCR) rule) under the direction of a licensed professional engineer with Golder Associates Inc.

I hereby certify that this *SCPC – Alternative Source Demonstration, Sioux Energy Center, St. Charles County, Missouri, USA* located at 8501 Missouri 94, West Alton, Missouri 63386 has been prepared to meet the requirements of 40 CFR §257.94(e)(2).

GOLDER ASSOCIATES INC.

MARK N.
HADDOCK
NUMBER
E-2001018745
1-30-20

Mark Haddock, P.E., R.G.

Principal, Practice Leader

2.0 INTRODUCTION

In accordance with the United States Environmental Protection Agency (EPA) coal combustion residual (CCR) rule (CCR Rule or The Rule), this *SCPC – Alternative Source Demonstration* has been prepared to document an Alternative Source Demonstration (ASD) for a Statistically Significant Increase (SSI) calculated at Ameren Missouri's (Ameren) Sioux Energy Center (SEC), Utility Waste Landfill (UWL) SCPC Cell 1. This document satisfies the requirements of §257.94(e)(2) which allows the owner or operator to demonstrate that a source other than the CCR Unit has caused an SSI and that the apparent SSI was the result of an alternative source or resulted from errors in sampling, analysis, statistical evaluation, or natural variation in groundwater quality.

3.0 SITE DESCRIPTION AND BACKGROUND

Ameren owns and operates the SEC in St. Charles County, Missouri located approximately 12 miles west-northwest of the confluence of the Mississippi and Missouri Rivers. **Figure 1** depicts the site location and layout, including the location of SCPC. The SEC is approximately 1,025 acres and is located in the floodplain between the Mississippi and Missouri Rivers. The SEC is bounded to the north by wooded areas associated with the Mississippi River. The property is bounded to the south by a railroad. The SEC is bounded to the east and west by agricultural fields.

3.1 Geological and Hydrogeological Setting

The SCPC lies between the Mississippi River to the north and the Missouri River to the south. Flow and deposition from these rivers have resulted in thick alluvial deposits which lie unconformable on top of bedrock. These alluvial deposits, which can range from approximately 100 to 130 feet thick, make up the uppermost aquifer called the alluvial aquifer. Overall, this aquifer is described as a fining upwards sequence of stratified sands and gravels with varying amounts of silts and clays. Drilling in the alluvial aquifer identified different sub-units, including floodplain deposits, natural levee deposits, and channel deposits along with volumetrically less important loess deposits. Grain sizes of these alluvial deposits are highly variable.

Beneath the alluvial aquifer lies the bedrock aquifer. Bedrock in this region includes Mississippian-aged rocks of the Meramecian Series. Formations include primarily limestone, dolomite, and shale and are comprised of the Salem Formation overlying the Warsaw Formation and the Burlington-Keokuk Formation.

3.2 Utility Waste Landfill Cell 1 - SCPC

UWL Cell 1 is referred to by Ameren as the SCPC, or "Gypsum Pond" Cell 1. The SCPC is approximately 37.5 acres in size and is located south of the generating plant on the south side of Highway 94 (**Figure 1**). The CCR Unit manages Coal Combustion Residuals (CCR) from the SEC Wet Flue-Gas Desulfurization System (WFGD) which began operation in 2010.

The WFGD process occurs after the removal of slag and fly ash where a crushed limestone ($CaCO_3$) mix is introduced into the boiler flue gas flow. The limestone reacts with the sulfur dioxide (SO_2) in the flue gas and produces 'synthetic' gypsum (calcium sulfate dihydrate ($CaSO_4 * 2H_2O$)). The resultant gypsum material is wet sluiced from the plant across the highway to the SCPC. Once there, the gypsum dewaters by gravity with the sluice conveying water recycled back to the WFGD for reuse. The primary soluble constituents of the gypsum CCR are sulfate, calcium, chloride, and sodium (Gredell and Reitz & Jens, 2014).

The SCPC was constructed with a composite liner system consisting of two feet of compacted clay soil with a hydraulic conductivity of less than 1 X 10^{-7} centimeters per second (cm/sec) overlain by an 80-mil HDPE geomembrane liner. Information on the design of the UWL is available in the 2014 Proposed Construction Permit Modification, Construction Permit Number 0918301 (Gredell and Reitz & Jens, 2014).

A groundwater monitoring well network was installed in 2007 and 2008 in order to permit the UWL construction. This monitoring well network was approved by the Missouri Department of Natural Resources (MDNR) and consists of 16 monitoring wells ringing the current and proposed future extents of the UWL (**Figure 1**). These monitoring wells are installed in the uppermost portions of the alluvial aquifer, just below the seasonally low elevation for groundwater. Quarterly groundwater samples have been collected in these monitoring wells since June 2008 for the state required UWL parameters.

The permit for the SCPC was issued July 30, 2010 (permit #0918301). Nine (9) sampling events were performed prior to July 30, 2010 and represent groundwater quality prior to WFGD placement in the UWL. The results from these pre-disposal monitoring events are used in conjunction with other site information in the ASD presented below.

3.3 CCR Rule Groundwater Monitoring

As required by the CCR Rule, the following were completed prior to the October 17, 2017 deadline; (1) a groundwater monitoring well system was installed and certified by a Professional Engineer, (2) a Statistical Method Certification was prepared and certified by a Professional Engineer, (3) a Groundwater Monitoring Plan (GMP) was prepared recording the design, installation, development, sampling procedures, as well as statistical methods, and placed in the owner’s operating record, and (4) eight baseline groundwater sampling events were completed for all Appendix III and Appendix IV parameters of CCR Rule.

The groundwater monitoring system for the SCPC consists of eight (8) monitoring wells screened in the uppermost aquifer (alluvial aquifer) as shown on **Figure 1**. Six (6) existing monitoring wells (UG-1A, UG-2, DG-1, DG-2, DG-3, and DG-4) were installed by Gredell Engineering Resources, Inc. in December 2007 and June 2008 as a part of the state UWL monitoring program. The remaining monitoring wells (BMW-1S and BMW-3S) were installed by Golder in 2016 for CCR Rule groundwater monitoring purposes. More information on the design and installation of the monitoring wells is provided in the SCPC GMP and the SCPC 2017 Annual Report.

Between May 2016 and June 2017, eight (8) baseline sampling events were completed for the SCPC. After baseline sampling, the first Detection Monitoring event was completed in November of 2017. The following Appendix III constituents were sampled during detection monitoring;

- Boron
- Calcium
- Chloride
- pH
- Sulfate
- Total Dissolved Solids (TDS)
- Fluoride

In January 2018, background results from the eight (8) baseline sampling events were used to calculate statistical upper prediction limits (UPLs). These UPLs were then compared to the Detection Monitoring results from the November 2017 samples and subsequent semi-annual detection monitoring sampling events. If results from the Detection Monitoring sampling were higher than the calculated UPL, it was considered to be an initial exceedance, in which case a verification sample was then collected and tested in accordance with the SCPC Statistical Analysis Plan. At the SCPC in November 2017, initial exceedances were identified in monitoring wells UG-2 for fluoride and DG-4 for boron. Verification sampling results confirmed a Statistically Significant Increase (SSI) for fluoride at UG-2. An ASD was prepared that demonstrated that this SSI was primarily caused by natural temporal and spatial variability in the aquifer, a relatively low calculated UPL when compared to historical data from this well, and low fluoride results that are near the laboratory practical quantitation limit (PQL). In May 2018, there were three (3) initial exceedances for boron at DG-1, DG-3, and DG-4 but none were confirmed by verification sampling. In November 2018, there were five initial exceedances for pH at DG-1, DG-2, and DG-3; boron at DG-1; and sulfate at DG-3. Similar to May 2018, none were confirmed by verification sampling.

For the August 2019 sampling event, there were four initial exceedances for calcium and chloride at UG-1A, for fluoride at UG-2 and for sulfate at DG-3. All except sulfate at DG-3 were confirmed by verification sampling. The SSIs from the August 2019 sampling event are displayed in **Table 1** below and are for calcium and chloride at UG-1A and fluoride at UG-2.

4.0 REVIEW OF THE STATISTICALLY SIGNIFICANT INCREASES

Analytical data from two monitoring wells confirmed SSIs during the August 2019 sampling event; UG-1A and UG-2. These wells are screened in the upper portion of the alluvial aquifer just below the average seasonal low for groundwater. As shown on **Figure 1**, UG-1A and UG-2 are located north or northwest of the SCPC and south of Highway 94, the generating plant, and the two surface impoundments near the plant (SCPA and SCPB).

Based on Golder's review of the pre-disposal data discussed in Section 3.2 above, and our comparison of those pre-disposal data with the results from the eight CCR-rule baseline events, it was concluded that the groundwater at the SCPC contained low-level pre-existing impacts from CCR that pre-dated SCPC operation. As a result of these pre-existing impacts, the SCPC statistical analysis plan uses intrawell UPLs to determine SSIs. Intrawell UPLs are calculated from historical data within a particular well, and not by pooling data from the background wells, such that individual limits are calculated for each constituent in each well in the monitoring program.

Table 1 - Review of Statistically Significant Increases

Constituent	Well ID	UPL Based on Baseline Events	August 2019 Updated UPL	Baseline Sampling Event Range	All CCR Sampling Events (through January 2019) Range	State UWL Program Sampling Events Range	August 2019 Results	October 2019 Results
Calcium (µg/L)	UG-1A	164,715	177,869	124,000 - 154,000	116,000 - 154,000	129,000 - 212,000	177,000	166,600
Chloride (mg/L)	UG-1A	131.6	145.9	25.4 - 99.8	25.4 - 99.8	15 - 159	145	140
Fluoride (mg/L)	UG-2	0.24	0.3308	0.17 - 0.24	ND - 0.28	0.16 - 0.34	0.25	0.30

Notes

1) mg/L – milligrams per liter.
2) µg/L – micrograms per liter.
3) UPL – Upper Prediction Limit. UPL's calculated using Sanitas^{TM} software.
4) ND – Non-detect.

5.0 EVIDENCE OF SSI FROM ALTERNATIVE SOURCE

Several different lines of evidence indicate that the SSIs at the SCPC are not caused by a release from the SCPC, but rather from an alternative source. The following section describes the different lines of evidence, listed below, that demonstrate this position.

- Documentation of pre-existing, low level concentrations of CCR indicators in groundwater that pre-date the SCPC operation.
- Comparison of key WFGD indicator parameter concentrations (sulfate, calcium, chloride, and boron) prior to and following receipt of CCR in the SCPC.
- Documentation of the construction of the SCPC with a 80-mil geomembrane liner and a 2-foot thick clay barrier.
- Preparation of geochemical models displaying current and historical groundwater chemistries.
- Road salt (sodium chloride) is commonly used for road de-icing purposes on Missouri State Highway 94, which is located within 300 feet of UG-1A.

5.1 CCR Indicators

Several types of CCR byproducts are generated by coal-fired power plants. The different types of CCR typically display distinct geochemical signatures and indicator parameters. **Table 2** below describes the different types of CCRs and their typical indicator parameters (USEPA 2018, EPRI 2011, EPRI 2012, and EPRI 2017).

Table 2: Types of CCR and Typical Indicator Parameters

Type of CCR	Description of CCR (USEPA 2018)	Key Indicators (EPRI 2011, 2012, 2017)
Fly Ash	Fine grained, powdery material composed mostly of silica made from the burning of finely ground coal in the boiler.	■ Boron ■ Molybdenum ■ Lithium ■ Sulfate ■ Bromide ■ Potassium ■ Sodium ■ Fluoride
Boiler Slag / Bottom Ash	Molten bottom ash from the slag tap and cyclone type furnaces that turns into pellets that have a smooth glassy appearance after quenching with water.	
Flue Gas Desulfurization Material (FGD)	A material leftover from the process of reducing sulfur dioxide emissions from a coal-fired boiler that can be a wet sludge consisting of calcium sulfite or calcium sulfate or a dry powdered material that is a mixture of sulfites and sulfates.	■ Sulfate ■ Fluoride ■ Calcium ■ Boron ■ Bromide ■ Chloride

Notes:

1) Fly Ash and Boiler Slag/Bottom Ash typically have the same indicator parameters.

2) Definitions from USEPA website, available at https://www.epa.gov/coalash/coal-ash-basics.
3) Key indicators from EPRI 2011, 2012, and 2017 as well as Gredell and Reitz & Jens, 2014.

In 2011, the Electric Power Research Institute (EPRI) completed a study of FGD composition from many sites across the country and determined that greater than 90% of the material present in FGD deposits is calcium sulfate dihydrate ($CaSO_4$*$2H_20$). Therefore, impacts from WFGD deposits will likely contain high concentrations of sulfate and calcium compared to background and adjacent samples. Additionally, chloride, fluoride, boron, and sodium concentrations are also potential indicators of WFGD gypsum (EPRI 2012, EPRI 2017).

5.1.1 Sulfate Concentrations at the SCPC

Sulfate is the key indicator of potential WFGD impacts because high concentrations of sulfate are found ubiquitously in WFGD materials with the exception of strongly reducing conditions, and sulfate is relatively mobile in most hydrogeological environments. The groundwater around the SCPC does not demonstrate strongly reducing conditions, such as dissolved oxygen values below 0.5 milligrams per liter (mg/L), negative oxidation reduction potential (ORP), dissolved iron concentrations above 1 mg/L, nor are hydrogen sulfide odors reported at the SCPC. Therefore, if the SSI was caused by impacts from the SCPC, it would be expected that high sulfate values would increase following placement of CCR materials.

Figure 2 displays the full historical set of sulfate concentrations at UG-1A and UG-2 including the period prior to the receipt of CCR. If the SSI was caused by impacts from the SCPC, sulfate concentrations would be expected to increase following the placement of CCR materials. **Figure 2** demonstrates that current sulfate concentrations are at levels similar too or below those from pre-CCR placement.

5.1.2 Boron Concentrations

Based on the EPRI (2011, 2012, 2017) reports, elevated concentrations in boron may indicate WFGD impacts. Like chloride and sodium, boron is soluble and mobile, and thus a good tracer for CCR related impacts. However, any increased boron concentrations associated with a release from a WFGD type impoundment would be expected to also contain increasing sulfate and calcium concentrations, as discussed in previous sections. If groundwater was impacted by the SCPC, current boron concentrations should be statistically elevated with respect to pre-CCR placement.

Figure 3 displays boron concentrations at UG-1A and UG-2 from prior to the receipt of CCR through the current CCR Rule sampling. This figure demonstrates that current boron concentrations are at similar levels to those from pre-CCR placement.

5.2 SSIs at UG-1A

5.2.1 Calcium Concentrations

Calcium is a key indicator in WFGD impoundments because there are high concentrations of calcium (calcium sulfate dihydrate) in WFGD type impoundments. Like sulfate, if the SSI was caused by impacts from the SCPC, calcium concentrations would be noticeably higher and at levels statistically higher than pre-CCR placement.

The initial intrawell UPL for calcium at UG-1A is 164,715 micrograms per liter (µg/L) and was calculated using the results of the eight initial CCR Rule baseline sampling events that ranged from 124,000 to 154,000 µg/L. The UPLs were updated after the August 2019 sampling event as outlined by the Statistical Analysis Plan. The updated UPL value that will be used for UG-1A, starting with the November 2019 sampling event, is 177,869 µg/L (**Figure 4**). During the August 2019 Detection Monitoring event, a value of 177,000 µg/L was reported, which was confirmed by a value of 166,600 µg/L during the verification sampling.

Figure 4 shows a time series plot of calcium and compares data from historic State UWL sampling and CCR Rule sampling. Current calcium concentrations in monitoring well UG-1A are similar to or lower than those reported prior to the operation of the SCPC. If only the data collected in the state program prior to the receipt of CCR was used to calculate the prediction limit, the resulting limit would be 233,576 µg/L, which is well above the August value of 177,000 µg/L.

Based on these data, in addition to the observations reported above for sulfate and boron, the variability in calcium concentrations over time is not a result of WFGD influence on the groundwater. It is likely a result of geochemical variability and the limited sample set used for UPL calculation that does not reflect the whole variability of the aquifer.

5.2.2 Chloride and Sodium Concentrations

Chloride and sodium can be present at elevated concentrations within the SCPC because the water used for transporting the slurry to the SCPC is in a closed loop, meaning water is being recycled and re-used, resulting in increased chloride and sodium concentrations. Chloride and sodium are also highly soluble, mobile, and conservative (i.e., don’t interact with geologic materials) under most hydrogeological environments, and as such, are routinely used as indicator parameters of landfill leachate migration at municipal waste facilities throughout the United States. Therefore, if the SSI was caused by an impact from the SCPC, chloride and sodium concentrations would be expected to increase after the placement of CCR. Only chloride is required to be monitored as part of the CCR Rule.

The initial intrawell UPL for chloride at UG-1A is 131.6 mg/L and was calculated using the results of the eight initial CCR Rule baseline sampling events that ranged from 25.4 to 99.8 mg/L. UPLs were updated after the August 2019 sampling event as outlined by the Statistical Analysis Plan. The updated chloride UPL value that will be used for UG-1A, starting with the November 2019 sampling event, is 145.9 mg/L (**Figure 5**). During the August 2019 Detection Monitoring event, a value of 145 mg/L was reported, which was confirmed by a value of 140 mg/L during the verification sampling.

Figure 5 shows a time series plot of chloride and compares data from historic State UWL sampling and CCR Rule sampling. Current chloride concentrations in monitoring well UG-1A are similar to or lower than those reported prior to the operation of the SCPC. If only the data collected in the state program prior to the receipt of CCR was used to calculate the prediction limit, the resulting limit would be 215.5 mg/L, which is well above the August value of 145 mg/L.

Based on these data, in addition to the observations reported above for sulfate and boron, the variability in chloride concentrations over time is not a result of WFGD influence on the groundwater. It is likely a result of geochemical variability and the limited sample set used for UPL calculation that does not reflect the whole variability of the aquifer.

Additionally, while WGFD CCR materials contain high concentrations of chloride, a common alternative source for chloride is road salt (sodium chloride). Road salt is commonly used for road de-icing purposes on Missouri State Highway 94, which is located within 300 feet of UG-1A. **Figure 6** is a multi-constituent time series plot displaying sodium and chloride concentrations. Results from this plot display a good correlation between sodium and chloride results. The seasonal variation in sodium and chloride results is likely caused by road salt application, which subsequently dissolves and infiltrates into the shallow alluvial aquifer.

5.3 SSI at UG-2

5.3.1 Fluoride Concentrations

The intrawell UPL for fluoride at UG-2 is 0.24 mg/L, which is only slightly above the PQL of 0.20 mg/L provided by the laboratory. The UPL of 0.24 mg/L was based on the results of the eight CCR Rule baseline sampling events for UG-2 that ranged from 0.17 to 0.24 mg/L. The results from this small dataset could not be normalized, therefore, a non-parametric limit was used as the prediction limit (i.e., the highest of the baseline sampling results). UPLs were updated after the August 2019 sampling event as outlined by the Statistical Analysis Plan. Using the expanded dataset, the values could be normalized and the updated UPL value that will be used for UG-2, starting with the November 2019 sampling event, is 0.3308 mg/L. During the August 2019 Detection Monitoring event, a value of 0.25 mg/L was reported, which was confirmed by a value of 0.30 mg/L during subsequent verification sampling. These values do represent an SSI, but it is important to note they are very low (within 0.01 and 0.06 mg/L of the baseline UPL, respectively) and close to the PQL value the laboratory can accurately detect.

While sulfate and calcium are the two primary components of WFGD byproducts, fluoride (which triggered the SSI at UG-2) may also be an indicator of potential impacts from WFGD deposits. However, any increased fluoride concentrations associated with a release from a WFGD type impoundment would be expected to also contain increasing sulfate and calcium concentrations. So, while it is possible that the SSI reported for fluoride in monitoring well UG-2 is from a release of WFGD, the absence of increased concentrations for sulfate and calcium effectively eliminate WFGD as the source.

Figure 7 shows a time series plot of fluoride and compares data from historic State UWL sampling and CCR Rule sampling. Current fluoride concentrations in monitoring well UG-2 are similar to those reported prior to the operation of the SCPC. In addition, fluoride concentrations have varied between 0.16 mg/L and 0.34 mg/L over the entire historical monitoring period. Based on these data, in addition to the observations reported above for sulfate and calcium, the variability in fluoride concentrations over time is not a result of WFGD influence on the groundwater, but is likely a result of geochemical variability or other sources not related to the SCPC.

As also shown on **Figure 7**, if only the fluoride results reported prior to placement of WFGD waste are used, the calculated UPL is 0.3371 mg/L, which is approximately 0.097 mg/L higher than the UPL calculated from the eight baseline samples collected for the CCR Rule and 0.037 mg/L higher than the result reported for the verification sampling event. From this, it is clear that the calculated prediction limit from the CCR Rule was biased low because the results reported during the initial eight (8) CCR Rule baseline sampling rounds were relatively low for fluoride in this well. If the historical data are used to supplement the results collected during the CCR Rule baseline period, no SSI would be triggered for fluoride in UG-2.

The pre-CCR based prediction limit of 0.3371 mg/L is also within the range of fluoride concentrations reported for upgradient background wells BMW-1S and BMW-3S, which are located approximately ½ mile to the northwest of the SEC. The calculated initial background limit for fluoride in background wells BMW-1S and BMW-3S is 0.38 mg/L. These similarities in concentrations between the upgradient background wells and the pre-CCR based prediction limit for the SCPC is an indication that the pre-CCR based prediction limit and the updated prediction limit for fluoride are more representative of true background limits for fluoride.

5.4 Geochemical Modeling

In June 2006, temporary groundwater piezometers that were installed as part of the Detailed Site Investigation (DSI) were sampled for major cation and anion concentrations. These data are available in Appendix 13 of the DSI and the piezometer locations are provided in **Figure 1**. Additionally, during the Detection Monitoring event in August 2019, major cation and anion concentrations were collected from the CCR Rule monitoring network for the

SCPC. These data were used to compare current major ion chemistry with the chemistry from 2006, four (4) years prior to placement of CCR in the UWL.

Table 3 contains the values of the major cations and anions from both the recent and historical sampling events. These data were used in the generation of the Stiff and Piper diagrams discussed below. While most of the numbers are similar between the two datasets, chloride and sodium values are significantly higher for some of the wells located near roads. As discussed above, these changes in groundwater chemistry are likely caused by the use of road salt on Highway 94 and are not a result of the SCPC or any other source of CCR.

5.4.1 Stiff Diagrams

Stiff diagrams visually display the major cation and anion data. **Figure 8**, displays the Stiff diagrams from the historical 2006 data, as well as the current SCPC and SCL4A CCR Rule monitoring data. Data from 2006 display a similar distribution to that of August 2019 data. The only major difference between the two sampling events is the increase in the sodium + potassium and chloride plots, causing a slightly different shape in monitoring wells UG-1A, UG-2, and UG-3 relative to piezometers PZ-4, PZ-21, and PZ-36. As discussed above, sodium and chloride concentrations are very seasonally dependent and are influenced by the use of road salt on the nearby Highway 94. Therefore, except for seasonal changes in chloride and sodium, overall groundwater chemistry at the UWL has remained similar since 2006, which is four (4) years prior to CCR placement in the SCPC.

5.4.2 Piper Diagram

A Piper diagram is a graphical technique used to classify different groundwater chemistry. The same data used to generate the Stiff diagram are plotted on a ternary Piper diagram according to major cation and anion concentrations. In addition to showing instantaneous concentrations, Piper diagrams can be used to determine if groundwater chemistry is changing, either spatially or temporally. **Figures 9** and **10** are Piper diagrams displaying data from 2006 and August 2019, respectively.

As shown by the similar placement on the Piper diagrams, the data from 2006 (**Figure 9**) display a similar distribution to that of August 2019 (**Figure 10**). The only notable difference between the two sampling events is the placement of UG-1A, UG-2, and UG-3 relative to other wells. UG-1A, UG-2, and UG-3 plot slightly higher on the sodium + potassium and chloride axes, causing them to be slightly shifted. As discussed above, sodium and chloride concentrations are seasonally dependent and are influenced by the use of road salt on the nearby Highway 94. Except for seasonal differences in chloride and sodium, overall groundwater chemistry at the UWL has remained similar since 2006, which was four (4) years prior to CCR placement in the SCPC.

6.0 DEMONSTRATION THAT SSI WAS NOT CAUSED BY SCPC IMPACT

Based on the information presented in Section 5 above, the SSIs for calcium, chloride and fluoride were not caused by impacts from the SCPC. The SSIs appear to be caused by numerous factors, but are primarily caused by the following:

- Relatively low calculated initial UPLs for the CCR Rule monitoring data, when compared to historical data.
- Very low fluoride concentrations that are near the laboratory PQL threshold for the testing method accuracy.
- Spatial and temporal variability in the alluvial aquifer sampling results that are influenced by pre-existing low-level CCR impacts.
- The use of road salt (NaCL) on Highway 94. This causes an increase in chloride concentrations in monitoring wells located near the highway such as UG-1A and UG-2. Additionally, UG-1A and UG-2 are located south of Highway 94, which is typically the downgradient direction of groundwater flow in that area.

As required by the CCR Rule, eight (8) baseline samples were collected prior to the October 2017 deadline which were used to calculate the UPL for UG-2. According to the *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (USEPA 2009), eight (8) samples is the minimum number of samples recommended in order to complete statistical tests and future data will be used to enlarge the dataset for UPL calculation. At the SCPC, previous data from State UWL monitoring show pre-existing low-level CCR impacts and put the SSI in context relative to historical groundwater conditions at the site.

As shown in Section 5, each of the SSIs was below historical results at that well. The eight (8) background events, all collected in a relatively short timeframe in accordance with the CCR Rule, had statistically lower results than typically found prior to the receipt of WFGD in the SCPC. Therefore, the UPLs calculated from those data only represent the lower range of values in the overall population.

The comparison of key WFGD indicator parameters (sulfate, calcium, chloride, fluoride, and boron) between current groundwater conditions and those present prior to SCPC operations support the conclusion that the SCPC is not the source of the SSIs. The data and analyses presented herein demonstrate that no significant change in groundwater conditions has occurred from SCPC operations.

Other supplemental lines of evidence also demonstrate that there are no impacts on groundwater from the SCPC. Hydrogeological analysis of groundwater flow since 2008 indicates that groundwater at the SCPC typically flows to the south. Therefore, impacts from the SCPC would likely be observed in the downgradient (DG) wells to the south of the SCPC instead of to the north. Geochemical comparisons also display that there has been no significant change in groundwater quality between pre-CCR conditions (2006) and present-day sampling, except for seasonal changes in sodium and chloride concentrations caused by road salt usage on Highway 94. Further, the double-lined construction of the SCPC with 2-feet of compacted clay overlain by an 80-mil HDPE liner, also limits the likelihood that the SSI is a result of impact from SCPC.

In summary, there are no indications to support migration of CCR contaminants from the SCPC. Instead, the data indicate that the cause for the SSIs is due to alluvial aquifer variability, of pre-existing impacts, laboratory method accuracy, limited baseline data available for the calculation of the UPL, and the use of road salt on Highway 94.

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Tables

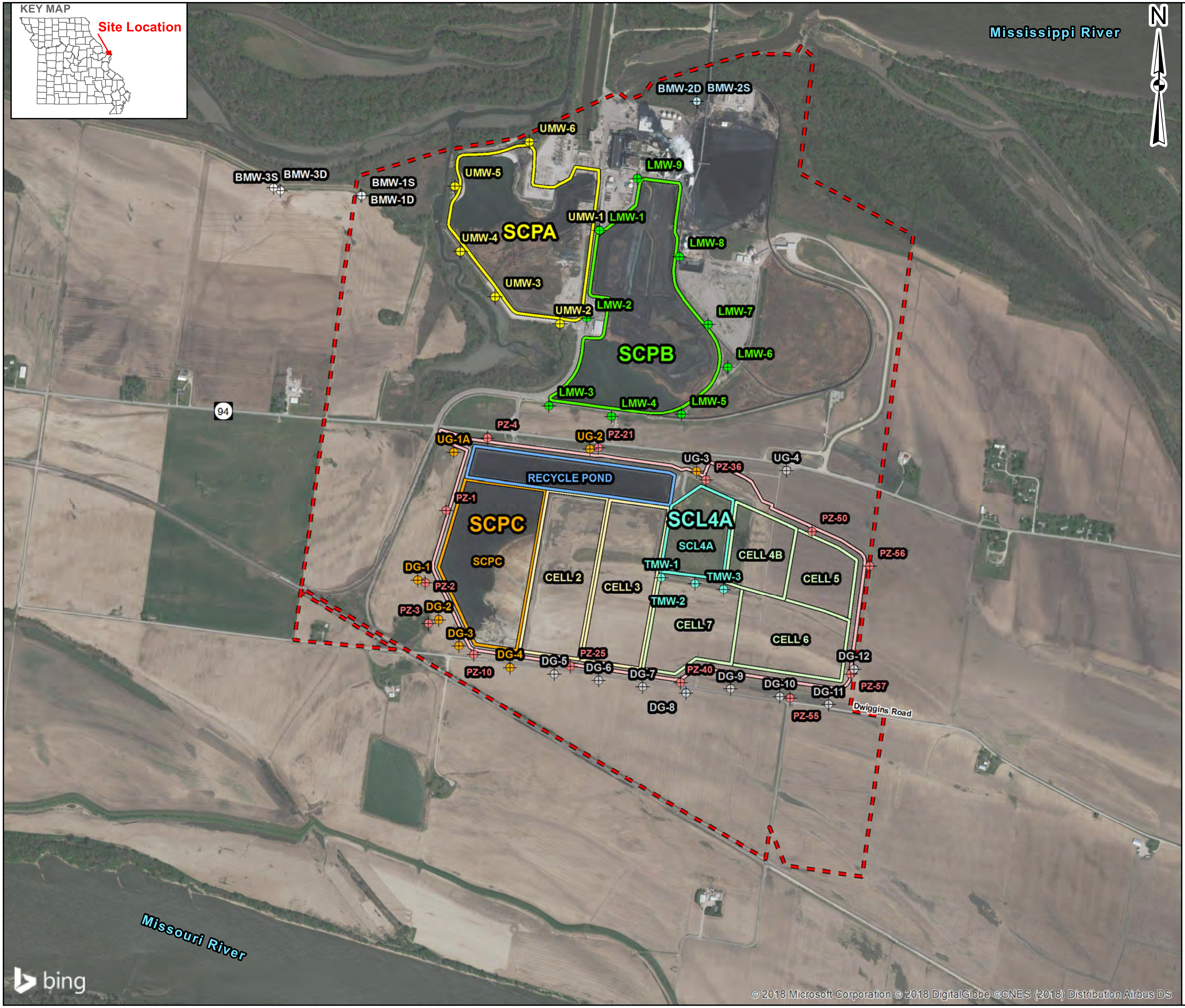
Table 3
Major Cation and Anion Concentrations
SCPC - Alternative Source Demonstration
Sioux Energy Center, St. Charles County, MO

Monitoring Well ID	Total Sodium (mg/L)	Total Potassium (mg/L)	Total Calcium (mg/L)	Total Magnesium (mg/L)	Total Chloride (mg/L)	Total Sulfate (mg/L)	Total Alkalinity [(2)] (mg/L)
Detection Monitoring - August 2019							
S-BMW-1S	5.35	0.383	149	28.4	8.8	34.1	432
S-BMW-3S	5.28	0.648	122	22.4	10.6	25.3	358
S-DG-1	4.23	4.01	135	32.3	6.2	41.7	411
S-DG-2	4.76	5.14	133	33.3	8.2	37.1	425
S-DG-3	4.68	6.47	148	39.1	4.8	49.5	450
S-DG-4	44.6	7.57	136	39.5	103	31.5	403
S-TMW-1	2.76	4.9	99.8	18.2	2.1	40.2	269 J
S-TMW-2	3.18	5.15	123 J	23.1	3.3	52.1	361 J
S-TMW-3	4.08	5.55	123	23.3	2.6	37.2	369 J
S-UG-1A	39.1	9.53	177	42	145	57.7	437
S-UG-2	30.4	4.7	116	24.6	30	45.2	362
S-UG-3	24.2	5.75	159	32.3	85	144	337 J
Historical Data - June 2006							
PZ-1	5.2	4.1	140	38	11	69	480
PZ-2	3.8	2.8	120	32	36	6.6	420
PZ-3	5.4	5.2	140	27	12	53	440
PZ-4	16	4.5	140	35	13	220	320
PZ-10	3.4	3.9	99	31	4.6	43	370
PZ-21	8.0	2.9	130	26	25	100	350
PZ-25	4.2	4.9	120	38	19	29	470
PZ-36	7.2	4.2	110	22	21	34	310
PZ-40	3.2	4.0	120	21	1.7	33	370
PZ-50	3.4	3.8	97	24	18	43	290
PZ-55	3.9	4.5	120	24	6.1	52	370
PZ-56	4.4	4.5	110	22	25	49	340
PZ-57	4.8	4.4	120	24	4.0	42	370

Notes:
1) 2006 Historical Data from Appendix 13 of the Detailed Site Investigation (DSI).
2) Alkalinity is equal to Carbonate + Bicarbonate.
3) mg/L - milligrams per liter.

Prepared by: EMS
Checked by: KAB
Reviewed by: MNH

Figures



LEGEND

🟥 Sioux Energy Center Property Boundary

Surface Impoundments

🟩 SCPB - Lined Fly Ash Surface Impoundment

🟨 SCPA - Unlined Bottom Ash Surface Impoundment

Utility Waste Landfill (UWL)

🟦 Active Dry CCR Disposal Area

🟧 Active WFGD Disposal Area

🟦 Active Water Recycle Pond

🟩 Proposed Dry CCR Disposal Area

🟨 Proposed WFGD Disposal Area

🟥 UWL Perimeter Fence

CCR Rule Monitoring Wells

⊕ Background Monitoring Well

⊕ SCPA - Bottom Ash Surface Impoundment Monitoring Well

⊕ SCPB - Fly Ash Surface Impoundment Monitoring Well

⊕ Existing UWL Monitoring Well Currently Used for CCR Monitoring

⊕ Temporary Monitoring Well for SCL4A

Other Piezometers and Monitoring Wells

⊕ Existing UWL Monitoring Well Not Currently Used for CCR Monitoring

⊕ Groundwater Elevation Piezometer

⊕ 2006 Detailed Site Investigation Piezometer and Sample Locations

NOTES

1.) ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2.) UWL - UTILITY WASTE LANDFILL.
3.) WFGD - WET FLUE GAS DESULFURIZATION.
4.) CCR - COAL COMBUSTION RESIDUALS.
5.) UWL BOUNDARIES, DESIGNATIONS AND EXISTING MONITORING WELL LOCATIONS BASED ON DRAWINGS IN THE UWL PROPOSED LANDFILL PERMIT (#0918301).

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3.) AMEREN MISSOURI SIOUX POWER PLANT UTILITY WASTE LANDFILL PROPOSED CONSTRUCTION PERMIT MODIFICATION (#0918301), AUGUST 2014.
4.) 2006 PIEZOMETER AND SAMPLE LOCATIONS FROM APPENDIX 13 OF THE DETAILED GEOLOGIC AND HYDROLOGIC SITE INVESTIGATION REPORT

0 500 1,000 1,500 2,000 2,500
Feet

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

Ameren

PROJECT
GROUNDWATER MONITORING PROGRAM

TITLE
SITE LOCATION AND AERIAL MAP

CONSULTANT

GOLDER

YYYY-MM-DD	2018-03-06
PREPARED	RJF
DESIGN	JSI
REVIEW	JSI
APPROVED	MNH

PROJECT No.
153-1406

FIGURE
1

Path: G:\Projects\150 Projects\1531406 - Ameren GW Monitoring Program - MO\Phase 0003 - Sioux Energy\800 - FIGURES-DRAWINGS\PRODUCTION\SEC ASD\SCPC\Figure 1 - Site Location and Aerial Map_Updated.mxd

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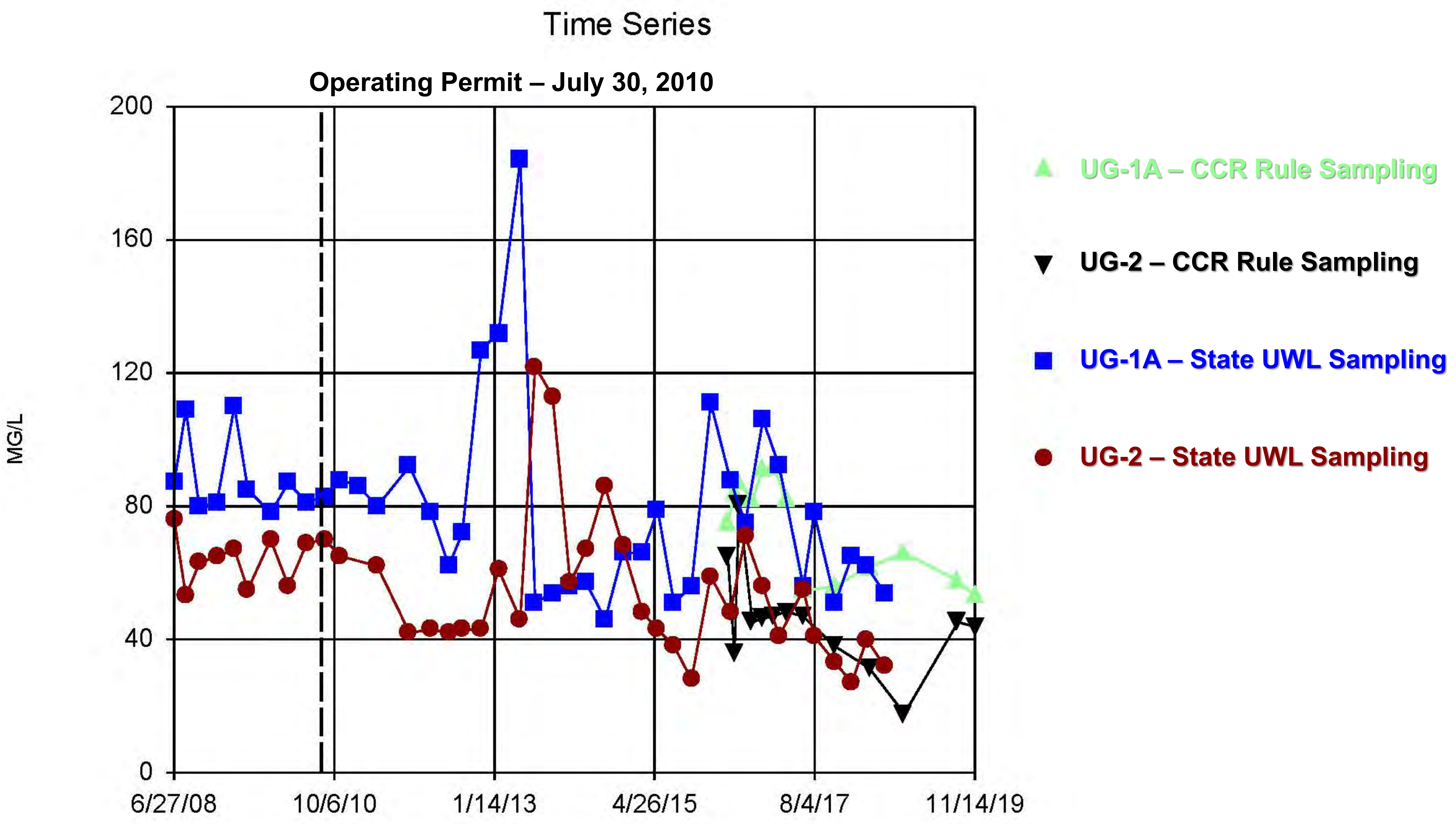


Notes
1) MG/L – Milligrams per liter.
2) CCR – Coal Combustion Residuals.
3) UWL – Utility Waste Landfill.

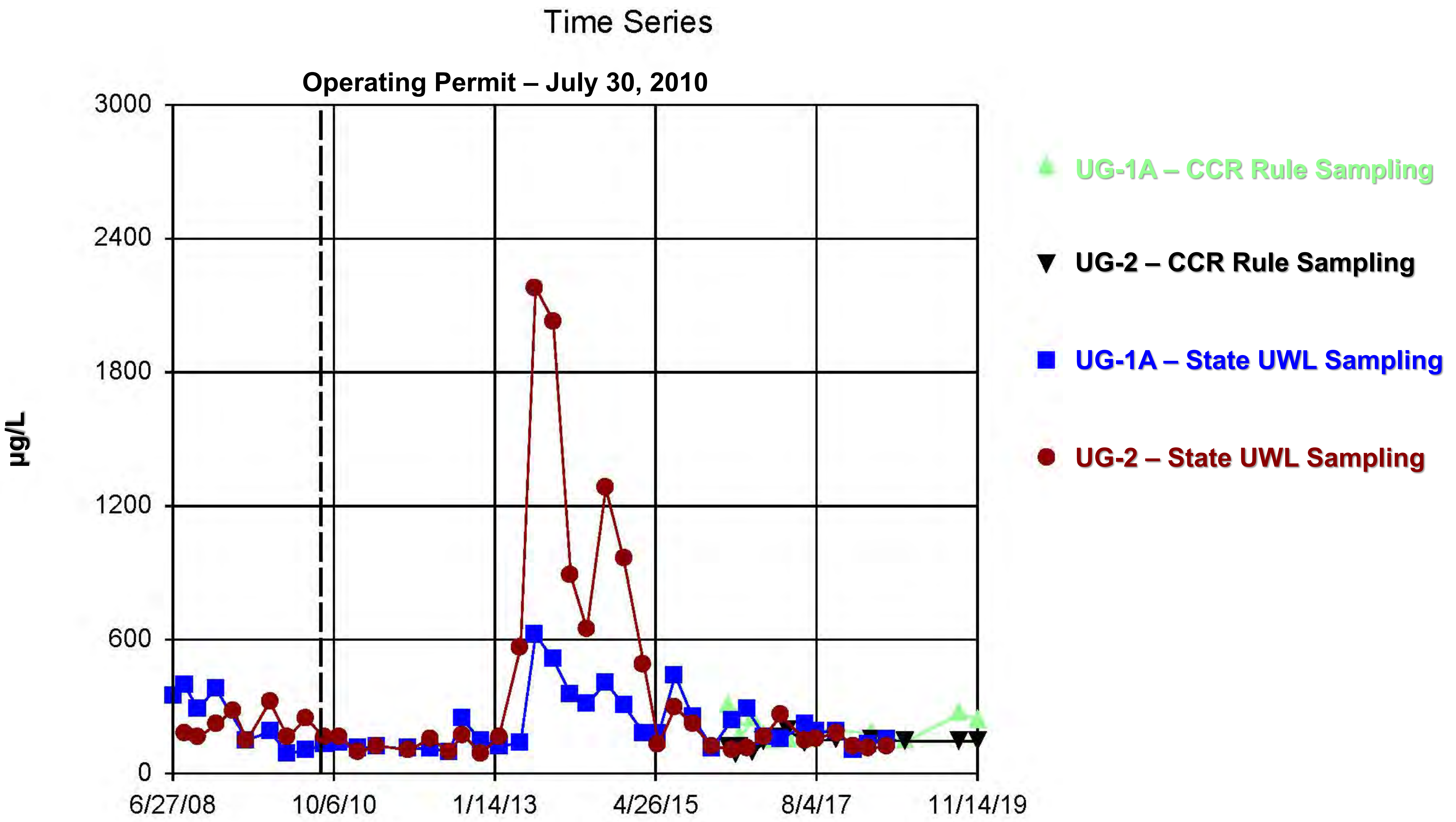
CLIENT/PROJECT
AMEREN MISSOURI
SIOUX ENERGY CENTER

Ameren

GOLDER

TITLE
UG-1A and UG-2 Time Series Plot for Sulfate

DRAWN	CHECKED	REVIEWED	DATE	SCALE	FILE NO.	JOB NO.	DWG NO.	SUBTITLE	REV. NO.	FIGURE
JSI	RJF	MNH	2020-01-20	N/A	N/A	153140601.0003	N/A	N/A	N/A	2



Notes
1) µg/L – Micrograms per liter.
2) CCR – Coal Combustion Residuals.
3) UWL – Utility Waste Landfill.

CLIENT/PROJECT **AMEREN MISSOURI** **SIOUX ENERGY CENTER**		TITLE **UG-1A and UG-2 Time Series Plot for Boron**

DRAWN	CHECKED	REVIEWED	DATE	SCALE	FILE NO.	JOB NO.	DWG NO.	SUBTITLE	REV. NO.	FIGURE
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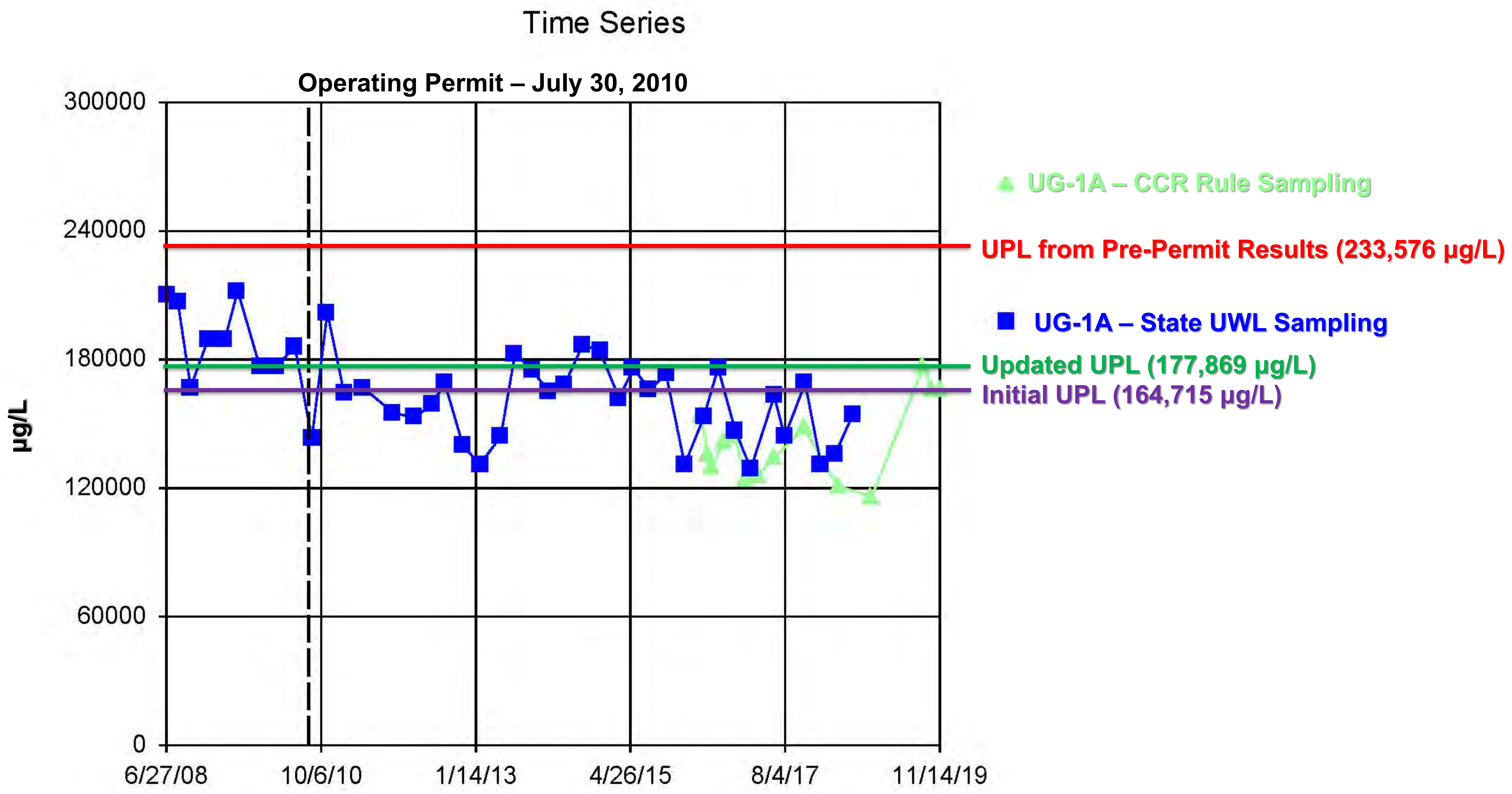

Notes
1) µg/L – Micrograms per liter.
2) CCR – Coal Combustion Residuals.
3) UWL – Utility Waste Landfill.
4) UPL – Upper Prediction Limit

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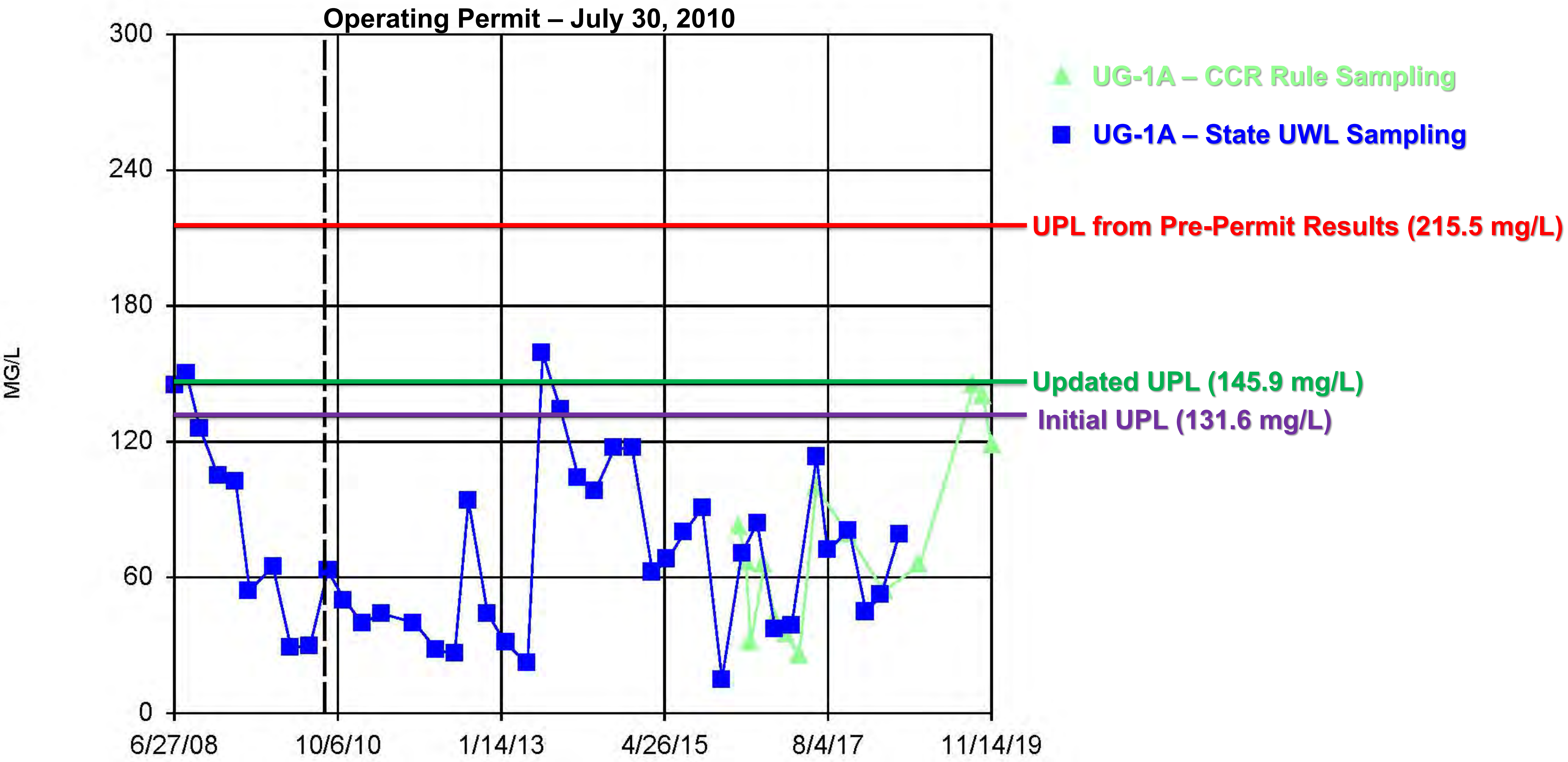
TITLE
UG-1A Time Series Plot for Calcium

DRAWN JSI	CHECKED RJF	REVIEWED MNH	DATE 2020-01-20	SCALE N/A	FILE NO. N/A	JOB NO. 153140601.0003	DWG NO. N/A	SUBTITLE N/A	REV. NO. N/A	FIGURE 4

Time Series

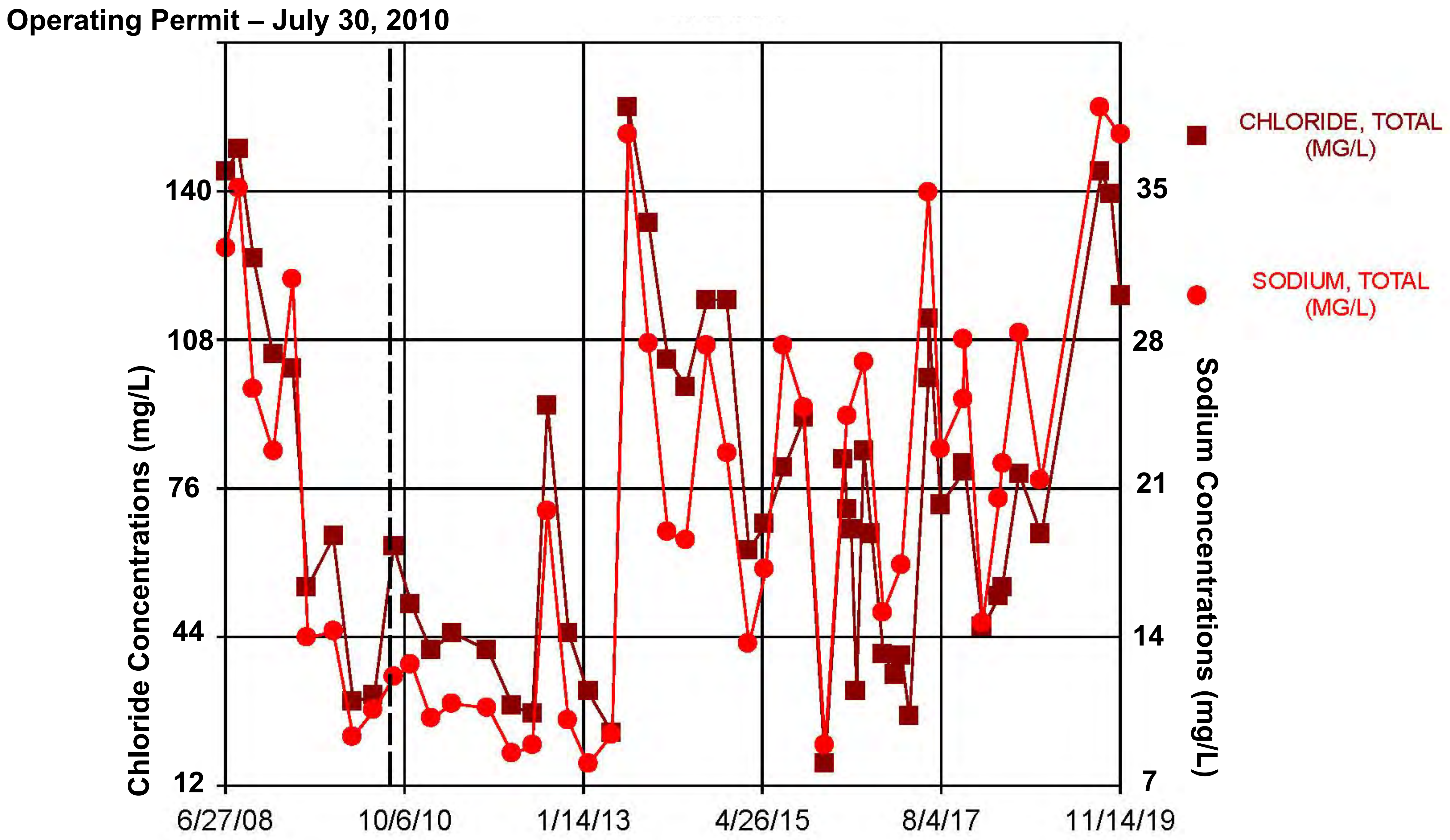


Notes
1) MG/L – Milligrams per liter.
2) CCR – Coal Combustion Residuals.
3) UWL – Utility Waste Landfill.
4) UPL – Upper Prediction Limit.

CLIENT/PROJECT **AMEREN MISSOURI** **SIOUX ENERGY CENTER**	Ameren	GOLDER	TITLE **UG-1A Time Series Plot for Chloride**

DRAWN	CHECKED	REVIEWED	DATE	SCALE	FILE NO.	JOB NO.	DWG NO.	SUBTITLE	REV. NO.	FIGURE
JSI	RJF	MNH	2020-01-20	N/A	N/A	153140601.0003	N/A	N/A	N/A	5

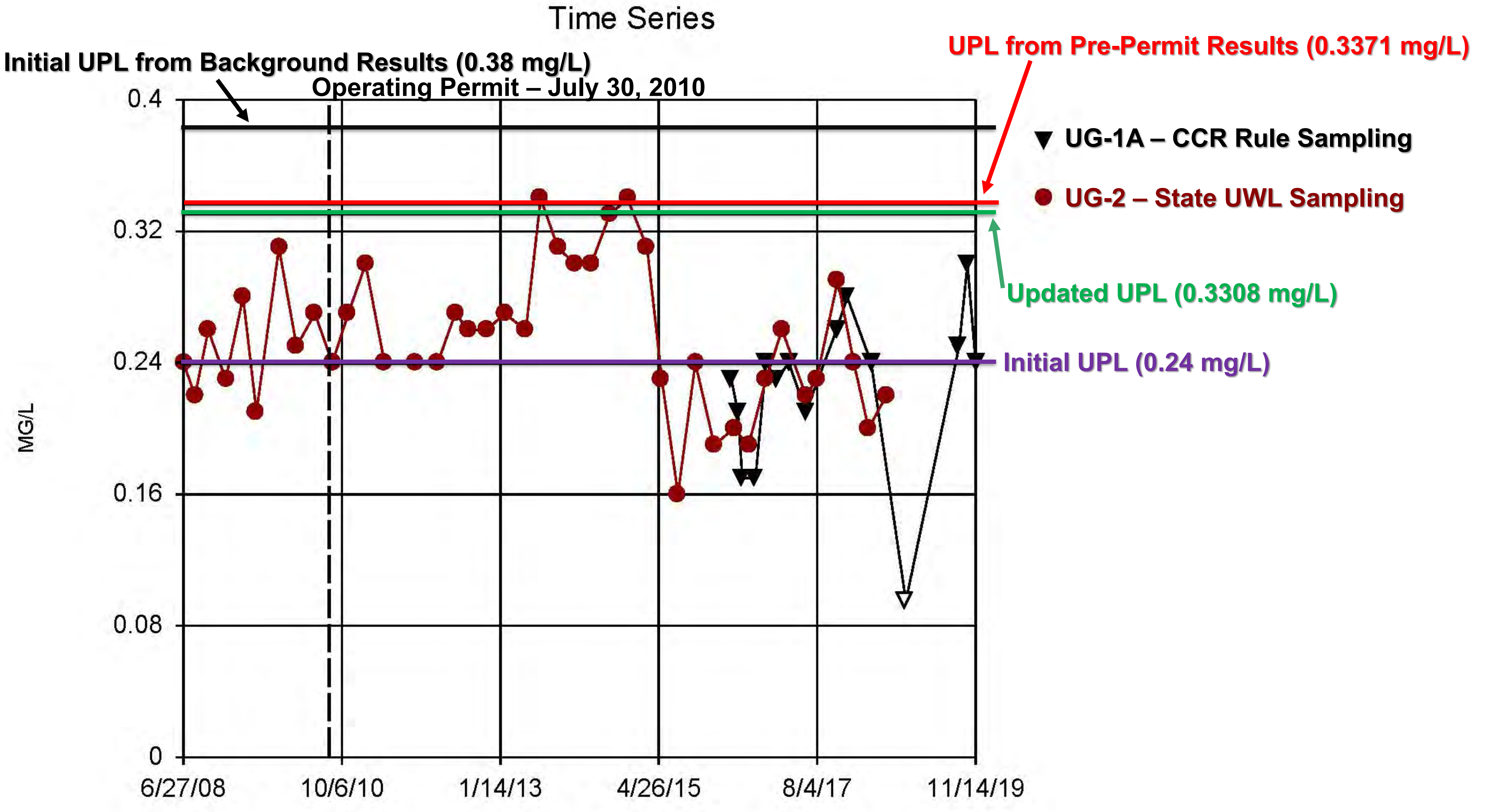
Time Series



Notes
1) MG/L – Milligrams per liter.

CLIENT/PROJECT **AMEREN MISSOURI** **SIOUX ENERGY CENTER**	Ameren	GOLDER	TITLE **UG-1A Time Series Plot Comparing Chloride and Sodium**

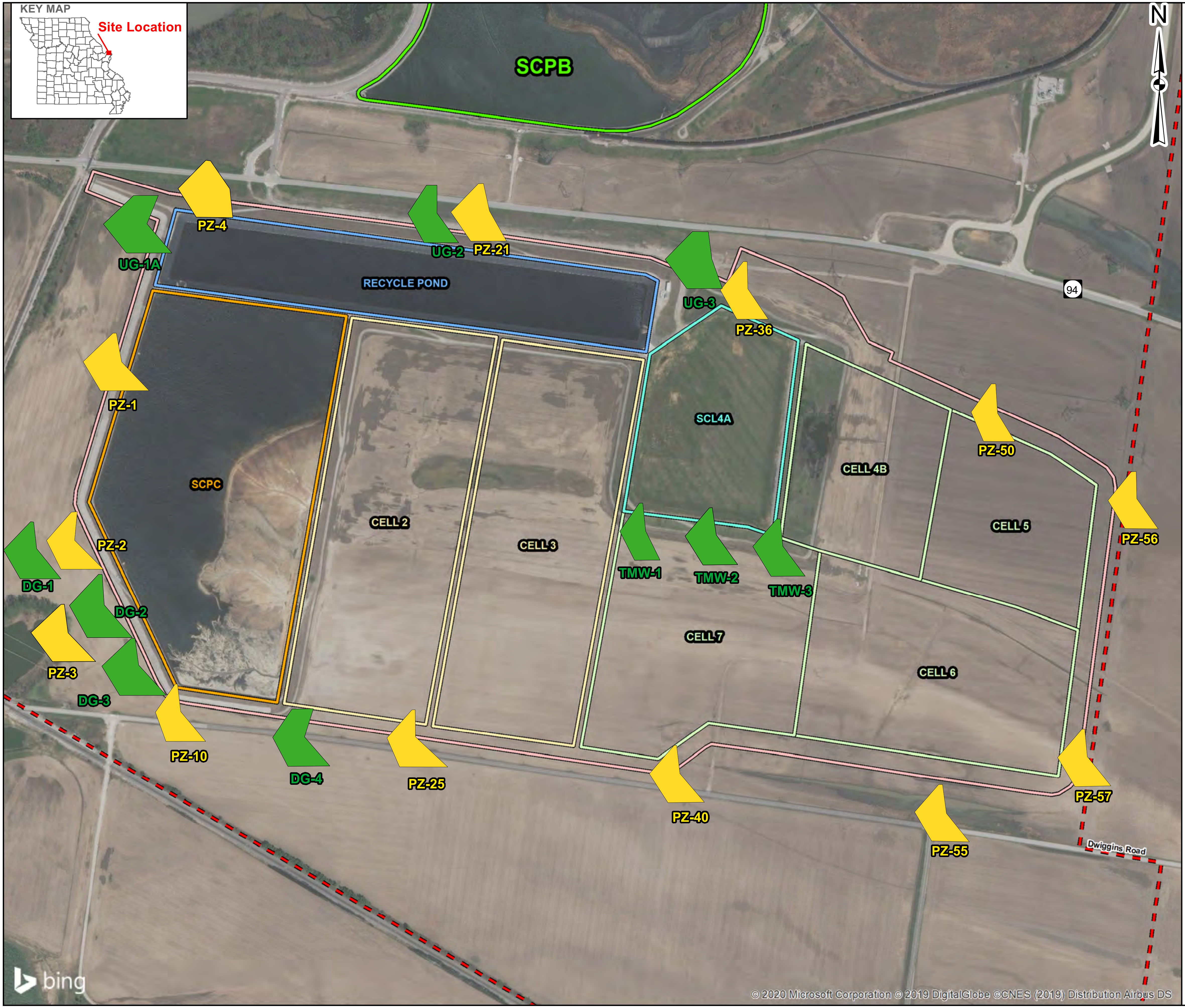
DRAWN	CHECKED	REVIEWED	DATE	SCALE	FILE NO.	JOB NO.	DWG NO.	SUBTITLE	REV. NO.	FIGURE
JSI	RJF	MNH	2020-01-20	N/A	N/A	153140601.0003	N/A	N/A	N/A	6



Notes
1) MG/L – Milligrams per liter.
2) CCR – Coal Combustion Residuals.
3) UWL – Utility Waste Landfill.
4) UPL – Upper Prediction Limit.

CLIENT/PROJECT **AMEREN MISSOURI** **SIOUX ENERGY CENTER**	Ameren	GOLDER	TITLE **UG-2 Time Series Plot for Fluoride**

DRAWN JSI	CHECKED RJF	REVIEWED MNH	DATE 2020-01-20	SCALE N/A	FILE NO. N/A	JOB NO. 153140601.0003	DWG NO. N/A	SUBTITLE N/A	REV. NO. N/A	FIGURE **7**



Path: G:\Projects\150 Projects\1531406 - Ameren GW Monitoring Program - MO\Phase 0003 - Sioux Energy\800 - FIGURES-DRAWINGS\PRODUCTION\2020-01-22 - Stiff Diagrams.mxd

LEGEND

🟥 Sioux Energy Center Property Boundary

Surface Impoundments

🟩 SCPB - Lined Fly Ash Surface Impoundment

Utility Waste Landfill (UWL)

▭ Active Dry CCR Disposal Area

🟧 Active WFGD Disposal Area

🟦 Active Water Recycle Pond

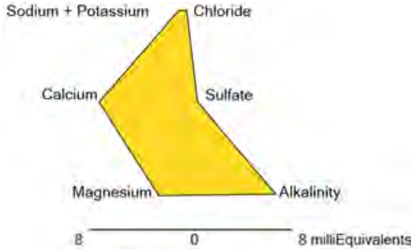
▭ Proposed Dry CCR Disposal Area

▭ Proposed WFGD Disposal Area

▭ UWL Perimeter Fence

Green Stiff Diagrams are from the August 2019 Detection Monitoring Event

Yellow Stiff Diagrams are from the Historical 2006 Detailed Site Investigation Event



NOTES

1.) ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2.) UWL - UTILITY WASTE LANDFILL.
3.) WFGD - WET FLUE GAS DESULFURIZATION.
4.) CCR - COAL COMBUSTION RESIDUALS.
5.) UWL BOUNDARIES, DESIGNATIONS AND EXISTING MONITORING WELL LOCATIONS BASED ON DRAWINGS IN THE UWL PROPOSED LANDFILL PERMIT (#0918301).
6.) STIFF DIAGRAMS CALCULATED USING SANITAS. DATA USED TO GENERATE DIAGRAMS IN TABLE 3.

REFERENCES

1.) AMEREN MISSOURI SIOUX ENERGY CENTER, SIOUX PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2401 FEET.
3.) AMEREN MISSOURI SIOUX POWER PLANT UTILITY WASTE LANDFILL PROPOSED CONSTRUCTION PERMIT MODIFICATION (#0918301), AUGUST 2014.
4.) 2006 PIEZOMETER AND SAMPLE LOCATIONS FROM APPENDIX 13 OF THE DETAILED GEOLOGIC AND HYDROLOGIC SITE INVESTIGATION REPORT

0 250 500 1,000
Feet

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

Ameren

PROJECT
GROUNDWATER MONITORING PROGRAM

TITLE
SPATIAL DISTRIBUTION OF STIFF DIAGRAMS

CONSULTANT

GOLDER

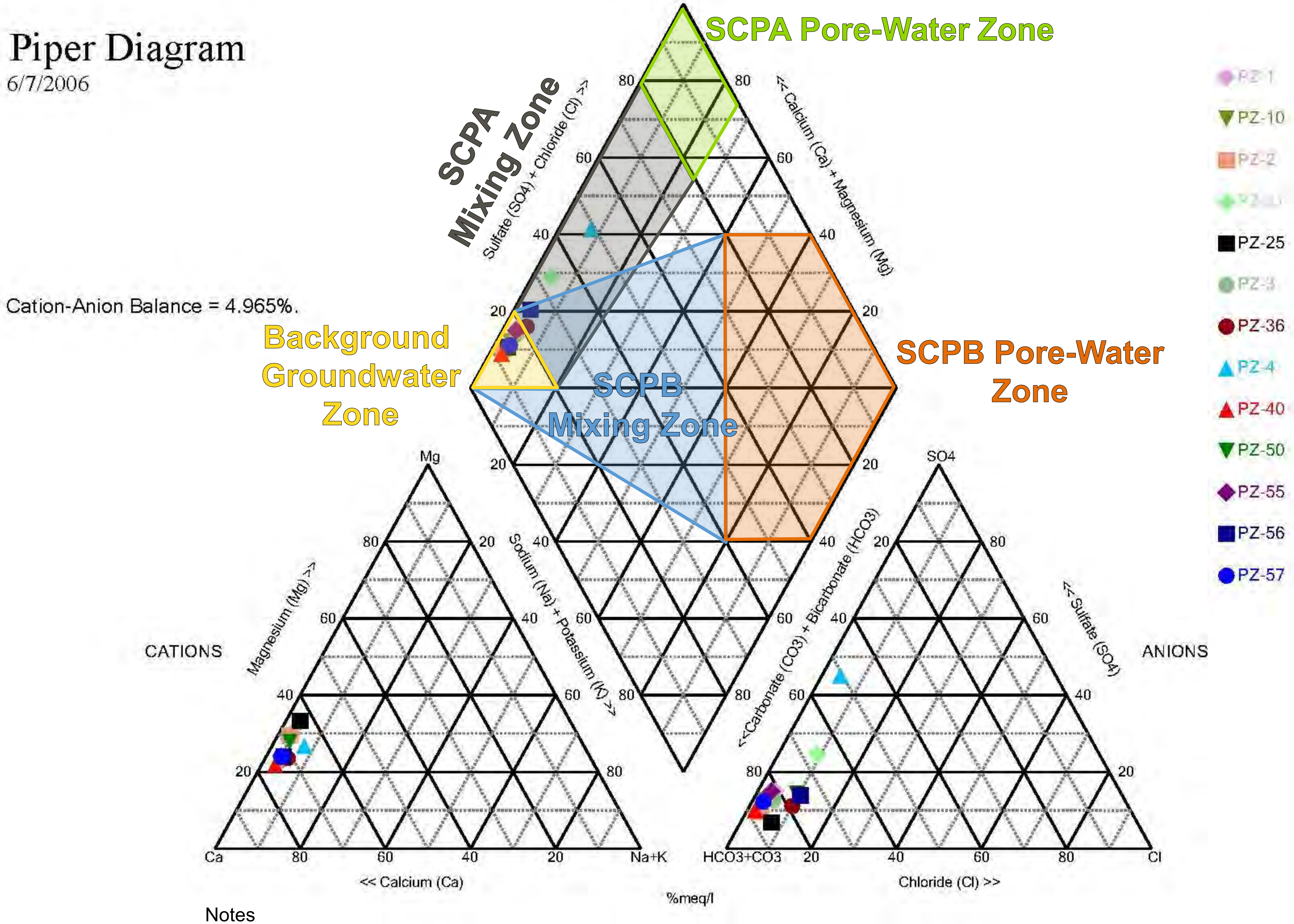
YYYY-MM-DD	2020-01-22
PREPARED	EMS
DESIGN	JSI
REVIEW	TJG
APPROVED	MNH

PROJECT No.
153-140601

FIGURE
8

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:

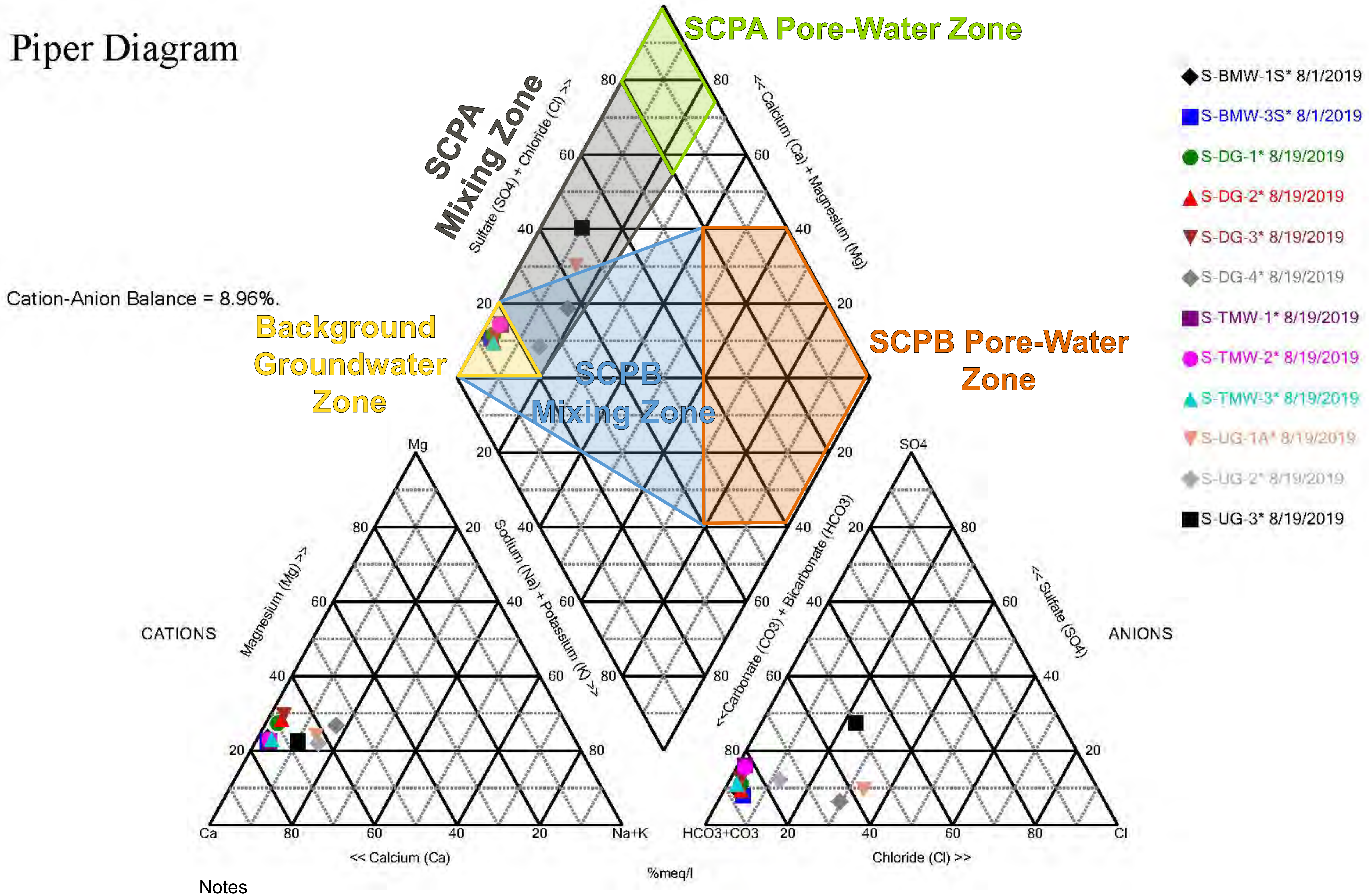
1 in
0



Notes
1) Data used to generate diagram is available in Table 3.
2) Piper diagram was generated using Sanitas software.
3) Data used to generate diagram and zones provided in the 2018 SCPB Alternative Source Demonstration

CLIENT/PROJECT **AMEREN MISSOURI** **SIOUX ENERGY CENTER**	Ameren	GOLDER	TITLE **June 2006 - Historical Piper Diagram**

DRAWN	CHECKED	REVIEWED	DATE	SCALE	FILE NO.	JOB NO.	DWG NO.	SUBTITLE	REV. NO.	FIGURE
JSI	JAP	MNH	2020/01/22	N/A	N/A	153140601.0003	N/A	N/A	N/A	9



Notes
1) Data used to generate diagram is available in Table 3.
2) Piper diagram was generated using Sanitas software.
3) Data used to generate diagram and zones provided in the 2018 SCPB Alternative Source Demonstration

CLIENT/PROJECT
AMEREN MISSOURI
SIOUX ENERGY CENTER

Ameren

GOLDER

TITLE
August 2019 – Detection Monitoring Piper Diagram

DRAWN	CHECKED	REVIEWED	DATE	SCALE	FILE NO.	JOB NO.	DWG NO.	SUBTITLE	REV. NO.	FIGURE
JSI	RJF	MNH	2020/01/22	N/A	N/A	153140601.0003	N/A	N/A	N/A	**10**

APPENDIX C

Potentiometric Surface Maps

Path: G:\Projects\150 Projects\1531406 - Ameren GW Monitoring Program - MO\Phase 0003 - Sioux Energy\800 - FIGURES-DRAWINGS\PRODUCTION\NEW_UPDATED_POTMAP_PRODUCTION\20190107_SECPM_153140601.mxd

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LEGEND

▬ ▬	Sioux Energy Center Property Boundary

CCR Units

🟨	SCPA - Bottom Ash Surface Impoundment
🟩	SCPB - Fly Ash Surface Impoundment
🟧	SCPC - WFGD Surface Impoundment
▭	SCL4A - Dry CCR Disposal Area
↖	Groundwater Flow Direction

Groundwater Elevation Contour (FT MSL)

═ ═	Inferred Groundwater Elevation Contour (FT MSL)
▭	Groundwater Elevation Contour (FT MSL)

Ground/Surface Water Measurement Locations

▲	SCPA Surface Impoundment Pond Gauge
⊙	River Gauge Location
⌖	Monitoring Well or Piezometer

NOTES

1.) ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2.) GROUNDWATER AND SURFACE WATER ELEVATIONS DISPLAYED IN FEET ABOVE MEAN SEA LEVEL (FT MSL).
3.) GROUNDWATER ELEVATION MEASUREMENTS OBTAINED BY GOLDER.
4.) MISSOURI RIVER ELEVATION ESTIMATED BASED ON NEARBY UNITED STATES GEOLOGICAL SURVEY (USGS) RIVER GAUGING LOCATIONS.
5.) MISSISSIPPI RIVER ELEVATION PROVIDED BY AMEREN MISSOURI.
6.) TP-1S, PZ-6S, AND DG-11 WERE NOT USED IN POTENTIOMETRIC CONTOURING.

REFERENCE

1.) AMEREN MISSOURI SIOUX ENERGY CENTER, SIOUX PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2,401 FEET.
3.) USGS NATIONAL WATER INFORMATION SYSTEM, USGS GAUGES 06935965 (ST. CHARLES), 07010000 (ST. LOUIS), 05587498 (ALTON), GRAFTON (05587450).

0 500 1,000 1,500 2,000
Feet

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

PROJECT
CCR GROUNDWATER MONITORING PROGRAM

TITLE
JANUARY 07, 2019 POTENTIOMETRIC SURFACE MAP

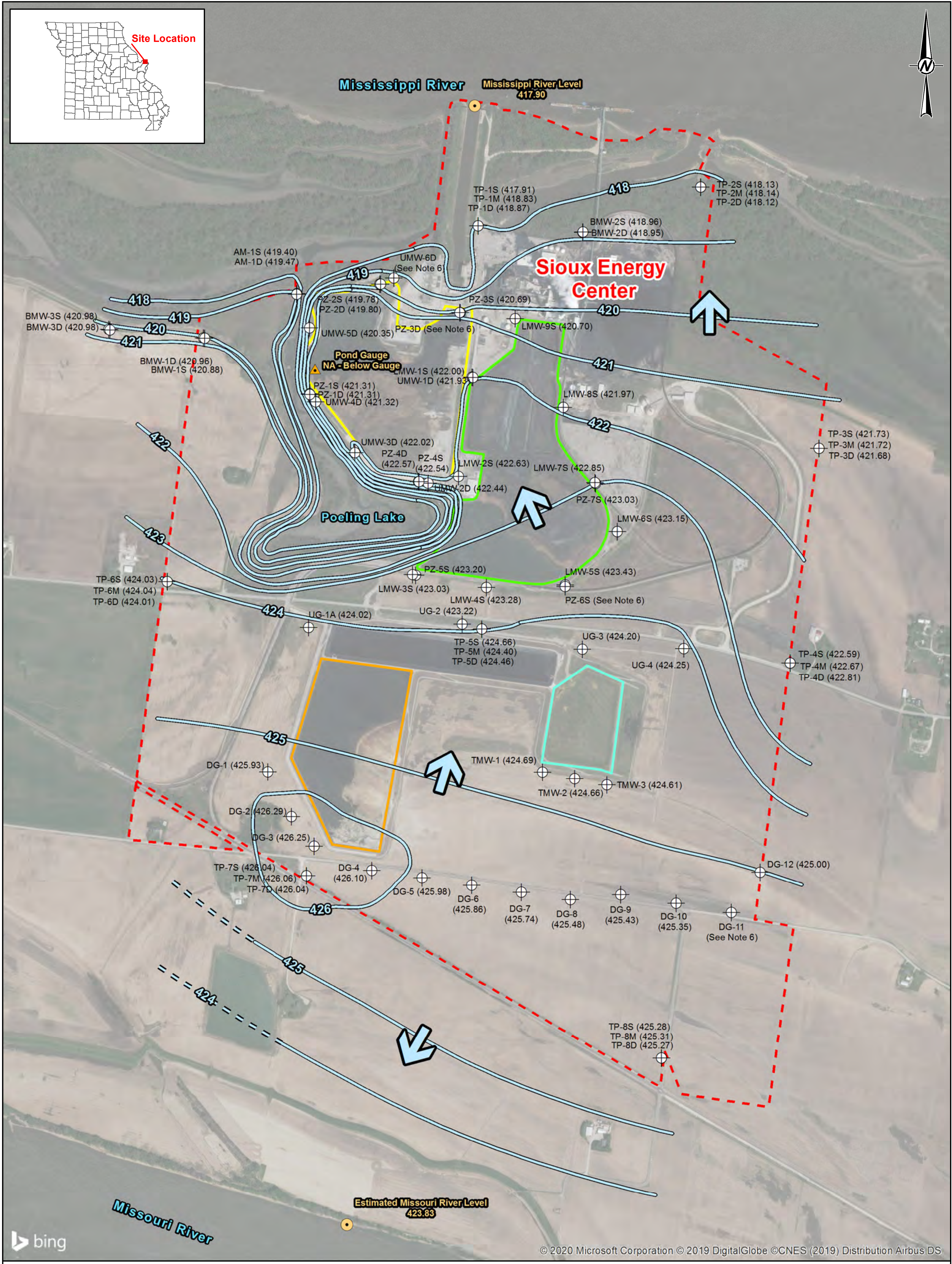
CONSUL

YYYY-MM-DD	2020-01-24
PREPARED	JSI
DESIGN	JSI
REVIEW	AMM
APPROVED	MNH

PROJECT No.	PHASE	FIGURE
153-1406	0003	**P1**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
1 in
0

Path: G:\Projects\150 Projects\1531406 - Ameren GW Monitoring Program - MO\Phase 0003 - Sioux Energy\800 - FIGURES-DRAWINGS\PRODUCTION\NEW_UPDATED_POTMAP_PRODUCTION\20190801_SECPM_153140601.mxd



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LEGEND

🟥 Sioux Energy Center Property Boundary

CCR Units

🟨 SCPA - Bottom Ash Surface Impoundment

🟩 SCPB - Fly Ash Surface Impoundment

🟧 SCPC - WFGD Surface Impoundment

🟦 SCL4A - Dry CCR Disposal Area

➚ Groundwater Flow Direction

Groundwater Elevation Contour (FT MSL)

= = Inferred Groundwater Elevation Contour (FT MSL)

— Groundwater Elevation Contour (FT MSL)

Ground/Surface Water Measurement Locations

▲ SCPA Surface Impoundment Pond Gauge

⊙ River Gauge Location

⊕ Monitoring Well or Piezometer

NOTES

1.) ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2.) GROUNDWATER AND SURFACE WATER ELEVATIONS DISPLAYED IN FEET ABOVE MEAN SEA LEVEL (FT MSL).
3.) GROUNDWATER ELEVATION MEASUREMENTS OBTAINED BY GOLDER.
4.) MISSOURI RIVER ELEVATION ESTIMATED BASED ON NEARBY UNITED STATES GEOLOGICAL SURVEY (USGS) RIVER GAUGING LOCATIONS.
5.) MISSISSIPPI RIVER ELEVATION PROVIDED BY AMEREN MISSOURI.
6.) DG-11, PZ-3D, PZ-6S, AND UMW-6D WERE NOT USED IN POTENTIOMETRIC CONTOURING.

REFERENCE

1.) AMEREN MISSOURI SIOUX ENERGY CENTER, SIOUX PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2,401 FEET.
3.) USGS NATIONAL WATER INFORMATION SYSTEM, USGS GAUGES 06935965 (ST. CHARLES), 07010000 (ST. LOUIS), 05587498 (ALTON), GRAFTON (05587450).

0 500 1,000 1,500 2,000 Feet

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

PROJECT
CCR GROUNDWATER MONITORING PROGRAM

TITLE
AUGUST 1, 2019 POTENTIOMETRIC SURFACE MAP

CONSULTANT
GOLDER

YYYY-MM-DD	2019-10-09
PREPARED	EMS
DESIGN	JSI
REVIEW	AMM
APPROVED	MNH

PROJECT No.
153-1406

PHASE
0003

FIGURE
P2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
0
1 in

LEGEND

▬ ▬	Sioux Energy Center Property Boundary

CCR Units

🟨	SCPA - Bottom Ash Surface Impoundment
🟩	SCPB - Fly Ash Surface Impoundment
🟧	SCPC - WFGD Surface Impoundment
▭	SCL4A - Dry CCR Disposal Area
➚	Groundwater Flow Direction

Groundwater Elevation Contour (FT MSL)

= =	Inferred Groundwater Elevation Contour (FT MSL)
▬	Groundwater Elevation Contour (FT MSL)

Ground/Surface Water Measurement Locations

▲	SCPA Surface Impoundment Pond Gauge
⊙	River Gauge Location
⊕	Monitoring Well or Piezometer

NOTES

1.) ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2.) GROUNDWATER AND SURFACE WATER ELEVATIONS DISPLAYED IN FEET ABOVE MEAN SEA LEVEL (FT MSL).
3.) GROUNDWATER ELEVATION MEASUREMENTS OBTAINED BY GOLDER.
4.) MISSOURI RIVER ELEVATION ESTIMATED BASED ON NEARBY UNITED STATES GEOLOGICAL SURVEY (USGS) RIVER GAUGING LOCATIONS.
5.) MISSISSIPPI RIVER ELEVATION PROVIDED BY AMEREN MISSOURI.
6.) DG-11 AND PZ-6S WERE NOT USED IN POTENTIOMETRIC CONTOURING.

REFERENCE

1.) AMEREN MISSOURI SIOUX ENERGY CENTER, SIOUX PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2,401 FEET.
3.) USGS NATIONAL WATER INFORMATION SYSTEM, USGS GAUGES 06935965 (ST. CHARLES), 07010000 (ST. LOUIS), 05587498 (ALTON), GRAFTON (05587450).

0 500 1,000 1,500 2,000 Feet

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

PROJECT
CCR GROUNDWATER MONITORING PROGRAM

TITLE
OCTOBER 1, 2019 POTENTIOMETRIC SURFACE MAP

CONSULTANT

YYYY-MM-DD	2019-10-21
PREPARED	AMM
DESIGN	JSI
REVIEW	BCW
APPROVED	MNH

PROJECT No. 153-1406
PHASE 0003
FIGURE **P3**

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LEGEND

- Sioux Energy Center Property Boundary

CCR Units

- SCPA - Bottom Ash Surface Impoundment
- SCPB - Fly Ash Surface Impoundment
- SCPC - WFGD Surface Impoundment
- SCL4A - Dry CCR Disposal Area
- Groundwater Flow Direction

Groundwater Elevation Contour (FT MSL)

- Inferred Groundwater Elevation Contour (FT MSL)
- Groundwater Elevation Contour (FT MSL)

Ground/Surface Water Measurement Locations

- ▲ SCPA Surface Impoundment Pond Gauge
- ● River Gauge Location
- ⊕ Monitoring Well or Piezometer

NOTES

1.) ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2.) GROUNDWATER AND SURFACE WATER ELEVATIONS DISPLAYED IN FEET ABOVE MEAN SEA LEVEL (FT MSL).
3.) GROUNDWATER ELEVATION MEASUREMENTS OBTAINED BY GOLDER.
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5.) MISSISSIPPI RIVER ELEVATION PROVIDED BY AMEREN MISSOURI.
6.) DG-11, PZ-6S AND TP-5S WERE NOT USED IN POTENTIOMETRIC CONTOURING.

REFERENCE

1.) AMEREN MISSOURI SIOUX ENERGY CENTER, SIOUX PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2,401 FEET.
3.) USGS NATIONAL WATER INFORMATION SYSTEM, USGS GAUGES 06935965 (ST. CHARLES), 07010000 (ST. LOUIS), 05587498 (ALTON), GRAFTON (05587450).

0 500 1,000 1,500 2,000 Feet

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

Ameren

PROJECT
CCR GROUNDWATER MONITORING PROGRAM

TITLE
NOVEMBER 13, 2019 POTENTIOMETRIC SURFACE MAP

CONSULTANT

GOLDER

YYYY-MM-DD	2020-01-07
PREPARED	EMS
DESIGN	JSI
REVIEW	TJG
APPROVED	CMR

PROJECT No.	PHASE	FIGURE
153-140601	0003	P4

GOLDER

golder.com

Attachment 7

Corrective Measures Assessment Report

www.haleyaldrich.com

CORRECTIVE MEASURES ASSESSMENT
AMEREN MISSOURI SIOUX ENERGY CENTER
ST CHARLES COUNTY, MISSOURI

by
Haley & Aldrich, Inc.
Cleveland, Ohio

for
Ameren Missouri
St. Louis, Missouri

May 2019

Overview

This Corrective Measures Assessment (CMA) was prepared by Haley & Aldrich, Inc. (Haley & Aldrich) for Union Electric Company d/b/a Ameren Missouri (Ameren) for the Coal Combustion Residual (CCR) surface impoundment (SCPA) located at the Sioux Energy Center (SEC). The SEC is a coal-fired power plant located between the Mississippi and Missouri Rivers in St. Charles County, Missouri. The CMA was completed in accordance with requirements stated in the U.S. Environmental Protection Agency's (USEPA) rule entitled *Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities*. 80 Fed. Reg. 21302 (Apr. 17, 2015) (promulgating 40 CFR §257.61); 83 Fed. Reg. 36435 (July 30, 2018) (amending 40 CFR §257.61) (CCR Rule).

Ameren implemented groundwater monitoring under the CCR Rule through a phased approach to allow for a graduated response and evaluation of steps to address groundwater quality. Assessment monitoring completed in 2018 evaluated the presence and concentration of constituents in groundwater specified in the CCR Rule (i.e. Appendix IV). Of the 23 CCR parameters evaluated, only one constituent of concern (COC), molybdenum, exceeds to a very limited extent, the Groundwater Protection Standards (GWPS) established for the SCPA. In fact, as described in **Section 3.3.1**, 96% of Appendix IV parameters tested complied with CCR Rule requirements.

Ameren completed a detailed environmental evaluation of the SCPA and surrounding area, including voluntary, supplemental surface water sampling. In 2018, a risk evaluation was undertaken to identify whether current groundwater conditions pose an unacceptable risk to human health and the environment, and whether corrective measures mitigate such an unacceptable risk, if present. The risk evaluation concluded that there are **no adverse effects on human health or the environment currently or under reasonably anticipated future uses** from either surface water or groundwater due to CCR management practices at SCPA.

In performing this CMA, Haley & Aldrich considered the following: presence and distribution of molybdenum, SCPA configuration, hydrogeologic setting, and the results of the detailed risk evaluation. Within the SCPA, CCR is managed in an impoundment that extends to a depth of approximately 75 feet (ft) below ground surface (bgs). The alluvial aquifer beneath the SCPA is approximately 100 ft in thickness. Although flow within the alluvial aquifer is directly controlled by the river stages of the Mississippi and Missouri Rivers and will generally flow from the higher of the two rivers toward the lower elevation river.

To provide a comprehensive CMA, this effort included surface impoundment closures and groundwater remediation alternatives, including:

- Alternative 1: Closure in place (CIP) with low permeability capping and monitored natural attenuation (MNA);
- Alternative 2: CIP with in-situ stabilization (ISS), low permeability capping and MNA;
- Alternative 3: CIP with low permeability capping and in-situ groundwater treatment;
- Alternative 4: CIP with low permeability capping, hydraulic containment (HC) of groundwater, and ex-situ groundwater treatment; and
- Alternative 5: Closure by removal (CBR) with MNA.

These five alternatives were evaluated based on the threshold criteria provided in the CCR rule and then compared to three of the four balancing criteria stated in the CCR Rule. The four balancing criteria consider:

1. The long- and short-term effectiveness and protectiveness of the potential remedy(s), along with the degree of certainty that the remedy will prove successful;
2. The effectiveness of the remedy in controlling the source to reduce further releases;
3. The ease or difficulty of implementing a potential remedy; and
4. The degree to which community concerns are addressed by a potential remedy.

Balancing criteria four, which considers community concerns, will be evaluated following a public information session scheduled for May 2019.

The following observations are made regarding closure scenarios and groundwater remedial alternatives for the SCPA and are described more fully in this report:

- **Cap Integrity and Hydrogeologic Conditions:** For all CIP alternatives, Ameren intends to install a geomembrane cap and cover system that exceeds by two orders-of-magnitude the performance criteria set forth in the CCR Rule and is referred to in this CMA as a "low permeability cap." Vertical infiltration via precipitation is virtually eliminated following installation of the geomembrane cover system. Modelling predicts that post-closure, 95% of groundwater will travel horizontally via a preferential pathway around the unit due to permeability differentials in the surrounding soils. In addition, groundwater flow in this area moves very slowly, approximately 11 feet per year, less than the length of a midsized vehicle.

- **No Risk:** Risk assessment evaluations confirm that the SCPA, even prior to closure, presents no **unacceptable risk** to human health or the environment. In fact, concentration levels of molybdenum would need to be **more than 1,000 times higher** than currently measured levels before an adverse impact in the Mississippi River could occur. Therefore, since no adverse risk currently exists, implementation of any of the remedies considered will not result in a meaningful reduction in risk.

- **Groundwater Compliance:** Ameren has retained XDD Environmental (XDD) to evaluate targeted in-situ treatment methods to address elevated levels of molybdenum. Bench-scale testing indicates that certain pH adjustments can reduce concentration levels and that in-situ treatment evaluations, including bio-augmentation, are ongoing at all facilities and will be completed this summer.

- **Excavation Timeframe:** As described in an Extraction & Transportation Study prepared by the Lochmueller Group, removal of large volumes of CCR stored at the SEC creates extensive logistical challenges – including excavation, transportation, and disposal, and could take decades to complete during which time the impoundment would remain open and would be subject to ongoing infiltration from precipitation.

In accordance with §257.98, Ameren will implement a groundwater monitoring program to document the effectiveness of the selected remedial alternative. Corrective measures are considered complete when monitoring reflects groundwater downgradient of the SCPA does not exceed Appendix IV GWPS for three consecutive years. USEPA is in the process of modifying certain CCR Rule requirements and, depending upon the nature of such changes, assessments made herein could be modified or supplemented to reflect such future regulatory revisions. See *Federal Register (March 15, 2018; 83 FR 11584*).

Table of Contents

Table of Contents

List of Tables

List of Figures

List of Acronyms and Abbreviations

Ameren	Ameren Missouri
AMSL	Above Mean Sea Level
bgs	Below Ground Surface
CBR	Closure by Removal
CCR	Coal Combustion Residuals
CIP	Closure In-Place
CMA	Corrective Measures Assessment
cm/sec	Centimeters per Second
COC	Constituents of Concern
CSM	Conceptual Site Model
DSI	Detailed Site Investigation
ft	Feet
Golder	Golder Associates Inc.
GMP	Groundwater Monitoring Plan
GWPS	Groundwater Protection Standards
Haley & Aldrich	Haley & Aldrich, Inc.
HC	Hydraulic Containment
ISS	In-Situ Stabilization
MM	Million
MM CY	Million Cubic Yards
mg/kg	Milligrams per kilogram
mg/l	Milligrams per liter
MNA	Monitored Natural Attenuation
N&E	Nature and Extent
NAS	U.S. National Academy of Sciences
O&M	Operations and Maintenance
ORP	Oxidation Reduction Potential
ppm	Parts per Million
PRB	Permeable Reactive Barrier
RDA	Recommended Daily Allowance
RO	Reverse Osmosis
SCL4A	Dry CCR Disposal Area
SCPA	Bottom Ash Surface Impoundment
SCPB	Fly Ash Surface Impoundment
SCPC	Gypsum Disposal Area
SEC	Sioux Energy Center
SSI	Statistically Significant Increase
SSL	Statistically Significant Level
ug/L	Micrograms per liter
UL	Tolerable Upper Limit
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
XDD	XDD Environmental

1. Introduction

Haley & Aldrich, Inc. (Haley & Aldrich) has prepared this Corrective Measures Assessment (CMA) for the Coal Combustion Residual (CCR) surface impoundment (SCPA) located at the Ameren Missouri (Ameren) Sioux Energy Center (SEC). Ameren has conducted detailed geologic and hydrogeologic investigations under Missouri's utility and solid waste landfill requirements as well as the USEPA rule entitled *Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities*. 80 Fed. Reg. 21302 (Apr. 17, 2015) (promulgating 40 CFR §257.61); 83 Fed. Reg. 36435 (July 30, 2018) (amending 40 CFR §257.61) (CCR Rule). These investigations were, in part, related to determination of requirements related to the potential for both SCPA closure and groundwater corrective action.

This CMA includes a summary of the results of groundwater and site investigations at the SEC. Groundwater impacted by the SCPA exceeds the statistically-derived GWPS for molybdenum at only four monitoring well locations. This report evaluates potential corrective measures to address these limited exceedance of the GWPS.

1.1 FACILITY DESCRIPTION/BACKGROUND

The SEC is located near the confluence of the Missouri and Mississippi Rivers in rural St. Charles County. Historically, the SEC managed CCR in an unlined bottom ash pond (SCPA), and a lined fly ash (SCPB) pond. The SCPA is approximately 47 acres in size and is the focus of this CMA (**Figure 1-1**). The Mississippi River, Poeling Lake, and the Missouri River are located to the north, southwest and south of the facility, respectively. The facility is surrounded by agricultural fields and in 2008, Ameren constructed a utility waste landfill (UWL) to manage CCR and gypsum waste from the SEC's scrubber system. Site features are illustrated on **Figure 1-2**

Sioux Energy Center

Ameren is constructing wastewater treatment facilities and will terminate usage of the impoundment system in 2020 and commence closure of both the bottom and fly ash ponds in 2021.

1.2 SITE CHARACTERIZATION WORK SUMMARY

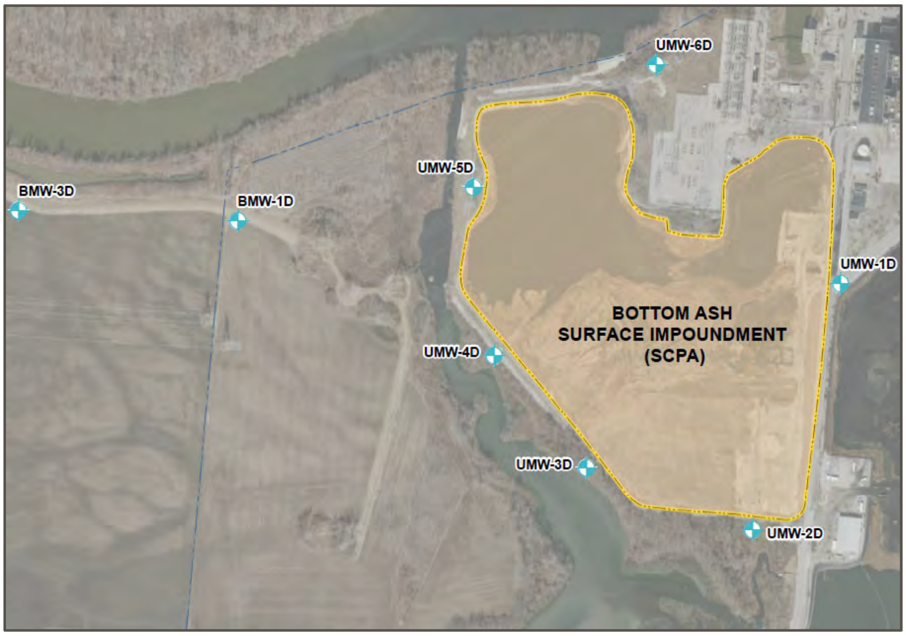
Extensive subsurface investigations have occurred pursuant Missouri's utility and solid waste landfill requirements as well as the CCR Rule. In August 2006, a Detailed Site Investigation (DSI) Report prepared by Gredell Engineering Resourcing, Inc. characterized the geology and hydrogeology of the UWL to support the development of a hydrogeologic Conceptual Site Model (CSM). The DSI investigation at the SEC included:

- Soil borings and sampling;
- Geotechnical testing;
- Rock coring;
- Well and piezometer installation;
- Slug testing; and
- Groundwater sampling.

The CSM has been further enhanced with ongoing CCR groundwater monitoring and supplemental subsurface investigation activities performed by Golder Associates, Inc. (Golder). Findings from these extensive and updated series of geologic, geotechnical, and hydrogeologic investigations, including voluntary surface water sampling conducted, have produced a robust CSM that supports the CMA activities discussed in this report.

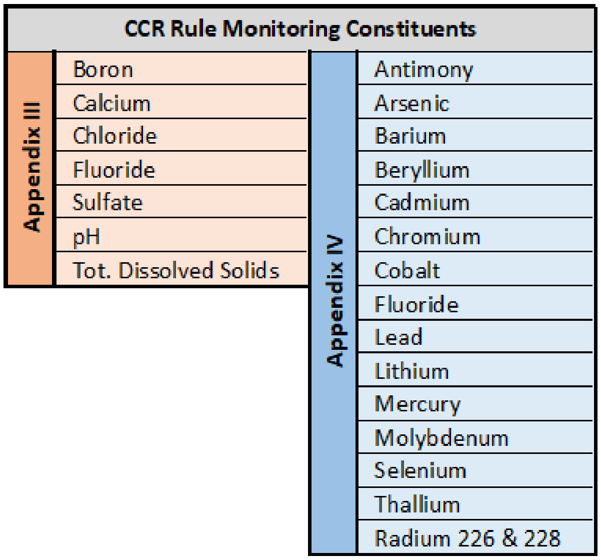
1.3 GROUNDWATER MONITORING

Groundwater monitoring under the CCR Rule occurs through a phased approach to allow for a graduated response (i.e., baseline, detection, and assessment monitoring as applicable) and evaluation of steps to address groundwater quality. Golder prepared a Groundwater Monitoring Plan (GMP) as required by the CCR Rule. The GMP presents the design of the groundwater monitoring system, groundwater sampling and analysis procedures, and groundwater statistical analysis methods.



Groundwater Monitoring Well Locations

Monitoring wells were installed in November and December 2015 and includes two background wells (BMW-1D and BMW-3D) and six downgradient monitoring wells (UMW-1 through UMW-6) located around the perimeter of the SCPA. In general, the monitoring wells are screened in the alluvial aquifer zone near the base elevation of the SCPA.



CCR Rule Monitoring Constituents			
Appendix III	Boron	Appendix IV	Antimony
	Calcium		Arsenic
	Chloride		Barium
	Fluoride		Beryllium
	Sulfate		Cadmium
	pH		Chromium
	Tot. Dissolved Solids		Cobalt
			Fluoride
			Lead
			Lithium
			Mercury
			Molybdenum
			Selenium
			Thallium
			Radium 226 & 228

Detection monitoring sampling events occurred in 2017 and 2018. The results of the sampling events were then compared to background, or natural groundwater values, using statistical methods to determine if Appendix III constituents at the base of the ash basin are present at concentrations above background, called statistically significant increases (SSI). Detection of Appendix III analytes triggered a verification sampling event in January 2018 and verified SSIs. The results of this analysis indicated SSIs necessitating the establishment of an Assessment Monitoring Program and respective notification of the same.

During the Assessment Monitoring phase, CCR groundwater monitoring well samples were collected during April, May and November 2018 and subsequently analyzed for Appendix IV constituents. Appendix IV analytical results for the baseline and Assessment Monitoring events are summarized in **Table I**.

1.4 CORRECTIVE MEASURES ASSESSMENT PROCESS

The CMA process involves development of groundwater remediation technologies that will result in the following threshold criteria: protection of human health and the environment, attainment of GWPS, source control, COC removal and compliance with standards for waste management. Once these technologies are demonstrated to meet these criteria, they are then compared to one another with respect to long- and short-term effectiveness, source control, and implementability. Input from the community on such proposed measures will occur as part of a public meeting scheduled for May 2019.

1.5 RISK REDUCTION AND REMEDY

The CCR Rule at §257.97 (Selection of Remedy) at (b)(1) requires that remedies must be protective of human health and the environment. Further, at (c) the CCR Rule requires that in selecting a remedy, the owner or operator of the CCR unit shall consider specific evaluation factors, including the risk reduction achieved by each of the proposed corrective measures. Each of the evaluation factors listed here and discussed in **Section 4** are those that consider risk to human health or the environment.

> (1)(i) Magnitude of reduction of existing risks;
>
> (1)(ii) Magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy;
>
> (1)(iv) Short-term risks that might be posed to the community or the environment during implementation of such a remedy, including potential threats to human health and the environment associated with excavation, transportation, and re-disposal of contaminant;

(1)(vi) Potential for exposure of humans and environmental receptors to remaining wastes, considering the potential threat to human health and the environment associated with excavation, transportation, re-disposal, or containment;

(4) Potential risks to human health and the environment from exposure to contamination prior to completion of the remedy[1];

(5)(i) Current and future uses of the aquifer;

(5)(ii) Proximity and withdrawal rate of users; and

(5)(iv) The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to CCR constituents.

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[1] Factors 4 and 5 are not part of the CMA evaluation process as described in §257.97(d)(4), §257.97(d)(5)(i)(ii)(iv); rather they are factors the owner or operator must consider as part of the schedule for remedy implementation.

2. Groundwater Conceptual Site Model

To evaluate the magnitude of risk reduction, the degree of existing risk must first be identified. Prior risk evaluations and data collected are summarized below.

2.1 SITE SETTING

The SEC Site is in St. Charles County, Missouri and located between the Mississippi and Missouri Rivers. The Site is bounded to the north by wooded areas associated with the Mississippi River, to the south by a railroad, and to the east and west is a largely agricultural area that is served by municipal water.

The SCPA is constructed with perimeter berms at an elevation of approximately 446 ft above mean sea level (AMSL). Immediately adjacent to the SEC is a channelized area of the Mississippi River that is referred to as the Mississippi River Chute. Both fly ash and bottom ash have historically been managed and stored in the SCPA surface impoundment. Borings completed in the SCPA indicate a CCR thickness of up to approximately 75 ft bgs around 373 ft AMSL in the center of the unit and thinning out towards the edges.

2.2 GEOLOGY AND HYDROGEOLOGY

The SEC is located in the extreme southeastern corner of the Central Lowland Physiographic Province and the Dissected Till Plains. However, because the SEC lies between two major river systems in an area that has been mostly deposited by flow and deposition of river deposits, the regional physiographic setting is not representative of local Site geology.

Alluvial deposits associated with the Missouri and Mississippi Rivers overlie older sedimentary bedrock. These alluvial deposits comprise the surficial alluvial aquifer, which lies unconformably on top of bedrock and is typically 100 to 120 ft thick with base elevations of approximately 300 to 330 ft AMSL[2]. Overall, this aquifer is described as a fining upwards sequence of stratified sands and gravels with varying amounts of silts and clays. The alluvial deposits are comprised of various sub-units, including flood basin deposits, floodplain deposits, natural levee deposits, and channel deposits along with volumetrically less important loess deposits. Grain sizes of the alluvial deposits are highly variable.

The alluvial deposits are underlain by bedrock that includes Mississippian-aged rocks of the Meramecian Series. Formations include primarily limestone, dolomite, and shale and are comprised of the Salem Formation, Warsaw Formation, and the Osagean aged Burlington-Keokuk Formation. The depth to bedrock typically increases towards the Mississippi River. Based on regional well logs the upper-most

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[2] 40 CFR Part 257, Groundwater Monitoring Plan SCPA, Sioux Energy Center, St. Charles County, Missouri (Golder 2017)

Generalized Geologic Cross Section

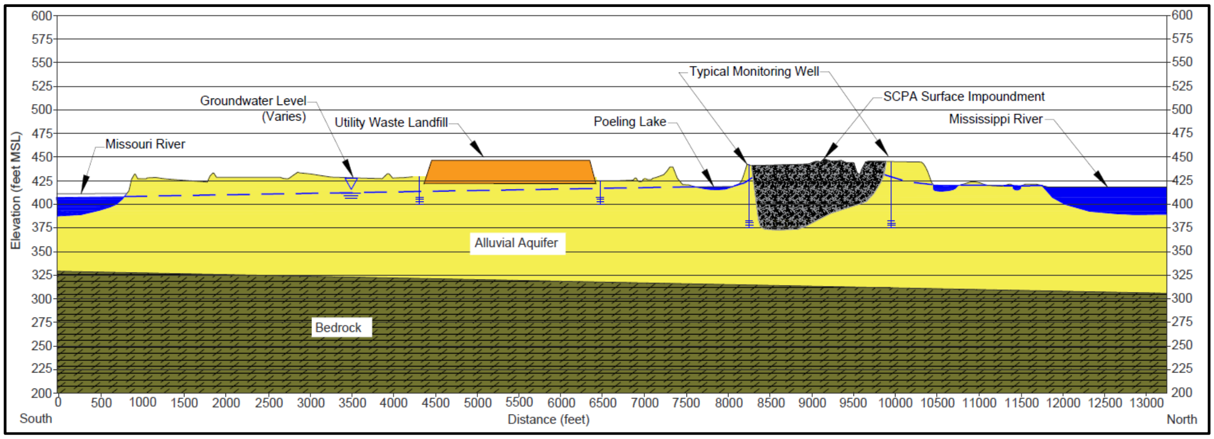

Image from Figure 3, Groundwater Monitoring Plan, SCPA SEC (Golder 2017)

bedrock unit beneath the SEC is the Salem formation. Proceeding northward from St. Louis County, the thickness of this unit thins to about 40 to 60 ft and is describes as a buff limestone with dolomitic limestone, dolomite and shale.

The alluvial aquifer is the uppermost aquifer across the Site and consist primarily of alluvial sands with some silt, clay, and gravel associated with the Missouri and Mississippi River Valley alluvium. Groundwater flow within the alluvial aquifer is directly controlled by the river stages of the Mississippi and Missouri Rivers, since the alluvial aquifer is hydraulically connected to these water bodies. Groundwater will generally flow from the higher of the two rivers toward the lower elevation river. The SCPA and Poeling Lake also locally affect water levels and flow directions. Horizontal groundwater hydraulic gradients in the alluvial aquifer are typically low and flat.

Groundwater Flow Map-November 12, 2018

Image from Figure C3, 2018 Annual Groundwater Monitoring and Corrective Action Report (Golder 2019)

Groundwater flow direction and gradient were estimated for the downgradient SCPA monitoring wells using the USEPA's On-line Tool for Site Assessment Calculation for Hydraulic Gradient (Magnitude and Direction) (USEPA, 2016). Results from this assessment indicate that while groundwater flow direction is variable and gradients are relatively flat, the overall net groundwater flow at the SCPA was slightly toward the north or toward the Mississippi River. Horizontal gradients calculated by the program range from 0.0002 to 0.0011 ft/ft with an estimated net annual groundwater velocity of approximately 11 ft per year[3].

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[3] 2018 Annual Groundwater Monitoring and Corrective Action Report, SCPA Surface Impoundment, SEC, St. Charles County, Missouri (Golder 2019)

Vertical hydraulic gradients adjacent to the SCPA demonstrate low downward gradients, with the difference in groundwater elevations between the shallow and intermediate/deep groundwater monitoring zones typically less than 0.01 ft. Vertical gradients within the SCPA and the underlying alluvial groundwater zone changes seasonally based on river levels and fluctuating alluvial aquifer groundwater levels.

Groundwater flow modeling completed by Golder evaluated the flux of groundwater passing through the CCR, following closure and dewatering of the SCPA. As shown in the figure below, post-closure 95% of groundwater moving laterally through the alluvial aquifer preferentially flows under (and around) the SCPA, due to the notably lower horizontal hydraulic conductivity of the CCR.

Groundwater Preferentially Flows Under/Around the SCPA

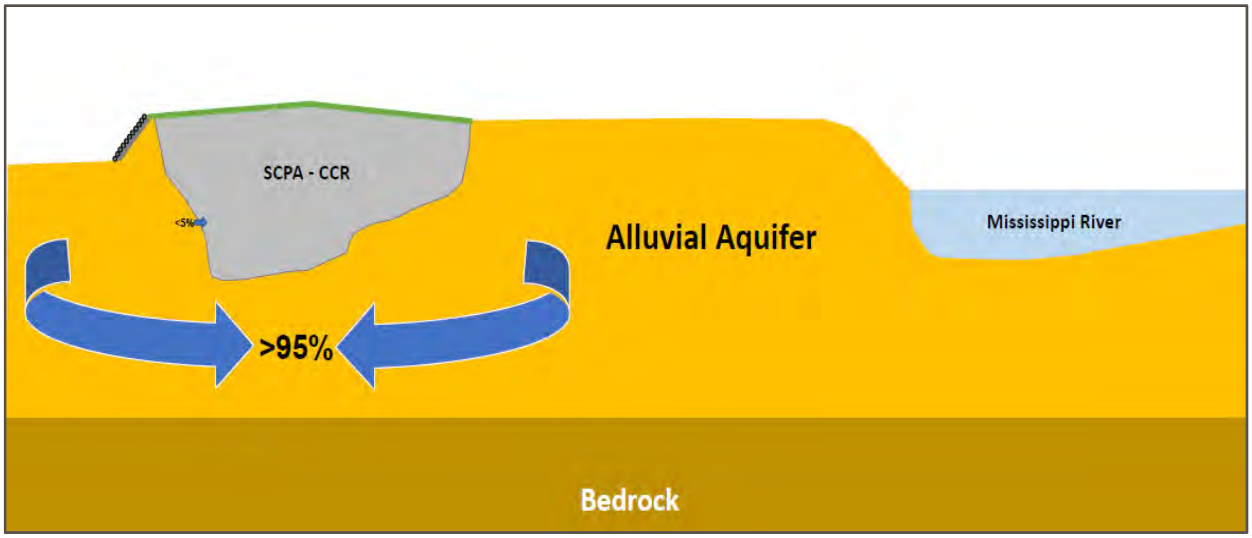

Image provided by Golder 2019

2.3 GROUNDWATER PROTECTION STANDARDS

Golder completed a statistical evaluation of groundwater samples using the methods and procedures outlined in the Groundwater Monitoring Plan's *Statistical Analysis Plan* (Golder 2017) to develop site-specific GWPS for each Appendix IV constituent.

Groundwater results were compared to the site-specific GWPS. Statistically significant levels (SSLs) above the GWPS are limited to four monitoring wells (UMW-2D, UMW-3D, UMW-4D and UMW-5D) and only for one parameter (molybdenum).

Parameter	Site GWPS	Units
Antimony	6	µg/L
Arsenic	10	µg/L
Barium	2000	µg/L
Beryllium	4	µg/L
Cadmium	5	µg/L
Chromium	100	µg/L
Cobalt	6	µg/L
Fluoride	4	mg/l
Lead	15	µg/L
Lithium	40	µg/L
Mercury	2	µg/L
Molybdenum	100	µg/L
Radium 226+228	5	pCi/L
Selenium	50	µg/L
Thallium	2	µg/L

Groundwater Protection Standards
ug/L – micrograms per liter
mg/l – milligrams per liter
pCi/L – picoCuries per liter

2.4 NATURE AND EXTENT OF GROUNDWATER IMPACTS

Ameren initiated a nature and extent (N&E) investigation as required by the CCR Rule in 2018 by installing 26 monitoring wells and piezometers (N&E wells). The N&E wells are screened in three different, generalized zones of the alluvial aquifer: shallow zone, middle/intermediate zone, and deep zone. Well screen lengths range from 5 to 10 ft long and total depths range from approximately 21 to 99 ft bgs.

Analytical results from the N&E wells indicate that molybdenum concentrations are limited in their extent. In the shallow alluvial aquifer zone, the results from monitoring wells at the property boundary are below the GWPS in all directions. In the intermediate and deep alluvial aquifer zone, molybdenum concentrations are below the GWPS in all N&E nested monitoring wells to the south, east, and west of the SCPA. One sample at AM-1D to the northwest of the SCPA has a molybdenum concentration above the GWPS. Concentrations of molybdenum are highest in the intermediate zone of the aquifer to the southwest of the SCPA. Results from the N&E wells were used to develop corrective measures alternatives. Monitoring Well locations are show on **Figure 2-1**.

2.5 SURFACE WATER SAMPLING

Elevated levels of molybdenum have not impacted surface waters. Prior to the CCR Rule, Ameren voluntarily collected samples of surface water from the Mississippi River, Missouri River and Mississippi River Chute to evaluate whether ash management operations at the SEC have impacted these surface water bodies. Surface water sampling locations are shown on **Figure 2-2.**

Surface water samples were collected by Golder from 12 locations in the Mississippi River in September 2017 and May 2018. At each sample location, samples were collected near the surface of the river. Where the depth of water was greater than four feet, a second sample was collected mid-depth in the river. A total of 40 samples were collected from the Mississippi River. Surface water samples were also collected by Golder from 12 locations (total of 20 samples) in the Missouri River and from 12 locations (total of 20 samples) in the Mississippi River Chute in September 2017.

Samples were analyzed for the same Appendix III and Appendix IV constituents listed in **Section 1.3**. There are no analytical results for the Mississippi River or the Missouri River above drinking water screening levels or human health recreational levels, with two exceptions not caused by the SEC[4]. All surface water results are below ecological screening levels.

The results of this investigation demonstrate that the Mississippi River, Missouri River and Mississippi River Chute sampling do not show evidence of impact of constituents derived from the SCPA.

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[4] Even though the lithium results for the Missouri River are slightly above the drinking water screening level and arsenic concentrations in the Mississippi and Missouri Rivers are slightly above the human health recreational screening levels, the concentrations are statistically no different in upstream and downstream samples for both arsenic and lithium indicating **that the facility is not the source** of the arsenic and lithium detected in the rivers. With respect to groundwater, arsenic and lithium concentrations comply with GWPS established under the CCR Rule.

3. Risk Assessment and Exposure Evaluation

As described in this report, Ameren has conducted detailed environmental evaluations of the SEC and its environs. These investigations have been detailed in a risk evaluation report available to the public on the Ameren website:

- February 2018: Human Health and Ecological Assessment of the Sioux Energy Center. Available at: https://www.ameren.com/-/media/corporate-site/files/environment/ccr-rule/2017/groundwater-monitoring/sioux-haley-aldrich-report.ashx?la=en&hash=3DE8D6FAA7414CF6D875C5CCC99D1785C720185B

The purpose of the risk evaluations is to identify whether current groundwater conditions pose a risk to human health and the environment and, if so, whether the corrective measures identified in this report mitigate such risk.

3.1 APPROACH

The risk evaluation provided in the 2018 risk assessment report evaluated the environmental setting of the SEC, which has been in operation for over 50 years, including its location and ash management operations at the facility. Golder provided information on groundwater location and direction, the rate(s) of groundwater flow, and where waterbodies may intercept groundwater flow.

A conceptual model was then developed based on this physical setting information and used to identify whether human populations could contact groundwater and/or surface water in the area of the facility. This information was also used to identify locations where ecological populations could come into contact with surface water. Based on this conceptual model approach, Ameren's environmental consultants and risk assessors identified surface water sampling locations to evaluate potential impact to the environment. Sampling results were then evaluated, as appropriate, on both a human health and ecological risk basis.

Human health risk assessment is a process used to estimate the chance that contact with constituents in the environment may result in harm to people. Generally, there are four components to the process (USEPA, 1989): (1) Hazard Identification, (2) Toxicity Assessment, (3) Exposure Assessment, and (4) Risk Characterization.

The USEPA develops “screening levels” of constituent concentrations in groundwater (and other media) that are protective of specific human exposures. These screening levels are referred to as “Regional Screening Levels” and are published by USEPA and updated twice yearly (USEPA, 2018). In developing the screening levels, USEPA uses a specific target risk level (component 4) combined with an assumed exposure scenario (component 3) and toxicity information from USEPA (component 2) to derive an estimate of a concentration of a constituent in an environmental medium, for example groundwater, (component 1) that is protective of a person in that exposure scenario (for example, drinking water). Similarly, ecological screening levels for surface water are developed by Federal and State agencies to be protective of the wide range of potential aquatic ecological resources, or receptors.

Risk-based screening levels are designed to provide a conservative estimate of the concentration to which a receptor (human or ecological) can be exposed without experiencing adverse health effects.

Due to the conservative methods used to derive risk-based screening levels, it can be assumed with reasonable certainty that concentrations below screening levels will not result in adverse health effects, and that no further evaluation is necessary. Concentrations above conservative risk-based screening levels do not necessarily indicate that a potential risk exists but indicate that further evaluation may be warranted.

The surface water and groundwater data were evaluated using human health risk-based and ecological risk-based screening levels drawn from Federal sources. The screening levels are used to determine if the concentration levels of constituents could pose an unacceptable risk to human health or the environment. The evaluation also considers whether constituents are present in groundwater and surface water above screening levels, and if so, if the results could be due to the ash management operations.

3.2 CONCEPTUAL SITE MODEL

There are no on-site users of alluvial groundwater adjacent to SEC. As documented in the 2018 risk assessment report, there are two private wells recorded within a one-mile radius of the facility. One is located at the facility and is not in service, the second private well is screened in bedrock, located near the Missouri River and south of both the plant and nature and extent wells that are unimpacted by CCR. Impacts are not expected in a well that is further from the plant and screened in the less conductive bedrock aquifer.

Based on this CSM and the facility setting shown in **Figure 1-2**, samples have been collected from each of these environmental media – groundwater, Mississippi River surface water, and Missouri River surface water. The samples have been analyzed for constituents that are commonly associated with coal ash.

3.3 RESULTS

3.3.1 Alluvial Aquifer

Figure 1-2 shows the location of the CCR monitoring wells at the SCPA. A summary of the screening results is presented in the table below.

Table: Assessment Monitoring Reflects High Percentage Compliance

	Sioux Energy Center SCPA – Shallow Alluvial Aquifer
Percent of Assessment Monitoring Parameter Compliance	96%
Percent of Assessment Monitoring Parameter Results Requiring Corrective Action (Constituents)	4% Molybdenum

This is striking, given that the wells are located directly adjacent to and at the base of the ash management area, and the facility has been in operation for over 50 years. Over 96% of the groundwater results for the CCR Rule monitoring wells located at the edges of SCPA (UMW-1D, UMW-2D, UMW-3D, UMW-4D, UMW-5D, UMW-6D), are below the GWPS.

3.3.2 Surface Water

The Mississippi River and Missouri River sampling results do not show evidence of impact of constituents derived from the SCPA. There are also no analytical results for the Mississippi River that are above drinking water screening levels. While arsenic concentrations in the Mississippi and Missouri Rivers are slightly above the human health recreational screening levels and lithium concentrations are above the drinking water screening levels in the Missouri River, the concentrations are statistically no different in upstream and downstream samples for both arsenic and lithium indicating that **the facility is not the source** of either the arsenic or lithium detected in the rivers. Furthermore, groundwater samples reflect that arsenic and lithium concentrations attain the CCR Rule's GWPS for the SEC.

3.3.3 National Pollutant Discharge Elimination System Outfall

The outfall for the SCPA is identified as 002 and is shown on **Figure 2-2**. This is a permitted outfall under the National Pollutant Discharge Elimination System program. The outfall effluent water is tested for toxicity on a periodic basis as required by the permit. The biological toxicity testing results for Outfall 002 at the SCPA shows no evidence of aquatic toxicity in the outfall effluent.

3.4 CONCLUSION

The sampling results for the Mississippi River and Missouri River are important. Although groundwater at the edge of the SCPA shows that one constituent is present in some wells above the GWPS, less than 4% of the results are above a GWPS, and the adjacent surface water bodies do not show evidence of impact of constituents derived from the SCPA. This is important because the absence of concentrations above risk-based screening levels means that there is not a significant pathway of exposure.

Impacts to groundwater do not mean that surface waters are impaired. The degree of interface between groundwater and surface waters is variable and complex and dependent upon a variety of factors including gradient and flow rate. It is possible, however, to determine the maximum concentration level that would need to be present on-site in groundwater and still be protective of the surface water environment. Groundwater and surface waters flow at very different rates and volumes. The Mississippi River is the largest river system in North America and as groundwater at the facility flows into the river, it is diluted by more than 90,000 times.

This conservative estimate of dilution is used to further understand how high a molybdenum groundwater concentration would have to be to potentially have an adverse impact on the Mississippi River. The following table shows how this factor is applied to the most conservative of the human health and ecological risk-based screening levels for surface water.

CALCULATING RISK-BASED SCREENING LEVELS FOR SCPA GROUNDWATER BASED ON THE MISSISSIPPI RIVER

	Estimated Dilution Factor for the Mississippi River	90,000			
Constituents	Lowest of the Human Health and Ecological Screening Levels (mg/L)	Groundwater Risk-Based Screening Level* (mg/L)	Maximum SCPA Groundwater Concentration (mg/L)		Ratio Between Groundwater Risk-Based Screening Level and the Maximum SEC Groundwater Concentration
Molybdenum	0.1	9000	8.3	S-UMW-4D	>1000

*Where the Groundwater Risk-Based Screening Level = Screening Level x Dilution Factor.

The groundwater alternative risk-based screening levels are calculated in units of milligrams of constituent per liter of water (mg/L). One mg/L is equivalent to one part per one million parts.

The table identifies the maximum groundwater concentration of molybdenum detected in the SCPA monitoring wells. The comparison between the target levels and the maximum concentrations indicates that there is a wide margin of safety between the two values. This margin is shown in the last column of the table. To illustrate, concentration levels molybdenum would need to be **more than 1,000 times higher** than currently measured levels before an adverse impact in the Mississippi River could occur.

The comprehensive evaluation summarized here demonstrates that there are no adverse impacts on human health from either surface water or groundwater uses resulting from coal ash management practices at the SCPA.

3.4.1 Trace Elements in Coal Ash

All of the inorganic minerals and elements that are present in coal ash are also present naturally in our environment. Molybdenum is referred to as a trace element, so called because it is present in soils (and in coal ash) at such low concentrations (in the milligrams per kilogram (mg/kg) or part per million (ppm) range). Together, the trace elements generally make up less than 1 percent of the total mass of these materials. To put these concentrations into context, a mg/kg or ppm is equivalent to:

- 1 penny in a large container holding $10,000 worth of pennies, or
- 1 second in 11.5 days, or
- 1 inch in 15.8 miles

All of the constituents present in coal ash occur naturally in our environment. U.S. Geological Survey (USGS) data demonstrate the presence of these constituents in the soils across the U.S. These soils are found in our backyards, schools, parks, etc., and because of their presence in soil, these constituents are also present in the foods we eat. Some of these constituents are present in our vitamins, such as molybdenum. Thus, we are exposed to these trace elements in our natural environment every day, and in many ways.

3.4.2 Molybdenum

Haley & Aldrich has prepared a Fact Sheet (**Appendix B**) that provides information on molybdenum so that the groundwater data can be considered in context. There is no public exposure to groundwater at the SEC and concentration levels of molybdenum in adjacent surface waters are all well below health-based regulatory standards.

As discussed in more detail in **Appendix B**, molybdenum is an essential nutrient for humans, and the Institute of Medicine of the U.S. National Academy of Sciences (NAS) has provided recommended daily allowances (RDA) and tolerable upper limits (UL) to be used as guidelines for vitamins and supplements and other exposures (NAS, 2001).

The RDA for a nutrient is "the average daily dietary nutrient intake level sufficient to meet the nutrient requirement of nearly all (97 to 98 percent) health individuals" (NAS, 2001). The RDA for molybdenum for adults set by the NAS in 2001 is 0.045 mg/day and is based on the amount of molybdenum needed to achieve a steady healthy balance in the body for the majority of the population.

The UL for molybdenum set by the NAS is 2 mg/day. This level is based on an evaluation of the potential toxicity of molybdenum at high levels of intake. Based on the UL, a safe drinking water level for molybdenum is 0.6 mg/L or 600 ug/L, or six-fold higher than the level set by USEPA of 0.1 mg/L or 100 ug/L in the CCR Rule. This difference serves to underscore the conservatism of the USEPA value when evaluating groundwater under the CCR Rule. As reflected in the chart below, over 90% of the GW results across all four energy centers, including 80% of Sioux samples, are below the standard the National Academy of Science developed for vitamins and supplements.

	Labadie	Meramec	Rush Island	Sioux
Groundwater				
Number of Samples	208	88	77	244
Molybdenum greater than CCR GWPS of 0.1 mg/L (a)	81	35	38	77
Molybdenum greater than NAS standard of 0.6 mg/L (b)	3	1	11	49
Surface Water				
Number of Samples	67	74	50	80
Molybdenum greater than 0.1 mg/L (a)	0	0	0	0

Notes:

mg/L - milligrams per liter.

(a) - Drinking water-based groundwater protection standard specified in the Coal Combustion Residuals Rule.

(b) - Alternative health-protective drinking water screening level based on the National Academy of Sciences review of molybdenum.

3.5 EVALUATION OF RISK IN THE CORRECTIVE MEASURES ASSESSMENT

In summary, there are no adverse impacts resulting from coal ash management practices at the SEC on human health or the environment from either surface water or groundwater uses. There are no users of groundwater near SCPA. In fact, as described above, concentrations of molybdenum detected in groundwater would need to be more than **1,000 times higher** before such an unacceptable risk could exist in the Mississippi River under current and reasonable anticipated future uses.

Although the purpose of this CMA is to evaluate remedies to address assumed risks from the SSLs, the current conditions at the SCPA, even prior to closure, do not pose an unacceptable risk to human health or the environment. Therefore, the risk-based evaluation provides additional support for the selection of a remedy moving forward.

4. Corrective Measures Alternatives

4.1 CORRECTIVE MEASURES ASSESSMENT GOALS

The overall goal of this CMA is to identify and evaluate the appropriateness of potential corrective measures to prevent further releases of Appendix IV constituents above their GWPS, to remediate releases of Appendix IV constituents detected during groundwater monitoring above their GWPS that have already occurred, and to restore groundwater in the affected area to conditions that do not exceed the GWPS for these Appendix IV constituents. The corrective measures evaluation that is discussed below and subsequent sections provides an analysis of the effectiveness of five potential corrective measures in meeting the requirements and objectives of remedies as described under §257.97 (also shown graphically on **Figure 4-1**). This assessment also meets the requirements promulgated in §257.96 which require the assessment to evaluate:

- The performance, reliability, ease of implementation, and potential impacts of appropriate potential remedies, including safety impacts, cross-media impacts, and control of exposure to residual contamination;
- The time required to complete the remedy; and
- The institutional requirements, such as state or local permit requirements or other environmental or public health requirements that may substantially affect implementation of the remedy.

The criteria listed above are included in the balancing criteria considered during the corrective measures evaluation, described in **Section 5**.

4.2 GROUNDWATER MODELING

Modeling is an analytical tool used to create estimates based on computer-simulated conditions. Groundwater flow and geochemical modeling[5] performed by Golder evaluated the hydrogeologic and geochemical conditions at the SCPA. Golder used the numerical computer code MODFLOW to simulate groundwater flow and the software package MT3DMS to simulate groundwater transport of dissolved phase constituents. Golder used the geochemical modeling software PHREEQC to evaluate groundwater quality and determine the potential for attenuation of molybdenum.

4.3 GROUNDWATER TREATMENT EVALUATION

In-situ treatment to reduce the concentrations of dissolved metals in groundwater can occur via stabilization of metals through precipitation of a metal compound, co-precipitation of the target metal within the structure of another compound, and/or sorption of the target metal onto other compounds in the subsurface. In simple terms, groundwater amendments are injected into the aquifer to create a chemical reaction that attenuates metals through precipitation or sorption.

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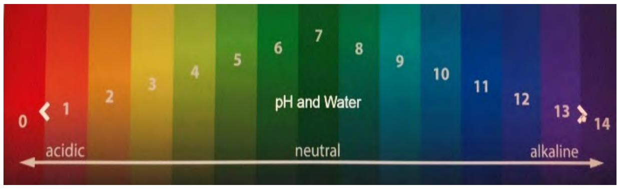
[5] Groundwater flow modeling was performed using MODFLOW 2000 supported by Groundwater Vistas as the graphical user interface.

Chemical precipitation is an available and demonstrated groundwater treatment technology recognized by USEPA[6]. Groundwater geochemistry (including oxidation reduction potential (ORP)) can greatly impact metals mobility at a site, where some metal compounds may be more soluble under highly oxidative (positive ORP) conditions while others are more soluble under reduced conditions (negative ORP). Also, the solubilities of many metal compounds are highly dependent on pH.



pH and Water (USGS - Water Science School publication).

Ameren has retained XDD Environmental (XDD) to research and develop appropriate treatment options for molybdenum and is performing bench-scale treatability studies to demonstrate the effectiveness of treatment options on site-specific basis. Evaluations of the Rush Island and Meramec Energy Centers commenced earlier this year and XDD has collected soil and groundwater samples from the SCPA impoundment area and, based on laboratory results from Rush Island, is developing bench scale studies targeted specific to the SEC. Bench-scale treatment results are expected to be completed in the Summer of 2019.

4.4 CORRECTIVE MEASURES ALTERNATIVES

Corrective measures can terminate when groundwater impacted by the SCPA does not exceed the Appendix IV GWPS for three consecutive years of groundwater monitoring. In accordance with §257.97, the groundwater corrective measures to be considered must meet, at a minimum, the following threshold criteria:

1. Be protective of human health and the environment;
2. Attain the GWPS;
3. Control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of COCs to the environment;
4. Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, considering factors such as avoiding inappropriate disturbance of sensitive ecosystems; and
5. Comply with standards (regulations) for waste management.

Each of the remedial alternatives assembled as part of this CMA meet the requirements of the threshold criteria listed above.

The remedial alternatives presented below contemplate both CIP (Alternatives 1 through 4) and CBR (Alternative 5) of the SCPA. Both closure methods are expressly authorized under the CCR Rule. Ameren has prepared closure design documents, completed necessary closure notifications, engaged a qualified contractor and is currently in the process of closing the SCPA in place.

4.4.1 Alternative 1 – Closure in Place with Capping and Monitored Natural Attenuation

The SCPA would be closed in place with a geomembrane and soil protective cap system to reduce infiltration of surface water to groundwater thereby isolating source material. This cap selection

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[6] EPA, "Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category: EPA's Response to Public Comments; Part 7 of 10", SE05958A6, p. 7-20

exceeds regulatory requirements by more than two orders of magnitude (<1 x 10^{-7} centimeters per second (cm/sec) planned versus 1 x 10-5 cm/sec required by the CCR Rule). Over time, depletion of COCs in CCR would allow the concentration of COCs in downgradient groundwater to decline and overall groundwater concentrations of COCs to attenuate. Geochemical modeling results indicate that post-closure 95% of groundwater will flow around and not through the SCPA, thereby isolating the source. The dissolved phase plume of molybdenum remaining above the GWPS post-closure eventually attenuates, albeit very slowly.

CIP can be completed safely, in compliance with applicable federal and state regulations, and be protective of public health and the environment. In general, CIP consists of installing a cap/cover designed to significantly reduce infiltration from surface water or rainwater, resist erosion, contain CCR materials, and prevent exposures to CCR. For this alternative, Ameren would install a geomembrane with a permeability that is 100 times lower than what the CCR Rule requires thus further reducing infiltration. At the SEC, CIP construction activities will take approximately 18-24 months and are expected to be completed in 2021.

MNA is a viable remedial technology recognized by both state and federal regulators that is applicable to inorganic compounds in groundwater. The USEPA defines MNA as “the reliance on natural attenuation processes to achieve site-specific remediation objectives within a time frame that is reasonable compared to that offered by other more active methods”. The ‘natural attenuation processes’ that are at work in such a remediation approach include a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil or groundwater. These in-situ processes include biodegradation; dispersion; dilution; sorption; volatilization; radioactive decay; and chemical or biological stabilization, transformation, or destruction of contaminants (USEPA, 2015). When combined with a low-permeability cap to address the source by limiting the infiltration of precipitation into and through the CCR, MNA can reduce concentrations of molybdenum in groundwater at the SCPA boundary, although the time required to achieve the GWPS would be lengthy due to the low groundwater flux.

Following the installation of the cap system, Ameren would implement post-closure care activities. Post-closure care includes long-term groundwater monitoring until such time that groundwater conditions return to regulatory levels and cap system maintenance. Future development of the capped surface could be used for solar photovoltaic arrays or other site staging/ancillary operational needs.

4.4.2 Alternative 2 – CIP with In-Situ Stabilization, Capping and Monitored Natural Attenuation

In-situ stabilization is a technique that uses mixing of the CCR with amendments to solidify the material in place. Amendments typically include Portland Cement and the solidification is completed in-situ using large diameter augers. CCR located beneath the water table would be isolated by ISS, followed by capping of the surface impoundment. Groundwater impacts would be addressed through the processes of natural attenuation. This alternative would isolate the source (through solidification and installation of a low-permeability cap) and over time, allow the concentrations of COCs in downgradient groundwater to decline and overall groundwater concentrations of COCs to attenuate.

In-situ stabilization of the SCPA is predicted to take a number of years to complete, depending on the availability of specialized contractors and equipment. Additionally, implementation of ISS will require a detailed design effort with bench scale testing to determine the appropriate amendment mix. Pilot testing will also be needed to verify the ability of equipment to solidify material at depth. ISS has not been commonly used to stabilize entire ash units as part of a closure strategy. Changes to groundwater chemistry relative to the mobility of Appendix IV constituents following completion of ISS, where large volumes of amendments (typically Portland cement) are added to the subsurface, are unknown and would require pilot testing.

Following the ISS completion and low-permeability final cover system ($<1 \times 10^{-7}$ cm/sec) installation, Ameren would implement post-closure care activities that includes long-term groundwater monitoring and cover system maintenance; future development of the capped surface could be used for solar photovoltaic arrays or other site staging/ancillary operational needs.

4.4.3 Alternative 3 – CIP with Capping and In-Situ Groundwater Treatment

Similar to Alternative 1, the SCPA would be CIP with a low-permeability ($<1 \times 10^{-7}$ cm/sec) cap to reduce infiltration of surface water to groundwater and to isolate source material. Molybdenum would be addressed through in-situ injection of groundwater amendments downgradient of the SCPA with the objective of accelerating the time required to achieve the GWPS within the treatment zone.

Following the installation of the low-permeability cover and in-situ treatment system, Ameren would implement post-closure care activities that include periodic amendment injections or periodic replenishment of the treatment reagents within a permeable reactive barrier (PRB), long-term groundwater sampling to monitor treatment system performance, and cover system maintenance.

Future development of the capped surface could be used for solar photovoltaic arrays or other site staging/ancillary operational needs.

4.4.4 Alternative 4 – CIP with Capping and Hydraulic Containment Through Groundwater Pumping and Ex-situ Treatment

The SCPA would be closed in place with a low-permeability ($<1 \times 10^{-7}$ cm/sec) cap to reduce infiltration and isolate source material. Pumping wells would be used to hydraulically control the downgradient migration of molybdenum. However, pumping wells would generate large volumes of effluent that would require ex-situ treatment, likely with an ion exchange or a reverse osmosis (RO) treatment system. Both treatment systems are complex with ongoing operation and maintenance and would generate a secondary waste stream – including regeneration/replacement of the ion exchange media or concentration reject water from the RO system. Approvals and permitting would be required for the construction and installation of the treatment systems and discharge of the treated groundwater.

Implementation of a large-scale hydraulic containment (HC) system will require a detailed design effort with bench scale testing to verify groundwater treatment. Pilot testing, such as pumping tests and additional groundwater modeling, will be needed to verify the hydraulic capture zone. While HC is a widely used remediation technology, it has not been commonly used as part of a large-scale CCR unit closure strategy.

Following the installation of the low-permeability cover, groundwater pumping well network, and ex-situ treatment system, Ameren would implement post-closure care activities that includes operation and maintenance of the HC system, long-term groundwater sampling to monitor HC system performance, and cover system maintenance. Future development of the capped surface could be used for solar photovoltaic arrays or other site staging/ancillary operational needs.

4.4.5 Alternative 5 – Closure by Removal with Monitored Natural Attenuation

This alternative evaluates the removal of CCR from all impoundments at the SEC followed by natural attenuation of molybdenum in groundwater. While this alternative would eliminate (through removal) the source, it takes decades to implement during which time the impounded ash would remain open and subject to ongoing infiltration for the duration of the removal activities. As with Alternative 1, 2, and 3, concentrations of molybdenum in downgradient groundwater would decline via natural attenuation processes.

Lochmueller Group prepared an Extraction and Transportation Study (Lochmueller Study) to evaluate closure by removal excavation and disposal scenarios. On-site and off-site disposal options were considered. The SEC presents unique challenges that can impact cost estimates and closure times. It is important to note that the existing on-site utility waste landfill was designed and permitted to manage ongoing production through the retirement date of the SEC. Accordingly, excavated material would need to be transported off-site to a commercial landfill **or** Ameren would need to permit and construct a new on-site landfill. The regulatory process for construction of an on-site landfill could require multiple levels of approval including environmental permits, conditional use local authorization and, if necessary, certificate issuance from the Missouri Public Service Commission. Opposition to such projects and regulatory approval would take years to resolve *before* construction could commence.

There are also several potential community impacts, safety concerns and project duration challenges associated with the CBR alternative for the off-site disposal option. Given the magnitude of the total estimated haul volume (6.1 MM CY) along with the travel distance required to transport the CCR to one or more landfills, injuries and fatalities would be likely. The Lochmueller Study (**Appendix C)** estimated that the time period needed to transport off-site to a commercial landfill could be 15 plus years. The Lochmueller study bases its time estimate on assumed productivity rates that are subject to significant variability and potential disruptions (e.g., weather conditions, available landfill capacity, travel route traffic congestion, etc.) that could impact the overall CBR timeframe. As the report makes clear, there is simply a limit on how much excavation, and roundtrip truck hauls can occur on a given eight-hour workday.

Excavated CCR materials would not be suitable for beneficial use applications, due to chemical reactions that occurred during the placement of class C fly ash via wet sluicing. Traditional beneficial use applications for class C fly ash, such as replacement for cement in the production of ready-mix concrete and concrete related products require the materials to be capable of reacting chemically to produce cementitious bonds. The capability to produce these chemical reactions have been expended with the wet-sluicing process. In contrast, the chemistry of class F fly ash, produced at other utility sites, does not react with sluice water to create cementitious bonds, and thus may be suitable for recovery and processing for use in ready mix concrete and concrete related products[7].

In addition to the logistical challenges of designing and construction an on-site landfill, technical and logistical challenges of implementing a large-scale ash removal project also need to be considered (removal of CCR over 75-ft deep). Removal activities will be difficult and require full-time dewatering, implementation of CCR stabilization methods and temporary staging/stockpiling of material for drying

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[7] Information provided by Ameren technical staff, May 2019.

prior to transportation; these considerations will affect productivity and increase removal duration. Excavation and construction safety during the removal duration is another major concern due to heavy equipment (bulldozers, excavators, front end loaders, off-road trucks) and dump truck operation within the active SEC site. Additional community impacts associated with the use of heavy equipment and truck traffic are also a consideration for this alternative. Lastly, further review of local restrictions and approvals would be required to verify that any selected landfill could receive the ash for disposal.

5. Comparison of Corrective Measures Alternatives

The purpose of this section is to evaluate, compare, and rank the five corrective measures alternatives using the balancing criteria described in §257.97.

5.1 EVALUATION CRITERIA

In accordance with §257.97, remedial alternatives that satisfy the threshold criteria are then compared to four balancing (evaluation) criteria. The balancing criteria allow a comparative analysis for each corrective measure, thereby providing the basis for final corrective measure selection. The four balancing criteria include the following:

1. The long- and short-term effectiveness and protectiveness of the potential remedy(s), along with the degree of certainty that the remedy will prove successful;
2. The effectiveness of the remedy in controlling the source to reduce further releases;
3. The ease or difficulty of implementing a potential remedy; and
4. The degree to which community concerns are addressed by a potential remedy.

Public input and feedback will be considered following a public information session to be held in May 2019.

5.2 COMPARISON OF ALTERNATIVES

This section compares the alternatives to each other based on evaluation of the balancing criteria listed above. The goal of this analysis is to identify the alternative that is technologically feasible, relevant and readily implementable, provides adequate protection to human health and the environment, and minimizes impacts to the community.

A graphic is provided within each subsection below to provide a visual snapshot of the favorability of each alternative, where green represents favorable, yellow represents less favorable, and red represents unfavorable.

5.2.1 The Long- and Short-Term Effectiveness and Protectiveness of the Potential Remedy, along with the Degree of Certainty that the Remedy Will Prove Successful

This balancing criterion takes into consideration the following sub criteria relative to the long-term and short-term effectiveness of the remedy, along with the anticipated success of the remedy.

5.2.1.1 Magnitude of reduction of existing risks

As summarized in **Section 3**, no unacceptable risk to human health and the environment exists with respect to the SCPA. Therefore, none of the remedial alternatives are necessary to reduce an assumed risk posed by Appendix IV constituents in groundwater because no such adverse risk currently exists. However, other types of impacts can be posed by the various remedial alternatives considered here. The remedial alternatives that pose the lowest risk to human health and the environment is Alternative 1 (CIP with MNA) and 3 (CIP with in-situ treatment) because they are implemented on-site and involve the least amount of construction, operations and maintenance activities and associated impacts.

Alternative 5 (CBR with MNA) has the highest potential impact due to the prolonged truck traffic, which increases the likelihood of roadway accidents during the estimated 15 years needed to complete off-site removal. Construction and material transportation will also be required for Alternative 2 (CIP with ISS) during the process of solidifying the CCR. Construction of the treatment system and cap will be required for Alternative 3 (CIP with in-situ treatment) and 4 (CIP with HC) and a waste stream will be generated for Alternative 4 (CIP with HC) posing additional risk. However, these alternatives, like Alternatives 1 (CIP with MNA) and 2 (CIP with ISS), pose a lesser risk than Alternative 5 (CBR with MNA).

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
Category 1 - Subcriteria i) Magnitude of reduction of risks	🟩	🟨	🟩	🟩	🟥

5.2.1.2 Magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy

Alternative 5 (CBR with MNA) has the lowest long-term residual risk in that removal of the source material reduces the likelihood of future releases to groundwater. However, implementation of this alternative will take approximately 15 to 20 years (whether by off-site removal or a new on-site landfill) during which time the CCR material will remain open to the environment, thereby increasing the likelihood of releases during the implementation period. For Alternatives 1 through 4, the SCPA would be CIP with the installation of a low permeability ($<1 \times 10^{-7}$ cm/s) cap that would significantly reduce the infiltration of precipitation into the SCPA. The source is isolated under Alternatives 1 through 4, and dissolved phase molybdenum in groundwater is addressed through MNA. Molybdenum concentration in groundwater is not significant because it does not threaten human health or the environment even under current conditions. Alternatives 3 (CIP with in-situ treatment) and 4 (CIP with HC) also provide additional mitigation measures. A low risk for further releases exists with Alternative 2 (CIP with ISS) when completed, however implementation will require several years to complete with the potential for ongoing impacts during construction. The likelihood of a further release during the ISS construction period is high, relative to the other CIP alternatives but Alternative 4 (CIP with HC) will result in an additional waste stream.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
Category 1 - Subcriteria ii) Magnitude of residual risk in terms of likelihood of further release	🟩	🟨	🟩	🟩	🟥

5.2.1.3 The type and degree of long-term management required, including monitoring, operation, and maintenance

Alternative 1 (CIP with MNA) is the most favorable alternative with respect to this criterion because it requires the least amount of long-term management and involves no mechanical systems as part of the remedy. Alternative 5 (CBR with MNA) is least favorable because off-site removal and a new on-site landfill are estimated to take 15 to 20 years to complete and are both logistically complex as previously noted. The remaining alternatives fall between Alternatives 1 and 5 because they involve more intensive systems to implement and/or maintain throughout their remediation life cycle.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
Category 1 - Subcriteria iii) Type and degree of long-term management required	🟩	🟨	🟨	🟨	🟥

5.2.1.4 *Short-term risks that might be posed to the community or the environment during implementation of such a remedy*

The highest short-term impact posed to the community or environment would be during implementation of Alternative 5 (CBR with MNA), followed by Alternative 2 (CIP with ISS), making these alternatives least favorable. Potential environmental impacts include noise and emissions from heavy equipment, the potential for a release during excavation and dewatering, and fugitive dust emissions. Community impacts include general impacts to the community due to increased truck traffic on public roads during the entire project duration, including construction of the on-site landfill (if off-site disposal is not selected), along with an increased potential for traffic accidents and fatalities, noise, and truck emissions. As noted, Alternative 5 (whether off-site disposal or a new onsite landfill) will require a substantial period of time when the CCR material will be open to the environment posing risk during implementation of this remedy.

For Alternatives 1 (CIP with MNA), 3 (CIP with in-situ treatment), and 4 (CIP with HC), risk to the community during implementation is considered the same and would be minimal compared to the other alternatives. Long-term sampling of the monitoring well network to verify treatment system effectiveness will pose no risk to the community.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
Category 1 - Subcriteria iv) Short term risk to community or environment during implementation	🟩	🟨	🟩	🟩	🟥

5.2.1.5 *Time until full protection is achieved*

There is currently no unacceptable risk to human health and the environment associated with groundwater at the SCPA; therefore, protection is already achieved. Alternatives 1 (CIP with MNA), 3 (CIP with in-situ treatment), and 4 (CIP with HC) are anticipated to take a similar period of time until source depletion and natural attenuation reduces COCs to GWPS concentrations, but a waste stream is produced by implementation of Alternative 4. Although the Alternative 4 (CIP with HC) time duration may be slightly shorter due to the increase in groundwater flux through pumping, these three alternatives are considered equivalent due to the similar timeframe.

Alternative 5, (CBR with MNA), could take approximately 15 years or greater for construction with off-site disposal. This timeframe increases to 20 years or greater for on-site landfill disposal due to design, permitting, construction and disposal. Removal construction would be followed by a period of groundwater monitoring to verify natural attenuation of the groundwater plume, which makes this alternative not only unfavorable but will not achieve compliance with the CCR Rule closure time mandates. The period for construction is limited mainly by the construction of an on-site landfill, the amount of material that can be handled in one day (for both on site or off-site disposal), disposal facility capacity (if off-site disposal is selected), and the volume of ash to be handled.

Pending equipment availability, Alternative 2 (CIP with ISS) could take the least amount of time (if multiple mixing machines are available for ISS) at approximately 5 years to complete and a period of groundwater monitoring to verify natural attenuation of the groundwater plume. Implementation of Alternative 2 would require extensive engineering analysis and field testing. Assuming such studies confirm the viability of ISS technology at the SCPA and equipment availability, field implementation could take a significant amount of time to implement.

Due to the extended time frame that will be required to achieve the GWPS for each Alternative, each Alternative was given the same ranking for this balancing sub-criterion.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
Category 1 - Subcriteria v) Time until full protection is achieved	🟨	🟨	🟨	🟨	🟨

5.2.1.6 *Potential for exposure of humans and environmental receptors to remaining wastes, considering the potential threat to human health and the environment associated with excavation, transportation, re-disposal, or containment*

Alternatives 1 (CIP with MNA), 3 (CIP with in-situ treatment), and 4 (CIP with HC) all have similar, minimal potential for exposure to humans and environmental receptors during regrading and cap construction; monitoring well system installation; and installation of the in-situ treatment system or HC system. Alternative 1 (CIP with MNA) is the most favorable alternative since, aside from capping, no additional contact with CCR or impacted groundwater would be needed. Alternative 3 (CIP with in-situ treatment) is also favorable because treatment occurs below ground and no waste stream is generated. A waste stream would be generated under Alternative 4 (CIP with HC) and need to be managed either onsite or offsite, which creates a potential for exposure.

Alternatives 2 (CIP with ISS) and 5 (CBR with MNA) have moderate and high potential for exposure, respectively, which makes them the least favorable remedy for this criterion. A high potential for exposure exists during the excavation and transport (both off-site and on-site) of the CCR if Alternative 5 is implemented. A moderate potential to exposure exists during ISS construction (Alternative 2) if some CCR needs to be disposed off-site as part of the preliminary removal effort prior to ISS implementation.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
Category 1 - Subcriteria vi) Potential for exposure of humans and environmental receptors to remaining wastes	🟩	🟥	🟩	🟨	🟥

5.2.1.7 *Long-term reliability of the engineering and institutional controls*

Alternatives 1 (CIP with MNA), 3 (CIP with in-situ treatment), and 4 (CIP with HC) are all expected to have high long-term reliability, as capping and long-term monitoring are common methods for long-term waste management. HC and ex-situ treatment (Alternative 4) are considered proven technologies and would have high long-term reliability but create a significant, large-volume waste stream and require bench scale and pilot testing. Alternative 3 will require bench scale (in progress) and pilot scale testing to confirm treatability of molybdenum. Of the CIP alternatives, Alternative 1 (CIP with MNA) is considered the most favorable because no additional ongoing operations and maintenance (O&M)

would be needed, other than periodic groundwater sampling and verification of decreasing concentrations.

For Alternatives 1 through 4, which include CIP, institutional controls, such as recording of an environmental covenant restricting the use of groundwater can easily be implemented because the SCPA is located on property owned by Ameren.

Alternative 5 (CBR with MNA) engineering and institutional controls would have high long-term reliability because the CCR will have been removed from the SCPA and placed in a new on-site or existing off-site permitted landfill. With the CCR no longer in place, no additional engineering and institutional controls are anticipated. Alternative 2 (CIP with ISS) is also expected to have a high long-term reliability because the CCR would be isolated within the ISS monolith.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
Category 1 - Subcriteria vii) Long-term reliability of engineering and institutional controls	🟩	🟩	🟨	🟨	🟩

5.2.1.8 *Potential need for replacement of the remedy*

Closure in place of the SCPA with ISS and closure by removal are both considered permanent and can be effective in appropriate circumstances. Detailed engineering assessments would need to be completed before the viability of such approaches could be considered at a site such as the SCPA given its depth. Field pilot testing would be needed for ISS to confirm the ability of equipment to reach the bottom of CCR. From the perspective of needing to replace the remedy, source removal (Alternative 5) is permanent but takes decades to implement.

Alternatives 1 (CIP with MNA), 3 (CIP with in-situ treatment), and 4 (CIP with HC) are expected to have permanent closures with capping in place. Should monitoring results indicate that the selected remedial alternative is not effective at reducing the concentration of COCs over time, alternate and/or additional active remedial methods for groundwater may be considered in the future.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
Category 1 - Subcriteria viii) Potential need for replacement of the remedy	🟨	🟩	🟨	🟨	🟩

5.2.1.9 *Long- and short-term effectiveness and protectiveness criterion summary*

The following graphic provides a summary of the long- and short-term effectiveness and protectiveness of the potential remedy, along with the degree of certainty that the remedy will prove successful. Alternatives 1 (CIP with MNA) is the most favorable, while Alternative 5 (CBR with MNA) is the least favorable. Alternative 1 does not include additional treatment technology aside from MNA, and therefore long-term management requirements are minimal. Alternative 1 does not rely on mechanical systems aside from low-permeability capping. Alternatives 3 (CIP with in-situ treatment) and 4 (CIP with HC) provide groundwater treatment at the waste boundary but require additional long-term operation maintenance. Alternative 5 (CBR with MNA) includes large-scale construction, and a lengthy permitting and approval period if an on-site landfill is constructed, which adds the potential for exposure to humans and the environment during the construction period. Alternative 2 (CIP with ISS) also includes potential exposure to humans and environment during construction, although the construction duration is expected to be shorter than Alternative 5. Further, to implement Alternative 5, the CCR material will be open to the environment for decades during the lengthy removal process.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
CATEGORY 1 Long- and Short Term Effectiveness, Protectiveness, and Certainty of Success	🟩	🟨	🟨	🟨	🟥

5.2.2 The Effectiveness of the Remedy in Controlling the Source to Reduce Further Releases

This balancing criterion takes into consideration the ability of the remedy to control a future release, and the extensiveness of treatment technologies that will be required.

5.2.2.1 The extent to which containment practices will reduce further releases

For remedial Alternatives 1 (CIP with MNA), 3 (CIP with in-situ treatment), and 4 (CIP with HC), installation of the low permeability cap will reduce the infiltration of surface water into the SCPA and decrease the flux of molybdenum to groundwater over time. Groundwater mounding, and associated outward hydraulic gradient, present at the SCPA during operation is expected to dissipate after closure. Alternatives 3 and 4 are considered the most favorable because active treatment technologies (in-situ treatment and HC with ex-situ treatment, respectively) will be implemented to limit further down-gradient migration of molybdenum in groundwater.

Under Alternatives 2 (CIP with ISS) and 5 (CBR with MNA), no further releases are anticipated following removal or stabilization of the CCR material. However, the implementation of each alternative is anticipated to require multiple years or decades to complete with MNA monitoring following completion of construction. During the period of design, permitting, and construction for Alternatives 2 and 5, there would be no source control of the Appendix IV constituents.

For Alternatives 3 (CIP with in-situ treatment) and 4 (CIP with HC), additional containment or treatment practices (in-situ treatment and HC with ex-situ treatment) will address COCs in groundwater migrating downgradient from the SCPA, achieving the performance criteria at the waste boundary. Alternative 4, however, will create additional waste streams requiring management on and off site. Alternative 1 will not have an additional containment technology beyond natural attenuation.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
Category 2 - Subcriteria i) Extent to which containment practices will reduce further releases	🟨	🟨	🟩	🟩	🟨

5.2.2.2 The extent to which treatment technologies may be used

No groundwater treatment technologies, other than natural attenuation, will be used for Alternatives 1 (CIP with MNA) and 5 (CBR with MNA). There would be no ongoing operation and maintenance of a treatment technology, other than periodic groundwater monitoring. Alternative 1 relies only on low-permeability capping with long-term groundwater monitoring, and therefore is the most favorable.

Alternative 2 (CIP with ISS) uses solidification of the CCR below the water table to address COCs in groundwater.

Alternative 3 will use one additional technology, in-situ treatment, while Alternative 4 will use two additional technologies, HC and ex-situ treatment. The operation of an ex-situ treatment system will create a secondary waste stream, such as concentrated reject water (RO) requiring off-site disposal, or depleted resin (ion exchange) requiring regeneration or off-site disposal.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
Category 2 - Subcriteria ii) Extent to which treatment technologies may be used	🟩	🟨	🟩	🟨	🟩

5.2.2.3 Effectiveness of the remedy in controlling the source to reduce further releases summary

The graphic below provides a summary of the effectiveness of the remedial alternatives to control the source to reduce further releases. Alternatives 3 (CIP with in-situ treatment) is the most favorable, while Alternatives 1 (CIP with MNA), 2 (CIP with ISS), 4 (CIP with HC) and 5 (CBR with MNA) are less favorable. The construction period for Alternative 3 (CIP with in-situ treatment) is expected to be brief and will begin treating groundwater at the unit boundary immediately. Further releases under Alternative 2 (CIP with ISS) and Alternative 5 (CBR with MNA) will not be addressed until construction is complete.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
CATEGORY 2 Effectiveness in controlling the source to reduce further releases	🟨	🟨	🟩	🟨	🟨

5.2.3 The Ease or Difficulty of Implementing a Potential Remedy

This balancing criterion takes into consideration technical and logistical challenges required to implement a remedy, including practical considerations such as equipment availability and disposal facility capacity.

5.2.3.1 Degree of difficulty associated with constructing the technology

CIP with a low permeability cap will be straightforward and can be implemented with common construction methods for Alternatives 1 (CIP with MNA), 3 (CIP with in-situ treatment), and 4 (CIP with HC). No construction difficulties are anticipated if Alternatives 1, 3, and 4 are implemented. Specialty equipment or contractors are not required. For Alternative 1, no additional treatment technology is needed other than monitoring wells for groundwater monitoring. Installation of an in-situ treatment system (Alternative 3) or groundwater pumping wells with an ex-situ treatment system (Alternative 4) is expected to be straightforward, although with Alternative 4, an additional waste stream will require handling.

Alternatives 2 (CIP with ISS) and 5 (CBR with MNA) will be difficult to implement due to technical and logistical challenges. Alternative 5 will include a deep excavation below the water table, ongoing excavation, dewatering, CCR stabilization, seasonal impacts to construction due to wet weather and winter weather, and transportation. If the CCR is disposed on-site in a new landfill for Alternative 5, additional effort will be required for the design, permitting, approval, and construction. Under Alternative 2, the successful completion of ISS to target depths will be technically challenging and will require field pilot testing to confirm equipment reach. Alternatives 2 and 5 will both include large-scale construction, extensive permitting, specialty equipment and contractors, long project durations, and significant technical challenges.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
Category 3 - Subcriteria i) Degree of difficulty associated with constructing the technology	🟩	🟥	🟩	🟩	🟥

5.2.3.2 Expected operational reliability of the technologies

Alternative 1, (CIP with MNA) is considered the most favorable from an operational perspective because capping with MNA has a proven track record and requires limited O&M. While alternative 2 (CIP with ISS) is a proven technology and isolates the ponded material, pilot testing would be required to ensure ISS will be able to solidify CCR at depth. The potential for geochemical impact on the groundwater aquifer from the solidification amendments would need to be evaluated. Alternatives 3 (CIP with in-situ treatment) and 4 (CIP with HC) are expected to be reliable but will utilize additional groundwater treatment technologies. Alternative 5, CBR with MNA is considered a reliable alternative as all CCR material would be removed, although implementation would be challenging.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
Category 3 - Subcriteria ii) Expected operational reliability of the technologies	🟩	🟩	🟨	🟨	🟩

5.2.3.3 Need to coordinate with and obtain necessary approvals and permits from other agencies

Alternative 1, (CIP with MNA), is the most favorable since the implementation of the remedy is straightforward and only includes capping and MNA. Alternatives 2 (CIP with ISS) and 5 (CBR with MNA) will require extensive permitting for large-scale construction whereas the permitting is expected to be straightforward for CIP Alternatives 1, 3, and 4. Alternative 5 in particular, has the potential to present the greatest need for coordination of and obtaining numerous permits and approvals if on-site landfilling is selected. Additional approval and permitting may be required for Alternative 3 (CIP with in-situ treatment) because this alternative may include subsurface treatment via groundwater amendment and permitting will be required for Alternative 4 for the construction and installation of treatment systems and discharge of treated groundwater.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
Category 3 - Subcriteria iii) Need to coordinate with and obtain necessary approvals and permits from other agencies	🟩	🟥	🟨	🟨	🟥

5.2.3.4 Availability of necessary equipment and specialists

Alternative 1, (CIP with MNA), is the most favorable since specialty equipment and specialists will not be required to implement the MNA remedy. For Alternative 3, specialists have already been retained by Ameren. Alternative 4 will require equipment for pumping and treatment and is less favorable than Alternatives 1 and 3 but equipment required should not present great challenge.

Alternatives 2 (CIP with ISS) and 5 (CBR with MNA) are the least favorable since both will require specialty remediation contractors to implement full removal or ISS, respectively, which will include large-scale construction dewatering and effluent management and treatment, deep excavations below the water table, transportation of material for disposal, and implementation of ISS at depth (for Alternative 2 only). Alternative 4 does require the availability of necessary equipment so this Alternative is less favorable than Alternative 1. The specialists for Alternative 3 have already been retained so Alternative 3 is favorable as well.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
Category 3 - Subcriteria iv) Availability of necessary equipment and specialists	🟩	🟥	🟩	🟩	🟥

5.2.3.5 Available capacity and location of needed treatment, storage, and disposal services

The Lochmueller Study assists in the consideration of the CBR alternative (Alternative 5) by evaluating available capacity at landfills reasonably proximate to the SEC that could potentially receive CCR for disposal if off-site disposal is selected. However, Ameren intends to close ash impoundments at **all** of its energy centers over the next four years and it is uncertain whether nearby landfills have sufficient available capacity to accommodate such massive excavation projects in addition to their general municipal solid waste customers. Additionally, local restrictions will need to be reviewed to determine whether the ash material generated outstate can be accepted at such facilities. If on-site disposal is selected for Alternative 5, a new on-site landfill would need to be designed, permitted, and approved since the existing on-site landfills were designed and permitted to manage production needs of the SEC through the facility’s planned retirement date. Due to the disposal requirements, Alternative 5 (CBR with MNA) is the least favorable alternative.

Alternative 2, (CIP with ISS), includes ISS of CCR below the water table. Amendments such as Portland Cement will be imported to the SEC to solidify the material in-situ.

Because the SCPA will be CIP for Alternatives 1, 2, 3, and 4, storage and disposal services for CCR material will not be needed. Temporary stockpiling of CCR during SCPA regrading and capping can be completed within the current boundaries of the ash unit. Alternative 1 is the most favorable alternative since no active treatment is needed. Both Alternatives 2 and 3 include treatment. For Alternative 4, the ex-situ treatment system may also generate a concentrated waste stream which would require onsite treatment or off-site transportation and disposal that the other alternatives would not require. For Alternative 1, the existing on-site UWL was designed and permitted to manage ongoing production through the retirement date of the SEC and not ponded CCR material. As such there is no available on-site capacity. Excavated material would need to be transported off-site to a commercial landfill **<u>or</u>** Ameren Missouri would need to permit and construct a new on-site landfill.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
Category 3 - Subcriteria v) Available capacity and location of needed treatment, storage, and disposal services	🟩	🟨	🟩	🟨	🟨

5.2.3.6 Ease or difficulty of implementation summary

The color ribbon below provides a summary of the ease or difficulty that will be needed to implement each alternative. Alternatives 1 (CIP with MNA) is the most favorable, while Alternatives 2 (CIP with ISS) and 5 (CBR with MNA) are the least favorable.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with Cap, ISS, & MNA	**Alternative 3** CIP with Cap & In-Situ GW Treatment	**Alternative 4** CIP with Cap & Hydraulic Containment	**Alternative 5** CBR with MNA
CATEGORY 3 Ease of implementation	🟩	🟥	🟨	🟨	🟥

6. Summary

This Corrective Measures Assessment has evaluated the following alternatives:

- Alternative 1 – Closure in Place (CIP) with Capping and Monitored Natural Attenuation
- Alternative 2 – CIP with In-Situ Stabilization, Capping and MNA
- Alternative 3 – CIP with Capping and In-Situ Groundwater Treatment
- Alternative 4 – CIP with Capping and Hydraulic Containment Through Groundwater Pumping and Ex-situ Treatment
- Alternative 5 – Closure by Removal with Monitored Natural Attenuation

In accordance with §257.97, each of these alternatives has been evaluated in the context of the following threshold criteria:

- Be protective of human health and the environment;
- Attain the GWPS;
- Control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of COCs to the environment;
- Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, considering factors such as avoiding inappropriate disturbance of sensitive ecosystems; and
- Comply with standards (regulations) for waste management.

In addition, in accordance with §257.96, each of the alternatives has been evaluated in the context of the following balancing criteria:

- The performance, reliability, ease of implementation, and potential impacts of appropriate potential remedies, including safety impacts, cross-media impacts, and control of exposure to residual contamination;
- The time required to complete the remedy; and
- The institutional requirements, such as state or local permit requirements or other environmental or public health requirements that may substantially affect implementation of the remedy.

This Corrective Measures Assessment, and the input received during the public comment period, will be used to identify a final corrective measure for implementation at the SEC.

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TABLES

TABLE I
GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
AMEREN MISSOURI SIOUX ENERGY CENTER
ST. CHARLES COUNTY, MISSOURI

		Constituents													
Monitoring Well ID	Date Sampled	Antimony, Total	Arsenic, Total	Barium, Total	Beryllium, Total	Cadmium, Total	Chromium, Total	Cobalt, Total	Fluoride Total	Lead, Total	Lithium, Total	Mercury, Total	Molybdenum, Total	Selenium, Total	Thallium, Total
		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
	Site GWPS	**6**	**10**	**2000**	**4**	**5**	**100**	**6**	**4**	**15**	**40**	**2**	**100**	**50**	**2**
S-BMW-1D	3/16/2016	1 U	0.20 J	334	1 U	0.5 U	1 U	0.73 J	0.3	5 U	14.2	0.2 U	1.3 J	1 U	1 U
	5/9/2016	1 U	1 U	314	1 U	0.5 U	0.58 J	5 U	0.35	3.7 J	16.8	0.2 U	0.53 J	1 U	1 U
	7/5/2016	1 U	0.17 J	261	1 U	0.5 U	0.35 J	5 U	0.26	5 U	12.8	0.2 U	20 U	1 U	1 U
	9/14/2016	1 U	1 U	309	1 U	0.5 U	0.41 J	5 U		5 U	12.9	0.2 U	20 U	1 U	1 U
	10/20/2016								0.32						
	11/7/2016	1 U	0.15 J	308	1 U	0.5 U	0.35 J	5 U	0.29	5 U	14.8	0.2 U	20 U	1 U	1 U
	1/3/2017	1 U	1 U	334	1 U	0.5 U	0.42 J	5 U	0.27	5 U	15.1	0.2 U	0.75 J	1 U	1 U
	3/8/2017	1 U	1 U	376	1 U	0.5 U	1 U	5 U	0.25	5 U	13.7	0.2 U	20 U	1 U	1 U
	6/6/2017	1 U	0.16 J	332	1 U	0.5 U	0.16 J	5 U	0.24	5 U	10 U	0.1 U	20 U	1 U	1 U
	11/13/2017								0.28						
	4/5/2018	1 U	0.16 J	370	1 U	0.5 U	1 U	5 U	0.078 J	10 U	10.7	0.2 U	20 U	1 U	1 U
	5/14/2018		0.85 J	335					0.3		13.4		1.3 J		
	11/12/2018	1 U	0.20 J	297	1 U	0.5 U	1 U	5 U	0.29	10 U	16.2		20 U	1 U	1 U
S-BMW-3D	11/17/2016	1 U	0.24 J	612	1 U	0.5 U	0.46 J	5 U	0.28	5 U	14.2	0.2 U	20 U	1 U	1 U
	12/8/2016	0.076 J	1 U	667	1 U	0.5 U	0.99 J	5 U	0.34	5 U	20.6	0.2 U	1.8 J	1 U	1 U
	1/3/2017	1 U	1.5	183	1 U	0.5 U	0.59 J	2.8 J	0.34	5 U	7.9 J	0.2 U	6.2 J	1 U	1 U
	2/2/2017	1 U	1 U	650	1 U	0.5 U	0.61 J	5 U	0.34	5 U	20	0.2 U	20 U	1 U	0.082 J
	3/8/2017	1 U	0.086 J	699	1 U	0.5 U	0.70 J	5 U	0.26	5 U	21.5	0.2 U	20 U	1 U	1 U
	4/5/2017	0.041 J	1 U	684	1 U	0.5 U	1 U	5 U	0.31	5 U	23.6	0.2 U	20 U	0.10 J	1 U
	6/5/2017	1 U	1 U	665	1 U	0.5 U	0.17 J	5 U	0.27	5 U	10 U	0.1 U	20 U	1 U	1 U
	6/26/2017	1 U	1 U	668	1 U	0.5 U	1 U	5 U	0.29	5 U	25.3	0.2 U	20 U	1 U	1 U
	11/13/2017								0.29						
	4/5/2018	1 U	1 U	652	1 U	0.5 U	1 U	5 U	0.13 J	10 U	19.5	0.2 U	20 U	1 U	1 U
	5/14/2018		0.63 J	685					0.32		21.6		20 U		
	11/12/2018	1 U	1 U	645	1 U	0.5 U	1 U	5 U	0.3	10 U	25.4		20 U	1 U	1 U
S-UMW-1D	3/17/2016	0.13 J	0.90 J	161	1 U	0.5 U	1 U	5 U	0.34	5 U	13.1	0.2 U	31.7	1 U	1 U
	5/10/2016	0.11 J	0.90 J	120	1 U	0.5 U	0.62 J	5 U	0.31	3.0 J	14.6	0.2 U	38.3	1 U	1 U
	7/5/2016	0.078 J	1.1	138	1 U	0.5 U	1 U	5 U	0.22	5 U	13.7	0.2 U	40.3	1 U	1 U
	9/15/2016	0.066 J	0.98 J	195	1 U	0.5 U	0.36 J	5 U	0.19 J	5 U	14.2	0.2 U	27.9	1 U	1 U
	11/8/2016	1 U	1	184	1 U	0.5 U	1 U	5 U	0.25	5 U	15.5	0.2 U	27.9	1 U	1 U
	1/5/2017	1 U	0.98 J	146	1 U	0.5 U	0.71 J	5 U	0.27	5 U	13.5	0.2 U	40.9	1 U	1 U
	3/9/2017	0.041 J	1.1	123	1 U	0.5 U	1.5	5 U	0.34	5 U	10.1	0.2 U	35.7	1 U	0.17 J
	6/7/2017	1 U	0.98 J	109	1 U	0.5 U	0.22 J	5 U	0.34	5 U	10.7 J	0.1 U	36.4	1 U	1 U
	11/14/2017								0.41						
	1/8/2018								0.42						
	4/5/2018	0.037 J	1.2	130	1 U	0.38 J	0.062 J	5 U	0.15 J	10 U	14.3	0.2 U	31.4	1 U	1 U
	5/16/2018		1.5	133					0.33		11.6		25.7		
	11/14/2018	1 U	1.4	134	1 U	0.5 U	1 U	5 U	0.19 J	10 U	15.7		24	1 U	1 U
S-UMW-2D	3/16/2016	0.067 J	0.87 J	122	1 U	0.5 U	0.35 J	5 U	1.1	3.9 J	24.6	0.2 U	**1,310**	1 U	1 U
	5/10/2016	0.077 J	1.1	121	1 U	0.5 U	0.66 J	5 U	1.3	5 U	29.7	0.2 U	**1,440**	1 U	1 U
	7/6/2016	1 U	1.4	119	1 U	0.5 U	1 U	5 U	1.1	5 U	28.7	0.2 U	**1,360**	1 U	1 U
	9/14/2016	1 U	1.3	105	1 U	0.5 U	1 U	5 U	1	5 U	28	0.2 U	**1,270**	1 U	1 U
	11/7/2016	1 U	1.5	85.8	1 U	0.5 U	0.55 J	5 U	1	5 U	31.1	0.2 U	**989**	1 U	1 U
	1/5/2017	1 U	1.4	92.8	1 U	0.23 J	1 U	5 U	1.1	5 U	29.7	0.2 U	**1,310**	1 U	1 U
	3/9/2017	0.048 J	2.1	131	1 U	0.5 U	1.7 J	5 U	0.72	5 U	30.2	0.2 U	**1,880**	0.12 J	0.25 J
	6/7/2017	0.044 J	1.9	96.8	1 U	0.24 J	0.12 J	5 U	0.78	3.0 J	18.6	0.1 U	**2,170**	1 U	0.10 J
	11/13/2017								0.7						
	1/8/2018								0.58						
	4/6/2018	0.068 J	2.1	57.4	1 U	0.15 J	0.066 J	5 U	0.35	10 U	19.1	0.2 U	**1,590**	0.094 J	1 U
	5/14/2018		2.4	54.3					0.63		12.5		**1,530**		
	11/13/2018	1 U	2.8	65.7	1 U	0.29 J	1 U	5 U	0.46	10 U	23.4		**1,540**	0.11 J	1 U
S-UMW-3D	3/16/2016	0.083 J	0.82 J	88	1 U	1 U	0.56 J	5 U	0.81	4.2 J	14.7	0.2 U	**4,800**	1 U	1 U
	5/10/2016	0.21 J	0.85 J	75.6	1 U	0.5 U	0.62 J	5 U	1.1	5 U	27.2	0.2 U	**4,250**	0.23 J	1 U
	7/6/2016	1 U	0.44 J	70.1	1 U	0.5 U	1 U	5 U	1	2.7 J	26	0.2 U	**3,770**	0.30 J	1 U
	9/14/2016	1 U	0.29 J	71.8	1 U	0.25 J	1 U	5 U	1	3.1 J	18.4	0.2 U	**4,280**	0.30 J	1 U
	11/7/2016	1 U	0.41 J	70.9	1 U	0.12 J	1 U	5 U	0.95	3.5 J	16.2 J	0.2 U	**4,230**	0.27 J	1 U
	1/5/2017	1 U	0.14 J	76.1	1 U	0.79	0.35 J	5 U	1	5 U	18.4	0.2 U	**3,430**	0.21 J	1 U
	3/9/2017	1 U	1 U	79.8	1 U	0.5 U	1 U	5 U	0.99	2.8 J	14.9	0.2 U	**4,120**	0.12 J	0.084 J
	6/7/2017	0.030 J	0.23 J	70.5	1 U	0.53	0.67 J	5 U	0.94	5 U	16.7	0.1 U	**3,920**	0.17 J	0.052 J
	11/13/2017								1						
	1/8/2018								1.1						
	4/6/2018	1 U	0.58 J	90	0.40 J	0.37 J	0.083 J	5 U	0.9	10 U	25.9 J	0.2 U	**4,600**	0.22 J	1 U
	5/14/2018		1.8 J	92.4					0.98		14.8		**4,560**		
	11/13/2018	1 U	0.82 J	75	1 U	1	1 U	5 U	0.96	10 U	11.7		**4,000**	0.20 J	1 U

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GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
AMEREN MISSOURI SIOUX ENERGY CENTER
ST. CHARLES COUNTY, MISSOURI

Monitoring Well ID	Date Sampled	Constituents													
		Antimony, Total	Arsenic, Total	Barium, Total	Beryllium, Total	Cadmium, Total	Chromium, Total	Cobalt, Total	Fluoride Total	Lead, Total	Lithium, Total	Mercury, Total	Molybdenum, Total	Selenium, Total	Thallium, Total
		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
	Site GWPS	**6**	**10**	**2000**	**4**	**5**	**100**	**6**	**4**	**15**	**40**	**2**	**100**	**50**	**2**
S-UMW-4D	3/16/2016	1 U	0.70 J	95.9	1 U	1.5 U	0.40 J	5 U	0.75	3.6 J	37.9	0.2 U	**8,300**	1 U	1 U
	5/10/2016	1 U	0.60 J	78.4	1 U	0.5 U	0.48 J	5 U	0.89	5 U	39.6	0.2 U	**7,220**	0.21 J	1 U
	7/6/2016	1 U	0.27 J	83.4	1 U	1 U	1 U	5 U	0.86	5 U	37.9	0.2 U	**7,550**	1 U	1 U
	9/14/2016	1 U	0.20 J	81.2	1 U	0.45 J	1 U	5 U	0.84	6.3	38	0.2 U	**7,200**	0.27 J	1 U
	11/7/2016	1 U	0.18 J	72	1 U	0.13 J	0.34 J	5 U	0.78	5.6	**41.3**	0.2 U	**7,190**	0.22 J	1 U
	1/5/2017	1 U	1 U	90.4	1 U	1.9	1 U	5 U	0.86	4.7 J	**44.2**	0.2 U	**7,830**	0.24 J	1 U
	3/9/2017	1 U	1 U	71.2	1 U	0.5 U	1 U	5 U	0.63	5 U	34.4	0.2 U	**6,480**	0.20 J	0.046 J
	6/7/2017	0.043 J	1 U	67.5	1 U	0.91	0.13 J	5 U	0.7	3.4 J	31.9	0.1 U	**6,120**	0.12 J	0.083 J
	11/13/2017								0.8						
	1/8/2018								0.82						
	4/6/2018	1 U	0.22 J	59.2	1 U	0.063 J	1 U	5 U	0.42	10 U	34	0.2 U	**4,380**	0.14 J	1 U
	5/14/2018		1.1	71.6					0.76		37.3		**5,870**		
	11/13/2018	1 U	0.29 J	56.9	1 U	0.94	1 U	5 U	0.49	10 U	38.3		**3,900**	0.12 J	1 U
S-UMW-5D	3/16/2016	1 U	0.80 J	369	1 U	0.5 U	0.42 J	5 U	0.58	4.8 J	31.4	0.2 U	**264**	0.20 J	1 U
	5/10/2016	1 U	0.88 J	333	1 U	0.5 U	0.56 J	5 U	0.65	2.5 J	32.5	0.2 U	**271**	1 U	1 U
	7/7/2016	1 U	0.65 J	312	1 U	0.5 U	0.46 J	5 U	0.66	3.0 J	29.8	0.2 U	**280**	0.22 J	1 U
	9/16/2016	1 U	0.51 J	300	1 U	0.5 U	0.64 J	5 U	0.63	5 U	31	0.2 U	**259**	0.20 J	1 U
	11/7/2016	1 U	0.62 J	296	1 U	0.5 U	0.44 J	5 U	0.7	5 U	32.5	0.2 U	**253**	0.29 J	1 U
	1/5/2017	1 U	0.26 J	281	1 U	0.041 J	1 U	5 U	0.56	5 U	28.4	0.2 U	**254**	1 U	1 U
	3/8/2017	1 U	1 U	248	1 U	0.5 U	1 U	5 U	0.47	5 U	21.5	0.2 U	**242**	0.091 J	1 U
	6/7/2017	1 U	0.41 J	284	1 U	0.028 J	1 U	5 U	0.53	5 U	24.7	0.2 U	**270**	0.11 J	0.038 J
	11/13/2017								0.55						
	1/8/2018								0.6						
	4/6/2018	1 U	0.32 J	249	1 U	0.5 U	1 U	5 U	0.4	10 U	19.6	0.2 U	**179**	0.094 J	1 U
	5/15/2018		0.64 J	265					0.62		18.9		**177**		
	11/13/2018	1 U	0.40 J	265	1 U	0.054 J	1 U	5 U	0.49	10 U	22.9		**181**	0.12 J	1 U
S-UMW-6D	3/17/2016	1 U	0.31 J	133	1 U	0.5 U	0.37 J	5 U	0.29	5 U	12.6	0.2 U	95.9	1 U	1 U
	5/10/2016	1 U	0.20 J	129	1 U	0.5 U	1 U	5 U	0.37	2.9 J	14.4	0.2 U	**106**	1 U	1 U
	7/7/2016	1 U	0.32 J	118	1 U	0.5 U	0.67 J	5 U	0.34	5 U	12.1	0.2 U	**109**	1 U	1 U
	9/16/2016	1 U	0.34 J	117	1 U	0.5 U	1 U	5 U	0.44	5 U	12	0.2 U	**112**	1 U	1 U
	11/8/2016	1 U	0.38 J	116	1 U	0.5 U	0.37 J	5 U	0.4	5 U	13.6	0.2 U	**114**	1 U	1 U
	1/5/2017	1 U	0.20 J	119	1 U	0.031 J	0.70 J	5 U	0.38	5 U	12.2	0.2 U	**110**	1 U	1 U
	3/8/2017	1 U	1 U	115	1 U	0.5 U	1 U	5 U	0.36	5 U	11.8	0.2 U	**108**	1 U	1 U
	6/6/2017	1 U	0.14 J	112	1 U	0.030 J	0.10 J	5 U	0.37	5 U	13.2	0.2 U	**115**	1 U	1 U
	11/13/2017								0.43						
	1/8/2018								0.47						
	4/6/2018	1 U	0.26 J	126	1 U	0.5 U	1 U	5 U	0.21	10 U	12.5	0.2 U	95.4	1 U	1 U
	5/14/2018		0.72 J	152					0.41		13.6		67.8		
	11/14/2018	1 U	0.29 J	182	1 U	0.5 U	1 U	5 U	0.33	10 U	20.3 J		52.8	1 U	1 U
S-AM-1D	11/13/2018	1 U	0.29 J	244	1 U	0.12 J	1 U	5 U	0.45	10 U	32.6	0.2 U	**446**	0.12 J	1 U
S-AM-1S	11/13/2018	1 U	1.3	112	1 U	0.055 J	1 U	1.5 J	0.6	10 U	19.3	0.2 U	58	1 U	1 U
S-TP-1D	11/16/2018	1 U	0.16 J	98	1 U	0.5 U	0.11 J	5 U	0.38	10 U	16.4	0.2 U	3.5 J	1 U	1 U
S-TP-1M	11/16/2018	1 U	0.12 J	212	1 U	0.5 U	0.19 J	5 U	0.35	10 U	17.5	0.2 U	1.8 J	1 U	1 U
S-TP-1S	11/16/2018	1 U	**25.3**	369	1 U	0.5 U	0.24 J	2.7 J	0.36	10 U	6.5 J	0.2 U	5.8 J	0.16 J	1 U
S-TP-2D	11/12/2018	1 U	0.12 J	87.2	1 U	0.5 U	1 U	5 U	0.2 U	10 U	**47.1**	0.2 U	20 U	0.095 J	1 U
S-TP-2M	11/12/2018	1 U	0.19 J	178	1 U	0.5 U	1 U	5 U	0.2 U	3.5 J	26.7	0.2 U	20 U	1 U	1 U
S-TP-2S	11/12/2018	1 U	**13.9**	283	1 U	0.5 U	1 U	2.9 J	0.2 U	3.3 J	13.2	0.2 U	11.8 J	0.15 J	1 U
S-TP-3D	11/14/2018	1 U	0.17 J	574	1 U	0.5 U	0.16 J	5 U	0.23	10 U	32.1	0.2 U	20 U	1 U	1 U
S-TP-3M	11/14/2018	1 U	0.26 J	434	1 U	0.5 U	0.22 J	5 U	0.29	10 U	21	0.2 U	1.2 J	1 U	1 U
S-TP-3S	11/14/2018	0.18 J	4.2	222	1 U	0.033 J	0.18 J	1.1 J	0.42	10 U	11.9	0.2 U	30.8	0.18 J	1 U
S-TP-4D	11/16/2018	1 U	0.95 J	557	1 U	0.5 U	0.16 J	5 U	0.31	10 U	29.6	0.2 U	20 U	1 U	1 U
S-TP-4M	11/16/2018	1 U	0.33 J	408	0.26 J	0.5 U	0.21 J	5 U	0.37	10 U	24.9	0.2 U	1.8 J	1 U	1 U
S-TP-4S	11/16/2018	1 U	5.8	192	1 U	0.5 U	1 U	1.4 J	0.35	10 U	14.8	0.2 U	33.1	0.21 J	1 U
S-TP-5D	11/13/2018	1 U	0.30 J	183	1 U	0.056 J	1 U	5 U	0.34	10 U	33.0 J	0.2 U	**175**	0.12 J	1 U
S-TP-5M	11/13/2018	1 U	3.5	252	1 U	0.5 U	1 U	5 U	0.3	10 U	31.0 J	0.2 U	12.8 J	1 U	1 U
S-TP-5S	11/13/2018	0.18 J	3.7	440	0.43 J	0.040 J	1 U	0.95 J	0.28 J	10 U	10 U	0.2 U	31.7	0.19 J	1 U
S-TP-6D	11/13/2018	1 U	0.17 J	391	0.33 J	0.5 U	1 U	5 U	0.2 U	10 U	28.0 J	0.2 U	2.0 J	1 U	1 U
S-TP-6M	11/13/2018	1 U	0.52 J	454	1 U	0.034 J	1 U	5 U	0.26	10 U	22.8 J	0.2 U	2.9 J	1 U	1 U
S-TP-6S	11/13/2018	1 U	2	224	1 U	0.5 U	1 U	1.2 J	0.27	10 U	33.7 J	0.2 U	4.3 J	1 U	1 U

TABLE I
GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
AMEREN MISSOURI SIOUX ENERGY CENTER
ST. CHARLES COUNTY, MISSOURI

		Constituents													
Monitoring Well ID	Date Sampled	Antimony, Total	Arsenic, Total	Barium, Total	Beryllium, Total	Cadmium, Total	Chromium, Total	Cobalt, Total	Fluoride Total	Lead, Total	Lithium, Total	Mercury, Total	Molybdenum, Total	Selenium, Total	Thallium, Total
		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
	Site GWPS	**6**	**10**	**2000**	**4**	**5**	**100**	**6**	**4**	**15**	**40**	**2**	**100**	**50**	**2**
S-TP-7D	11/14/2018	0.11 J	0.23 J	410	1 U	0.5 U	0.22 J	5 U	0.26	10 U	**43.8**	0.2 U	20 U	1 U	1 U
S-TP-7M	11/14/2018	1 U	0.67 J	382	1 U	0.5 U	0.84 J	5 U	0.33	10 U	**40.2**	0.2 U	2.4 J	1 U	1 U
S-TP-7S	11/14/2018	1 U	8.4	443	1 U	0.5 U	0.083 J	1.0 J	0.38	10 U	25.4	0.2 U	59.2	0.17 J	1 U
S-TP-8D	11/14/2018	1 U	0.88 J	363	1 U	0.5 U	0.36 J	5 U	0.26	10 U	33.1	0.2 U	1.5 J	1 U	1 U
S-TP-8M	11/14/2018	1 U	0.91 J	248	1 U	0.041 J	0.15 J	5 U	0.29	10 U	27.6	0.2 U	1.0 J	1 U	1 U
S-TP-8S	11/14/2018	0.32 J	0.43 J	167	1 U	0.085 J	0.079 J	5 U	0.25	10 U	18.3	0.2 U	16.6 J	3.9	1 U

Notes:
40.2 Bold denotes concentration exceeding the GWPS
Blank cells - Constituent not included in this analysis.
mg/L - milligrams per liter.
ug/L - micrograms per liter.

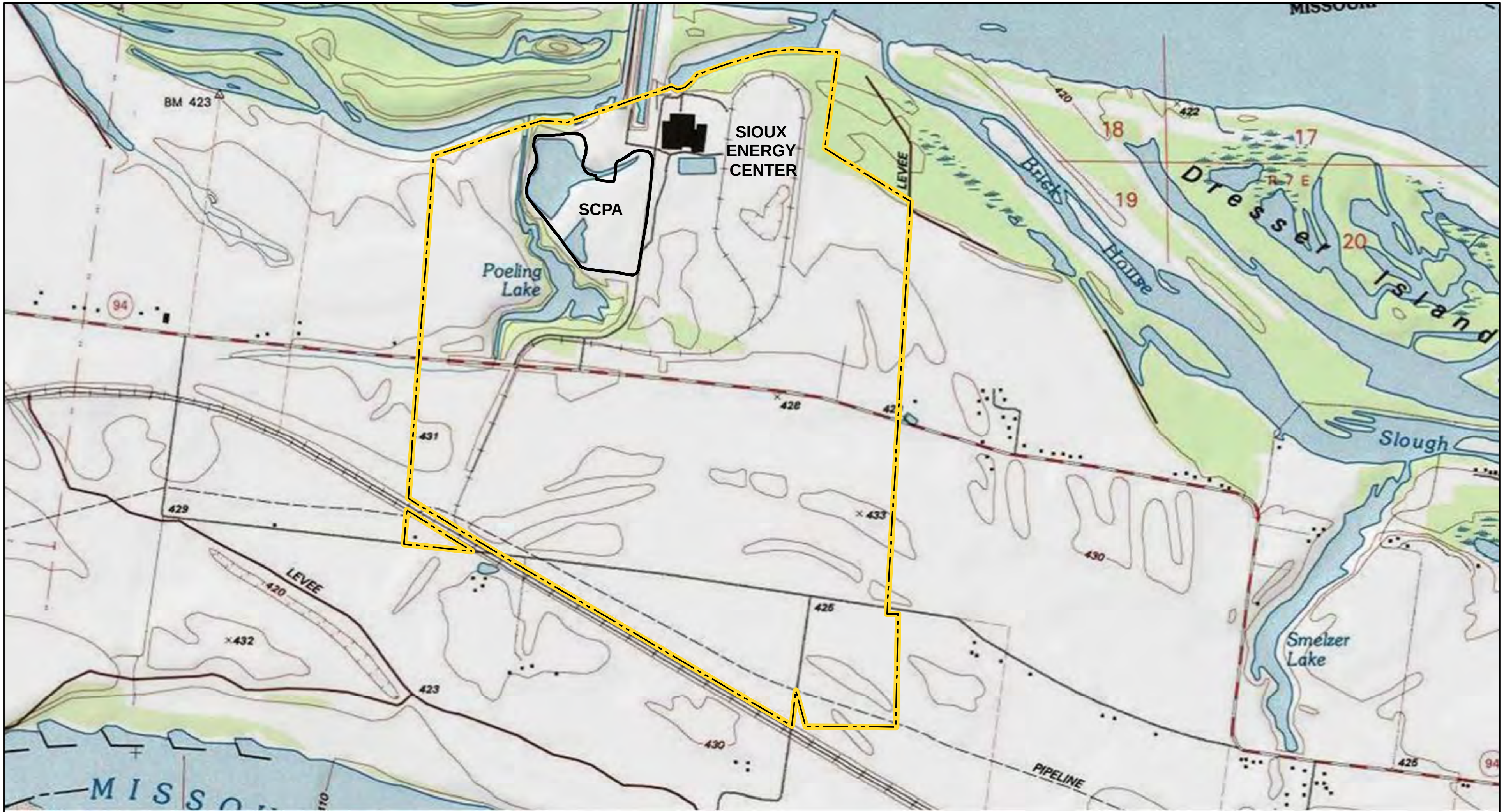
GWPS - Groundwater Protection Standard.
MCL - Maximum Contaminant Level.
RSL - Regional Screening Level.
S.U. - Standard Units.
TDS - Total Dissolved Solids.
USEPA - United States Environmental Protection Agency.

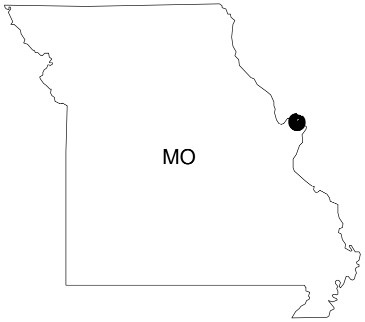
Qualifiers:
J - Value is estimated.
U - Constituent was not detected, value is the reporting limit.

Site GWPS is either the MCL/Health Based GWPS or based on background levels (calculated as described in the Statistical Analysis Plan for Assessment Monitoring), whichever is higher.
GWPS and background values calculated using baseline sampling results from monitoring wells BMW-1D and BMW-3D.

FIGURES

GIS FILE PATH: \\haleyaldrich.com\share\cle_common\Projects\132002 - Ameren Ash Pond Closure Assessment\005-Sioux\GIS\Maps\2019_04\132002_005_0001_SITE_LOCUS2.mxd — USER: hwachholz — LAST SAVED: 5/1/2019 3:36:26 PM





LEGEND

▭ BOTTOM ASH SURFACE IMPOUNDMENT (SCPA)

▭ SIOUX ENERGY CENTER PROPERTY BOUNDARY

NOTES

1. ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.

2. IMAGERY SOURCE: ESRI

N

0 1,000 2,000

SCALE IN FEET

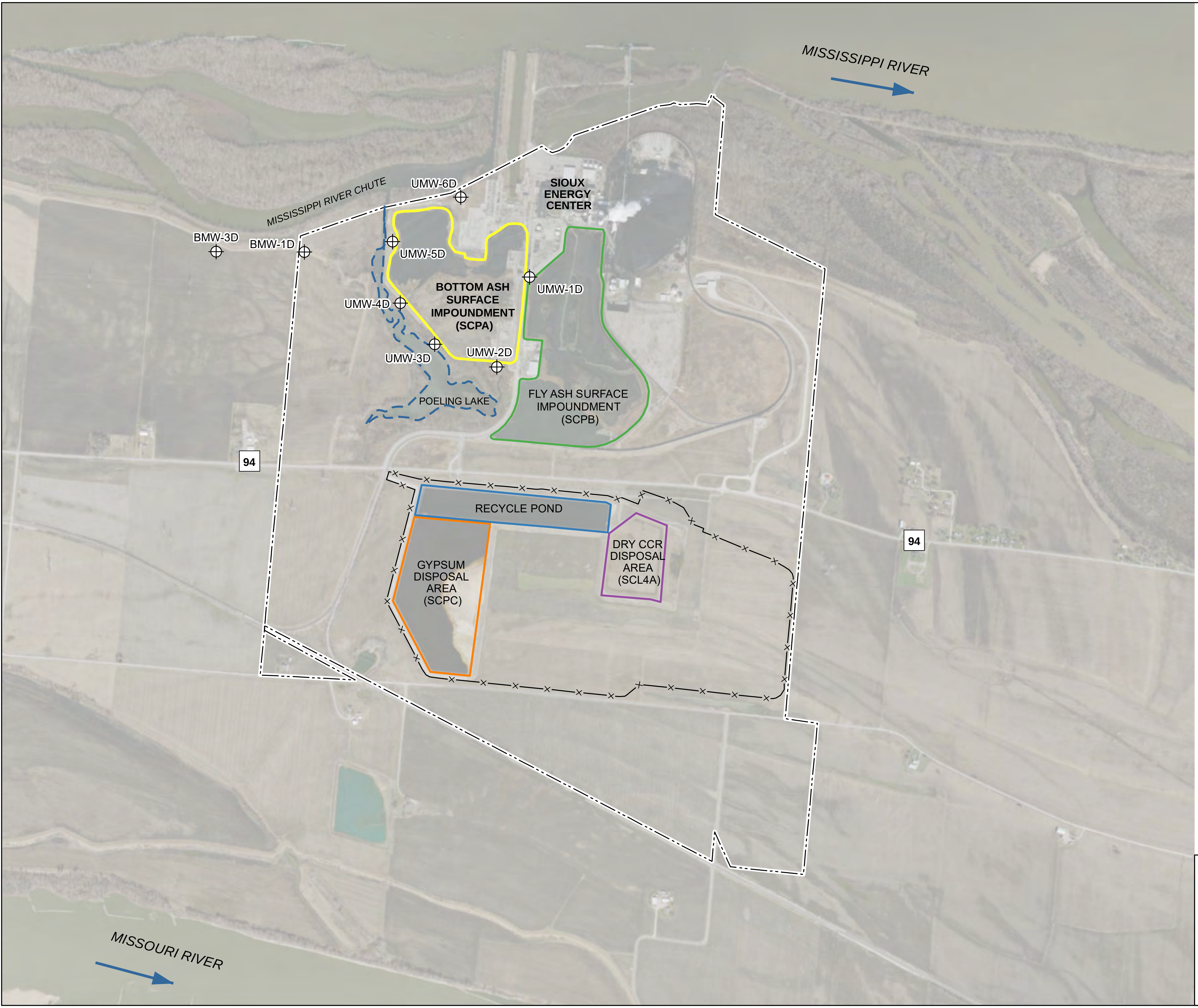
HALEY ALDRICH

CORRECTIVE MEASURES ASSESSMENT
AMEREN MISSOURI SIOUX ENERGY CENTER
ST. CHARLES COUNTY, MISSOURI

SITE LOCATION MAP

MAY 2019

FIGURE 1-1



LEGEND

⊕ SCPA BOTTOM ASH SURFACE IMPOUNDMENT MONITORING WELL LOCATION

SIOUX ENERGY CENTER PROPERTY BOUNDARY

UTILITY WASTE LANDFILL PERIMETER FENCE

NOTES

1. ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2. AERIAL IMAGERY SOURCE: ESRI

N

0 1,200 2,400

SCALE IN FEET

HALEY ALDRICH

CORRECTIVE MEASURES ASSESSMENT
AMEREN MISSOURI SIOUX ENERGY CENTER
ST. CHARLES COUNTY, MISSOURI

SITE FEATURES

MAY 2019

FIGURE 1-2

GIS FILE PATH: \\haleyaldrich.com\share\cle_common\Projects\132002 - Ameren Ash Pond Closure Assessment\005-Sioux\GIS\Maps\2019_05\132002_005_0002_SITE_FEATURES_WITH_WELLS.mxd — USER: hwachholz — LAST SAVED: 5/16/2019 10:31:12 AM

LEGEND

◑ NATURE AND EXTENT MONITORING WELL

⊕ SCPA BOTTOM ASH SURFACE IMPOUNDMENT MONITORING WELL LOCATION

SIOUX ENERGY CENTER PROPERTY BOUNDARY

BOTTOM ASH SURFACE IMPOUNDMENT (SCPA)

UTILITY WASTE LANDFILL PERIMETER FENCE

MOLYBDENUM CONCENTRATIONS - 2018 DATA

◑ ⊕ NO MOLYBDENUM DETECTED

◑ ⊕ MOLYBDENUM CONCENTRATION BELOW GWPS (<100 µg/L)

◑ ⊕ MOLYBDENUM CONCENTRATION ABOVE GWPS (101-1000 µg/L)

⊕ MOLYBDENUM CONCENTRATION ABOVE GWPS (>1000 µg/L)

NOTES

1. ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2. AERIAL IMAGERY SOURCE: ESRI
3. MOLYBDENUM CONCENTRATIONS SHOWN BASED ON 2018 GROUNDWATER ANALYTICAL RESULTS.

HALEY ALDRICH

CORRECTIVE MEASURES ASSESSMENT
AMEREN MISSOURI SIOUX ENERGY CENTER
ST. CHARLES COUNTY, MISSOURI

MONITORING WELL LOCATIONS

MAY 2019

FIGURE 2-1

GIS FILE PATH: \\haleyaldrich.com\share\cle_common\Projects\132002 - Ameren Ash Pond Closure Assessment\005-Sioux\GIS\Maps\2019_05\132002_005_0002_1_SITE_FEATURES.mxd — USER: hwachholz — LAST SAVED: 5/10/2019 3:59:51 PM

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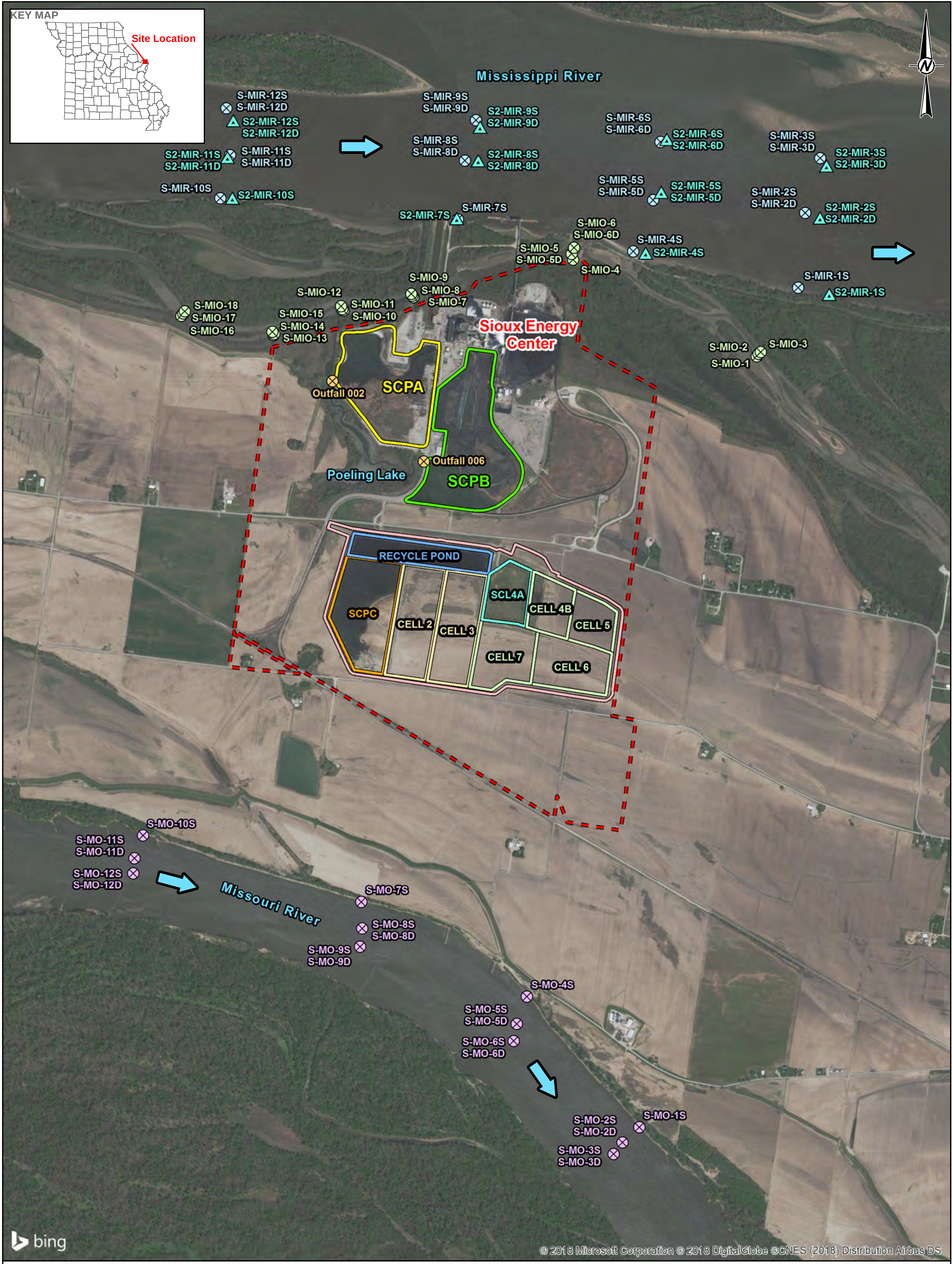

LEGEND

- Sioux Energy Center Property Boundary
- ⊗ NPDES Outfalls

Surface Impoundments

- 🟩 SCPB - Fly Ash Surface Impoundment
- 🟨 SCPA - Bottom Ash Surface Impoundment

Utility Waste Landfill (UWL)

- ▭ Active Dry CCR Disposal Area
- 🟧 Active WFGD Disposal
- 🟦 Active Water Recycle Pond
- ↙ Surface Water Flow Direction
- ▭ Proposed Dry CCR Disposal Area
- ▭ Proposed WFGD Disposal Area
- ▭ UWL Perimeter Fence

Surface Water Sampling Locations

- ⊗ September 2017 Missouri River Sample
- ⊗ September 2017 Mississippi River Sample
- ⊗ September 2017 Mississippi River chute Sample
- △ May 2018 Mississippi River Sample

NOTES

1. ALL LOCATIONS AND BOUNDARIES ARE APPROXIMATE.
2. NPDES - NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM.
3. SAMPLE LOCATIONS BASED ON HANDHELD TRIMBLE GPS MEASUREMENTS. SAMPLE LOCATION REPRESENTS CENTERPOINT BETWEEN SAMPLE STARTING AND ENDING LOCATION.
4. PREFIX S- USED FOR SAMPLES COLLECTED IN SEPTEMBER 2017 AND S2- USED FOR SAMPLES COLLECTED IN MAY 2018.

REFERENCE

1.) AMEREN MISSOURI SIOUX ENERGY CENTER, SIOUX PROPERTY CONTROL MAP, FEBRUARY 2011.
2.) COORDINATE SYSTEM: NAD 1983 STATE PLANE MISSOURI EAST FIPS 2,401 FEET.

0 500 1,000 2,000 3,000 4,000
Feet

CLIENT
AMEREN MISSOURI
SIOUX ENERGY CENTER

PROJECT
AMEREN HYDROGEOLOGICAL CONSULTING

TITLE
SURFACE WATER SAMPLING LOCATIONS
SIOUX ENERGY CENTER

CONSULTANT

YYYY-MM-DD	2018-05-25
PREPARED	JS
DESIGN	JSI
REVIEW	JSI
APPROVED	MNH

PROJECT No.
130-1560

PHASE
0006

Figure 2-2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
1 in
0

FIGURE 4-1
REMEDIAL ALTERNATIVE ROADMAP

CORRECTIVE MEASURES ASSESSMENT
BOTTOM ASH SURFACE IMPOUNDMENT (SCPA)
SIOUX ENERGY CENTER - ST. CHARLES COUNTY, MISSOURI

Alternative Number	Remedial Alternative Description	SCPA Closure Description	Groundwater Remedy Components		
			A. Groundwater Remedy Approach	B. Groundwater Treatment Method	C. Post-Closure Actions
1	**Closure In Place (CIP) with Capping and Monitored Natural Attenuation (MNA)**	**CIP with Geomembrane and Soil Cap**	**Natural Attenuation with Monitoring** Mitigate off-site migration of groundwater with CCR constituents above GWPS through process of natural attenuation	**No Active Treatment** No active treatment technologies for groundwater to address CCR constituents	**MNA** Long-term groundwater monitoring to confirm reduction of CCR constituents
2	**CIP with In-Situ Stabilization (ISS), Capping and MNA**	**CIP with ISS, Geomembrane and Soil Cap**			
3	**CIP with Capping and In-Situ Groundwater Treatment**	**CIP with Geomembrane and Soil Cap**	**Subsurface Treatment System** Mitigate off-site migration of groundwater with CCR constituents above GWPS using in-situ amendments	**In-Situ Treatment** Subsurface treatment to reduce Appendix IV constituent concentrations in groundwater	**In-Situ Treatment Long-Term** Continue periodic in-situ treatment of groundwater long-term to maintain reduction of CCR constituents in groundwater
4	**CIP with Capping and Hydraulic Containment through Groundwater Pumping and Ex-Situ Treatment**	**CIP with Geomembrane and Soil Cap**	**Hydraulic Containment** Mitigate off-site migration of groundwater with CCR constituents above GWPS using extraction wells	**Ex-Situ Treatment** Treatment system (ion exchange or reverse osmosis) to remove CCR constituents from groundwater	**Pump & Treat Long-Term** Operate groundwater treatment system long-term to maintain reduction of CCR constituents in groundwater.
5	**Closure by Removal (CBR) with MNA**	**CBR**	**Natural Attenuation with Monitoring** Mitigate off-site migration of groundwater with CCR constituents above GWPS through process of natural attenuation	**No Active Treatment** No active treatment technologies for groundwater to address CCR constituents	**MNA** Long-term groundwater monitoring to confirm reduction of CCR constituents

APPENDIX A

Surface Water Screening Tables

Appendix A
Sioux Energy Center Surface Water Screening Tables – TOC

TABLES

TABLE 1
HUMAN HEALTH SCREENING LEVELS
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

		Drinking Water Screening Levels (mg/L)				Surface Water Screening Levels (mg/L)	
Constituent	**CASRN**	**MCLs (b)**	**SMCLs (b)**	**November 2018 USEPA Tapwater RSLs (c)**	**Site-Specific Groundwater Protection Standards (d)**	**Drinking Water (e)**	**Recreational Use (a) (f)**
Antimony	7440-36-0	0.006	NA	0.0078 (m)	0.006	0.006	0.64
Arsenic	7440-38-2	0.01	NA	0.000052	0.03	0.01	0.00014 (i)
Barium	7440-39-3	2	NA	3.8	2	2	NA
Beryllium	7440-41-7	0.004	NA	0.025	0.004	0.004	NA
Boron	7440-42-8	NA	NA	4	NA	4	NA
Cadmium	7440-43-9	0.005	NA	0.0092	0.005	0.005	NA
Calcium	7440-70-2	NA	NA	NA	NA	NA	NA
Chloride	7647-14-5	NA	250	NA	NA	250	NA
Chromium	16065-83-1 (g)	0.1 (j)	NA	22 (n)	0.1	0.1	NA
Cobalt	7440-48-4	NA	NA	0.006	0.006	0.006	NA
Fluoride	16984-48-8	4	2	0.8	4	4	NA
Lead	7439-92-1	0.015 (k)	NA	0.015	0.015	0.015	NA
Lithium	7439-93-2	NA	NA	0.04	0.0647	0.04	NA
Mercury	7487-94-7 (h)	0.002 (l)	NA	0.0057 (o)	0.002	0.002	NA
Molybdenum	7439-98-7	NA	NA	0.1	0.1	0.1	NA
Radium 226/228 (pCi/L)	RADIUM226228	5	NA	NA	5	5	NA
Selenium	7782-49-2	0.05	NA	0.1	0.05	0.05	4.2
Sulfate	7757-82-6	NA	250	NA	NA	250	NA
Thallium	7440-28-0	0.002	NA	0.0002 (p)	0.002	0.002	0.00047
Total Dissolved Solids	TDS	NA	500	NA	NA	500	NA
pH (std)	PHFLD	NA	6.5 - 8.5	NA	NA	6.5 - 8.5	NA

Notes:

AWQC - Ambient Water Quality Criteria.
CASRN - Chemical Abstracts Service Re
GWPS - Groundwater Protection Standar
HI - Hazard Index (noncancer child).
MCL - Maximum Contaminant Level.
mg/L - milligram per liter.
NA - not available.
pCi/L - picoCurie per liter.
RSL - Risk-based Screening Levels (USEPA).
TR - Target Risk (carcinogenic).
USEPA - United States Environmental Protection Agency.

(a) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology.
https://www.epa.gov/wqc/national-recommended-water-quality-criteria-human-health-criteria-table
USEPA AWQC Human Health for the Consumption of Organism Only apply to total concentrations.
(b) - USEPA 2018 Edition of the Drinking Water Standards and Health Advisories. Spring 2018.
http://water.epa.gov/drink/contaminants/index.cfm
(c) - USEPA Regional Screening Levels (November 2018). Values for tapwater.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(d) - The site GWPS is either the MCL/Health Based GWPS or based on background levels, whichever is higher. GWPS and background values calculated using baseline sampling results from monitoring wells MW-B1 and MW-B2. See text for additional information.
(e) - Selected Drinking Water Screening Level uses the following hierarchy:
Federal USEPA MCL for Drinking Water.
Federal USEPA SMCL for Drinking Water.
Federal November 2018 USEPA Tapwater RSL.
(f) - The selected Human Health Recreational Use Screening Level is the Federal USEPA AWQC for Human Health Consumption of Organism Only.
(g) - CAS number for Trivalent Chromium.
(h) - CAS number for Mercuric Chloride.
(i) - Value applies to inorganic form of arsenic only.
(j) - Value for Total Chromium.
(k) - Lead Treatment Technology Action Level is 0.015 mg/L.
(l) - Value for Inorganic Mercury.
(m) - RSL for Antimony (metallic) used for Antimony.
(n) - RSL for Chromium (III), Insoluble Salts used for Chromium.
(o) - RSL for Mercuric Chloride used for Mercury.
(p) - RSL for Thallium (Soluble Salts) used for Thallium.

TABLE 2
ECOLOGICAL SCREENING LEVELS - MISSISSIPPI RIVER
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

		Federal Water Quality Criteria (mg/L)							
		Site-Specific USEPA Aquatic Life AWQC - 2018 Hardness Data Freshwater Acute (a)		Site-Specific USEPA Aquatic Life AWQC - 2018 Hardness Data Freshwater Chronic (a)		Site-Specific USEPA Aquatic Life AWQC - 2017 Hardness Data Freshwater Acute (b)		Site-Specific USEPA Aquatic Life AWQC - 2017 Hardness Data Freshwater Chronic (b)	
Constituent	**CASRN**	**Total**	**Dissolved**	**Total**	**Dissolved**	**Total**	**Dissolved**	**Total**	**Dissolved**
Antimony	7440-36-0	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	7440-38-2	0.34	0.34	0.15	0.15	0.34	0.34	0.15	0.15
Barium	7440-39-3	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	7440-41-7	NA	NA	NA	NA	NA	NA	NA	NA
Boron	7440-42-8	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	7440-43-9	0.0043 (c)	0.0039 (d)	0.0015 (c)	0.0013 (d)	0.0046 (f)	0.004 (g)	0.0016 (f)	0.0014 (g)
Calcium	7440-70-2	NA	NA	NA	NA	NA	NA	NA	NA
Chloride	16887-00-6	860	NA	230	NA	860	NA	230	NA
Chromium	7440-47-3	3.6 (e,c)	1.1 (e,d)	0.17 (e,c)	0.15 (e,d)	3.8 (e,f)	1.2 (e,g)	0.18 (e,f)	0.16 (e,g)
Cobalt	7440-48-4	NA	NA	NA	NA	NA	NA	NA	NA
Fluoride	16984-48-8	NA	NA	NA	NA	NA	NA	NA	NA
Lead	7439-92-1	0.23 (c)	0.16 (d)	0.009 (c)	0.0061 (d)	0.26 (f)	0.17 (g)	0.0101 (f)	0.0066 (g)
Lithium	7439-93-2	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	7439-97-6	0.0016	0.0014	0.001	0.00077	0.0016	0.001	0.00091	0.00077
Molybdenum	7439-98-7	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	7782-49-2	NA	NA	3.1	NA	NA	NA	3.1	NA
Sulfate	14808-79-8	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	7440-28-0	NA	NA	NA	NA	NA	NA	NA	NA
Total Dissolved Solids	TDS	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

AWQC - USEPA Ambient Water Quality Criteria.
CASRN - Chemical Abstracts Service Registry Number.
CMC - Criterion Maximum Concentration.

(a) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
Total values provided. Values adjusted for site-specific hardness using hardness data collected in May 2018 - see note (c).
USEPA provides AWQC for both total and dissolved results.
(a) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
Total values provided. Values adjusted for site-specific hardness using hardness data collected in April 2014 - see note (f).
USEPA provides AWQC for both total and dissolved results.
(c) - Hardness dependent value for total metals. Site-specific total recoverable mean hardness value for the Mississippi River of 229 mg/L as CaCO3 used.
(d) - Hardness dependent value for total metals adjusted for dissolved fraction. Site-specific total recoverable mean hardness value for the Mississippi River of 229 mg/L as CaCO3 used.
(e) - Value for trivalent chromium used.
(f) - Hardness dependent value for total metals. Site-specific total recoverable mean hardness value for the Mississippi River of 247 mg/L as CaCO3 used.
(g) - Hardness dependent value for total metals adjusted for dissolved fraction. Site-specific total recoverable mean hardness value for the Mississippi River of 247 mg/L as CaCO3 used.

TABLE 3
SUMMARY OF SCREENING RESULTS
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

	Mississippi River - Human Health Drinking Water						Mississippi River - Human Health Recreational					
	Dissolved			Total			Dissolved			Total		
Constituent	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream
Antimony												
Arsenic							10 : 10 100%	20 : 20 100%	10 : 10 100%	10 : 10 100%	20 : 20 100%	10 : 10 100%
Barium												
Beryllium												
Boron												
Cadmium												
Calcium												
Chloride												
Chromium												
Cobalt												
Fluoride												
Lead												
Lithium												
Mercury												
Molybdenum												
pH												
Selenium												
Sulfate												
Thallium												
TDS												
Radium 226/228												

Notes:

Blank cells - no results above screening levels for the specified constituent / media.

Number of exceedences : total number of samples.

TABLE 3
SUMMARY OF SCREENING RESULTS
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

	Mississippi River - Ecological						Mississippi River Chute - Human Health Drinking Water					
	Dissolved			Total			Dissolved			Total		
Constituent	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream
Antimony												
Arsenic												
Barium												
Beryllium												
Boron												
Cadmium												
Calcium												
Chloride												
Chromium												
Cobalt												
Fluoride												
Lead												
Lithium												
Mercury												
Molybdenum												
pH												
Selenium												
Sulfate												
Thallium												
TDS												
Radium 226/228												

Notes:
Blank cells - no results above screening levels for the specified constituent / media.
Number of exceedences : total number of samples.

TABLE 3
SUMMARY OF SCREENING RESULTS
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

	Mississippi River Chute - Human Health Recreational						Mississippi River Chute - Ecological					
	Dissolved			Total			Dissolved			Total		
Constituent	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream	Upstream	Adjacent	Downstream
Antimony												
Arsenic	3 : 3 100%	14 : 14 100%	3 : 3 100%	3 : 3 100%	14 : 14 100%	3 : 3 100%						
Barium												
Beryllium												
Boron												
Cadmium												
Calcium												
Chloride												
Chromium												
Cobalt												
Fluoride												
Lead												
Lithium												
Mercury												
Molybdenum												
pH												
Selenium												
Sulfate												
Thallium												
TDS												
Radium 226/228												

Notes:

Blank cells - no results above screening levels for the specified constituent / media.

Number of exceedences : total number of samples.

TABLE 3
SUMMARY OF SCREENING RESULTS
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

	Missouri River - Human Health Drinking Water						**Missouri River - Human Health Recreational**					
	Dissolved			**Total**			**Dissolved**			**Total**		
Constituent	**Upstream**	**Adjacent**	**Downstream**	**Upstream**	**Adjacent**	**Downstream**	**Upstream**	**Adjacent**	**Downstream**	**Upstream**	**Adjacent**	**Downstream**
Antimony												
Arsenic							5 : 5 100%	10 : 10 100%	5 : 5 100%	5 : 5 100%	10 : 10 100%	5 : 5 100%
Barium												
Beryllium												
Boron												
Cadmium												
Calcium												
Chloride												
Chromium												
Cobalt												
Fluoride												
Lead												
Lithium	5 : 5 100%	9 : 10 90%	5 : 5 100%	5 : 5 100%	10 : 10 100%	5 : 5 100%						
Mercury												
Molybdenum												
pH												
Selenium												
Sulfate												
Thallium												
TDS												
Radium 226/228												

Notes:

Blank cells - no results above screening levels for the specified constituent / media.
Number of exceedences : total number of samples.

TABLE 3
SUMMARY OF SCREENING RESULTS
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

	Missouri River - Ecological					
	Dissolved			Total		
Constituent	**Upstream**	**Adjacent**	**Downstream**	**Upstream**	**Adjacent**	**Downstream**
Antimony						
Arsenic						
Barium						
Beryllium						
Boron						
Cadmium						
Calcium						
Chloride						
Chromium						
Cobalt						
Fluoride						
Lead						
Lithium						
Mercury						
Molybdenum						
pH						
Selenium						
Sulfate						
Thallium						
TDS						
Radium 226/228						

Notes:

Blank cells - no results above screening levels for the specified constituent / media.

Number of exceedences : total number of samples.

TABLE 4a
COMPARISON OF MAY 2018 MISSISSIPPI RIVER SURFACE WATER RESULTS
TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS - TOTAL (UNFILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI SIOUX ENERGY CENTER
ST. CHARLES COUNTY, MISSOURI

Constituent	CAS	Units	Federal Water Quality Screening Levels			Selected Drinking Water Screening Level (h)	Mississippi River Upstream					Mississippi River Adjacent										Mississippi River Downstream				
			USEPA MCLs (b)	USEPA SMCLs (b)	USEPA Tapwater RSLs (c)		S2-MIR-10S	S2-MIR-11M	S2-MIR-11S	S2-MIR-12M	S2-MIR-12S	S2-MIR-4S	S2-MIR-5M	S2-MIR-5S	S2-MIR-6M	S2-MIR-6S	S2-MIR-7S	S2-MIR-8M	S2-MIR-8S	S2-MIR-9M	S2-MIR-9S	S2-MIR-1S	S2-MIR-2M	S2-MIR-2S	S2-MIR-3M	S2-MIR-3S
Antimony*	7440-36-0	mg/L	0.006	NA	0.0078	0.006																				
Arsenic	7440-38-2	mg/L	0.01	NA	0.000052	0.01	0.0017	0.0015	0.0016	0.0022	0.0021	0.0016	0.0016	0.0016	0.0017	0.0015	0.0015	0.0016	0.0015	0.0017	0.0015	0.0018	0.0016	0.0015	0.0015	0.0016
Barium	7440-39-3	mg/L	2	NA	3.8	2	0.0969	0.0937	0.0991	0.0966	0.0952	0.0901	0.0969	0.0932	0.0919	0.0767	0.0909	0.092	0.0904	0.0905	0.0908	0.108	0.0968	0.0861	0.0883	0.0868
Beryllium	7440-41-7	mg/L	0.004	NA	0.025	0.004																	0.00035 J			
Boron	7440-42-8	mg/L	NA	NA	4	4	0.0296 J	0.0276 J	0.0301 J	0.0285 J	0.0309 J	0.0313 J	0.0303 J	0.0289 J	0.0461 J	0.0437 J	0.0312 J	0.0286 J	0.0285 J	0.0366 J	0.0367 J	0.0338 J	0.0337 J	0.0273 J	0.0465 J	0.047 J
Cadmium	7440-43-9	mg/L	0.005	NA	0.0092	0.005											0.00058 J				0.00046 J					
Calcium	7440-70-2	mg/L	NA	NA	NA	NA	56	53.3	56	53.1	54.6	55	54.6	53.5	56.5	54.2	55.8	53	53.4	55.6	55.9	56.6	54.9	52.5	58.5	58
Chloride	16887-00-6	mg/L	NA	250	NA	250	22.7	22.2	22.4	25.2	24.5	22.5	23	22.6	40.7	38.4	22.6	24.1	23.1	32.8	32	23	23.2	22.6	41	40.9
Chromium	7440-47-3	mg/L	0.1 (e)	NA	22 (f)	0.1	0.0023 J	0.0026 J	0.0029 J	0.003 J	0.0023 J		0.0029 J	0.0023 J	0.0032 J	0.0013 J	0.0016 J	0.0014 J	0.0019 J	0.0021 J	0.0017 J	0.003 J	0.0019 J	0.0021 J	0.0012 J	0.0016 J
Cobalt	7440-48-4	mg/L	NA	NA	0.006	0.006	0.0013 J	0.0016 J	0.0016 J	0.002 J	0.0018 J	0.0012 J	0.0023 J	0.0017 J	0.0018 J		0.0014 J	0.0016 J	0.0014 J	0.0014 J	0.0019 J	0.002 J	0.0021 J	0.0015 J	0.0013 J	0.0012 J
Fluoride	16984-48-8	mg/L	4	2	0.8	4	0.22	0.22	0.23	0.22	0.21	0.23	0.22	0.22	0.23	0.21 J	0.23	0.21	0.21	0.21	0.21	0.23	0.24	0.23	0.22	0.23
Lead	7439-92-1	mg/L	0.015 (g)	NA	0.015	0.015	0.0047 J	0.0048 J	0.0055 J	0.0046 J	0.0034 J		0.005 J	0.0052 J	0.005 J	0.0034 J	0.0033 J	0.0045 J	0.0034 J	0.0046 J		0.0049 J	0.0038 J			0.004 J
Lithium	7439-93-2	mg/L	NA	NA	0.04	0.04	0.009 J	0.0089 J	0.0089 J	0.0088 J	0.0091 J	0.009 J	0.0091 J	0.0104	0.0089 J	0.0059 J	0.0092 J	0.0086 J	0.0104	0.0075 J	0.0085 J	0.0099 J	0.0089 J	0.0084 J	0.0074 J	0.0093 J
Mercury*	7439-97-6	mg/L	0.002	NA	0.0057 (d)	0.002																				
Molybdenum	7439-98-7	mg/L	NA	NA	0.1	0.1	0.001 J		0.00098 J	0.0011 J	0.0011 J	0.0011 J	0.0012 J	0.0011 J	0.0014 J	0.0018 J	0.0012 J		0.0013 J	0.0012 J	0.0012 J	0.0012 J	0.0015 J	0.001 J	0.0018 J	0.0018 J
Selenium*	7782-49-2	mg/L	0.05	NA	0.1	0.05																				
Sulfate	14808-79-8	mg/L	NA	250	NA	250	33.6	33	32.8	33.8	33.7	33.9	33.4	33.2	40.1	39.1	34	33.4	33.1	37.3	36.6	34.5	34	33.4	40.3	40.5
Thallium*	7440-28-0	mg/L	0.002	NA	0.0002	0.002																				
Total Hardness as CaCO3	471-34-1	mg/L	NA	NA	NA	NA	229	219	228	219	228	224	224	220	243	234	227	219	220	234	234	229	224	215	250	250
Total Dissolved Solids	TDS	mg/L	NA	500	NA	500	302	268	250	282	258	218	224	250	232 J	324	282	344	280	280	342	290	244	280	321	272

Notes:

Blank cells - Non-detect value.	mg/L - milligrams per liter.
* - Constituent was not detected in any samples.	NA - Not Available.
CAS - Chemical Abstracts Service.	RSL - Regional Screening Level.
J - Estimated value.	SMCL - Secondary Maximum Contaminant Level.
MCL - Maximum Contaminant Level.	USEPA - United States Environmental Protection Agency.

🟩 Detected Concentration > Selected Drinking Water Screening Level.

(a) - Surface water samples collected in May 2018.
(b) - USEPA 2018 Edition of the Drinking Water Standards and Health Advisories. Spring 2018.
http://water.epa.gov/drink/contaminants/index.cfm
(c) - USEPA Regional Screening Levels (November 2018). Values for tapwater.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(d) - RSL for Mercuric Chloride used for Mercury.
(e) - The drinking water standard or MCL for chromium is based on total chromium.
(f) - Value for trivalent chromium used. USEPA provides a screening level for hexavalent chromium that is not a drinking water standard, the basis of which has been questioned by USEPA's Science Advisory Board.
(g) - The Action Level presented is recommended in the USEPA Drinking Water Standards.
(h) - Selected Drinking Water Screening Level uses the following hierarchy:
  Federal USEPA MCL for Drinking Water.
  Federal USEPA SMCL for Drinking Water.
  Federal November 2018 USEPA Tapwater RSL.

TABLE 4b
COMPARISON OF MAY 2018 MISSISSIPPI RIVER SURFACE WATER RESULTS
TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI SIOUX ENERGY CENTER
ST. CHARLES COUNTY, MISSOURI

Constituent	CAS	Units	Federal Water Quality Screening Levels			Selected Drinking Water Screening Level (h)	Mississippi River Upstream					Mississippi River Adjacent										Mississippi River Downstream				
			USEPA MCLs (b)	USEPA SMCLs (b)	USEPA Tapwater RSLs (c)		S2-MIR-10S	S2-MIR-11M	S2-MIR-11S	S2-MIR-12M	S2-MIR-12S	S2-MIR-4S	S2-MIR-5M	S2-MIR-5S	S2-MIR-6M	S2-MIR-6S	S2-MIR-7S	S2-MIR-8M	S2-MIR-8S	S2-MIR-9M	S2-MIR-9S	S2-MIR-1S	S2-MIR-2M	S2-MIR-2S	S2-MIR-3M	S2-MIR-3S
Antimony*	7440-36-0	mg/L	0.006	NA	0.0078	0.006																				
Arsenic	7440-38-2	mg/L	0.01	NA	5.2E-05	0.01	0.0011	0.001	0.00096 J	0.0013	0.0014	0.0012	0.0011	0.0011	0.0011	0.0011 J	0.0011	0.0011	0.0011	0.0011	0.0011	0.0013	0.0012	0.0011	0.0012	0.0012
Barium	7440-39-3	mg/L	2	NA	3.8	2	0.0698	0.0659	0.0645	0.0619	0.0614	0.0727	0.0666	0.067	0.0614	0.0604	0.0719	0.0629	0.0654	0.0632	0.0614	0.0757	0.0657	0.0679	0.0629	0.0652
Beryllium	7440-41-7	mg/L	0.004	NA	0.025	0.004																				
Boron	7440-42-8	mg/L	NA	NA	4	4	0.0275 J	0.0278 J	0.0272 J	0.03 J	0.027 J	0.0323 J	0.0274 J	0.0299 J	0.0441 J	0.0427 J	0.0294 J	0.0271 J	0.0289 J	0.037 J	0.035 J	0.0315 J	0.0304 J	0.0305 J	0.0469 J	0.048 J
Cadmium*	7440-43-9	mg/L	0.005	NA	0.0092	0.005																				
Calcium	7440-70-2	mg/L	NA	NA	NA	NA	52.8	50.4	49.8	48.5	48.3	55.6	52.5	52.1	53.3	52.6	52.3	49.3	50.7	52.3	50.3	54.7	52	52.8	55.1	56.6
Chromium*	7440-47-3	mg/L	0.1 (e)	NA	22 (f)	0.1																				
Cobalt*	7440-48-4	mg/L	NA	NA	0.006	0.006																				
Lead*	7439-92-1	mg/L	0.015 (g)	NA	0.015	0.015							0.0035 J													
Lithium	7439-93-2	mg/L	NA	NA	0.04	0.04	0.0075 J	0.009 J	0.0083 J	0.0071 J	0.007 J	0.008 J	0.0085 J	0.0077 J	0.0074 J	0.0065 J	0.0083 J	0.0069 J	0.0067 J	0.0072 J	0.0067 J	0.0088 J	0.0088 J	0.0081 J	0.0074 J	0.0057 J
Mercury*	7439-97-6	mg/L	0.002	NA	0.0057 (d)	0.002																				
Molybdenum	7439-98-7	mg/L	NA	NA	0.1	0.1	0.0012 J			0.001 J		0.0013 J	0.001 J	0.0011 J	0.0016 J	0.0014 J	0.0015 J	0.00098 J		0.0014 J	0.0015 J	0.0018 J	0.0017 J	0.0014 J	0.0016 J	0.0018 J
Selenium*	7782-49-2	mg/L	0.05	NA	0.1	0.05																				
Thallium*	7440-28-0	mg/L	0.002	NA	0.0002	0.002																				

Notes:

Blank cells - Non-detect value.	mg/L - milligrams per liter.
* - Constituent was not detected in any samples.	NA - Not Available.
CAS - Chemical Abstracts Service.	RSL - Regional Screening Level.
J - Estimated value.	SMCL - Secondary Maximum Contaminant Level.
MCL - Maximum Contaminant Level.	USEPA - United States Environmental Protection Agency.

🟩 Detected Concentration > Selected Drinking Water Screening Level.

(a) - Surface water samples collected in May 2018.
(b) - USEPA 2018 Edition of the Drinking Water Standards and Health Advisories. Spring 2018.
http://water.epa.gov/drink/contaminants/index.cfm
(c) - USEPA Regional Screening Levels (November 2018). Values for tapwater.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(d) - RSL for Mercuric Chloride used for Mercury.
(e) - The drinking water standard or MCL for chromium is based on total chromium.
(f) - Value for trivalent chromium used. USEPA provides a screening level for hexavalent chromium that is not a drinking water standard, the basis of which has been questioned by USEPA's Science Advisory Board.
(g) - The Action Level presented is recommended in the USEPA Drinking Water Standards.
(h) - Selected Drinking Water Screening Level uses the following hierarchy:
  Federal USEPA MCL for Drinking Water.
  Federal USEPA SMCL for Drinking Water.
  Federal November 2018 USEPA Tapwater RSL.

TABLE 4c
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS
TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS - TOTAL (UNFILTERED) SAMPLE RESULTS (a)
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

Constituent	CAS	Units	Federal Water Quality Screening Levels			Selected Drinking Water Screening Level (h)	Mississippi River Chute			Mississippi River Chute														Mississippi River Chute		
							River Upstream			River Adjacent														River Downstream		
			USEPA MCLs (b)	USEPA SMCLs (b)	USEPA Tapwater RSLs (c)		S-MIO-16	S-MIO-17	S-MIO-18	S-MIO-4	S-MIO-5	S-MIO-5D	S-MIO-6	S-MIO-6D	S-MIO-7	S-MIO-8	S-MIO-9	S-MIO-10	S-MIO-11	S-MIO-12	S-MIO-13	S-MIO-14	S-MIO-15	S-MIO-1	S-MIO-2	S-MIO-3
Antimony*	7440-36-0	mg/L	0.006	NA	0.0078	0.006													0.0037 J							
Arsenic	7440-38-2	mg/L	0.01	NA	0.000052	0.01	0.0064	0.0062	0.0066	0.0025	0.002	0.002	0.002	0.0021	0.0072	0.0069	0.0062	0.0077	0.0078	0.0077	0.0066	0.006	0.0067	0.0024	0.0024	0.0023
Barium	7440-39-3	mg/L	2	NA	3.8	2	0.204	0.2	0.199	0.0746	0.0695	0.0669	0.0705	0.0668	0.263	0.256	0.235	0.288	0.278	0.285	0.212	0.193	0.232	0.0677	0.065	0.065
Beryllium*	7440-41-7	mg/L	0.004	NA	0.025	0.004									0.00023 J	0.00035 J		0.0004 J								
Boron	7440-42-8	mg/L	NA	NA	4	4	0.75	0.746	0.718	0.0402 J	0.0461 J	0.0379 J	0.041 J	0.034 J	0.805	0.782	0.705	0.859	0.839	0.838	0.651	0.654	0.715	0.0361 J	0.0351 J	0.0358 J
Cadmium*	7440-43-9	mg/L	0.005	NA	0.0092	0.005																				
Calcium	7440-70-2	mg/L	NA	NA	NA	NA	80.8	84.8	82	44.6	45	45.2	45.3	44.6	82.5	81.8	78	84.3	83.2	84	76.2	74.4	77.5	44.3	44.4	44
Chloride	16887-00-6	mg/L	NA	250	NA	250	24.7	24.9	25	23	22.9	23.2	22.9	23.4	23.3	23.5	23.5	23.4	23.4	23.3	24	24	24	23.2	23.1	23.2
Chromium	7440-47-3	mg/L	0.1 (e)	NA	22 (f)	0.1	0.0011 J		0.0013 J	0.0017 J	0.0011 J	0.00079 J		0.0015 J	0.002 J	0.0021 J	0.0018 J	0.0021 J	0.0027 J	0.0028 J	0.0024 J	0.0014 J	0.0024 J	0.00086 J	0.0012 J	0.0013 J
Cobalt	7440-48-4	mg/L	NA	NA	0.006	0.006	0.0011 J			0.0012 J	0.0017 J		0.0014 J		0.0011 J	0.001 J		0.0012 J	0.0015 J	0.0011 J	0.0015 J	0.0011 J	0.0016 J	0.0012 J	0.0012 J	0.0013 J
Fluoride	16984-48-8	mg/L	4	2	0.8	4	0.56	0.58	0.57	0.17 J	0.17 J	0.17 J	0.17 J	0.17 J	0.59	0.58	0.54	0.63	0.6	0.61	0.51	0.51	0.55	0.17 J	0.16 J	0.16 J
Lead	7439-92-1	mg/L	0.015 (g)	NA	0.015	0.015		0.0044 J	0.0053			0.0032 J			0.0026 J			0.0036 J	0.0033 J				0.0025 J			
Lithium	7439-93-2	mg/L	NA	NA	0.04	0.04	0.0186	0.0172	0.018	0.0068 J	0.007 J	0.0046 J	0.006 J	0.0049 J	0.0222	0.0214	0.0211	0.024	0.0214	0.0241	0.0174	0.0178	0.0206	0.0058 J	0.0067 J	0.0067 J
Mercury*	7439-97-6	mg/L	0.002	NA	0.0057 (d)	0.002																				
Molybdenum	7439-98-7	mg/L	NA	NA	0.1	0.1	0.0527	0.0516	0.0499	0.0018 J	0.0032 J	0.0017 J	0.0018 J	0.0017 J	0.0633	0.0635	0.0553	0.0683	0.0667	0.0656	0.0481	0.0501	0.0546	0.0015 J	0.0015 J	0.0014 J
Selenium	7782-49-2	mg/L	0.05	NA	0.1	0.05									0.0093 J	0.0054 J	0.0055 J	0.0077 J	0.0069 J	0.0067 J	0.0039 J	0.0045 J	0.0047 J			
Sulfate	14808-79-8	mg/L	NA	250	NA	250	143	144	144	31.3	32	32.3	31.7	31.5	162	157	143	177	173	169	135	133	146	30.2	30.2	30
Thallium*	7440-28-0	mg/L	0.002	NA	0.0002	0.002	0.000071 J	0.000044 J	0.000058 J						0.0001 J	0.00015 J	0.0001 J	0.00015 J	0.00012 J	0.0002 J	0.000085 J	0.000046 J	0.000083 J			
Total Hardness as CaCO3	HARDNESS	mg/L	NA	NA	NA	NA	312	319	308	204	206	205	208	203	312	311	300	318	313	316	298	292	299	204	204	203
Total Dissolved Solids	TDS	mg/L	NA	500	NA	500	467	451	444	254	262	242	256	250	472	460	444	480	496	483	418	419	445	259	256	253

Notes:
Blank cells - Non-detect value.
* - Constituent was not detected in any samples.
CAS - Chemical Abstracts Service.
J - Estimated value.
MCL - Maximum Contaminant Level.
mg/L - milligrams per liter.
NA - Not Available.
RSL - Regional Screening Level.
SMCL - Secondary Maximum Contaminant Level.
USEPA - United States Environmental Protection Agency.

🟩 Detected Concentration > Selected Drinking Water Screening Level

(a) - Surface water samples collected in September 2017.
(b) - USEPA 2018 Edition of the Drinking Water Standards and Health Advisories. Spring 2018.
http://water.epa.gov/drink/contaminants/index.cfm
(c) - USEPA Regional Screening Levels (November 2018). Values for tapwater.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(d) - RSL for Mercuric Chloride used for Mercury.
(e) - The drinking water standard or MCL for chromium is based on total chromium.
(f) - Value for trivalent chromium used. USEPA provides a screening level for hexavalent chromium that is not a drinking water standard, the basis of which has been questioned by USEPA's Science Advisory Board.
(g) - The Action Level presented is recommended in the USEPA Drinking Water Standards.
(h) - Selected Drinking Water Screening Level uses the following hierarchy:
  Federal USEPA MCL for Drinking Water.
  Federal USEPA SMCL for Drinking Water.
  Federal November 2018 USEPA Tapwater RSL.

TABLE 4c
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS
TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS - TOTAL (UNFILTERED) SAMPLE RESULTS (a)
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

Constituent	CAS	Units	Federal Water Quality Screening Levels			Selected Drinking Water Screening Level (h)	Mississippi River					Mississippi River										Mississippi River				
							River Upstream					River Adjacent										River Downstream				
			USEPA MCLs (b)	USEPA SMCLs (b)	USEPA Tapwater RSLs (c)		S-MIR-10S	S-MIR-11D	S-MIR-11S	S-MIR-12D	S-MIR-12S	S-MIR-4S	S-MIR-5D	S-MIR-5S	S-MIR-6D	S-MIR-6S	S-MIR-7S	S-MIR-8D	S-MIR-8S	S-MIR-9D	S-MIR-9S	S-MIR-1S	S-MIR-2D	S-MIR-2S	S-MIR-3D	S-MIR-3S
Antimony*	7440-36-0	mg/L	0.006	NA	0.0078	0.006																				
Arsenic	7440-38-2	mg/L	0.01	NA	0.000052	0.01	0.0019	0.0018	0.0016	0.0019	0.0019	0.0021	0.0018	0.0017	0.0021	0.002	0.0019	0.0019	0.0017	0.002	0.0019	0.002	0.0019	0.0018	0.0022	0.0022
Barium	7440-39-3	mg/L	2	NA	3.8	2	0.0599	0.0628	0.0566	0.064	0.0582	0.066	0.0607	0.0548	0.0642	0.0609	0.0596	0.0614	0.0557	0.0687	0.0584	0.0681	0.0646	0.0582	0.07	0.0668
Beryllium*	7440-41-7	mg/L	0.004	NA	0.025	0.004							0.00023 J			0.00022 J					0.00024 J				0.00027 J	
Boron	7440-42-8	mg/L	NA	NA	4	4	0.0271 J	0.033 J	0.0274 J	0.0404 J	0.0412 J	0.0391 J	0.0362 J	0.0328 J	0.0492 J	0.0513 J	0.0279 J	0.0348 J	0.0303 J	0.0404 J	0.0369 J	0.0404 J	0.0385 J	0.0387 J	0.0534 J	0.0599 J
Cadmium*	7440-43-9	mg/L	0.005	NA	0.0092	0.005																				
Calcium	7440-70-2	mg/L	NA	NA	NA	NA	44.5	44	45	44.4	47	44.6	44.4	42.5	46.7	46	44.8	44.4	45.2	46	47.2	44.7	46.1	44.3	48.9	48.5
Chloride	16887-00-6	mg/L	NA	250	NA	250	23.9	23.2	24.9	26.5	31.6	23.7	22.8	24	31.1	34.1	24.1	23.5	26.2	26.2	28.4	23.9	23.5	23.7	31.6	36
Chromium	7440-47-3	mg/L	0.1 (e)	NA	22 (f)	0.1		0.00081 J		0.00088 J		0.0013 J	0.00088 J		0.0011 J	0.0011 J		0.00081 J		0.00093 J		0.0018 J	0.0013 J	0.0013 J	0.0015 J	0.0015 J
Cobalt	7440-48-4	mg/L	NA	NA	0.006	0.006		0.00095 J				0.0016 J	0.0018 J	0.001 J	0.0012 J	0.00077 J		0.00088 J		0.00091 J		0.0013 J	0.0013 J		0.0011 J	0.0014 J
Fluoride	16984-48-8	mg/L	4	2	0.8	4	0.17 J	0.16 J	0.17 J	0.17 J	0.18 J	0.17 J	0.16 J	0.16 J	0.17 J	0.18 J	0.17 J	0.16 J	0.17 J	0.18 J	0.17 J	0.17 J	0.16 J	0.17 J	0.18 J	0.19 J
Lead	7439-92-1	mg/L	0.015 (g)	NA	0.015	0.015	0.0033 J		0.0024 J		0.0026 J				0.003 J						0.0025 J	0.0025 J				
Lithium	7439-93-2	mg/L	NA	NA	0.04	0.04	0.0031 J	0.005 J		0.006 J	0.0033 J	0.0063 J	0.0055 J	0.0053 J	0.0056 J	0.0047 J		0.0056 J	0.003 J	0.0047 J		0.0048 J	0.0079 J	0.0053 J	0.0049 J	0.0063 J
Mercury*	7439-97-6	mg/L	0.002	NA	0.0057 (d)	0.002																				
Molybdenum	7439-98-7	mg/L	NA	NA	0.1	0.1		0.0018 J			0.0017 J	0.0019 J	0.0023 J	0.002 J	0.0021 J	0.0021 J	0.0013 J			0.0014 J	0.0018 J	0.002 J	0.0021 J	0.0022 J	0.0023 J	0.0021 J
Selenium	7782-49-2	mg/L	0.05	NA	0.1	0.05									0.0037 J											
Sulfate	14808-79-8	mg/L	NA	250	NA	250	31.3	30.4	31.9	32.4	36.3	31.6	29.9	31.4	35.1	37.7	31.7	30.5	33.1	32.3	34.3	31.8	30.5	32.1	35.5	39.6
Thallium*	7440-28-0	mg/L	0.002	NA	0.0002	0.002											0.000069 J			0.000037 J	0.000058 J		0.000065 J		0.000078 J	
Total Hardness as CaCO3	HARDNESS	mg/L	NA	NA	NA	NA	203	204	206	206	214	209	205	200	214	214	204	205	206	212	215	207	211	206	223	225
Total Dissolved Solids	TDS	mg/L	NA	500	NA	500	248	247	256	265	266	249	251	252	279	280	256	256	258	251	271	244	248	253	288	297

Notes:
Blank cells - Non-detect value.
* - Constituent was not detected in any samples.
CAS - Chemical Abstracts Service.
J - Estimated value.
MCL - Maximum Contaminant Level.
mg/L - milligrams per liter.
NA - Not Available.
RSL - Regional Screening Level.
SMCL - Secondary Maximum Contaminant Level.
USEPA - United States Environmental Protection Agency.

🟩 Detected Concentration > Selected Drinking Water Screening Level

(a) - Surface water samples collected in September 2017.
(b) - USEPA 2018 Edition of the Drinking Water Standards and Health Advisories. Spring 2018.
http://water.epa.gov/drink/contaminants/index.cfm
(c) - USEPA Regional Screening Levels (November 2018). Values for tapwater.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(d) - RSL for Mercuric Chloride used for Mercury.
(e) - The drinking water standard or MCL for chromium is based on total chromium.
(f) - Value for trivalent chromium used. USEPA provides a screening level for hexavalent chromium that is not a drinking water standard, the basis of which has been questioned by USEPA's Science Advisory Board.
(g) - The Action Level presented is recommended in the USEPA Drinking Water Standards.
(h) - Selected Drinking Water Screening Level uses the following hierarchy:
Federal USEPA MCL for Drinking Water.
Federal USEPA SMCL for Drinking Water.
Federal November 2018 USEPA Tapwater RSL.

TABLE 4c
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS
TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS - TOTAL (UNFILTERED) SAMPLE RESULTS (a)
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

			Federal Water Quality Screening Levels				Missouri River River Upstream					Missouri River River Adjacent										Missouri River River Downstream				
Constituent	**CAS**	**Units**	**USEPA MCLs (b)**	**USEPA SMCLs (b)**	**USEPA Tapwater RSLs (c)**	**Selected Drinking Water Screening Level (h)**	**S-MO-10S**	**S-MO-11D**	**S-MO-11S**	**S-MO-12D**	**S-MO-12S**	**S-MO-4S**	**S-MO-5D**	**S-MO-5S**	**S-MO-6D**	**S-MO-6S**	**S-MO-7S**	**S-MO-8D**	**S-MO-8S**	**S-MO-9D**	**S-MO-9S**	**S-MO-1S**	**S-MO-2D**	**S-MO-2S**	**S-MO-3D**	**S-MO-3S**
Antimony*	7440-36-0	mg/L	0.006	NA	0.0078	0.006																				
Arsenic	7440-38-2	mg/L	0.01	NA	0.000052	0.01	0.0036	0.0035	0.0035	0.0036	0.0035	0.0036	0.0036	0.0035	0.0035	0.0036	0.0034	0.0035	0.0036	0.0036	0.0035	0.0034	0.0036	0.0034	0.0035	0.0036
Barium	7440-39-3	mg/L	2	NA	3.8	2	0.117	0.117	0.113	0.118	0.114	0.118	0.118	0.115	0.115	0.118	0.114	0.116	0.116	0.116	0.117	0.113	0.115	0.114	0.116	0.116
Beryllium*	7440-41-7	mg/L	0.004	NA	0.025	0.004																				
Boron	7440-42-8	mg/L	NA	NA	4	4	0.113	0.111	0.111	0.111	0.112	0.115	0.117	0.112	0.111	0.112	0.11	0.113	0.113	0.111	0.112	0.11	0.113	0.114	0.111	0.114
Cadmium*	7440-43-9	mg/L	0.005	NA	0.0092	0.005																				
Calcium	7440-70-2	mg/L	NA	NA	NA	NA	65.1	64.4	63.4	64.9	64.2	64.8	65.4	63.2	63.8	65.4	63.4	65	65.3	64.3	65	63	64.8	63.4	64.2	64.7
Chloride	16887-00-6	mg/L	NA	250	NA	250	23.5	23.4	23.6	23.6	23.7	23.3	23.4	23.9	23.3	23.3	23.9	23.5	23.4	23.4	23.6	23.3	23.3	23.4	23.4	23.3
Chromium	7440-47-3	mg/L	0.1 (e)	NA	22 (f)	0.1		0.0012 J	0.00076 J	0.00099 J	0.00075 J	0.0011 J	0.0012 J	0.0013 J	0.00097 J	0.0011 J		0.00095 J	0.00098 J	0.00073 J	0.00074 J	0.0013 J				0.00075 J
Cobalt	7440-48-4	mg/L	NA	NA	0.006	0.006				0.00083 J				0.00086 J	0.00074 J		0.00087 J	0.00085 J								0.00087 J
Fluoride	16984-48-8	mg/L	4	2	0.8	4	0.45	0.44	0.44	0.44	0.44	0.45	0.43	0.45	0.44	0.44	0.45	0.44	0.45	0.43	0.45	0.45	0.44	0.45	0.43	0.46
Lead	7439-92-1	mg/L	0.015 (g)	NA	0.015	0.015									0.0026 J				0.003 J						0.0028 J	
Lithium	7439-93-2	mg/L	NA	NA	0.04	0.04	0.0435	0.044	0.0429	0.0441	0.0436	0.0442	0.0444	0.0422	0.0427	0.0431	0.042	0.0428	0.0449	0.042	0.0423	0.042	0.0431	0.0427	0.0434	0.0435
Mercury*	7439-97-6	mg/L	0.002	NA	0.0057 (d)	0.002																				
Molybdenum	7439-98-7	mg/L	NA	NA	0.1	0.1	0.0031 J	0.0026 J	0.0028 J	0.0026 J	0.0027 J	0.003 J	0.0036 J	0.0026 J	0.003 J	0.0028 J	0.0031 J	0.003 J	0.0028 J	0.0028 J	0.003 J	0.0035 J	0.0029 J	0.0036 J	0.0028 J	0.0031 J
Selenium	7782-49-2	mg/L	0.05	NA	0.1	0.05	0.0042 J																			
Sulfate	14808-79-8	mg/L	NA	250	NA	250	195	192	194	191	191	192	192	193	193	188	192	196	192	193	190	193	194	189	192	190
Thallium*	7440-28-0	mg/L	0.002	NA	0.0002	0.002			0.000064 J			0.000047 J	0.000063 J		0.000037 J			0.000045 J				0.000055 J				0.000064 J
Total Hardness as CaCO3	HARDNESS	mg/L	NA	NA	NA	NA	266	263	259	265	262	266	267	259	260	267	259	265	267	263	265	258	265	259	262	264
Total Dissolved Solids	TDS	mg/L	NA	500	NA	500	475	496	492	497	490	493	490	491	491	488	478	496	482	476	473	487	496	485	484	465

Notes:
Blank cells - Non-detect value.
* - Constituent was not detected in any samples.
CAS - Chemical Abstracts Service.
J - Estimated value.
MCL - Maximum Contaminant Level.
mg/L - milligrams per liter.
NA - Not Available.
RSL - Regional Screening Level.
SMCL - Secondary Maximum Contaminant Level.
USEPA - United States Environmental Protection Agency.

🟩 Detected Concentration > Selected Drinking Water Screening Level

(a) - Surface water samples collected in September 2017.
(b) - USEPA 2018 Edition of the Drinking Water Standards and Health Advisories. Spring 2018.
http://water.epa.gov/drink/contaminants/index.cfm
(c) - USEPA Regional Screening Levels (November 2018). Values for tapwater.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(d) - RSL for Mercuric Chloride used for Mercury.
(e) - The drinking water standard or MCL for chromium is based on total chromium.
(f) - Value for trivalent chromium used. USEPA provides a screening level for hexavalent chromium that is not a drinking water standard, the basis of which has been questioned by USEPA's Science Advisory Board.
(g) - The Action Level presented is recommended in the USEPA Drinking Water Standards.
(h) - Selected Drinking Water Screening Level uses the following hierarchy:
   Federal USEPA MCL for Drinking Water.
   Federal USEPA SMCL for Drinking Water.
   Federal November 2018 USEPA Tapwater RSL.

TABLE 4d
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS
TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI

Constituent	CAS	Units	Federal Water Quality Screening Levels			Selected Drinking Water Screening Level (h)	Mississippi River Chute River Upstream			Mississippi River Chute River Adjacent														Mississippi River Chute River Downstream		
			USEPA MCLs (c)	USEPA SMCLs (c)	USEPA Tapwater RSLs (d)		S-MIO-16	S-MIO-17	S-MIO-18	S-MIO-4	S-MIO-5	S-MIO-5D	S-MIO-6	S-MIO-6D	S-MIO-7	S-MIO-8	S-MIO-9	S-MIO-10	S-MIO-11	S-MIO-12	S-MIO-13	S-MIO-14	S-MIO-15	S-MIO-1	S-MIO-2	S-MIO-3
Antimony*	7440-36-0	mg/L	0.006	NA	0.0078	0.006		0.0037 J																		
Arsenic	7440-38-2	mg/L	0.01	NA	0.000052	0.01	0.0055	0.0053	0.0053	0.0021	0.0017	0.0016	0.0017	0.0017	0.0064	0.0061	0.0056	0.0072	0.0071	0.0065	0.0052	0.0053	0.0057	0.0021	0.002	0.0021
Barium	7440-39-3	mg/L	2	NA	3.8	2	0.185	0.192	0.191	0.0592	0.0558	0.0553	0.0564	0.0544	0.25	0.246	0.219	0.267	0.266	0.252	0.182	0.182	0.209	0.0599	0.0595	0.0583
Beryllium*	7440-41-7	mg/L	0.004	NA	0.025	0.004												0.00019 J	0.0002 J							0.00026 J
Boron	7440-42-8	mg/L	NA	NA	4	4	0.755	0.769	0.769	0.039 J	0.0421 J	0.0431 J	0.0395 J	0.0406 J	0.805	0.796	0.715	0.853	0.849	0.812	0.652	0.657	0.734	0.0338 J	0.0351 J	0.0357 J
Cadmium*	7440-43-9	mg/L	0.005	NA	0.0092	0.005																				
Calcium (f)	7440-70-2	mg/L	NA	NA	NA	NA	79.8	81.4	82.1	44.8	44.5	44.1	45.2	43.8	83	82.1	77.2	82.9	83.2	81	73.9	74.2	76.8	45.1	44.7	44
Chromium	7440-47-3	mg/L	0.1 (e)	NA	22 (h)	0.1									0.00087 J			0.00095 J	0.0016 J	0.0008 J			0.00075 J			
Cobalt	7440-48-4	mg/L	NA	NA	0.006	0.006	0.00089 J	0.0012 J	0.0013 J		0.00078 J				0.001 J	0.0013 J	0.00074 J	0.00088 J		0.00098 J	0.0013 J					
Lead	7439-92-1	mg/L	0.015 (g)	NA	0.015	0.015		0.0031 J																		
Lithium	7439-93-2	mg/L	NA	NA	0.04	0.04	0.0161	0.018	0.0197	0.0055 J	0.0056 J	0.0044 J	0.0059 J	0.0051 J	0.0218	0.0209	0.0189	0.0213	0.023	0.0229	0.0166	0.0166	0.0201	0.0054 J	0.0058 J	0.0067 J
Mercury*	7439-97-6	mg/L	0.002	NA	0.0057 (d)	0.002																				
Molybdenum	7439-98-7	mg/L	NA	NA	0.1	0.1	0.0524	0.0576	0.0561	0.0018 J	0.0026 J	0.0019 J	0.0022 J	0.002 J	0.064	0.0633	0.057	0.068	0.0685	0.0638	0.0478	0.0489	0.055	0.0019 J	0.0019 J	0.0023 J
Selenium	7782-49-2	mg/L	0.05	NA	0.1	0.05		0.0061 J							0.0048 J	0.0046 J	0.0049 J	0.0052 J	0.0091 J	0.0062 J						
Silver*	7440-22-4	mg/L	NA	0.1	0.094	0.1																				
Thallium	7440-28-0	mg/L	0.002	NA	0.0002	0.002	0.000037 J						0.000039 J		0.000092 J	0.00014 J	0.000096 J	0.00011 J	0.00011 J	0.000096 J			0.0001 J	0.000055 J		

Notes:
Blank cells - Non-detect value.
* - Constituent was not detected in any samples.
CAS - Chemical Abstracts Service.
J - Estimated value.
MCL - Maximum Contaminant Level.
mg/L - milligrams per liter.
NA - Not Available.
RSL - Regional Screening Level.
SMCL - Secondary Maximum Contaminant Level.
USEPA - United States Environmental Protection Agency.

🟩 Detected Concentration > Selected Drinking Water Screening Level

(a) - Surface water samples collected in September 2017.
(b) - USEPA 2018 Edition of the Drinking Water Standards and Health Advisories. Spring 2018.
http://water.epa.gov/drink/contaminants/index.cfm
(c) - USEPA Regional Screening Levels (November 2018). Values for tapwater.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(d) - RSL for Mercuric Chloride used for Mercury.
(e) - The drinking water standard or MCL for chromium is based on total chromium.
(f) - Value for trivalent chromium used. USEPA provides a screening level for hexavalent chromium that is not a drinking water standard, the basis of which has been questioned by USEPA's Science Advisory Board.
(g) - The Action Level presented is recommended in the USEPA Drinking Water Standards.
(h) - Selected Drinking Water Screening Level uses the following hierarchy:
Federal USEPA MCL for Drinking Water.
Federal USEPA SMCL for Drinking Water.
Federal November 2018 USEPA Tapwater RSL.

TABLE 4d
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS
TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI

Constituent	CAS	Units	Federal Water Quality Screening Levels			Selected Drinking Water Screening Level (h)	Mississippi River					Mississippi River										Mississippi River				
							River Upstream					River Adjacent										River Downstream				
			USEPA MCLs (c)	USEPA SMCLs (c)	USEPA Tapwater RSLs (d)		S-MIR-10S	S-MIR-11D	S-MIR-11S	S-MIR-12D	S-MIR-12S	S-MIR-4S	S-MIR-5D	S-MIR-5S	S-MIR-6D	S-MIR-6S	S-MIR-7S	S-MIR-8D	S-MIR-8S	S-MIR-9D	S-MIR-9S	S-MIR-1S	S-MIR-2D	S-MIR-2S	S-MIR-3D	S-MIR-3S
Antimony*	7440-36-0	mg/L	0.006	NA	0.0078	0.006																				
Arsenic	7440-38-2	mg/L	0.01	NA	0.000052	0.01	0.0016	0.0016	0.0015	0.0017	0.0016	0.0017	0.0015	0.0015	0.0018	0.0018	0.0016	0.0014	0.0016	0.0016	0.0016	0.0017	0.0016	0.0016	0.0018	0.0018
Barium	7440-39-3	mg/L	2	NA	3.8	2	0.0504	0.0417	0.0439	0.0447	0.0467	0.0525	0.042	0.0421	0.0453	0.0464	0.0508	0.0422	0.0429	0.0438	0.0457	0.0534	0.043	0.0475	0.047	0.049
Beryllium*	7440-41-7	mg/L	0.004	NA	0.025	0.004									0.00025 J		0.00018 J			0.00029 J	0.00032 J		0.00025 J			
Boron	7440-42-8	mg/L	NA	NA	4	4	0.0332 J	0.0333 J	0.0372 J	0.0392 J	0.0476 J	0.0368 J	0.0329 J	0.0338 J	0.0489 J	0.0522 J	0.0374 J	0.0354 J	0.0398 J	0.0396 J	0.0409 J	0.0395 J	0.0391 J	0.0398 J	0.0559 J	0.0603 J
Cadmium*	7440-43-9	mg/L	0.005	NA	0.0092	0.005																				
Calcium (f)	7440-70-2	mg/L	NA	NA	NA	NA	44.8	44.4	44.9	45.7	45.9	45	43.4	44.4	45.8	46.2	43.8	43.9	43.6	45.4	44.8	44.4	45	44.3	47.4	48
Chromium	7440-47-3	mg/L	0.1 (e)	NA	22 (h)	0.1													0.00097 J							
Cobalt	7440-48-4	mg/L	NA	NA	0.006	0.006		0.0009 J		0.00091 J		0.0013 J	0.0013 J	0.00075 J		0.0012 J	0.00082 J		0.00078 J	0.0013 J	0.00091 J				0.00094 J	
Lead	7439-92-1	mg/L	0.015 (g)	NA	0.015	0.015																				
Lithium	7439-93-2	mg/L	NA	NA	0.04	0.04	0.0058 J	0.0063 J	0.0054 J	0.005 J	0.0068 J	0.0041 J	0.0043 J	0.0051 J	0.0033 J	0.0037 J	0.004 J	0.0041 J	0.0041 J	0.0043 J	0.0048 J	0.0059 J	0.0052 J	0.0033 J	0.0043 J	0.0078 J
Mercury*	7439-97-6	mg/L	0.002	NA	0.0057 (d)	0.002																				
Molybdenum	7439-98-7	mg/L	NA	NA	0.1	0.1	0.0015 J	0.0016 J	0.0019 J	0.002 J	0.0014 J	0.0022 J	0.0019 J	0.0014 J	0.002 J	0.0018 J	0.0027 J	0.0021 J	0.0026 J	0.0018 J	0.0023 J	0.002 J	0.0019 J	0.0016 J	0.0031 J	0.0022 J
Selenium	7782-49-2	mg/L	0.05	NA	0.1	0.05																	0.0036 J			
Silver*	7440-22-4	mg/L	NA	0.1	0.094	0.1																				
Thallium	7440-28-0	mg/L	0.002	NA	0.0002	0.002	0.000059 J																0.00004 J			0.000047 J

Notes:
Blank cells - Non-detect value.
* - Constituent was not detected in any samples.
CAS - Chemical Abstracts Service.
J - Estimated value.
MCL - Maximum Contaminant Level.
mg/L - milligrams per liter.
NA - Not Available.
RSL - Regional Screening Level.
SMCL - Secondary Maximum Contaminant Level.
USEPA - United States Environmental Protection Agency.

🟩 Detected Concentration > Selected Drinking Water Screening Level

(a) - Surface water samples collected in September 2017.
(b) - USEPA 2018 Edition of the Drinking Water Standards and Health Advisories. Spring 2018.
http://water.epa.gov/drink/contaminants/index.cfm
(c) - USEPA Regional Screening Levels (November 2018). Values for tapwater.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(d) - RSL for Mercuric Chloride used for Mercury.
(e) - The drinking water standard or MCL for chromium is based on total chromium.
(f) - Value for trivalent chromium used. USEPA provides a screening level for hexavalent chromium that is not a drinking water standard, the basis of which has been questioned by USEPA's Science Advisory Board.
(g) - The Action Level presented is recommended in the USEPA Drinking Water Standards.
(h) - Selected Drinking Water Screening Level uses the following hierarchy:
Federal USEPA MCL for Drinking Water.
Federal USEPA SMCL for Drinking Water.
Federal November 2018 USEPA Tapwater RSL.

TABLE 4d
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS
TO HUMAN HEALTH DRINKING WATER SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI

			Federal Water Quality Screening Levels				Missouri River					Missouri River										Missouri River				
							River Upstream					River Adjacent										River Downstream				
Constituent	**CAS**	**Units**	**USEPA MCLs (c)**	**USEPA SMCLs (c)**	**USEPA Tapwater RSLs (d)**	**Selected Drinking Water Screening Level (h)**	**S-MO-10S**	**S-MO-11D**	**S-MO-11S**	**S-MO-12D**	**S-MO-12S**	**S-MO-4S**	**S-MO-5D**	**S-MO-5S**	**S-MO-6D**	**S-MO-6S**	**S-MO-7S**	**S-MO-8D**	**S-MO-8S**	**S-MO-9D**	**S-MO-9S**	**S-MO-1S**	**S-MO-2D**	**S-MO-2S**	**S-MO-3D**	**S-MO-3S**
Antimony*	7440-36-0	mg/L	0.006	NA	0.0078	0.006																				
Arsenic	7440-38-2	mg/L	0.01	NA	0.000052	0.01	0.0034	0.0034	0.0032	0.0033	0.0033	0.0033	0.0034	0.0033	0.0032	0.0033	0.0032	0.0033	0.0033	0.0034	0.0032	0.0033	0.0034	0.0033	0.0032	0.0033
Barium	7440-39-3	mg/L	2	NA	3.8	2	0.108	0.11	0.108	0.109	0.109	0.11	0.11	0.107	0.106	0.109	0.109	0.109	0.107	0.108	0.108	0.112	0.107	0.111	0.107	0.109
Beryllium*	7440-41-7	mg/L	0.004	NA	0.025	0.004																				
Boron	7440-42-8	mg/L	NA	NA	4	4	0.115	0.12	0.116	0.118	0.118	0.119	0.12	0.114	0.115	0.116	0.117	0.118	0.117	0.118	0.116	0.12	0.115	0.122	0.115	0.119
Cadmium*	7440-43-9	mg/L	0.005	NA	0.0092	0.005																				
Calcium (f)	7440-70-2	mg/L	NA	NA	NA	NA	59.5	60.9	59.9	60.6	60.3	60.3	61.1	59.2	59.1	60	60.8	60.7	59.8	60	59.9	61.6	59.7	60.6	59.7	59.4
Chromium	7440-47-3	mg/L	0.1 (e)	NA	22 (h)	0.1																				0.00074 J
Cobalt	7440-48-4	mg/L	NA	NA	0.006	0.006																				
Lead	7439-92-1	mg/L	0.015 (g)	NA	0.015	0.015																				
Lithium	7439-93-2	mg/L	NA	NA	0.04	0.04	0.0422	0.0423	0.0435	0.0423	0.0417	0.0422	0.0422	0.0428	0.0412	0.0421	0.0432	0.0424	0.044	0.042	0.04	0.0441	0.0421	0.0446	0.0405	0.0437
Mercury*	7439-97-6	mg/L	0.002	NA	0.0057 (d)	0.002																				
Molybdenum	7439-98-7	mg/L	NA	NA	0.1	0.1	0.0039 J	0.004 J	0.0044 J	0.0036 J	0.0038 J	0.0037 J	0.0049 J	0.0037 J	0.004 J	0.0046 J	0.0038 J	0.0038 J	0.0036 J	0.0035 J	0.0038 J	0.0046 J	0.0038 J	0.0047 J	0.0032 J	0.0037 J
Selenium	7782-49-2	mg/L	0.05	NA	0.1	0.05																				
Silver*	7440-22-4	mg/L	NA	0.1	0.094	0.1																				
Thallium	7440-28-0	mg/L	0.002	NA	0.0002	0.002			0.000063 J				0.000072 J		0.000037 J							0.000048 J				0.000075 J

Notes:
Blank cells - Non-detect value.
* - Constituent was not detected in any samples.
CAS - Chemical Abstracts Service.
J - Estimated value.
MCL - Maximum Contaminant Level.
mg/L - milligrams per liter.
NA - Not Available.
RSL - Regional Screening Level.
SMCL - Secondary Maximum Contaminant Level.
USEPA - United States Environmental Protection Agency.

🟩 Detected Concentration > Selected Drinking Water Screening Level

(a) - Surface water samples collected in September 2017.
(b) - USEPA 2018 Edition of the Drinking Water Standards and Health Advisories. Spring 2018.
http://water.epa.gov/drink/contaminants/index.cfm
(c) - USEPA Regional Screening Levels (November 2018). Values for tapwater.
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm
(d) - RSL for Mercuric Chloride used for Mercury.
(e) - The drinking water standard or MCL for chromium is based on total chromium.
(f) - Value for trivalent chromium used. USEPA provides a screening level for hexavalent chromium that is not a drinking water standard, the basis of which has been questioned by USEPA's Science Advisory Board.
(g) - The Action Level presented is recommended in the USEPA Drinking Water Standards.
(h) - Selected Drinking Water Screening Level uses the following hierarchy:
  Federal USEPA MCL for Drinking Water.
  Federal USEPA SMCL for Drinking Water.
  Federal November 2018 USEPA Tapwater RSL.

TABLE 5a
COMPARISON OF MAY 2018 MISSISSIPPI RIVER SURFACE WATER RESULTS TO HUMAN HEALTH AWQC SCREENING LEVELS -
TOTAL (UNFILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI SIOUX ENERGY CENTER
ST. CHARLES COUNTY, MISSOURI

Constituent	CAS	Units	USEPA AWQC (b)	Mississippi River Upstream					Mississippi River Adjacent										Mississippi River Downstream				
				S2-MIR-10S	S2-MIR-11M	S2-MIR-11S	S2-MIR-12M	S2-MIR-12S	S2-MIR-4S	S2-MIR-5M	S2-MIR-5S	S2-MIR-6M	S2-MIR-6S	S2-MIR-7S	S2-MIR-8M	S2-MIR-8S	S2-MIR-9M	S2-MIR-9S	S2-MIR-1S	S2-MIR-2M	S2-MIR-2S	S2-MIR-3M	S2-MIR-3S
Antimony*	7440-36-0	mg/L	0.64																				
Arsenic	7440-38-2	mg/L	0.00014 (c)	0.0017	0.0015	0.0016	0.0022	0.0021	0.0016	0.0016	0.0016	0.0017	0.0015	0.0015	0.0016	0.0015	0.0017	0.0015	0.0018	0.0016	0.0015	0.0015	0.0016
Barium	7440-39-3	mg/L	NA	0.0969	0.0937	0.0991	0.0966	0.0952	0.0901	0.0969	0.0932	0.0919	0.0767	0.0909	0.092	0.0904	0.0905	0.0908	0.108	0.0968	0.0861	0.0883	0.0868
Beryllium*	7440-41-7	mg/L	NA																	0.00035 J			
Boron	7440-42-8	mg/L	NA	0.0296 J	0.0276 J	0.0301 J	0.0285 J	0.0309 J	0.0313 J	0.0303 J	0.0289 J	0.0461 J	0.0437 J	0.0312 J	0.0286 J	0.0285 J	0.0366 J	0.0367 J	0.0338 J	0.0337 J	0.0273 J	0.0465 J	0.047 J
Cadmium	7440-43-9	mg/L	NA											0.00058 J				0.00046 J					
Calcium	7440-70-2	mg/L	NA	56	53.3	56	53.1	54.6	55	54.6	53.5	56.5	54.2	55.8	53	53.4	55.6	55.9	56.6	54.9	52.5	58.5	58
Chloride	16887-00-6	mg/L	NA	22.7	22.2	22.4	25.2	24.5	22.5	23	22.6	40.7	38.4	22.6	24.1	23.1	32.8	32	23	23.2	22.6	41	40.9
Chromium	7440-47-3	mg/L	NA	0.0023 J	0.0026 J	0.0029 J	0.003 J	0.0023 J		0.0029 J	0.0023 J	0.0032 J	0.0013 J	0.0016 J	0.0014 J	0.0019 J	0.0021 J	0.0017 J	0.003 J	0.0019 J	0.0021 J	0.0012 J	0.0016 J
Cobalt	7440-48-4	mg/L	NA	0.0013 J	0.0016 J	0.0016 J	0.002 J	0.0018 J	0.0012 J	0.0023 J	0.0017 J	0.0018 J		0.0014 J	0.0016 J	0.0014 J	0.0014 J	0.0019 J	0.002 J	0.0021 J	0.0015 J	0.0013 J	0.0012 J
Fluoride	16984-48-8	mg/L	NA	0.22	0.22	0.23	0.22	0.21	0.23	0.22	0.22	0.23	0.21 J	0.23	0.21	0.21	0.21	0.21	0.23	0.24	0.23	0.22	0.23
Lead	7439-92-1	mg/L	NA	0.0047 J	0.0048 J	0.0055 J	0.0046 J	0.0034 J		0.005 J	0.0052 J	0.005 J	0.0034 J	0.0033 J	0.0045 J	0.0034 J	0.0046 J		0.0049 J	0.0038 J			0.004 J
Lithium	7439-93-2	mg/L	NA	0.009 J	0.0089 J	0.0089 J	0.0088 J	0.0091 J	0.009 J	0.0091 J	0.0104	0.0089 J	0.0059 J	0.0092 J	0.0086 J	0.0104	0.0075 J	0.0085 J	0.0099 J	0.0089 J	0.0084 J	0.0074 J	0.0093 J
Mercury*	7439-97-6	mg/L	NA																				
Molybdenum	7439-98-7	mg/L	NA	0.001 J		0.00098 J	0.0011 J	0.0011 J	0.0011 J	0.0012 J	0.0011 J	0.0014 J	0.0018 J	0.0012 J		0.0013 J	0.0012 J	0.0012 J	0.0012 J	0.0015 J	0.001 J	0.0018 J	0.0018 J
Selenium*	7782-49-2	mg/L	4.2																				
Sulfate	14808-79-8	mg/L	NA	33.6	33	32.8	33.8	33.7	33.9	33.4	33.2	40.1	39.1	34	33.4	33.1	37.3	36.6	34.5	34	33.4	40.3	40.5
Thallium*	7440-28-0	mg/L	0.00047																				
Total Hardness as CaCO3	471-34-1	mg/L	NA	229	219	228	219	228	224	224	220	243	234	227	219	220	234	234	229	224	215	250	250
Total Dissolved Solids	TDS	mg/L	NA	302	268	250	282	258	218	224	250	232 J	324	282	344	280	280	342	290	244	280	321	272

Notes:

Blank cells - Non-detect value.	J - Estimated value.
* - Constituent was not detected in any samples.	mg/L - milligrams per liter.
AWQC - Ambient Water Quality Criteria.	NA - Not Available.
CAS - Chemical Abstracts Service.	USEPA - United States Environmental Protection Agency.

🟩 Detected Concentration > AWQC.

(a) - Surface water samples collected in May 2018.
(b) - USEPA National Recommended Water Quality Criteria.
USEPA Office of Water and Office of Science and Technology.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
USEPA AWQC Human Health for the Consumption of Organism Only
apply to total concentrations.
(c) - Value applies to inorganic form of arsenic only.

TABLE 5b
COMPARISON OF MAY 2018 MISSISSIPPI RIVER SURFACE WATER RESULTS TO HUMAN HEALTH AWQC SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI SIOUX ENERGY CENTER
ST. CHARLES COUNTY, MISSOURI

Constituent	CAS	Units	USEPA	Mississippi River Upstream					Mississippi River Adjacent					Mississippi River Adjacent					Mississippi River Downstream				
			AWQC (b)	S2-MIR-10S	S2-MIR-11M	S2-MIR-11S	S2-MIR-12M	S2-MIR-12S	S2-MIR-4S	S2-MIR-5M	S2-MIR-5S	S2-MIR-6M	S2-MIR-6S	S2-MIR-7S	S2-MIR-8M	S2-MIR-8S	S2-MIR-9M	S2-MIR-9S	S2-MIR-1S	S2-MIR-2M	S2-MIR-2S	S2-MIR-3M	S2-MIR-3S
Antimony*	7440-36-0	mg/L	0.64																				
Arsenic	7440-38-2	mg/L	0.00014 (c)	0.0011	0.001	0.00096 J	0.0013	0.0014	0.0012	0.0011	0.0011	0.0011	0.0011 J	0.0011	0.0011	0.0011	0.0011	0.0011	0.0013	0.0012	0.0011	0.0012	0.0012
Barium	7440-39-3	mg/L	NA	0.0698	0.0659	0.0645	0.0619	0.0614	0.0727	0.0666	0.067	0.0614	0.0604	0.0719	0.0629	0.0654	0.0632	0.0614	0.0757	0.0657	0.0679	0.0629	0.0652
Beryllium	7440-41-7	mg/L	NA																				
Boron	7440-42-8	mg/L	NA	0.0275 J	0.0278 J	0.0272 J	0.03 J	0.027 J	0.0323 J	0.0274 J	0.0299 J	0.0441 J	0.0427 J	0.0294 J	0.0271 J	0.0289 J	0.037 J	0.035 J	0.0315 J	0.0304 J	0.0305 J	0.0469 J	0.048 J
Cadmium*	7440-43-9	mg/L	NA																				
Calcium	7440-70-2	mg/L	NA	52.8	50.4	49.8	48.5	48.3	55.6	52.5	52.1	53.3	52.6	52.3	49.3	50.7	52.3	50.3	54.7	52	52.8	55.1	56.6
Chromium*	7440-47-3	mg/L	NA																				
Cobalt*	7440-48-4	mg/L	NA																				
Lead*	7439-92-1	mg/L	NA							0.0035 J													
Lithium	7439-93-2	mg/L	NA	0.0075 J	0.009 J	0.0083 J	0.0071 J	0.007 J	0.008 J	0.0085 J	0.0077 J	0.0074 J	0.0065 J	0.0083 J	0.0069 J	0.0067 J	0.0072 J	0.0067 J	0.0088 J	0.0088 J	0.0081 J	0.0074 J	0.0057 J
Mercury*	7439-97-6	mg/L	NA																				
Molybdenum	7439-98-7	mg/L	NA	0.0012 J			0.001 J		0.0013 J	0.001 J	0.0011 J	0.0016 J	0.0014 J	0.0015 J	0.00098 J		0.0014 J	0.0015 J	0.0018 J	0.0017 J	0.0014 J	0.0016 J	0.0018 J
Selenium*	7782-49-2	mg/L	4.2																				
Thallium*	7440-28-0	mg/L	0.00047																				

Notes:

Blank cells - Non-detect value.	J - Estimated value.
* - Constituent was not detected in any samples.	mg/L - milligrams per liter.
AWQC - Ambient Water Quality Criteria.	NA - Not Available.
CAS - Chemical Abstracts Service.	USEPA - United States Environmental Protection Agency.

🟩 Detected Concentration > AWQC.

(a) - Surface water samples collected in May 2018.
(b) - USEPA National Recommended Water Quality Criteria.
USEPA Office of Water and Office of Science and Technology.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
USEPA AWQC Human Health for the Consumption of Organism Only
apply to total concentrations.
(c) - Value applies to inorganic form of arsenic only.

TABLE 5c
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS TO HUMAN HEALTH AWQC SCREENING LEVELS -
TOTAL (UNFILTERED) SAMPLE RESULTS (a)
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

Constituent	CAS	Units	USEPA	Mississippi River Chute			Mississippi River Chute													Mississippi River Chute		
				River Upstream			River Adjacent													River Downstream		
			AWQC (b)	S-MIO-16	S-MIO-17	S-MIO-18	S-MIO-4	S-MIO-5	S-MIO-5D	S-MIO-6	S-MIO-6D	S-MIO-7	S-MIO-8	S-MIO-9	S-MIO-10	S-MIO-11	S-MIO-12	S-MIO-13	S-MIO-14	S-MIO-15	S-MIO-1	S-MIO-2	S-MIO-3
Antimony*	7440-36-0	mg/L	0.64													0.0037 J							
Arsenic	7440-38-2	mg/L	0.00014 (c)	0.0064	0.0062	0.0066	0.0025	0.002	0.002	0.002	0.0021	0.0072	0.0069	0.0062	0.0077	0.0078	0.0077	0.0066	0.006	0.0067	0.0024	0.0024	0.0023
Barium	7440-39-3	mg/L	NA	0.204	0.2	0.199	0.0746	0.0695	0.0669	0.0705	0.0668	0.263	0.256	0.235	0.288	0.278	0.285	0.212	0.193	0.232	0.0677	0.065	0.065
Beryllium*	7440-41-7	mg/L	NA									0.00023 J	0.00035 J		0.0004 J								
Boron	7440-42-8	mg/L	NA	0.75	0.746	0.718	0.0402 J	0.0461 J	0.0379 J	0.041 J	0.034 J	0.805	0.782	0.705	0.859	0.839	0.838	0.651	0.654	0.715	0.0361 J	0.0351 J	0.0358 J
Cadmium*	7440-43-9	mg/L	NA																				
Calcium	7440-70-2	mg/L	NA	80.8	84.8	82	44.6	45	45.2	45.3	44.6	82.5	81.8	78	84.3	83.2	84	76.2	74.4	77.5	44.3	44.4	44
Chloride	16887-00-6	mg/L	NA	24.7	24.9	25	23	22.9	23.2	22.9	23.4	23.3	23.5	23.5	23.4	23.4	23.3	24	24	24	23.2	23.1	23.2
Chromium	7440-47-3	mg/L	NA	0.0011 J		0.0013 J	0.0017 J	0.0011 J	0.00079 J		0.0015 J	0.002 J	0.0021 J	0.0018 J	0.0021 J	0.0027 J	0.0028 J	0.0024 J	0.0014 J	0.0024 J	0.00086 J	0.0012 J	0.0013 J
Cobalt	7440-48-4	mg/L	NA	0.0011 J			0.0012 J	0.0017 J		0.0014 J		0.0011 J	0.001 J		0.0012 J	0.0015 J	0.0011 J	0.0015 J	0.0011 J	0.0016 J	0.0012 J	0.0012 J	0.0013 J
Fluoride	16984-48-8	mg/L	NA	0.56	0.58	0.57	0.17 J	0.17 J	0.17 J	0.17 J	0.17 J	0.59	0.58	0.54	0.63	0.6	0.61	0.51	0.51	0.55	0.17 J	0.16 J	0.16 J
Lead	7439-92-1	mg/L	NA		0.0044 J	0.0053			0.0032 J			0.0026 J			0.0036 J	0.0033 J				0.0025 J			
Lithium	7439-93-2	mg/L	NA	0.0186	0.0172	0.018	0.0068 J	0.007 J	0.0046 J	0.006 J	0.0049 J	0.0222	0.0214	0.0211	0.024	0.0214	0.0241	0.0174	0.0178	0.0206	0.0058 J	0.0067 J	0.0067 J
Mercury*	7439-97-6	mg/L	NA																				
Molybdenum	7439-98-7	mg/L	NA	0.0527	0.0516	0.0499	0.0018 J	0.0032 J	0.0017 J	0.0018 J	0.0017 J	0.0633	0.0635	0.0553	0.0683	0.0667	0.0656	0.0481	0.0501	0.0546	0.0015 J	0.0015 J	0.0014 J
Selenium	7782-49-2	mg/L	4.2									0.0093 J	0.0054 J	0.0055 J	0.0077 J	0.0069 J	0.0067 J	0.0039 J	0.0045 J	0.0047 J			
Sulfate	14808-79-8	mg/L	NA	143	144	144	31.3	32	32.3	31.7	31.5	162	157	143	177	173	169	135	133	146	30.2	30.2	30
Thallium*	7440-28-0	mg/L	0.00047	0.000071 J	0.000044 J	0.000058 J						0.0001 J	0.00015 J	0.0001 J	0.00015 J	0.00012 J	0.0002 J	0.000085 J	0.000046 J	0.000083 J			
Total Hardness as CaCO3	HARDNESS	mg/L	NA	312	319	308	204	206	205	208	203	312	311	300	318	313	316	298	292	299	204	204	203
Total Dissolved Solids	TDS	mg/L	NA	467	451	444	254	262	242	256	250	472	460	444	480	496	483	418	419	445	259	256	253

Notes:

* Constituent was not detected in any samples.
AWQC - Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.

mg/L - milligrams per liter.
NA - Not Analyzed/Not Available.
USEPA - United States Environmental Protection Agency.

🟩 Detected Concentration > AWQC.

(a) - Surface water samples collected in September 2017.
(b) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology. Accessed November 2014.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
USEPA AWQC Human Health for the Consumption of Organism Only apply to total concentrations.
(c) - Value applies to inorganic form of arsenic only.

TABLE 5c
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS TO HUMAN HEALTH AWQC SCREENING LEVELS - TOTAL (UNFILTERED) SAMPLE RESULTS (a)
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

Constituent	CAS	Units	USEPA	Mississippi River					Mississippi River										Mississippi River				
				River Upstream					River Adjacent										River Downstream				
			AWQC (b)	S-MIR-10S	S-MIR-11D	S-MIR-11S	S-MIR-12D	S-MIR-12S	S-MIR-4S	S-MIR-5D	S-MIR-5S	S-MIR-6D	S-MIR-6S	S-MIR-7S	S-MIR-8D	S-MIR-8S	S-MIR-9D	S-MIR-9S	S-MIR-1S	S-MIR-2D	S-MIR-2S	S-MIR-3D	S-MIR-3S
Antimony*	7440-36-0	mg/L	0.64																				
Arsenic	7440-38-2	mg/L	0.00014 (c)	0.0019	0.0018	0.0016	0.0019	0.0019	0.0021	0.0018	0.0017	0.0021	0.002	0.0019	0.0019	0.0017	0.002	0.0019	0.002	0.0019	0.0018	0.0022	0.0022
Barium	7440-39-3	mg/L	NA	0.0599	0.0628	0.0566	0.064	0.0582	0.066	0.0607	0.0548	0.0642	0.0609	0.0596	0.0614	0.0557	0.0687	0.0584	0.0681	0.0646	0.0582	0.07	0.0668
Beryllium*	7440-41-7	mg/L	NA							0.00023 J			0.00022 J					0.00024 J				0.00027 J	
Boron	7440-42-8	mg/L	NA	0.0271 J	0.033 J	0.0274 J	0.0404 J	0.0412 J	0.0391 J	0.0362 J	0.0328 J	0.0492 J	0.0513 J	0.0279 J	0.0348 J	0.0303 J	0.0404 J	0.0369 J	0.0404 J	0.0385 J	0.0387 J	0.0534 J	0.0599 J
Cadmium*	7440-43-9	mg/L	NA																				
Calcium	7440-70-2	mg/L	NA	44.5	44	45	44.4	47	44.6	44.4	42.5	46.7	46	44.8	44.4	45.2	46	47.2	44.7	46.1	44.3	48.9	48.5
Chloride	16887-00-6	mg/L	NA	23.9	23.2	24.9	26.5	31.6	23.7	22.8	24	31.1	34.1	24.1	23.5	26.2	26.2	28.4	23.9	23.5	23.7	31.6	36
Chromium	7440-47-3	mg/L	NA		0.00081 J		0.00088 J		0.0013 J	0.00088 J		0.0011 J	0.0011 J		0.00081 J		0.00093 J		0.0018 J	0.0013 J	0.0013 J	0.0015 J	0.0015 J
Cobalt	7440-48-4	mg/L	NA		0.00095 J				0.0016 J	0.0018 J	0.001 J	0.0012 J	0.00077 J		0.00088 J		0.00091 J		0.0013 J	0.0013 J		0.0011 J	0.0014 J
Fluoride	16984-48-8	mg/L	NA	0.17 J	0.16 J	0.17 J	0.17 J	0.18 J	0.17 J	0.16 J	0.16 J	0.17 J	0.18 J	0.17 J	0.16 J	0.17 J	0.18 J	0.17 J	0.17 J	0.16 J	0.17 J	0.18 J	0.19 J
Lead	7439-92-1	mg/L	NA	0.0033 J		0.0024 J		0.0026 J				0.003 J						0.0025 J	0.0025 J				
Lithium	7439-93-2	mg/L	NA	0.0031 J	0.005 J		0.006 J	0.0033 J	0.0063 J	0.0055 J	0.0053 J	0.0056 J	0.0047 J		0.0056 J	0.003 J	0.0047 J		0.0048 J	0.0079 J	0.0053 J	0.0049 J	0.0063 J
Mercury*	7439-97-6	mg/L	NA																				
Molybdenum	7439-98-7	mg/L	NA		0.0018 J			0.0017 J	0.0019 J	0.0023 J	0.002 J	0.0021 J	0.0021 J	0.0013 J			0.0014 J	0.0018 J	0.002 J	0.0021 J	0.0022 J	0.0023 J	0.0021 J
Selenium	7782-49-2	mg/L	4.2									0.0037 J											
Sulfate	14808-79-8	mg/L	NA	31.3	30.4	31.9	32.4	36.3	31.6	29.9	31.4	35.1	37.7	31.7	30.5	33.1	32.3	34.3	31.8	30.5	32.1	35.5	39.6
Thallium*	7440-28-0	mg/L	0.00047											0.000069 J			0.000037 J	0.000058 J		0.000065 J		0.000078 J	
Total Hardness as CaCO3	HARDNESS	mg/L	NA	203	204	206	206	214	209	205	200	214	214	204	205	206	212	215	207	211	206	223	225
Total Dissolved Solids	TDS	mg/L	NA	248	247	256	265	266	249	251	252	279	280	256	256	258	251	271	244	248	253	288	297

Notes:

* Constituent was not detected in any samples.	mg/L - milligrams per liter.
AWQC - Ambient Water Quality Criteria.	NA - Not Analyzed/Not Available.
CAS - Chemical Abstracts Service.	USEPA - United States Environmental Protection Agency.

🟩 Detected Concentration > AWQC.

(a) - Surface water samples collected in September 2017.

(b) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology. Accessed November 2014.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
USEPA AWQC Human Health for the Consumption of Organism Only apply to total concentrations.

(c) - Value applies to inorganic form of arsenic only.

TABLE 5c
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS TO HUMAN HEALTH AWQC SCREENING LEVELS -
TOTAL (UNFILTERED) SAMPLE RESULTS (a)
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

			USEPA	Missouri River					Missouri River								Missouri River				
				River Upstream					River Adjacent								River Downstream				
Constituent	**CAS**	**Units**	**AWQC (b)**	**S-MO-10S**	**S-MO-11D**	**S-MO-11S**	**S-MO-12D**	**S-MO-12S**	**S-MO-4S**	**S-MO-5D**	**S-MO-5S**	**S-MO-6D**	**S-MO-6S**	**S-MO-8S**	**S-MO-9D**	**S-MO-9S**	**S-MO-1S**	**S-MO-2D**	**S-MO-2S**	**S-MO-3D**	**S-MO-3S**
Antimony*	7440-36-0	mg/L	0.64																		
Arsenic	7440-38-2	mg/L	0.00014 (c)	0.0036	0.0035	0.0035	0.0036	0.0035	0.0036	0.0036	0.0035	0.0035	0.0036	0.0036	0.0036	0.0035	0.0034	0.0036	0.0034	0.0035	0.0036
Barium	7440-39-3	mg/L	NA	0.117	0.117	0.113	0.118	0.114	0.118	0.118	0.115	0.115	0.118	0.116	0.116	0.117	0.113	0.115	0.114	0.116	0.116
Beryllium*	7440-41-7	mg/L	NA																		
Boron	7440-42-8	mg/L	NA	0.113	0.111	0.111	0.111	0.112	0.115	0.117	0.112	0.111	0.112	0.113	0.111	0.112	0.11	0.113	0.114	0.111	0.114
Cadmium*	7440-43-9	mg/L	NA																		
Calcium	7440-70-2	mg/L	NA	65.1	64.4	63.4	64.9	64.2	64.8	65.4	63.2	63.8	65.4	65.3	64.3	65	63	64.8	63.4	64.2	64.7
Chloride	16887-00-6	mg/L	NA	23.5	23.4	23.6	23.6	23.7	23.3	23.4	23.9	23.3	23.3	23.4	23.4	23.6	23.3	23.3	23.4	23.4	23.3
Chromium	7440-47-3	mg/L	NA		0.0012 J	0.00076 J	0.00099 J	0.00075 J	0.0011 J	0.0012 J	0.0013 J	0.00097 J	0.0011 J	0.00098 J	0.00073 J	0.00074 J	0.0013 J				0.00075 J
Cobalt	7440-48-4	mg/L	NA				0.00083 J				0.00086 J	0.00074 J									0.00087 J
Fluoride	16984-48-8	mg/L	NA	0.45	0.44	0.44	0.44	0.44	0.45	0.43	0.45	0.44	0.44	0.45	0.43	0.45	0.45	0.44	0.45	0.43	0.46
Lead	7439-92-1	mg/L	NA									0.0026 J		0.003 J						0.0028 J	
Lithium	7439-93-2	mg/L	NA	0.0435	0.044	0.0429	0.0441	0.0436	0.0442	0.0444	0.0422	0.0427	0.0431	0.0449	0.042	0.0423	0.042	0.0431	0.0427	0.0434	0.0435
Mercury*	7439-97-6	mg/L	NA																		
Molybdenum	7439-98-7	mg/L	NA	0.0031 J	0.0026 J	0.0028 J	0.0026 J	0.0027 J	0.003 J	0.0036 J	0.0026 J	0.003 J	0.0028 J	0.0028 J	0.0028 J	0.003 J	0.0035 J	0.0029 J	0.0036 J	0.0028 J	0.0031 J
Selenium	7782-49-2	mg/L	4.2	0.0042 J																	
Sulfate	14808-79-8	mg/L	NA	195	192	194	191	191	192	192	193	193	188	192	193	190	193	194	189	192	190
Thallium*	7440-28-0	mg/L	0.00047			0.000064 J			0.000047 J	0.000063 J		0.000037 J					0.000055 J				0.000064 J
Total Hardness as CaCO3	HARDNESS	mg/L	NA	266	263	259	265	262	266	267	259	260	267	267	263	265	258	265	259	262	264
Total Dissolved Solids	TDS	mg/L	NA	475	496	492	497	490	493	490	491	491	488	482	476	473	487	496	485	484	465

Notes:

* Constituent was not detected in any samples.	mg/L - milligrams per liter.
AWQC - Ambient Water Quality Criteria.	NA - Not Analyzed/Not Available.
CAS - Chemical Abstracts Service.	USEPA - United States Environmental Protection Agency.

🟩 Detected Concentration > AWQC.

(a) - Surface water samples collected in September 2017.

(b) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology. Accessed November 2014.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
USEPA AWQC Human Health for the Consumption of Organism Only apply to total concentrations.

(c) - Value applies to inorganic form of arsenic only.

TABLE 5d
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS TO HUMAN HEALTH AWQC SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

			USEPA	Mississippi River Chute			Mississippi River Chute														Mississippi River Chute		
				River Upstream			River Adjacent														River Downstream		
Constituent	CAS	Units	AWQC (b)	S-MIO-16	S-MIO-17	S-MIO-18	S-MIO-4	S-MIO-5	S-MIO-5D	S-MIO-6	S-MIO-6D	S-MIO-7	S-MIO-8	S-MIO-9	S-MIO-10	S-MIO-11	S-MIO-12	S-MIO-13	S-MIO-14	S-MIO-15	S-MIO-1	S-MIO-2	S-MIO-3
Antimony*	7440-36-0	mg/L	0.64		0.0037 J																		
Arsenic	7440-38-2	mg/L	0.00014 (c)	0.0055	0.0053	0.0053	0.0021	0.0017	0.0016	0.0017	0.0017	0.0064	0.0061	0.0056	0.0072	0.0071	0.0065	0.0052	0.0053	0.0057	0.0021	0.002	0.0021
Barium	7440-39-3	mg/L	NA	0.185	0.192	0.191	0.0592	0.0558	0.0553	0.0564	0.0544	0.25	0.246	0.219	0.267	0.266	0.252	0.182	0.182	0.209	0.0599	0.0595	0.0583
Beryllium*	7440-41-7	mg/L	NA												0.00019 J	0.0002 J							0.00026 J
Boron	7440-42-8	mg/L	NA	0.755	0.769	0.769	0.039 J	0.0421 J	0.0431 J	0.0395 J	0.0406 J	0.805	0.796	0.715	0.853	0.849	0.812	0.652	0.657	0.734	0.0338 J	0.0351 J	0.0357 J
Cadmium*	7440-43-9	mg/L	NA																				
Calcium	7440-70-2	mg/L	NA	79.8	81.4	82.1	44.8	44.5	44.1	45.2	43.8	83	82.1	77.2	82.9	83.2	81	73.9	74.2	76.8	45.1	44.7	44
Chromium	7440-47-3	mg/L	NA									0.00087 J			0.00095 J	0.0016 J	0.0008 J			0.00075 J			
Cobalt	7440-48-4	mg/L	NA	0.00089 J	0.0012 J	0.0013 J		0.00078 J				0.001 J	0.0013 J	0.00074 J	0.00088 J		0.00098 J	0.0013 J					
Lead	7439-92-1	mg/L	NA		0.0031 J																		
Lithium	7439-93-2	mg/L	NA	0.0161	0.018	0.0197	0.0055 J	0.0056 J	0.0044 J	0.0059 J	0.0051 J	0.0218	0.0209	0.0189	0.0213	0.023	0.0229	0.0166	0.0166	0.0201	0.0054 J	0.0058 J	0.0067 J
Mercury*	7439-97-6	mg/L	NA																				
Molybdenum	7439-98-7	mg/L	NA	0.0524	0.0576	0.0561	0.0018 J	0.0026 J	0.0019 J	0.0022 J	0.002 J	0.064	0.0633	0.057	0.068	0.0685	0.0638	0.0478	0.0489	0.055	0.0019 J	0.0019 J	0.0023 J
Selenium	7782-49-2	mg/L	4.2		0.0061 J							0.0048 J	0.0046 J	0.0049 J	0.0052 J	0.0091 J	0.0062 J						
Silver*	7440-22-4	mg/L	NA																				
Thallium*	7440-28-0	mg/L	0.00047	0.000037 J						0.000039 J		0.000092 J	0.00014 J	0.000096 J	0.00011 J	0.00011 J	0.000096 J			0.0001 J	0.000055 J		

Notes:

* Constituent was not detected in any samples.	mg/L - milligrams per liter.
AWQC - Ambient Water Quality Criteria.	NA - Not Analyzed/Not Available.
CAS - Chemical Abstracts Service.	USEPA - United States Environmental Protection Agency.

🟩 Detected Concentration > AWQC.

(a) - Surface water samples collected in September 2017.

(b) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology. Accessed November 2014.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
USEPA AWQC Human Health for the Consumption of Organism Only apply to total concentrations.

(c) - Value applies to inorganic form of arsenic only.

TABLE 5d

COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS TO HUMAN HEALTH AWQC SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)

SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO

AMEREN MISSOURI

Constituent	CAS	Units	USEPA	Mississippi River					Mississippi River										Mississippi River				
				River Upstream					River Adjacent										River Downstream				
			AWQC (b)	S-MIR-10S	S-MIR-11D	S-MIR-11S	S-MIR-12D	S-MIR-12S	S-MIR-4S	S-MIR-5D	S-MIR-5S	S-MIR-6D	S-MIR-6S	S-MIR-7S	S-MIR-8D	S-MIR-8S	S-MIR-9D	S-MIR-9S	S-MIR-1S	S-MIR-2D	S-MIR-2S	S-MIR-3D	S-MIR-3S
Antimony*	7440-36-0	mg/L	0.64																				
Arsenic	7440-38-2	mg/L	0.00014 (c)	0.0016	0.0016	0.0015	0.0017	0.0016	0.0017	0.0015	0.0015	0.0018	0.0018	0.0016	0.0014	0.0016	0.0016	0.0016	0.0017	0.0016	0.0016	0.0018	0.0018
Barium	7440-39-3	mg/L	NA	0.0504	0.0417	0.0439	0.0447	0.0467	0.0525	0.042	0.0421	0.0453	0.0464	0.0508	0.0422	0.0429	0.0438	0.0457	0.0534	0.043	0.0475	0.047	0.049
Beryllium*	7440-41-7	mg/L	NA									0.00025 J		0.00018 J			0.00029 J	0.00032 J		0.00025 J			
Boron	7440-42-8	mg/L	NA	0.0332 J	0.0333 J	0.0372 J	0.0392 J	0.0476 J	0.0368 J	0.0329 J	0.0338 J	0.0489 J	0.0522 J	0.0374 J	0.0354 J	0.0398 J	0.0396 J	0.0409 J	0.0395 J	0.0391 J	0.0398 J	0.0559 J	0.0603 J
Cadmium*	7440-43-9	mg/L	NA																				
Calcium	7440-70-2	mg/L	NA	44.8	44.4	44.9	45.7	45.9	45	43.4	44.4	45.8	46.2	43.8	43.9	43.6	45.4	44.8	44.4	45	44.3	47.4	48
Chromium	7440-47-3	mg/L	NA													0.00097 J							
Cobalt	7440-48-4	mg/L	NA		0.0009 J		0.00091 J		0.0013 J	0.0013 J	0.00075 J		0.0012 J	0.00082 J		0.00078 J	0.0013 J	0.00091 J				0.00094 J	
Lead	7439-92-1	mg/L	NA																				
Lithium	7439-93-2	mg/L	NA	0.0058 J	0.0063 J	0.0054 J	0.005 J	0.0068 J	0.0041 J	0.0043 J	0.0051 J	0.0033 J	0.0037 J	0.004 J	0.0041 J	0.0041 J	0.0043 J	0.0048 J	0.0059 J	0.0052 J	0.0033 J	0.0043 J	0.0078 J
Mercury*	7439-97-6	mg/L	NA																				
Molybdenum	7439-98-7	mg/L	NA	0.0015 J	0.0016 J	0.0019 J	0.002 J	0.0014 J	0.0022 J	0.0019 J	0.0014 J	0.002 J	0.0018 J	0.0027 J	0.0021 J	0.0026 J	0.0018 J	0.0023 J	0.002 J	0.0019 J	0.0016 J	0.0031 J	0.0022 J
Selenium	7782-49-2	mg/L	4.2																	0.0036 J			
Silver*	7440-22-4	mg/L	NA																				
Thallium*	7440-28-0	mg/L	0.00047	0.000059 J																0.00004 J			0.000047 J

Notes:

* Constituent was not detected in any samples.

AWQC - Ambient Water Quality Criteria.

CAS - Chemical Abstracts Service.

mg/L - milligrams per liter.

NA - Not Analyzed/Not Available.

USEPA - United States Environmental Protection Agency.

🟩 Detected Concentration > AWQC.

(a) - Surface water samples collected in September 2017.

(b) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology. Accessed November 2014.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
USEPA AWQC Human Health for the Consumption of Organism Only apply to total concentrations.

(c) - Value applies to inorganic form of arsenic only.

TABLE 5d
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS TO HUMAN HEALTH AWQC SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

			USEPA	Missouri River					Missouri River								Missouri River				
				River Upstream					River Adjacent								River Downstream				
Constituent	**CAS**	**Units**	**AWQC (b)**	**S-MO-10S**	**S-MO-11D**	**S-MO-11S**	**S-MO-12D**	**S-MO-12S**	**S-MO-4S**	**S-MO-5D**	**S-MO-5S**	**S-MO-6D**	**S-MO-6S**	**S-MO-8S**	**S-MO-9D**	**S-MO-9S**	**S-MO-1S**	**S-MO-2D**	**S-MO-2S**	**S-MO-3D**	**S-MO-3S**
Antimony*	7440-36-0	mg/L	0.64																		
Arsenic	7440-38-2	mg/L	0.00014 (c)	0.0034	0.0034	0.0032	0.0033	0.0033	0.0033	0.0034	0.0033	0.0032	0.0033	0.0033	0.0034	0.0032	0.0033	0.0034	0.0033	0.0032	0.0033
Barium	7440-39-3	mg/L	NA	0.108	0.11	0.108	0.109	0.109	0.11	0.11	0.107	0.106	0.109	0.107	0.108	0.108	0.112	0.107	0.111	0.107	0.109
Beryllium*	7440-41-7	mg/L	NA																		
Boron	7440-42-8	mg/L	NA	0.115	0.12	0.116	0.118	0.118	0.119	0.12	0.114	0.115	0.116	0.117	0.118	0.116	0.12	0.115	0.122	0.115	0.119
Cadmium*	7440-43-9	mg/L	NA																		
Calcium	7440-70-2	mg/L	NA	59.5	60.9	59.9	60.6	60.3	60.3	61.1	59.2	59.1	60	59.8	60	59.9	61.6	59.7	60.6	59.7	59.4
Chromium	7440-47-3	mg/L	NA																		0.00074 J
Cobalt	7440-48-4	mg/L	NA																		
Lead	7439-92-1	mg/L	NA																		
Lithium	7439-93-2	mg/L	NA	0.0422	0.0423	0.0435	0.0423	0.0417	0.0422	0.0422	0.0428	0.0412	0.0421	0.044	0.042	0.04	0.0441	0.0421	0.0446	0.0405	0.0437
Mercury*	7439-97-6	mg/L	NA																		
Molybdenum	7439-98-7	mg/L	NA	0.0039 J	0.004 J	0.0044 J	0.0036 J	0.0038 J	0.0037 J	0.0049 J	0.0037 J	0.004 J	0.0046 J	0.0036 J	0.0035 J	0.0038 J	0.0046 J	0.0038 J	0.0047 J	0.0032 J	0.0037 J
Selenium	7782-49-2	mg/L	4.2																		
Silver*	7440-22-4	mg/L	NA																		
Thallium*	7440-28-0	mg/L	0.00047			0.000063 J				0.000072 J		0.000037 J					0.000048 J				0.000075 J

Notes:

* Constituent was not detected in any samples.	mg/L - milligrams per liter.
AWQC - Ambient Water Quality Criteria.	NA - Not Analyzed/Not Available.
CAS - Chemical Abstracts Service.	USEPA - United States Environmental Protection Agency.

🟩 Detected Concentration > AWQC.

(a) - Surface water samples collected in September 2017.
(b) - USEPA National Recommended Water Quality Criteria. USEPA Office of Water and Office of Science and Technology. Accessed November 2014.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
USEPA AWQC Human Health for the Consumption of Organism Only apply to total concentrations.
(c) - Value applies to inorganic form of arsenic only.

TABLE 6a
COMPARISON OF MAY 2018 MISSISSIPPI RIVER SURFACE WATER RESULTS
TO ECOLOGICAL SCREENING LEVELS - TOTAL (UNFILTERED) SAMPLE RESULTS (a)
AMEREN MISSOURI SIOUX ENERGY CENTER
ST. CHARLES COUNTY, MISSOURI

			Federal Water Quality Criteria		Mississippi River Upstream					Mississippi River Adjacent										Mississippi River Downstream				
Constituent	CAS	Units	USEPA Aquatic Life AWQC Freshwater Acute (b)	USEPA Aquatic Life AWQC Freshwater Chronic (b)	S2-MIR-10S	S2-MIR-11M	S2-MIR-11S	S2-MIR-12M	S2-MIR-12S	S2-MIR-4S	S2-MIR-5M	S2-MIR-5S	S2-MIR-6M	S2-MIR-6S	S2-MIR-7S	S2-MIR-8M	S2-MIR-8S	S2-MIR-9M	S2-MIR-9S	S2-MIR-1S	S2-MIR-2M	S2-MIR-2S	S2-MIR-3M	S2-MIR-3S
Antimony*	7440-36-0	mg/L	NA	NA																				
Arsenic	7440-38-2	mg/L	0.34	0.15	0.0017	0.0015	0.0016	0.0022	0.0021	0.0016	0.0016	0.0016	0.0017	0.0015	0.0015	0.0016	0.0015	0.0017	0.0015	0.0018	0.0016	0.0015	0.0015	0.0016
Barium	7440-39-3	mg/L	NA	NA	0.0969	0.0937	0.0991	0.0966	0.0952	0.0901	0.0969	0.0932	0.0919	0.0767	0.0909	0.092	0.0904	0.0905	0.0908	0.108	0.0968	0.0861	0.0883	0.0868
Beryllium*	7440-41-7	mg/L	NA	NA																	0.00035 J			
Boron	7440-42-8	mg/L	NA	NA	0.0296 J	0.0276 J	0.0301 J	0.0285 J	0.0309 J	0.0313 J	0.0303 J	0.0289 J	0.0461 J	0.0437 J	0.0312 J	0.0286 J	0.0285 J	0.0366 J	0.0367 J	0.0338 J	0.0337 J	0.0273 J	0.0465 J	0.047 J
Cadmium	7440-43-9	mg/L	0.0043 (d)	0.0015 (d)											0.00058 J				0.00046 J					
Calcium	7440-70-2	mg/L	NA	NA	56	53.3	56	53.1	54.6	55	54.6	53.5	56.5	54.2	55.8	53	53.4	55.6	55.9	56.6	54.9	52.5	58.5	58
Chloride	16887-00-6	mg/L	860	230	22.7	22.2	22.4	25.2	24.5	22.5	23	22.6	40.7	38.4	22.6	24.1	23.1	32.8	32	23	23.2	22.6	41	40.9
Chromium	7440-47-3	mg/L	3.55 (c,d)	0.170 (c,d)	0.0023 J	0.0026 J	0.0029 J	0.003 J	0.0023 J		0.0029 J	0.0023 J	0.0032 J	0.0013 J	0.0016 J	0.0014 J	0.0019 J	0.0021 J	0.0017 J	0.003 J	0.0019 J	0.0021 J	0.0012 J	0.0016 J
Cobalt	7440-48-4	mg/L	NA	NA	0.0013 J	0.0016 J	0.0016 J	0.002 J	0.0018 J	0.0012 J	0.0023 J	0.0017 J	0.0018 J		0.0014 J	0.0016 J	0.0014 J	0.0014 J	0.0019 J	0.002 J	0.0021 J	0.0015 J	0.0013 J	0.0012 J
Fluoride	16984-48-8	mg/L	NA	NA	0.22	0.22	0.23	0.22	0.21	0.23	0.22	0.22	0.23	0.21 J	0.23	0.21	0.21	0.21	0.21	0.23	0.24	0.23	0.22	0.23
Lead	7439-92-1	mg/L	0.23 (d)	0.009 (d)	0.0047 J	0.0048 J	0.0055 J	0.0046 J	0.0034 J		0.005 J	0.0052 J	0.005 J	0.0034 J	0.0033 J	0.0045 J	0.0034 J	0.0046 J		0.0049 J	0.0038 J			0.004 J
Lithium	7439-93-2	mg/L	NA	NA	0.009 J	0.0089 J	0.0089 J	0.0088 J	0.0091 J	0.009 J	0.0091 J	0.0104	0.0089 J	0.0059 J	0.0092 J	0.0086 J	0.0104	0.0075 J	0.0085 J	0.0099 J	0.0089 J	0.0084 J	0.0074 J	0.0093 J
Mercury*	7439-97-6	mg/L	0.0016	0.001																				
Molybdenum	7439-98-7	mg/L	NA	NA	0.001 J		0.00098 J	0.0011 J	0.0011 J	0.0011 J	0.0012 J	0.0011 J	0.0014 J	0.0018 J	0.0012 J		0.0013 J	0.0012 J	0.0012 J	0.0012 J	0.0015 J	0.001 J	0.0018 J	0.0018 J
Selenium*	7782-49-2	mg/L	NA	3.1																				
Sulfate	14808-79-8	mg/L	NA	NA	33.6	33	32.8	33.8	33.7	33.9	33.4	33.2	40.1	39.1	34	33.4	33.1	37.3	36.6	34.5	34	33.4	40.3	40.5
Thallium*	7440-28-0	mg/L	NA	NA																				
Total Hardness as CaCO3	471-34-1	mg/L	NA	NA	229	219	228	219	228	224	224	220	243	234	227	219	220	234	234	229	224	215	250	250
Total Dissolved Solids	TDS	mg/L	NA	NA	302	268	250	282	258	218	224	250	232 J	324	282	344	280	280	342	290	244	280	321	272

Notes:

Blank cells - Non-detect value.	J - Estimated value.
* Constituent was not detected in any samples.	mg/L - milligrams per liter.
AWQC - USEPA Ambient Water Quality Criteria.	NA - Not Available.
CAS - Chemical Abstracts Service.	USEPA - United States Environmental Protection Agency.

🟧	Detected Concentration> USEPA Aquatic Life AWQC Chronic.
🟨	Detected Concentration> USEPA Aquatic Life AWQC Acute and Chronic.

(a) - Surface water samples collected in May 2018.

(b) - USEPA National Recommended Water Quality Criteria.
USEPA Office of Water and Office of Science and Technology.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
Total values provided. Values adjusted for site-specific hardness - see note (d).
USEPA provides AWQC for both total and dissolved results.

(c) - Value for trivalent chromium used.

(d) - Hardness dependent value for total metals. Site-specific total recoverable mean hardness value for the Mississippi River of 229 mg/L as CaCO3 used.

TABLE 6b

COMPARISON OF MAY 2018 MISSISSIPPI RIVER SURFACE WATER RESULTS TO ECOLOGICAL SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)

AMEREN MISSOURI SIOUX ENERGY CENTER

ST. CHARLES COUNTY, MISSOURI

			Federal Water Quality Criteria		Mississippi River Upstream					Mississippi River Adjacent										Mississippi River Downstream				
Constituent	**CAS**	**Units**	**USEPA Aquatic Life AWQC Freshwater Acute (b)**	**USEPA Aquatic Life AWQC Freshwater Chronic (b)**	**S2-MIR-10S**	**S2-MIR-11M**	**S2-MIR-11S**	**S2-MIR-12M**	**S2-MIR-12S**	**S2-MIR-4S**	**S2-MIR-5M**	**S2-MIR-5S**	**S2-MIR-6M**	**S2-MIR-6S**	**S2-MIR-7S**	**S2-MIR-8M**	**S2-MIR-8S**	**S2-MIR-9M**	**S2-MIR-9S**	**S2-MIR-1S**	**S2-MIR-2M**	**S2-MIR-2S**	**S2-MIR-3M**	**S2-MIR-3S**
Antimony*	7440-36-0	mg/L	NA	NA																				
Arsenic	7440-38-2	mg/L	0.34	0.15	0.0011	0.001	0.00096 J	0.0013	0.0014	0.0012	0.0011	0.0011	0.0011	0.0011 J	0.0011	0.0011	0.0011	0.0011	0.0011	0.0013	0.0012	0.0011	0.0012	0.0012
Barium	7440-39-3	mg/L	NA	NA	0.0698	0.0659	0.0645	0.0619	0.0614	0.0727	0.0666	0.067	0.0614	0.0604	0.0719	0.0629	0.0654	0.0632	0.0614	0.0757	0.0657	0.0679	0.0629	0.0652
Beryllium	7440-41-7	mg/L	NA	NA																				
Boron	7440-42-8	mg/L	NA	NA	0.0275 J	0.0278 J	0.0272 J	0.03 J	0.027 J	0.0323 J	0.0274 J	0.0299 J	0.0441 J	0.0427 J	0.0294 J	0.0271 J	0.0289 J	0.037 J	0.035 J	0.0315 J	0.0304 J	0.0305 J	0.0469 J	0.048 J
Cadmium*	7440-43-9	mg/L	0.0039 (d)	0.0013 (d)																				
Calcium	7440-70-2	mg/L	NA	NA	52.8	50.4	49.8	48.5	48.3	55.6	52.5	52.1	53.3	52.6	52.3	49.3	50.7	52.3	50.3	54.7	52	52.8	55.1	56.6
Chromium*	7440-47-3	mg/L	1.12 (c,d)	0.15 (c,d)																				
Cobalt*	7440-48-4	mg/L	NA	NA																				
Lead*	7439-92-1	mg/L	0.157 (d)	0.0061 (d)							0.0035 J													
Lithium	7439-93-2	mg/L	NA	NA	0.0075 J	0.009 J	0.0083 J	0.0071 J	0.007 J	0.008 J	0.0085 J	0.0077 J	0.0074 J	0.0065 J	0.0083 J	0.0069 J	0.0067 J	0.0072 J	0.0067 J	0.0088 J	0.0088 J	0.0081 J	0.0074 J	0.0057 J
Mercury*	7439-97-6	mg/L	0.0014	0.00077																				
Molybdenum	7439-98-7	mg/L	NA	NA	0.0012 J			0.001 J		0.0013 J	0.001 J	0.0011 J	0.0016 J	0.0014 J	0.0015 J	0.00098 J		0.0014 J	0.0015 J	0.0018 J	0.0017 J	0.0014 J	0.0016 J	0.0018 J
Selenium*	7782-49-2	mg/L	NA	NA																				
Thallium*	7440-28-0	mg/L	NA	NA																				

Notes:

Blank cells - Non-detect value.	J - Estimated value.
* Constituent was not detected in any samples.	mg/L - milligrams per liter.
AWQC - USEPA Ambient Water Quality Criteria.	NA - Not Available.
CAS - Chemical Abstracts Service.	USEPA - United States Environmental Protection Agency.

🟧	Detected Concentration> USEPA Aquatic Life AWQC Chronic.
🟨	Detected Concentration> USEPA Aquatic Life AWQC Acute and Chronic.

(a) - Surface water samples collected in May 2018.

(b) - USEPA National Recommended Water Quality Criteria.
USEPA Office of Water and Office of Science and Technology.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
Total values provided. Values adjusted for site-specific hardness - see note (d).
USEPA provides AWQC for both total and dissolved results.

(c) - Value for trivalent chromium used.

(d) - Hardness dependent value for total metals. Site-specific total recoverable mean hardness value for the Mississippi River of 229 mg/L as CaCO3 used.

TABLE 6c

COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS TO ECOLOGICAL SCREENING LEVELS -
TOTAL (UNFILTERED) SAMPLE RESULTS (a)
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

			Federal Water Quality Criteria		Mississippi River Chute			Mississippi River Chute														Mississippi River Chute		
					River Upstream			River Adjacent														River Downstream		
Constituent	**CAS**	**Units**	**USEPA Aquatic Life AWQC Freshwater Acute (b)**	**USEPA Aquatic Life AWQC Freshwater Chronic (b)**	**S-MIO-16**	**S-MIO-17**	**S-MIO-18**	**S-MIO-4**	**S-MIO-5**	**S-MIO-5D**	**S-MIO-6**	**S-MIO-6D**	**S-MIO-7**	**S-MIO-8**	**S-MIO-9**	**S-MIO-10**	**S-MIO-11**	**S-MIO-12**	**S-MIO-13**	**S-MIO-14**	**S-MIO-15**	**S-MIO-1**	**S-MIO-2**	**S-MIO-3**
Antimony	7440-36-0	mg/L	NA	NA													0.0037 J							
Arsenic	7440-38-2	mg/L	0.34	0.15	0.0064	0.0062	0.0066	0.0025	0.002	0.002	0.002	0.0021	0.0072	0.0069	0.0062	0.0077	0.0078	0.0077	0.0066	0.006	0.0067	0.0024	0.0024	0.0023
Barium	7440-39-3	mg/L	NA	NA	0.204	0.2	0.199	0.0746	0.0695	0.0669	0.0705	0.0668	0.263	0.256	0.235	0.288	0.278	0.285	0.212	0.193	0.232	0.0677	0.065	0.065
Beryllium*	7440-41-7	mg/L	NA	NA									0.00023 J	0.00035 J		0.0004 J								
Boron	7440-42-8	mg/L	NA	NA	0.75	0.746	0.718	0.0402 J	0.0461 J	0.0379 J	0.041 J	0.034 J	0.805	0.782	0.705	0.859	0.839	0.838	0.651	0.654	0.715	0.0361 J	0.0351 J	0.0358 J
Cadmium*	7440-43-9	mg/L	0.0046 (d)	0.00163 (d)																				
Calcium	7440-70-2	mg/L	NA	NA	80.8	84.8	82	44.6	45	45.2	45.3	44.6	82.5	81.8	78	84.3	83.2	84	76.2	74.4	77.5	44.3	44.4	44
Chloride	16887-00-6	mg/L	860	230	24.7	24.9	25	23	22.9	23.2	22.9	23.4	23.3	23.5	23.5	23.4	23.4	23.3	24	24	24	23.2	23.1	23.2
Chromium	7440-47-3	mg/L	3.8 (c,d)	0.181 (c,d)	0.0011 J		0.0013 J	0.0017 J	0.0011 J	0.00079 J		0.0015 J	0.002 J	0.0021 J	0.0018 J	0.0021 J	0.0027 J	0.0028 J	0.0024 J	0.0014 J	0.0024 J	0.00086 J	0.0012 J	0.0013 J
Cobalt	7440-48-4	mg/L	NA	NA	0.0011 J			0.0012 J	0.0017 J		0.0014 J		0.0011 J	0.001 J		0.0012 J	0.0015 J	0.0011 J	0.0015 J	0.0011 J	0.0016 J	0.0012 J	0.0012 J	0.0013 J
Fluoride	16984-48-8	mg/L	NA	NA	0.56	0.58	0.57	0.17 J	0.17 J	0.17 J	0.17 J	0.17 J	0.59	0.58	0.54	0.63	0.6	0.61	0.51	0.51	0.55	0.17 J	0.16 J	0.16 J
Lead	7439-92-1	mg/L	0.258 (d)	0.0101 (d)		0.0044 J	0.0053			0.0032 J			0.0026 J			0.0036 J	0.0033 J				0.0025 J			
Lithium	7439-93-2	mg/L	NA	NA	0.0186	0.0172	0.018	0.0068 J	0.007 J	0.0046 J	0.006 J	0.0049 J	0.0222	0.0214	0.0211	0.024	0.0214	0.0241	0.0174	0.0178	0.0206	0.0058 J	0.0067 J	0.0067 J
Mercury*	7439-97-6	mg/L	0.0016	0.001																				
Molybdenum	7439-98-7	mg/L	NA	NA	0.0527	0.0516	0.0499	0.0018 J	0.0032 J	0.0017 J	0.0018 J	0.0017 J	0.0633	0.0635	0.0553	0.0683	0.0667	0.0656	0.0481	0.0501	0.0546	0.0015 J	0.0015 J	0.0014 J
Selenium	7782-49-2	mg/L	NA	3.1									0.0093 J	0.0054 J	0.0055 J	0.0077 J	0.0069 J	0.0067 J	0.0039 J	0.0045 J	0.0047 J			
Sulfate	14808-79-8	mg/L	NA	NA	143	144	144	31.3	32	32.3	31.7	31.5	162	157	143	177	173	169	135	133	146	30.2	30.2	30
Thallium	7440-28-0	mg/L	NA	NA	0.000071 J	0.000044 J	0.000058 J						0.0001 J	0.00015 J	0.0001 J	0.00015 J	0.00012 J	0.0002 J	0.000085 J	0.000046 J	0.000083 J			
Total Hardness as CaCO3	HARDNESS	mg/L	NA	NA	312	319	308	204	206	205	208	203	312	311	300	318	313	316	298	292	299	204	204	203
Total Dissolved Solids	TDS	mg/L	NA	NA	467	451	444	254	262	242	256	250	472	460	444	480	496	483	418	419	445	259	256	253

Notes:
Blank cells - Non-detect value.
* Constituent was not detected in any samples.
AWQC - USEPA Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
J - Estimated value.
mg/L - milligrams per liter.
NA - Not Available.
USEPA - United States Environmental Protection Agency.

🟧	Detected Concentration> USEPA Aquatic Life AWQC Chronic.
🟨	Detected Concentration> USEPA Aquatic Life AWQC Acute and Chronic.

(a) - Surface water samples collected in September 2017.
(b) - USEPA National Recommended Water Quality Criteria.
USEPA Office of Water and Office of Science and Technology.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
Total values provided. Values adjusted for site-specific hardness - see note (d).
USEPA provides AWQC for both total and dissolved results.
(c) - Value for trivalent chromium used.
(d) - Hardness dependent value for total metals. Site-specific total recoverable mean hardness value for Mississippi and Missouri River of 247 mg/L as CaCO3 used.

TABLE 6c
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS TO ECOLOGICAL SCREENING LEVELS -
TOTAL (UNFILTERED) SAMPLE RESULTS (a)
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

			Federal Water Quality Criteria		Mississippi River					Mississippi River										Mississippi River				
					River Upstream					River Adjacent										River Downstream				
Constituent	CAS	Units	USEPA Aquatic Life AWQC Freshwater Acute (b)	USEPA Aquatic Life AWQC Freshwater Chronic (b)	S-MIR-10S	S-MIR-11D	S-MIR-11S	S-MIR-12D	S-MIR-12S	S-MIR-4S	S-MIR-5D	S-MIR-5S	S-MIR-6D	S-MIR-6S	S-MIR-7S	S-MIR-8D	S-MIR-8S	S-MIR-9D	S-MIR-9S	S-MIR-1S	S-MIR-2D	S-MIR-2S	S-MIR-3D	S-MIR-3S
Antimony	7440-36-0	mg/L	NA	NA																				
Arsenic	7440-38-2	mg/L	0.34	0.15	0.0019	0.0018	0.0016	0.0019	0.0019	0.0021	0.0018	0.0017	0.0021	0.002	0.0019	0.0019	0.0017	0.002	0.0019	0.002	0.0019	0.0018	0.0022	0.0022
Barium	7440-39-3	mg/L	NA	NA	0.0599	0.0628	0.0566	0.064	0.0582	0.066	0.0607	0.0548	0.0642	0.0609	0.0596	0.0614	0.0557	0.0687	0.0584	0.0681	0.0646	0.0582	0.07	0.0668
Beryllium*	7440-41-7	mg/L	NA	NA							0.00023 J			0.00022 J					0.00024 J				0.00027 J	
Boron	7440-42-8	mg/L	NA	NA	0.0271 J	0.033 J	0.0274 J	0.0404 J	0.0412 J	0.0391 J	0.0362 J	0.0328 J	0.0492 J	0.0513 J	0.0279 J	0.0348 J	0.0303 J	0.0404 J	0.0369 J	0.0404 J	0.0385 J	0.0387 J	0.0534 J	0.0599 J
Cadmium*	7440-43-9	mg/L	0.0046 (d)	0.00163 (d)																				
Calcium	7440-70-2	mg/L	NA	NA	44.5	44	45	44.4	47	44.6	44.4	42.5	46.7	46	44.8	44.4	45.2	46	47.2	44.7	46.1	44.3	48.9	48.5
Chloride	16887-00-6	mg/L	860	230	23.9	23.2	24.9	26.5	31.6	23.7	22.8	24	31.1	34.1	24.1	23.5	26.2	26.2	28.4	23.9	23.5	23.7	31.6	36
Chromium	7440-47-3	mg/L	3.8 (c,d)	0.181 (c,d)		0.00081 J		0.00088 J		0.0013 J	0.00088 J		0.0011 J	0.0011 J		0.00081 J		0.00093 J		0.0018 J	0.0013 J	0.0013 J	0.0015 J	0.0015 J
Cobalt	7440-48-4	mg/L	NA	NA		0.00095 J				0.0016 J	0.0018 J	0.001 J	0.0012 J	0.00077 J		0.00088 J		0.00091 J		0.0013 J	0.0013 J		0.0011 J	0.0014 J
Fluoride	16984-48-8	mg/L	NA	NA	0.17 J	0.16 J	0.17 J	0.17 J	0.18 J	0.17 J	0.16 J	0.16 J	0.17 J	0.18 J	0.17 J	0.16 J	0.17 J	0.18 J	0.17 J	0.17 J	0.16 J	0.17 J	0.18 J	0.19 J
Lead	7439-92-1	mg/L	0.258 (d)	0.0101 (d)	0.0033 J		0.0024 J		0.0026 J				0.003 J						0.0025 J	0.0025 J				
Lithium	7439-93-2	mg/L	NA	NA	0.0031 J	0.005 J		0.006 J	0.0033 J	0.0063 J	0.0055 J	0.0053 J	0.0056 J	0.0047 J		0.0056 J	0.003 J	0.0047 J		0.0048 J	0.0079 J	0.0053 J	0.0049 J	0.0063 J
Mercury*	7439-97-6	mg/L	0.0016	0.001																				
Molybdenum	7439-98-7	mg/L	NA	NA		0.0018 J			0.0017 J	0.0019 J	0.0023 J	0.002 J	0.0021 J	0.0021 J	0.0013 J			0.0014 J	0.0018 J	0.002 J	0.0021 J	0.0022 J	0.0023 J	0.0021 J
Selenium	7782-49-2	mg/L	NA	3.1									0.0037 J											
Sulfate	14808-79-8	mg/L	NA	NA	31.3	30.4	31.9	32.4	36.3	31.6	29.9	31.4	35.1	37.7	31.7	30.5	33.1	32.3	34.3	31.8	30.5	32.1	35.5	39.6
Thallium	7440-28-0	mg/L	NA	NA											0.000069 J			0.000037 J	0.000058 J		0.000065 J		0.000078 J	
Total Hardness as CaCO3	HARDNESS	mg/L	NA	NA	203	204	206	206	214	209	205	200	214	214	204	205	206	212	215	207	211	206	223	225
Total Dissolved Solids	TDS	mg/L	NA	NA	248	247	256	265	266	249	251	252	279	280	256	256	258	251	271	244	248	253	288	297

Notes:
Blank cells - Non-detect value.
* Constituent was not detected in any samples.
AWQC - USEPA Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
J - Estimated value.
mg/L - milligrams per liter.
NA - Not Available.
USEPA - United States Environmental Protection Agency.

🟧	Detected Concentration> USEPA Aquatic Life AWQC Chronic.
🟨	Detected Concentration> USEPA Aquatic Life AWQC Acute and Chronic.

(a) - Surface water samples collected in September 2017.
(b) - USEPA National Recommended Water Quality Criteria.
USEPA Office of Water and Office of Science and Technology.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
Total values provided. Values adjusted for site-specific hardness - see note (d).
USEPA provides AWQC for both total and dissolved results.
(c) - Value for trivalent chromium used.
(d) - Hardness dependent value for total metals. Site-specific total recoverable mean hardness value
for Mississippi and Missouri River of 247 mg/L as CaCO3 used.

TABLE 6c

COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS TO ECOLOGICAL SCREENING LEVELS -
TOTAL (UNFILTERED) SAMPLE RESULTS (a)
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

			Federal Water Quality Criteria		Missouri River					Missouri River								Missouri River				
			USEPA Aquatic Life AWQC Freshwater Acute (b)	USEPA Aquatic Life AWQC Freshwater Chronic (b)	River Upstream					River Adjacent								River Downstream				
Constituent	**CAS**	**Units**			**S-MO-10S**	**S-MO-11D**	**S-MO-11S**	**S-MO-12D**	**S-MO-12S**	**S-MO-4S**	**S-MO-6D**	**S-MO-6S**	**S-MO-7S**	**S-MO-8D**	**S-MO-8S**	**S-MO-9D**	**S-MO-9S**	**S-MO-1S**	**S-MO-2D**	**S-MO-2S**	**S-MO-3D**	**S-MO-3S**
Antimony	7440-36-0	mg/L	NA	NA																		
Arsenic	7440-38-2	mg/L	0.34	0.15	0.0036	0.0035	0.0035	0.0036	0.0035	0.0036	0.0035	0.0036	0.0034	0.0035	0.0036	0.0036	0.0035	0.0034	0.0036	0.0034	0.0035	0.0036
Barium	7440-39-3	mg/L	NA	NA	0.117	0.117	0.113	0.118	0.114	0.118	0.115	0.118	0.114	0.116	0.116	0.116	0.117	0.113	0.115	0.114	0.116	0.116
Beryllium*	7440-41-7	mg/L	NA	NA																		
Boron	7440-42-8	mg/L	NA	NA	0.113	0.111	0.111	0.111	0.112	0.115	0.111	0.112	0.11	0.113	0.113	0.111	0.112	0.11	0.113	0.114	0.111	0.114
Cadmium*	7440-43-9	mg/L	0.0046 (d)	0.00163 (d)																		
Calcium	7440-70-2	mg/L	NA	NA	65.1	64.4	63.4	64.9	64.2	64.8	63.8	65.4	63.4	65	65.3	64.3	65	63	64.8	63.4	64.2	64.7
Chloride	16887-00-6	mg/L	860	230	23.5	23.4	23.6	23.6	23.7	23.3	23.3	23.3	23.9	23.5	23.4	23.4	23.6	23.3	23.3	23.4	23.4	23.3
Chromium	7440-47-3	mg/L	3.8 (c,d)	0.181 (c,d)		0.0012 J	0.00076 J	0.00099 J	0.00075 J	0.0011 J	0.00097 J	0.0011 J		0.00095 J	0.00098 J	0.00073 J	0.00074 J	0.0013 J				0.00075 J
Cobalt	7440-48-4	mg/L	NA	NA				0.00083 J			0.00074 J		0.00087 J	0.00085 J								0.00087 J
Fluoride	16984-48-8	mg/L	NA	NA	0.45	0.44	0.44	0.44	0.44	0.45	0.44	0.44	0.45	0.44	0.45	0.43	0.45	0.45	0.44	0.45	0.43	0.46
Lead	7439-92-1	mg/L	0.258 (d)	0.0101 (d)							0.0026 J				0.003 J						0.0028 J	
Lithium	7439-93-2	mg/L	NA	NA	0.0435	0.044	0.0429	0.0441	0.0436	0.0442	0.0427	0.0431	0.042	0.0428	0.0449	0.042	0.0423	0.042	0.0431	0.0427	0.0434	0.0435
Mercury*	7439-97-6	mg/L	0.0016	0.001																		
Molybdenum	7439-98-7	mg/L	NA	NA	0.0031 J	0.0026 J	0.0028 J	0.0026 J	0.0027 J	0.003 J	0.003 J	0.0028 J	0.0031 J	0.003 J	0.0028 J	0.0028 J	0.003 J	0.0035 J	0.0029 J	0.0036 J	0.0028 J	0.0031 J
Selenium	7782-49-2	mg/L	NA	3.1	0.0042 J																	
Sulfate	14808-79-8	mg/L	NA	NA	195	192	194	191	191	192	193	188	192	196	192	193	190	193	194	189	192	190
Thallium	7440-28-0	mg/L	NA	NA			0.000064 J			0.000047 J	0.000037 J			0.000045 J				0.000055 J				0.000064 J
Total Hardness as CaCO3	HARDNESS	mg/L	NA	NA	266	263	259	265	262	266	260	267	259	265	267	263	265	258	265	259	262	264
Total Dissolved Solids	TDS	mg/L	NA	NA	475	496	492	497	490	493	491	488	478	496	482	476	473	487	496	485	484	465

Notes:
Blank cells - Non-detect value.
* Constituent was not detected in any samples.
AWQC - USEPA Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
J - Estimated value.
mg/L - milligrams per liter.
NA - Not Available.
USEPA - United States Environmental Protection Agency.

🟧	Detected Concentration> USEPA Aquatic Life AWQC Chronic.
🟨	Detected Concentration> USEPA Aquatic Life AWQC Acute and Chronic.

(a) - Surface water samples collected in September 2017.
(b) - USEPA National Recommended Water Quality Criteria.
USEPA Office of Water and Office of Science and Technology.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
Total values provided. Values adjusted for site-specific hardness - see note (d).
USEPA provides AWQC for both total and dissolved results.
(c) - Value for trivalent chromium used.
(d) - Hardness dependent value for total metals. Site-specific total recoverable mean hardness value
for Mississippi and Missouri River of 247 mg/L as CaCO3 used.

TABLE 6d
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS TO
ECOLOGICAL SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

			Federal Water Quality Criteria		Mississippi River Chute			Mississippi River Chute													Mississippi River Chute		
					River Upstream			River Adjacent													River Downstream		
Constituent	**CAS**	**Units**	**USEPA Aquatic Life AWQC Freshwater Acute (c)**	**USEPA Aquatic Life AWQC Freshwater Chronic (c)**	**S-MIO-16**	**S-MIO-17**	**S-MIO-18**	**S-MIO-4**	**S-MIO-5**	**S-MIO-5D**	**S-MIO-6**	**S-MIO-6D**	**S-MIO-7**	**S-MIO-8**	**S-MIO-9**	**S-MIO-10**	**S-MIO-11**	**S-MIO-12**	**S-MIO-13**	**S-MIO-14**	**S-MIO-15**	**S-MIO-1**	**S-MIO-2**	**S-MIO-3**
Antimony*	7440-36-0	mg/L	NA	NA		0.0037 J																		
Arsenic	7440-38-2	mg/L	0.34	0.15	0.0055	0.0053	0.0053	0.0021	0.0017	0.0016	0.0017	0.0017	0.0064	0.0061	0.0056	0.0072	0.0071	0.0065	0.0052	0.0053	0.0057	0.0021	0.002	0.0021
Barium	7440-39-3	mg/L	NA	NA	0.185	0.192	0.191	0.0592	0.0558	0.0553	0.0564	0.0544	0.25	0.246	0.219	0.267	0.266	0.252	0.182	0.182	0.209	0.0599	0.0595	0.0583
Beryllium*	7440-41-7	mg/L	NA	NA												0.00019 J	0.0002 J							0.00026 J
Boron	7440-42-8	mg/L	NA	NA	0.755	0.769	0.769	0.039 J	0.0421 J	0.0431 J	0.0395 J	0.0406 J	0.805	0.796	0.715	0.853	0.849	0.812	0.652	0.657	0.734	0.0338 J	0.0351 J	0.0357 J
Cadmium*	7440-43-9	mg/L	0.0042 (b)	0.00142 (b)																				
Calcium	7440-70-2	mg/L	NA	NA	79.8	81.4	82.1	44.8	44.5	44.1	45.2	43.8	83	82.1	77.2	82.9	83.2	81	73.9	74.2	76.8	45.1	44.7	44
Chromium	7440-47-3	mg/L	1.19 (c,d)	0.155 (c,d)									0.00087 J			0.00095 J	0.0016 J	0.0008 J			0.00075 J			
Cobalt	7440-48-4	mg/L	NA	NA	0.00089 J	0.0012 J	0.0013 J		0.00078 J				0.001 J	0.0013 J	0.00074 J	0.00088 J		0.00098 J	0.0013 J					
Lead	7439-92-1	mg/L	0.170 (b)	0.0066 (b)		0.0031 J																		
Lithium	7439-93-2	mg/L	NA	NA	0.0161	0.018	0.0197	0.0055 J	0.0056 J	0.0044 J	0.0059 J	0.0051 J	0.0218	0.0209	0.0189	0.0213	0.023	0.0229	0.0166	0.0166	0.0201	0.0054 J	0.0058 J	0.0067 J
Mercury*	7439-97-6	mg/L	0.0014	0.00077																				
Molybdenum	7439-98-7	mg/L	NA	NA	0.0524	0.0576	0.0561	0.0018 J	0.0026 J	0.0019 J	0.0022 J	0.002 J	0.064	0.0633	0.057	0.068	0.0685	0.0638	0.0478	0.0489	0.055	0.0019 J	0.0019 J	0.0023 J
Selenium	7782-49-2	mg/L	NA	NA		0.0061 J							0.0048 J	0.0046 J	0.0049 J	0.0052 J	0.0091 J	0.0062 J						
Thallium	7440-28-0	mg/L	NA	NA	0.000037 J						0.000039 J		0.000092 J	0.00014 J	0.000096 J	0.00011 J	0.00011 J	0.000096 J			0.0001 J	0.000055 J		

Notes:
Blank cells - Non-detect value.
* Constituent was not detected in any samples.
AWQC - USEPA Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
J - Estimated value.
mg/L - milligrams per liter.
NA - Not Available.
USEPA - United States Environmental Protection Agency.

🟧	Detected Concentration> USEPA Aquatic Life AWQC Chronic.
🟨	Detected Concentration> USEPA Aquatic Life AWQC Acute and Chronic.

(a) - Surface water samples collected in September 2017.
(b) - USEPA National Recommended Water Quality Criteria.
USEPA Office of Water and Office of Science and Technology.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
Total values provided. Values adjusted for site-specific hardness - see note (d).
USEPA provides AWQC for both total and dissolved results.
(c) - Value for trivalent chromium used.
(d) - Hardness dependent value for total metals. Site-specific total recoverable mean hardness value for Mississippi and Missouri River of 247 mg/L as CaCO3 used.

TABLE 6d
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS TO
ECOLOGICAL SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

Constituent	CAS	Units	Federal Water Quality Criteria		Mississippi River					Mississippi River										Mississippi River				
					River Upstream					River Adjacent										River Downstream				
			USEPA Aquatic Life AWQC Freshwater Acute (c)	USEPA Aquatic Life AWQC Freshwater Chronic (c)	S-MIR-10S	S-MIR-11D	S-MIR-11S	S-MIR-12D	S-MIR-12S	S-MIR-4S	S-MIR-5D	S-MIR-5S	S-MIR-6D	S-MIR-6S	S-MIR-7S	S-MIR-8D	S-MIR-8S	S-MIR-9D	S-MIR-9S	S-MIR-1S	S-MIR-2D	S-MIR-2S	S-MIR-3D	S-MIR-3S
Antimony*	7440-36-0	mg/L	NA	NA																				
Arsenic	7440-38-2	mg/L	0.34	0.15	0.0016	0.0016	0.0015	0.0017	0.0016	0.0017	0.0015	0.0015	0.0018	0.0018	0.0016	0.0014	0.0016	0.0016	0.0016	0.0017	0.0016	0.0016	0.0018	0.0018
Barium	7440-39-3	mg/L	NA	NA	0.0504	0.0417	0.0439	0.0447	0.0467	0.0525	0.042	0.0421	0.0453	0.0464	0.0508	0.0422	0.0429	0.0438	0.0457	0.0534	0.043	0.0475	0.047	0.049
Beryllium*	7440-41-7	mg/L	NA	NA									0.00025 J		0.00018 J			0.00029 J	0.00032 J		0.00025 J			
Boron	7440-42-8	mg/L	NA	NA	0.0332 J	0.0333 J	0.0372 J	0.0392 J	0.0476 J	0.0368 J	0.0329 J	0.0338 J	0.0489 J	0.0522 J	0.0374 J	0.0354 J	0.0398 J	0.0396 J	0.0409 J	0.0395 J	0.0391 J	0.0398 J	0.0559 J	0.0603 J
Cadmium*	7440-43-9	mg/L	0.0042 (b)	0.00142 (b)																				
Calcium	7440-70-2	mg/L	NA	NA	44.8	44.4	44.9	45.7	45.9	45	43.4	44.4	45.8	46.2	43.8	43.9	43.6	45.4	44.8	44.4	45	44.3	47.4	48
Chromium	7440-47-3	mg/L	1.19 (c,d)	0.155 (c,d)													0.00097 J							
Cobalt	7440-48-4	mg/L	NA	NA		0.0009 J		0.00091 J		0.0013 J	0.0013 J	0.00075 J		0.0012 J	0.00082 J		0.00078 J	0.0013 J	0.00091 J				0.00094 J	
Lead	7439-92-1	mg/L	0.170 (b)	0.0066 (b)																				
Lithium	7439-93-2	mg/L	NA	NA	0.0058 J	0.0063 J	0.0054 J	0.005 J	0.0068 J	0.0041 J	0.0043 J	0.0051 J	0.0033 J	0.0037 J	0.004 J	0.0041 J	0.0041 J	0.0043 J	0.0048 J	0.0059 J	0.0052 J	0.0033 J	0.0043 J	0.0078 J
Mercury*	7439-97-6	mg/L	0.0014	0.00077																				
Molybdenum	7439-98-7	mg/L	NA	NA	0.0015 J	0.0016 J	0.0019 J	0.002 J	0.0014 J	0.0022 J	0.0019 J	0.0014 J	0.002 J	0.0018 J	0.0027 J	0.0021 J	0.0026 J	0.0018 J	0.0023 J	0.002 J	0.0019 J	0.0016 J	0.0031 J	0.0022 J
Selenium	7782-49-2	mg/L	NA	NA																	0.0036 J			
Thallium	7440-28-0	mg/L	NA	NA	0.000059 J																0.00004 J			0.000047 J

Notes:
Blank cells - Non-detect value.
* Constituent was not detected in any samples.
AWQC - USEPA Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
J - Estimated value.
mg/L - milligrams per liter.
NA - Not Available.
USEPA - United States Environmental Protection Agency.

🟧	Detected Concentration> USEPA Aquatic Life AWQC Chronic.
🟨	Detected Concentration> USEPA Aquatic Life AWQC Acute and Chronic.

(a) - Surface water samples collected in September 2017.
(b) - USEPA National Recommended Water Quality Criteria.
USEPA Office of Water and Office of Science and Technology.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
Total values provided. Values adjusted for site-specific hardness - see note (d).
USEPA provides AWQC for both total and dissolved results.
(c) - Value for trivalent chromium used.
(d) - Hardness dependent value for total metals. Site-specific total recoverable mean hardness value for Mississippi and Missouri River of 247 mg/L as CaCO3 used.

TABLE 6d
COMPARISON OF SEPTEMBER 2017 SURFACE WATER RESULTS TO ECOLOGICAL SCREENING LEVELS - DISSOLVED (FILTERED) SAMPLE RESULTS (a)
SIOUX ENERGY CENTER, ST CHARLES COUNTY, WEST ALTON, MO
AMEREN MISSOURI

			Federal Water Quality Criteria		Missouri River					Missouri River										Missouri River				
					River Upstream					River Adjacent										River Downstream				
Constituent	**CAS**	**Units**	**USEPA Aquatic Life AWQC Freshwater Acute (c)**	**USEPA Aquatic Life AWQC Freshwater Chronic (c)**	**S-MO-10S**	**S-MO-11D**	**S-MO-11S**	**S-MO-12D**	**S-MO-12S**	**S-MO-4S**	**S-MO-5D**	**S-MO-5S**	**S-MO-6D**	**S-MO-6S**	**S-MO-7S**	**S-MO-8D**	**S-MO-8S**	**S-MO-9D**	**S-MO-9S**	**S-MO-1S**	**S-MO-2D**	**S-MO-2S**	**S-MO-3D**	**S-MO-3S**
Antimony*	7440-36-0	mg/L	NA	NA																				
Arsenic	7440-38-2	mg/L	0.34	0.15	0.0034	0.0034	0.0032	0.0033	0.0033	0.0033	0.0034	0.0033	0.0032	0.0033	0.0032	0.0033	0.0033	0.0034	0.0032	0.0033	0.0034	0.0033	0.0032	0.0033
Barium	7440-39-3	mg/L	NA	NA	0.108	0.11	0.108	0.109	0.109	0.11	0.11	0.107	0.106	0.109	0.109	0.109	0.107	0.108	0.108	0.112	0.107	0.111	0.107	0.109
Beryllium*	7440-41-7	mg/L	NA	NA																				
Boron	7440-42-8	mg/L	NA	NA	0.115	0.12	0.116	0.118	0.118	0.119	0.12	0.114	0.115	0.116	0.117	0.118	0.117	0.118	0.116	0.12	0.115	0.122	0.115	0.119
Cadmium*	7440-43-9	mg/L	0.0042 (b)	0.00142 (b)																				
Calcium	7440-70-2	mg/L	NA	NA	59.5	60.9	59.9	60.6	60.3	60.3	61.1	59.2	59.1	60	60.8	60.7	59.8	60	59.9	61.6	59.7	60.6	59.7	59.4
Chromium	7440-47-3	mg/L	1.19 (c,d)	0.155 (c,d)																				0.00074 J
Cobalt	7440-48-4	mg/L	NA	NA																				
Lead	7439-92-1	mg/L	0.170 (b)	0.0066 (b)																				
Lithium	7439-93-2	mg/L	NA	NA	0.0422	0.0423	0.0435	0.0423	0.0417	0.0422	0.0422	0.0428	0.0412	0.0421	0.0432	0.0424	0.044	0.042	0.04	0.0441	0.0421	0.0446	0.0405	0.0437
Mercury*	7439-97-6	mg/L	0.0014	0.00077																				
Molybdenum	7439-98-7	mg/L	NA	NA	0.0039 J	0.004 J	0.0044 J	0.0036 J	0.0038 J	0.0037 J	0.0049 J	0.0037 J	0.004 J	0.0046 J	0.0038 J	0.0038 J	0.0036 J	0.0035 J	0.0038 J	0.0046 J	0.0038 J	0.0047 J	0.0032 J	0.0037 J
Selenium	7782-49-2	mg/L	NA	NA																				
Thallium	7440-28-0	mg/L	NA	NA			0.000063 J				0.000072 J		0.000037 J							0.000048 J				0.000075 J

Notes:
Blank cells - Non-detect value.
* Constituent was not detected in any samples.
AWQC - USEPA Ambient Water Quality Criteria.
CAS - Chemical Abstracts Service.
J - Estimated value.
mg/L - milligrams per liter.
NA - Not Available.
USEPA - United States Environmental Protection Agency.

🟧	Detected Concentration> USEPA Aquatic Life AWQC Chronic.
🟨	Detected Concentration> USEPA Aquatic Life AWQC Acute and Chronic.

(a) - Surface water samples collected in September 2017.
(b) - USEPA National Recommended Water Quality Criteria.
USEPA Office of Water and Office of Science and Technology.
http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
Total values provided. Values adjusted for site-specific hardness - see note (d).
USEPA provides AWQC for both total and dissolved results.
(c) - Value for trivalent chromium used.
(d) - Hardness dependent value for total metals. Site-specific total recoverable mean hardness value for Mississippi and Missouri River of 247 mg/L as CaCO3 used.

APPENDIX B

What You Need to Know About Molybdenum

WHAT YOU NEED TO KNOW ABOUT MOLYBDENUM

Molybdenum is the one constituent that is present in at least one groundwater sample at each of the four Ameren energy centers in Missouri above the screening level used by the U.S. Environmental Protection Agency (USEPA) under the Coal Combustion Residuals (CCR) Rule. The purpose of this fact sheet is to provide information on molybdenum so that data can be considered in context. There is no public exposure to groundwater at the Ameren energy centers and concentration levels of molybdenum in adjacent surface waters are all well below health-based regulatory standards.

SOURCES OF INFORMATION ON MOLYBDENUM

Molybdenum had been evaluated by regulatory and health agencies in the U.S. As discussed below, molybdenum is an essential nutrient for humans, and the Institute of Medicine of the U.S. National Academy of Sciences (NAS) has provided recommended daily allowances and tolerable upper limits to be used as guidelines for vitamins and supplements and other exposures (NAS, 2001).

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency within the U.S. Department of Health and Human Services. The ATSDR Toxicological Profile for Molybdenum (ATSDR, 2017) provides a comprehensive summary and interpretation of available toxicological and epidemiological information on molybdenum and provides information on the naturally occurring levels in our environment and in our diet.

The U.S. Environmental Protection Agency (USEPA) published an oral toxicity value for molybdenum in 1992 (USEPA, 1992); this value serves as the basis for the tapwater screening level for molybdenum of 0.1 milligrams per liter (mg/L) or 100 micrograms per liter (ug/L) that was included in the Phase 1 Part update to the CCR Rule (USEPA, 2018a).

MOLYBDENUM IS NATURALLY OCCURRING AND AN ESSENTIAL NUTRIENT FOR PLANTS AND HUMANS

Molybdenum is a naturally occurring trace element that can be found extensively in nature. Biologically, molybdenum plays an important role as a micronutrient in plants and animals, including humans.

Molybdenum in Our Natural Environment

Molybdenum naturally accumulates in poorly drained soils and soils with high organic content (for example, peat bogs and wetlands). It is also present at high concentrations in “black shales,” which are shale deposits with high organic content. The U.S. Geological Survey (USGS, 2013) reports that the average concentration in U.S. soils is approximately 1 milligram per kilogram of soil (mg/kg). USGS (2011) estimates the median concentration of molybdenum in groundwater is 0.001 milligrams per liter (mg/L), with most concentrations below 0.008 mg/L.

Molybdenum in Our Diet

Molybdenum is considered an essential nutrient or trace element for living beings. It is required in several mammalian enzyme systems and is present in most adult multi-vitamins. A deficiency syndrome has only been seen in people with a genetic defect that prevents the synthesis of a specific enzyme for which molybdenum is a cofactor. The deficiency leads to severe neurological damage and early death.

Because it is present in soils, it is also present in our diet. Food derived from above ground plants, such as legumes, leafy vegetables, and cauliflower generally has a relatively higher concentration of molybdenum in comparison to food from tubers or animals. Beans, cereal grains, leafy vegetables, legumes, liver, and milk are reported as the richest sources of molybdenum in the average diet (ATSDR, 2017). The amount of molybdenum in plants varies according to the amount in the soil. The National Academy of Sciences (NAS) has estimated that the average dietary intakes of molybdenum by adult men and women are 0.109 and 0.076 milligrams per day (mg/day), respectively. A study of the dietary intake of adult residents in Denver, Colorado reported a mean molybdenum ingestion rate of 180 µg/day (range 120–240 µg/day) (ATSDR, 2017).

Molybdenum for Health

How Much Do You Need - Daily Allowance:

The Institute of Medicine of the NAS sets dietary intake values for essential nutrients. The recommended dietary allowance (RDA) for a nutrient is “the average daily dietary nutrient intake level sufficient to meet the nutrient requirement of nearly all (97 to 98 percent) health individuals” (NAS, 2001). The RDA for molybdenum for adults set by the NAS in 2001 is 0.045 milligram per day (mg/day) and is based on the amount of molybdenum needed to achieve a steady healthy balance in the body for the majority of the population.

How Much is Too Much - Upper Limits:

In addition to the RDA, the NAS also defines a Tolerable Upper Intake Level (UL) for essential nutrients. The UL is “the highest average daily nutrient intake level that is likely to pose no risk of adverse health effects to almost all individuals in the general population.” Thus, the RDA is a level that is considered to be sufficient for the health of the general population, while intake can be as high as the UL and pose no adverse health effects.

The UL for molybdenum set by the NAS is 2 mg/day. This level is based on an evaluation of the potential toxicity of molybdenum at high levels of intake. The most sensitive effect in the literature is associated with reproductive outcomes in rats, and the study was used to develop an oral toxicity value for humans of 0.03 milligrams of molybdenum ingested per day per kilogram of body weight (mg/kg-day). This value is used with an average adult body weight of 68-70 kg (154 lbs) to set the UL[1].

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[1] The oral toxicity value identifies a level of intake in terms of milligrams of constituent per kilogram of body weight per day (mg/kg-day) that is considered to be safe for daily exposure for a lifetime. The oral toxicity value is used to calculate a safe drinking water level as follows: if the oral toxicity value is 0.03 mg/kg-day, and a 70 kg adult that consumes 2 liters of water per day, then the safe drinking water level = (0.03 mg/kg-day) x (70 kg) ÷ (2 liters water/day) = 1.05 milligrams per liter (mg/L).

USEPA'S ORAL TOXICITY VALUE FOR MOLYBDENUM

USEPA developed a lower oral toxicity value for molybdenum of 0.005 mg/kg-day (USEPA, 1992) based on a 1962 study of a small population (52 exposure subjects) in Armenia that had a high level of molybdenum in their diet. This population had high levels of uric acid and experienced gout. The findings from the Armenian study have not been replicated, and other regulatory bodies such as the NAS and ATSDR have rejected the study due to its many deficiencies. [It is likely that the observance of gout in the Armenian population had some other cause.]

The NAS concluded that there were "serious methodological difficulties with the [Armenian] study" and noted that no other studies in humans or animals have replicated this effect. The NAS toxicity value is 0.03 mg/kg-day, six-fold higher than the USEPA value. Based on the NAS toxicity value and USEPA assumptions (for body weight and drinking water intake) results in a calculated safe drinking water level of 0.6 mg/L or 600 ug/L.

ATSDR noted the study of the Armenian population was not considered suitable for derivation of a chronic-duration oral toxicity value for molybdenum due to deficiencies in the control group size and composition, and a lack of controlling for confounders, such as diet and alcohol, that could affect the results. ATSDR developed an oral toxicity value of 0.008 mg/kg-day, using the same study reproductive outcomes in rats as the NAS, but applying different assumptions, most notably a 3-fold higher uncertainty factor. Based on the ATSDR toxicity value and USEPA assumptions (for body weight and drinking water intake) results in a calculated safe drinking water level of 0.16 mg/L or 160 ug/L.

MOLYBDENUM UNDER THE CCR RULE

When the CCR Rule was published in 2015, groundwater standards were provided only for those Appendix IV constituents that have primary drinking water standards published by the USEPA under the Safe Drinking Water Act – values known as MCLs or maximum contaminant levels. Molybdenum does not have an MCL[2]. In a subsequent 2018 CCR rule-making, USEPA designated a health-based groundwater protection standard for molybdenum of 0.1 mg/L or 100 ug/L. That is the value used to evaluate groundwater at the Ameren facilities. This level is very conservative and could be much higher and still protective of human health, as described above. [Note that in its March 3, 2019 report the Environmental Integrity Project used a screening level for molybdenum of 0.04 mg/L (or 40 ug/L), which is not the level USEPA has required in the CCR Rule.]

However, based on the USEPA toxicity value, the drinking water levels USEPA has developed for molybdenum are:

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[2] USEPA is in the process of gathering information on the occurrence of molybdenum in public drinking water systems. The decision to develop an MCL (which is a multi-year process) is based on occurrence in public drinking water systems, the severity of adverse health effects, whether the constituent is present in public drinking water systems at levels of public health concern, and whether regulation would provide a meaningful opportunity for health risk reduction. No decision has yet been made as to whether molybdenum will be a candidate for the development of a drinking standard. Note that when USEPA included molybdenum for public water supply testing, it cited USEPA 1992, ATSDR 2017, and NAS 2001 as toxicity references. No mention was made of the differences in toxicity studies used or the values developed.

- 0.1 mg/L – The USEPA tapwater value in its Regional Screening Level (RSL) table and the value identified by USEPA for the CCR Rule (USEPA, 2018b). This is the value USEPA uses in the CCR Rule (USEPA, 2018a).
- 0.2 mg/L – The USEPA Office of Water value for the Drinking Water Equivalent Level (DWEL), which is a *lifetime exposure* concentration protective of adverse, non-cancer health effects, that assumes all of the exposure to a constituent is from drinking water (USEPA, 2018c).
- 0.04 mg/L – The USEPA Office of Water value for the Health Advisory Level (HA), which is based on the DWEL, but using a default assumption that only 20% of intake can come from water (USEPA, 2018c).

Therefore, drinking water concentrations of molybdenum up to 0.2 mg/L to are expected to be **without** adverse health effects. Based on the NAS review, daily exposure to drinking water concentrations of molybdenum up to 0.6 mg/L would be **without** adverse health effects.

WHAT THIS MEANS FOR THE AMEREN ENERGY CENTERS

This information from the NAS has been used to evaluate the levels of molybdenum in groundwater at the Ameren Energy Centers and in nearby surface waters. A total of 930 groundwater and surface water samples were collected from the four energy centers. The concentration levels in approximately 866 samples were below the screening level based on the National Academy of Science Tolerable Upper Intake Level (UL), while 241 are above the GWPS established by USEPA in the CCR Rule.

	Labadie	Meramec	Rush Island	Sioux
Groundwater				
Number of Samples	208	88	77	244
Molybdenum greater than CCR GWPS of 0.1 mg/L (a)	81	35	38	77
Molybdenum greater than NAS standard of 0.6 mg/L (b)	3	1	11	49
Surface Water				
Number of Samples	67	74	50	80
Molybdenum greater than 0.1 mg/L (a)	0	0	0	0

Notes:
mg/L - milligrams per liter.
(a) - Drinking water-based groundwater protection standard specified in the Coal Combustion Residuals Rule.
(b) - Alternative health-protective drinking water screening level based on the National Academy of Sciences review of molybdenum.

The groundwater results were collected from monitoring wells placed as close as practical to the ash basins' boundaries and provide near-source groundwater monitoring results. The groundwater downgradient of each of the Ameren ash basins is not used as a source of drinking water. Deep bedrock groundwater used as drinking water in the vicinity of Labadie and in the vicinity of Rush Island was sampled and demonstrated no impacts from CCR.

Surface water adjacent to each of the energy centers was sampled and all results for molybdenum in surface water are well below the USEPA drinking water screening level of 0.1 mg/L.

Thus, although there are some results for molybdenum in groundwater that are above the USEPA drinking water screening level, the groundwater at these facilities is not used as a source of drinking water, and molybdenum is not present in any of the adjacent water bodies above the drinking water screening level. These results confirm that molybdenum does not pose a risk to human health or the environment at any of the Ameren facilities.

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APPENDIX C

Extraction & Transportation Study

LOCHMUELLER GROUP

ADDENDUM

Meramec, Labadie and Sioux Ash Pond Closure: Extraction and Transportation Assessment

Lochmueller Group applied the methodology from the Extraction and Transportation Study for the Rush Island Energy Center to develop high-level estimates of the costs and timeframes associated with hypothetical CCR excavation processes at the Labadie, Sioux and Meramec Energy Centers. Specifically, the formula used to estimate daily productivity (i.e. number of trucks hauling excavated material offsite) was adapted for use at Labadie, Sioux and Meramec along with site-specific considerations.

Estimates from the Rush Island Study assumed a maximum of 192 truck loads per day over an 8-hour work day (24 per hour), with 155 to 193 days of annual operation. Once loaded, trucks would make multiple roundtrips to the closest available commercial landfill. Such estimates assume that the excavation, staging, and loading process is capable of accommodating a steady stream of trucks loading **every 2.5 minutes** and that such material can be quickly unloaded at the receiving commercial landfill without significant delay. While such productivity rates are undoubtedly optimistic, the resulting estimates nevertheless are useful in capturing the enormity of such projects and are sufficient at a planning-level.

It is important to note that the existing onsite utility waste landfills (UWLs) at Labadie and Sioux were designed and permitted to manage production needs of the energy centers through each facility's retirement date. To facilitate permanent storage, excavated CCR material would need to be transported offsite to a commercial landfill **or** Ameren Missouri would need to permit and construct new onsite landfills. Given the absence of an existing utility waste landfill at Meramec, onsite disposal options were considered for the Labadie and Sioux locations only.

Each facility presents unique challenges that are likely to impact cost estimates and closure times beyond the scope of this assessment. For example, the regulatory process for construction of an onsite landfill would require multiple levels of approval, including environmental permits, zoning or land use authorization, and potentially a certificate of issuance from the Missouri Public Service Commission. Opposition to such projects may further delay the regulatory approval process such that it would be years *before* construction could commence.[1]

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[1] Efforts to permit and construct the Labadie UWL commenced in 2008 with the completion of Preliminary Site Investigation (PSI). The landfill was placed in service in 2016 after years of opposition from environmental groups and litigation. See *Petition for Writ of Certiorari [to invalidate county landfill ordinance] Franklin County Circ. Ct., 11/23/11, Case # 11AB-C286; Appeal to Franklin County Board of Adjustment, #14-00002, Filed 1/8/14 (of Land Use Administrator 10/10/13 and 12/10/13 Decisions), Denied by BZA 6/24/14; Appealed to Circ. Ct. by Writ of Certiorari, Cause # 14AB-CC00155, 7/24/14; Intervention and Motion to Dismiss in PSC Case EA 2012-0281, Ameren Application to PSC for CCN to operate landfill (PSC overruled Motion to Dismiss on 4/17/13); Administrative Hearing Commission Petition for Review [of MDNR Solid Waste Disposal Construction Permit], Filed 1-30-15, #15-0136, dismissed by AHC 3/5/15.* See also *Campbell v. County Commission of Franklin County, 453 S.W.3d 762 (Mo. banc 2015).*

Based on experience, it would be virtually impossible to sustain productivity at the planning level rate over extended, multi-year timeframe due to a variety of unpredictable factors. Excavation activities could be limited or precluded for several days following weather events. Other potential disruptions could include:

- loading equipment failure
- site restrictions that limit the number of excavation equipment
- traffic congestion on travel route
- truck breakdown
- staffing
- weather conditions
- commercial landfill available capacity in Illinois and Missouri
- landfill unloading equipment failure

In addition, site specific conditions can impact productivity. For example, an elementary school is located along Fine Road between the Meramec Energy Center and Telegraph Road. To accommodate local safety concerns, the hauling company would likely limit trips during the beginning and end of the school day, thereby limiting effective hauling hours to 5-6 per day during the school year.

Route 94 east of the Sioux Energy Center travels beneath multiple narrow, low-clearance railroad overpasses in the West Alton area. An entirely new roadway by-passing West Alton would avoid the railroad entirely, but would require regulatory approvals, land acquisition, and potentially eminent domain. Assumptions were adjusted to account for these impacts, but it is not possible to foresee every challenge and quantify every impact likely to surface.

Scenarios:

The following summarizes the assessment of five scenarios for CCR removal for the Meramec, Labadie and the Sioux Energy Centers. The assessment utilized the same methodology, assumptions, and unit costing information as for Rush Island. The volume of ash, hauling distances, and the anticipated infrastructure upgrades were adjusted for each site.

For each scenario, the total volume of excavated ash, total cost of removal, and closure duration are summarized. The reported volume of ash incorporates a swell factor. The closure duration is measured from the time the decision is made to close the ponds (i.e. removal from service) until such time that the CCR material is fully removed. It was assumed that 5 years of preparation time would be needed in advance of starting an offsite removal operation, whereas an onsite removal operation would require 10 years of preparation time to account for the regulatory process to secure approvals for construction of new onsite landfills.

The five scenarios are as follows:

1. Labadie Bottom Ash and Fly Ash Pond CCR Removal to an Offsite Landfill
2. Labadie Bottom Ash and Fly Ash Pond CCR Removal to an Onsite Landfill

3. Sioux Bottom Ash and Fly Ash Pond CCR Removal to an Offsite Landfill
4. Sioux Bottom Ash and Fly Ash Pond CCR Removal to an Onsite Landfill
5. Meramec Bottom Ash and Fly Ash Pond CCR Removal to an Offsite Landfill

Scenario 1: Offsite CCR Removal for Labadie

This scenario assumes offsite removal for the Labadie ash pond sites and includes the following:

- Pre-CCR removal preparation (5 years, included on a prorated basis in the Closure Duration for each pond);
- Stabilization, loading, and pond restoration;
- Seasonal impacts from wet and winter weather conditions impeding productivity;
- Hauling to an offsite landfill in Missouri;
- Landfill placement; and
- Loading and transportation infrastructure.

Labadie Energy Center	Estimated Ash Volume (CY) [2]	Estimated Total Removal Cost	Closure Duration (Years)
	17,325,126	**$2,440 M – $2,930 M**	**35 plus years**

Scenario 2: Onsite CCR Removal for Labadie

This scenario assumes onsite disposal the Labadie ash pond sites and includes the following:

- Pre-CCR removal preparation (10 years, included on a prorated basis in the Closure Duration for each pond);
- Stabilization, loading, and pond restoration;
- Hauling to an onsite landfill located near the existing ponds;
- Seasonal impacts from wet and winter weather conditions impeding productivity;
- Landfill placement; and
- Loading infrastructure.

Labadie Energy Center	Estimated Ash Volume (CY)	Estimated Total Removal Cost	Closure Duration (Years)
	17,325,126	**$1,270 M - $1,520 M**	**40 plus years**

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[2] Estimated volumes do not include any dry amendment materials.

Scenario 3: Offsite CCR Removal for Sioux

This scenario assumes offsite removal for the Sioux ash pond sites and includes the following:

- Pre-CCR removal preparation (5 years, included on a prorated basis in the Closure Duration for each pond);
- Stabilization, loading, and pond restoration;
- Hauling to an offsite landfill in Illinois[3];
- Seasonal impacts from wet and winter weather conditions impeding productivity;
- Landfill placement; and
- Loading and transportation infrastructure.

Sioux Energy Center	**Estimated Ash Volume (CY)**	**Estimated Total Removal Cost**	**Closure Duration (Years)**
	6,079,808	**$890 M - $1,060 M**	**15 plus years**

Scenario 4: Onsite CCR Removal for Sioux

This scenario assumes onsite disposal the Sioux ash pond sites and includes the following:

- Pre-CCR removal preparation (10 years, included on a prorated basis in the Closure Duration for each pond);
- Stabilization, loading, and pond restoration;
- Hauling to an onsite landfill located near the existing ponds;
- Seasonal impacts from wet and winter weather conditions impeding productivity;
- Landfill placement; and
- Loading infrastructure.

Sioux Energy Center	**Estimated Ash Volume (CY)**	**Estimated Total Removal Cost**	**Closure Duration (Years)**
	6,079,808	**$470 M - $570 M**	**20 plus years**

Scenario 5: Onsite CCR Removal for Meramec

This scenario assumes offsite removal for the Meramec ash pond sites and includes the following:

- Pre-CCR removal preparation (5 years, included on a prorated basis in the Closure Duration for each pond);

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[3] Lochmueller did not review local siting requirements but many Illinois counties contain such restrictions.

- Stabilization, loading, and pond restoration;
- Hauling to an offsite landfill in Illinois;
- Seasonal impacts from wet and winter weather conditions impeding productivity;
- Site specific constraints with transportation access and associated limitations;
- Landfill placement; and
- Loading and transportation infrastructure.

Meramec Energy Center	**Estimated Ash Volume (CY)**	**Estimated Total Removal Cost**	**Closure Duration (Years)**
	5,194,923	**$740 M - $890 M**	**20 plus years**

APRIL 29, 2019

EXTRACTION & TRANSPORTATION STUDY: Rush Island
Ash Pond Closure Assessment

Rush Island Site

Jefferson County, Missouri

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Table of Contents

Introduction

Lochmueller Group completed the following planning-level assessment of the costs and logistics associated with extracting, stabilizing, and transporting coal combustion residuals (CCR) from the existing ash pond system at the Rush Island Power Generation Center to existing offsite, commercially available landfill facilities. The Rush Island site is located along the Mississippi River in Jefferson County, Missouri approximately nine (9) miles southeast of Festus, Missouri. The purpose of this assessment is to describe the methods, determine the impacts, and quantify the order-of-magnitude costs associated with removing and transporting all CCR from its current disposal location at the Rush Island site to a private landfill for permanent storage.

Extraction & Stabilization

Description of Method

Extraction and stabilization of the CCR material from the CCR unit at Rush Island Energy Center is complicated due to its depth and location. In addition, the CCR unit contains both Class C and F fly ash that complicates excavation methods. CCR material from the unit would need to be excavated at depths of up to 100 feet, dewatered, dried and conditioned, before being and loaded into trucks and transported offsite.

Removal of the CCR material would require multiple phases including dry extraction, partially wet extraction and fully submerged extraction. The various phases are described below:

Dry Extraction:

This phase includes the handling and removal of the existing CCR material from the current surface elevation down to the groundwater elevation (approximately 18' below the ground surface (BGS) elevation) (Geotechnical Investigation and Report, prepared by CEC and dated December 20, 2011). Generally, it is assumed that this material can be direct loaded and transported without additional drying or conditioning procedures (moisture content between approximately 25% and 35%). The work associated with this phase includes the extraction, on-site transportation to Staging/Loading Areas, storage, and loading onto transportation for off-site removal. Standard earth-moving equipment and procedures would be utilized including dozers, loaders, and excavators. In general, dozers would be used to excavate and move the CCR material into piles and loaders would be used to load the CCR material into the waiting trucks for transport off-site. Excavators would be used in a support role to dig in areas where dozers are not efficient. Sub-areas of the pond area would need to be established to facilitate extraction operations. The general size of these sub-areas, laterally and vertically, will be determined based on on-site conditions as the operation progresses and the CCR material is removed.

Partially Wet Extraction:

This phase includes the handling and removal of the existing CCR material from the groundwater elevation to a point in which hydraulic excavation is feasible (18' below ground surface to 28' below ground surface). This material is assumed to be in acceptable condition for loading and transportation with no additional drying and conditioning after the dewatering procedure described below is completed.

Dewatering of this material would involve excavation of channels to promote material drying prior to excavation and transportation. Water would be diverted from excavated depressions utilizing pumps and piping systems to transport the water away from the material excavation area. After sufficient dewatering and drying time, the CCR materials would be removed using the same means as described for dry excavation.

Fully Submerged Extraction:

CCR materials located further down in the pond (28' below ground surface to 100' below ground surface) may be saturated and would require drying and conditioning prior to off-site transport. Such materials would need to be extracted via hydraulic dredging methods. The complexities and potential costs associated with such dredging efforts are significantly higher per unit volume than the "Dry Extraction" and "Partially Wet Extraction" phases. In fact, successful pond closures at the depths required for the Rush Island site could were not discovered. Removal operations for CCR ponds with depths up to 50 feet were found.

This method employs equipment that removes the CCR material directly from the bottom of the CCR unit and pumps the “slurry” through a piping system to “geotubes” located in nearby drying areas. Geotubes are a geotextile filtration “bag” manufactured by sewing together multiple sheets of geotextiles using polyester or polypropylene. As the dredged water enters the geotubes, the geotextile captures the CCR materials as the water drains. Chemical addition during the pumping and piping operation using coagulants and flocculants will be necessary to aid in the dewatering process. The specific makeup of CCR materials are site specific. Therefore, selection of the most effective and efficient coagulants and flocculants will require bench testing. Maintenance of the dredging equipment, piping system, drying areas, settling ponds, and temporary roads will be necessary to facilitate the operation.

Significantly large drying areas will be required to accommodate the multi-week week drying procedure. After dewatering is complete, the geotubes are opened and the CCR material is loaded onto transportation for off-site removal. The transportation of material for off-site removal was the assumed limiting factor for the overall CCR disposal process flow based on the analysis performed in this study. However, extended, unforeseen weather conditions can contribute to additional lost working time due to icy conditions, mechanical system freeze-ups, or flooding.

Site Restoration:

This phase includes the final restoration of the site. This would include removal of all temporary access roads and residual ash in project area. Backfilling would likely need to occur for at least some volume of the remaining pond in conjunction with excavation activities to minimize infiltration from the Mississippi River. The closest source of backfill material would be sand dredged from the Mississippi River. Stabilization of the site with vegetative practices would be required for erosion control. The river banks and the remaining embankment along the river would require additional analysis and appropriate stabilization, but may include a combination of vegetation, large rocks or manufactured concrete products.

Extraction and Stabilization Impacts

Safety

Accidents

Workforce safety during the operation is a significant risk factor. With several unit processes operating with heavy machinery, proper safety planning is important. Accidents can be minimized during operations, but the planning and implementation of a safety plan will have significant costs associated with the effort.

Exposure

There is not only immediate physical injury risks, but there is also exposure risk to the people working on the site. Proper safety equipment will be necessary to limit exposure to potentially harmful substances in the CCR material removal process such as flocculants and coagulant used for the dewatering process.

Environment

Floodplain

The project area is currently shown within the 100 year floodplain for both the current and pending FIRM maps. The potential for the area to experience flooding during excavation activities creates additional risk to the extraction and stabilization operations.

River Embankment

The existing ash ponds are adjacent to the Mississippi River. There is a strip of land that separates these surface water bodies and serves and an embankment that separates the pond from the river. Proper excavation techniques and monitoring will need to be employed to ensure the land between the two surface water bodies remains stable during excavation and dredging activities. After dredging activities are complete, the embankment will require analysis to confirm stability. Removal of the embankment and/or significant re-stabilization may be necessary for the restoration of the site.

Emissions

The heavy equipment used during the extraction and stabilization phase of the project includes dozers, loaders, excavators, hydraulic dredges, and onsite hauling trucks. These types of equipment typically utilize diesel fuel and would generate emissions during operations. These emissions are in addition to the emissions discussed in the transportation impacts section of this assessment.

Fugitive Ash Particulate

As the CCR material is being extracted and stabilized, fugitive ash particulate will be created and would need to be managed through an ash management plan.

Capital Projects

Onsite Access Roads

The onsite access road utilized for the offsite hauling trucks is discussed in the transportation section of this assessment. The construction of temporary on-site hauling roads will be required throughout the extraction and stabilization process. These haul roads will need to be modified frequently in order to provide efficient transportation of the CCR to the stabilization and loading areas and to maintain dust control.

Geotube Staging Areas

Geotube staging areas will need to be constructed within the project area that are relatively flat to allow for proper dewatering of the CCR. These staging areas will be temporary and will need to be moved throughout the closure process as CCR is removed during different phases of the operation. Filtrate from the geotubes would be directed back to the settling ponds for treatment.

Water Treatment Facilities

The existing ponds could be utilized throughout the CCR removal process for settling any remaining solids from the filtrate from the drying process. There may be a need for the construction of new settling ponds toward the end of the process to fully remove CCR from the existing ponds. The filtrate will likely contain suspended solids and some form of treatment or settling may need to be evaluated depending on the final characteristics of the filtrate.

Loading Areas

Once the CCR is stabilized, the material may require some additional layout and loading area to ensure the material is dry enough for offsite hauling and ultimate placement in a landfill. The loading areas will need to be constructed as appropriate for the CCR removal areas that are active. The loading areas will require the construction of scales for measuring the weight of trucks and truck washing facilities to wash down tires of residual ash material.

Restoration of Former Ash Ponds

The post-CCR-removal condition of the ponds will be dependent on the final planned use of the area. Some options may include backfilling, removing embankment, creating or restoring habitat, etc. Achieving the desired future use may include utilizing the soil material that would remain between the pond and the river to backfill some of the remaining pond area. Sand backfill material could also be dredged from the Mississippi river for additional backfill material. Overall stabilization of the site would be required and would include vegetative, natural rock, and manufactured products to meet regulatory requirements.

Transportation & Disposal

This section addresses the transportation of CCR material from the site and its permanent disposal at a private landfill.

Modal Options (Truck, Rail, Barge)

The Rush Island site is located along the Mississippi River. Additionally, a BNSF rail line runs adjacent to the site. Therefore, the ability to haul CCR by barge and rail from Rush Island may be possible. However, significant infrastructure improvements would be required at the Rush Island site to provide ash loading capabilities for these modes.

The preferred landfill locations are all located within 80 miles of Rush Island. None of the sites have direct water access. Therefore, any CCR transported by barge from Rush Island would need to be transferred from barge to truck to reach the landfill destinations. The inefficiency of this transfer would render barge transportation considerably more costly than truck hauling. Moreover, most of the landfill sites are located further inland (east or west) from Rush Island such that north-south travel along the Mississippi River would not be beneficial.

With regards to rail, none of the preferred landfill sites have direct rail access. Several sites are located adjacent to rail corridors but spurs would need to be constructed to facilitate direct landfill access and allow for the temporary storage and unloading of rail cars. Additionally, three of the four preferred landfill sites are located in Illinois, which would require trains to travel through the congested St. Louis rail network to cross the Mississippi River. Rail is most efficient when transporting bulk materials over long distances. Given the relatively short travel distance to each landfill site, rail would not be cost-competitive with truck hauling.

This assessment assumed truck hauling to be the most cost-effective and feasible mode of transport. All subsequent analyses reflect truck hauling.

Truck Hauling

To determine a timeframe for extraction and removal of all CCR from its current, impounded location, the following was assumed:

- Truck hauling via 40-foot end load dump trucks loaded via conventional equipment – each trailer has a payload capacity of 25 tons based on a typical 80,000 lb. gross loaded maximum;
- 8-hour daily operation and a range of 155 to 193 days of annual operation (accounting for weekends, holidays, and time lost due to weather and imperfect execution);
- Loading operations on the Rush Island site occur adjacent to the impoundment and on the south portion of the site; and
- A maximum daily haul rate of 5,000 tons.

The resulting transportation haul assumptions are summarized in **Table 1**.

Table 1: Transportation Haul Summary

Total Tons of CCR Removed	Annual Tons of CCR Removed	Closure Duration*
21.6 million	742,772 to 928,465	28-34 Years

*Measured from the decision to begin extraction until fully removed

To accommodate the volume of truck traffic identified in **Table 1**, roadways internal to the Rush Island site would need to be improved. Specifically, a heavy-duty concrete roadway would need to be constructed along the western perimeter of the site extending from Big Hollow Road south to the ash pond area. Multiple at-grade railroad crossings with the site's rail spur would be required.

In the vicinity of the pond area, staging would need to be provided to accommodate several trucks in queue for multiple loading stations. Hence, a large loading station would need to be constructed. Once loaded, trucks would need to proceed to a washout area and scaled to verify the truck is loaded properly. A quick route back to the loading pad from the scale area would be needed for any overweight trucks.

Landfill Options

Four preferred landfills were identified as potential destinations for the CCR removed from the Rush Island site as shown in **Table 2**. Landfill disposal costs supplied by Ameren are similar across the four locations. With costs paid to the landfill being essentially equal, transportation costs would drive the landfill location decision. Assumed haul rates per ton to each landfill location were also supplied by Ameren. The lowest cost haul rate would be to the Progressive Waste site in Richwoods, which is also significantly closer to Rush Island than the other sites. Therefore, this assessment prioritized CCR disposal at the Progressive Waste landfill.

Table 2: Preferred Landfill Locations

Landfill Site	Address	Distance to Site (mi)	Travel Time to Site (min)
Progressive Waste	12581 State Hwy H, Richwoods, MO	34.7	44
Republic Services	4601 Cahokia Road, Roxana, IL	67.3	67
Waste Management	10400 Hillstown Road, Marissa, IL	73.4	82
Perry Ridge	6305 Sacred Heart Road, DuQuoin, IL	79.8	97

Capacity calculations were performed to determine the total space available for CCR disposal in aggregate. The annual disposal amount currently received by the landfill was assumed to remain constant over time and the incremental annual disposal amount due to the Rush Island CCR was added. Based on the capacity of the Progressive Waste site, at the combined disposal volume, it was estimated that the Progressive Waste landfill would become full upon receiving approximately 80 percent of the total CCR from Rush Island.

It was also assumed that the Progressive Waste site could feasibly accept the maximum daily load of trucks (192) and that Progressive Waste would be willing to receive the maximum amount of CCR possible and dedicate the necessary space on site for monofill construction to isolate the CCR material from other waste on site.

Given these assumptions, the calculations indicate that a second landfill site with available capacity would need to receive the final 20 percent of Rush Island CCR material once Progressive Waste reaches capacity. However, for purposes of the subsequent routing and transportation evaluations, it was assumed that the entire Rush Island CCR volume would be disposed at Progressive Waste.

Transportation Route

Many factors were considered when establishing a preferred route suitable for the removal of the CCR from the Rush Island site to the Progressive Waste landfill, including roadway functional classification and the available connectivity between the two sites using the existing roadway network. The selected route is approximately 36.5 miles long and utilizes the following roadways:

- Begin at the Rush Island site on Big Hollow Road
- Johnson Road west
- Danby Road west
- Highway 61 south
- Highway TT west
- Interstate 55 north
- Highway 67 south
- MO-110 west
- MO-21 south
- Highway H west
- End off Highway H at Progressive Waste

This route prioritizes roadways with the highest functional classifications along a reasonably direct line of travel. While a shorter route may be possible, it would rely upon roadways less suitable for truck traffic and therefore was not considered. The selected route emphasizes major numbered state routes, with the exception of leaving the Rush Island site (via Big Hollow Road, Johnson Road, and Danby Road) and accessing Progressive Waste (via Highway H).

The egress route from the Rush Island site utilizes Johnson Road and Danby Road instead of remaining on Big Hollow Road to Drury Road. Johnson Road/Danby Road is the designated route for truck traffic in and out of the Rush Island site. This route also promotes use of the half diamond interchange on Interstate 55 at Route TT, which was constructed approximately 10 years ago for purposes of serving truck traffic to/from the nearby Holcim Cement Plant.

Transportation Impacts

The following transportation impacts would be anticipated as a result of the hauling operation.

Traffic Flow

The selected route between Rush Island and Progressive Waste was evaluated in terms of its ability to accommodate the additional truck traffic, including both loaded and unloaded trucks. Overall, the truck volume distributed over the course of the day would not be expected to generate significant traffic flow impacts. The route emphasizes major roadways, which would be capable of handling the additional traffic. In fact, no improvements were assumed for Interstate 55 or Highway 67.

That said, the following transportation improvements would be recommended to mitigate anticipated impacts of the additional truck traffic at select locations:

- Big Hollow Road, Johnson Road, and Danby Road, which connect the Rush Island site with Highway 61, are not suitable for the volume of truck traffic anticipated. These roadways typically have 11-foot lanes and no shoulders. The horizontal and vertical geometry is substandard in places. The existing asphalt pavement would not likely withstand the effects of heavy truck traffic. It is recommended that this corridor be upgraded to provide an appropriate truck route between Rush Island and Highway 61. The assumed improvements consist of heavy-duty concrete pavement and alignment corrections along the existing roadway.
- The intersection of Danby Road with Highway 61 should be improved to include a dedicated northbound right-turn lane on Highway 61 and enlarged right-turn radius. This turn lane would serve trucks en route to Rush Island from Interstate 55. This intersection would be expected to remain unsignalized.
- The intersection of Route TT with Highway 61 should be improved to include a dedicated southbound right-turn lane on Highway 61 and enlarged right-turn radius. This turn lane would serve trucks en route to Progressive Waste. This intersection would be expected to remain unsignalized.
- The intersection of Highway 21 and Highway 110 was recently realigned and upgraded to current standards, so it should be well-equipped to serve truck turning maneuvers. However, the intersection remains unsignalized. Installation of a signal would be recommended in order to safely and efficiently serve trucks turning from westbound Highway 110 to southbound Highway 21 en route to Progressive Waste.
- The intersection of Highway 21 with Route H is signalized and currently includes a dedicated southbound right-turn lane and dedicated eastbound left-turn lane to serve truck turning movements along the selected route. It is recommended that the eastbound left-turn lane be extended to provide additional storage capacity. The existing turn lane is approximately 75 feet in length, which would accommodate only a single truck and possibly one additional vehicle.
- Route H is a low-volume and narrow two-lane highway with lane widths of approximately 10 feet, low shoulders, and substandard alignment in select areas. While upgrades to this corridor would be beneficial, given the length of the route, significant upgrades for purposes of the hauling operation would likely be deemed cost prohibitive.

Safety & Environment

The safety implications of the truck hauling operation were evaluated using information provided in the Highway Safety Manual (HSM), published by the American Association of State Highway and Transportation Officials (AASHTO). The HSM relates traffic volumes and roadway character to crash expectancy. Changes in volumes would then cause an increase or decrease in the crash expectancy. It is anticipated that the additional truck traffic would result in an increase of 6 crashes total on an annual basis along the entirety of the haul route, as follows:

- Net increase of 2 Severe (Fatal or Injury) Crashes per year
- Net increase of 4 PDO (Property Damage Only) Cashes per year

Additional environmental costs would also be incurred as a result of the hauling operation.[1] In total, transportation safety and environmental costs are estimated to be approximately $490 million to $611 million over the duration of the hauling operation. These costs would not be borne directly by Ameren but instead would be incurred by the general population.

Pavement

The additional truck volume would depreciate the pavement design life and accelerate pavement deterioration along the selected route. To compensate for the increased wear, pavement mill and overlay were assumed at 5-year increments along all segments of the route, with the exception of Interstate 55 (which as an interstate should be build to withstand truck traffic) and the upgraded access route to the Rush Island site (which would be reconstructed with heavy duty concrete).

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[1] According to the Environmental Protection Agency's (EPA) publication on National Average In-Use Emissions from Heavy-Duty Trucks, semi-tractor trailer rigs are responsible for emitting 12.5 grams of pollutants per mile into the air. The economic cost attributable to truck emissions using EPA's methodology was estimated to be $434M. This accounts for increased healthcare costs, lost productivity, welfare costs, environmental remediation, etc.

Conclusion

Lochmueller Group completed the preceding planning-level assessment of the methods and impacts associated with extracting, stabilizing, and transporting CCR from the existing Rush Island Power Generation Center. The purpose of this assessment was to determine the impacts and quantify the order-of-magnitude costs associate with completely removing all CCR from the Rush Island site and transporting it to a private landfill for permanent storage. The information contained herein is provided at a planning-level.

This study assumed that 12,725,000 cubic yards of coal combustion residuals would ultimately need to be removed from the Rush Island site. This would equate to approximately 21,650,000 tons of material to transport. This transport weight was calculated by multiplying the in place cubic yards by a swell factor to account for the uncompacted volume after excavation. The weight of the uncompacted unit volume was established from geotechnical testing data that provided the pounds per cubic foot and the percent moisture content. Based on a range of operating days per calendar year, it would take from 28 to 34 years to extract all material from the site.

Restoration of the site would include backfilling and stabilization with vegetative and structural practices. Restoration costs could be significant in that the resulting 70 – 100 foot depression may need to be backfilled via a dredging operation within the Mississippi River.

The total cost to extract, stabilize, transport, and dispose of the CCR material is summarized below in 2019 dollars. The total cost to Ameren could range from $1.9 to $2.1 Billion, depending upon the total period of removal operations. This includes transportation infrastructure upgrades both internal and external to the Rush Island site as discussed.

Extraction of CCR and Transport to Offsite Landfill	
Ameren Project Costs	
Extraction, Stabilization, Loading, and Restoration	$773-891 Million
Hauling	$372-375 Million
Landfill Placement Costs	$691-757 Million
Transportation Infrastructure (on and off-site)	$66-77 Million
Project Cost Total	**$1.9-$2.1 Billion**

Costs in 2019 Dollars

Attachment 8

Remedy Selection Report

August 30, 2019

REMEDY SELECTION REPORT - 40 CFR § 257.97
RUSH ISLAND, LABADIE, SIOUX AND MERAMEC CCR BASINS

In May 2019, Ameren Missouri completed Corrective Measures Assessment (CMA) Reports for certain coal ash (CCR) basins located at the Rush Island, Labadie, Meramec, and Sioux energy centers. For each site, the CMAs considered a series of alternatives, all of which are protective of human health and the environment, control source material, minimize the potential for further releases and, over time, will attain site-specific groundwater protection standards. After sharing the CMAs publicly, Ameren Missouri solicited public input. In addition to the CMAs, Ameren Missouri and its consultants performed numerous technical evaluations, all of which help to inform the Company's remedy selection. Those evaluations include groundwater modeling; human health and ecological risk assessments; groundwater treatment assessments; onsite and offsite monitoring data; rail, barge and truck transportation studies; and a deep excavation study report.[1] The technical assessments, data and public input inform the evaluation of selection factors that has led to this final remedy selection.

Set forth below is a summary of Ameren Missouri's remedial plan that, when fully implemented and completed, will achieve CCR Rule requirements. As previously announced, Ameren Missouri intends to expeditiously close CCR basins at its energy centers by completing necessary steps to remove the basins from service and then installing an engineered cap system that exceeds, by more than two orders of magnitude, the federal regulatory requirements and, as modeling indicates, will minimize the limited and localized impact to groundwater observed at the CCR basins. In time, the sites will attain site-specific groundwater protection standards. As conditions stabilize after cover system installation, groundwater evaluations and monitoring will continue, and, as necessary, be modified. Ameren Missouri intends to implement the following corrective action measures in conjunction with the closure of CCR basins.

CORRECTIVE MEASURES REMEDIAL PLAN

CMA Reports Alternative 1: Source Control Through Installation of Low Permeable Cover System & Monitored Natural Attenuation

1. Source control, stabilization and containment of CCR by installation of a low-permeability geomembrane cap (a minimum 1 x 10 -7 centimeters per second (cm/sec) versus 1 x 10 -5 cm/sec required by the CCR Rule).

2. Once source control is achieved, monitor the natural attenuation (MNA) of groundwater concentrations to address limited and localized CCR-related impacts. Ongoing monitoring and modeling evaluations will document that concentrations are

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[1] Technical assessments are appended to the CMA reports and/or to Ameren Missouri's Response to Public Concerns and all have been posted to Ameren's CCR website.

decreasing as modeled. MNA occurs due to naturally occurring processes within the aquifer.

3. Annual Groundwater *Monitoring and Corrective Action Reports* for each site will address the following:

    - Demonstrate that groundwater plume(s) are stable or decreasing and not expanding;

    - Contain an ongoing summary of baseline and periodic geochemical analysis including groundwater chemistry, subsurface soils chemical composition and mineralogy;

    - Determine site-specific attenuation factors and rate of attenuation process; and

    - Design a long-term performance monitoring program based on the specific attenuation mechanism to confirm concentration reductions and document trends.

The installation of a low-permeability, geomembrane cap system satisfies both the CCR Rule's basin closure requirements and can constitute an appropriate remedial corrective measure for groundwater impacts, as recently confirmed by the Missouri Department of Natural Resources (MDNR). A properly engineered and installed cap will practically eliminate the infiltration of water into the stored ash material. As summarized in the CMA reports, concentrations will reduce once the cap system stops recharge into the ash and groundwater conditions, such as pH levels, stabilize. Ameren Missouri will establish a long-term performance monitoring plan in accordance with the CCR Rule to document and confirm such reductions. MNA encompasses a variety of physical and chemical processes (biodegradation, sorption, dilution, chemical reactions and evaporation), which, under the right conditions, can immobilize metals in aquifer sediments. In addition to capping as a remedial corrective measure, both EPA and MDNR recognize MNA as a corrective action component for addressing inorganics (metals) in groundwater. *EPA Directive 9283.1-36 (2015); Section 644.143 RSMo (1999).* As MDNR notes, <u>MNA is not a "no action" alternative and is complementary to source control measures</u>. *(<u>See</u> Fact Sheet: MNA of Groundwater at Brownfields/Voluntary Cleanup Program Sites.)*

<u>IMPLEMENTATION OF REMEDY</u>

Under its current schedule, Ameren Missouri will close more than 67% (428 acres) of its CCR units by the end of 2020, with the remaining 33% by December 2023. Installation of a geomembrane cap at the energy centers will practically eliminate infiltration. Site preparation activities are underway at Rush Island and Labadie, with construction of the cap/cover systems occurring over the next 12 -18 months. Closure of additional basins at Meramec will occur in 2020 and 2021, with closure of remaining basins following the retirement of the energy center in 2023. At Sioux, use of the ash basins will terminate once wastewater and dry ash handling facilities are completed in 2020. Set forth below are key milestones in the implementation of Ameren's remedial plans. Such schedule is subject to revision based upon each energy center's construction schedule, ongoing field investigations and, if needed, regulatory approvals.

Facility	Ash Basin Removed from Service	Ash Basin Cap System Completed	Performance Review: Groundwater & Cap System
Rush Island	04/2019	12/2020	Annual - Commencing 2021
Labadie	09/2019	12/2020	Annual - Commencing 2021
Sioux	12/2020	2021	Annual - Commencing 2023
Meramec	12/2022	2023	Annual - Commencing 2024

SUPPLEMENTAL CORRECTIVE MEASURES

In its laboratories, XDD, Ameren Missouri's environmental consultant, reproduced existing (i.e. pre-closure) groundwater and soil conditions so as to evaluate potential treatment methods to accelerate existing natural attenuation processes. Under appropriate conditions, metals can attenuate through precipitation, co-precipitation and/or sorption processes with subsurface soil minerals. XDD is evaluating potential treatment methods such as the use of pH adjustment, zero valent iron (ZVI), and bio-augmentation.[2] Laboratory results for arsenic and molybdenum, the primary contaminants of concern (COC) at some of Ameren's energy centers, indicate that through the adjustment of pH levels in subsurface soils and groundwater, groundwater protection standards (GWPS) can be met for each site[3] and that the use of chemical reduction (ZVI) and bioremediation may be helpful in the reduction process for these and other compounds.

Set forth below is a summary chart reflecting results from ongoing treatment studies. Boron is included for evaluation purposes even though under the Federal CCR Rule it is not currently an Appendix IV parameter.

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[2] Ameren Missouri and XDD have experience with the use of ZVI and bio-augmentation at its Huster Substation property, a groundwater remediation project supervised by USEPA and MDNR, (CERCLA-07-2017-0129). Using a drill rig, XDD injected a slurry comprised of water and ZVI into subsurface soils and groundwater forming a reactive barrier that successfully contained groundwater contaminants that had migrated from the substation. In addition, ongoing degradation of source contaminants continues to occur through a bio-augmentation process consisting of the injection of feedstock into the sands of the aquifer.

[3] The slow groundwater flow rate at the Sioux energy center has allowed for the concentration of molybdenum at levels higher than those observed at the other energy centers. Such conditions however may be particularly conducive to the use of ZVI or bioremediation.

SUMMARY OF LABORATORY TREATMENT STUDIES

	Arsenic	Molybdenum	Boron	Lithium	Attenuation Mechanism
	mg/L				
pH 10	▨	🟧 R/M5/M6	▨	🟦 M6	P,C
pH 9	🟦 R	▨	▨	▨	P,C
pH 8	🟦 R	🟧 M6	▨	▨	P,C
pH 7	🟦 R	▨	▨	▨	P,C
pH 6	🟩 R/M5*/M6*	🟦 R/M5/M6/L/S	▨	▨	P,C
CaSx	🟦 R	🟧 R/M5/M6/L	🟦 M6	🟩 M5	P,C
Dissolved Iron (Anaerobic)	🟦 R	🟦 L	▨	▨	P,C
Dissolved Iron (Aerobic)	🟦 R	🟦 L	▨	▨	P,C
ZVI Injectable	🟩 R	🟦 R/M5/M6/L/S	🟦 L/S 🟩 R/M5/M6	🟦 M5/M6	P,C
ZVI PRB	🟩 R	🟩 R/M5/M6/L	🟦 R/M5/M6	🟦 M5/M6	P,C
ZVI Injectable + Bio	🟩 R	🟦 R/M5/M6/L/S	🟩 R/M5/M6	🟦 M5/M6	P,C
ZVI Injectable pH 8 + Bio	🟩 R	🟩 R/L	🟩 R	⬜	P,C
ZVI PRB + Bio	🟩 R	🟩 M5/M6/L/S	🟦 S	🟦 M5/M6 🟩 L/S	P,C
ZVI PRB pH 8 + Bio	🟩 R	🟩 R/L	🟩 R	🟦 M6 🟩 L/S	P,C

Notes: -

▨ No Effect

🟦 Reduce

🟧 Increase

🟩 Attains Standard

⬜ Non-Detect

L = Labadie

S = Sioux

R = Rush Island

M5/M6 =Meramec monitoring wells

PRB = permeable reactive barrier

Injectable = iron particles at micro-scale; potentially applied through injection

Dissolved iron = 50 mg/L Iron(II) sulfate

CaSx = calcium polysulfide

P = Precipitation

C = Co-precipitation

* = arsenic was not detected in M5/M6 baseline despite being detected during quarterly sampling at M5. Results indicate arsenic would likely be removed under pH 6 conditions.

Additional pilot studies are needed to confirm that laboratory results can be replicated and appropriately scaled under field conditions. Assuming such confirmation, corrective action Measures may also include groundwater treatment to facilitate reductions. Field demonstrations and groundwater treatment applications could require a state-issued permit pursuant to *10 CSR 20-6.010*. Remedial actions are iterative in nature and Ameren Missouri (as part of the long-term performance monitoring program) will periodically evaluate then-existing groundwater conditions relative to GWPS and determine whether additional treatment measures are warranted.

Attachment 9

Base of UWL Liner in Intermittent Contact with Groundwater Demonstration

DEMONSTRATION: BASE OF A UTILITY WASTE LANDFILL LINER IN INTERMITTENT CONTACT WITH GROUNDWATER

1.0 INTRODUCTION

The Missouri Solid Waste Management Rules for utility waste disposal (reference Chapter 11, Utility Waste Landfill) were effective on July 30, 1997, in response to statutory changes to the Missouri Solid Waste Management Law. The statutory changes were intended to distinguish the physical and chemical characteristics of utility waste from the sanitary and demolition wastes that were the focus of the original solid waste management Rules (reference Chapter 3, Sanitary Landfill, and Chapter 4, Demolition Landfill), as well as to address other unique issues of the electric power generation industry. Chapter 11 is patterned after Chapter 3 and Chapter 4, which were originally created in 1973 in response to the new Missouri Solid Waste Management Law.

10 CSR 80-11.010(1) General Provisions, states the overall intent of the rule, stating in part:

> This rule is intended to provide for utility waste landfill operations that will have minimal impact on the environment. The rule sets forth requirements and the method of satisfactory compliance to ensure that the design, construction and operation of utility waste landfills will protect the public health, prevent nuisances and meet applicable environmental standards. *The requirement subsections contained in this rule delineate minimum levels of performance required of any utility waste landfill operation. The satisfactory compliance subsections are presented as the authorized methods by which the objectives of the requirements can be realized. The satisfactory compliance subsections are based on the practice of landfilling utility waste. If techniques other than those listed as satisfactory compliance in design or operation are used, it is the obligation of the utility waste landfill owner/operator to demonstrate to the department in advance that the techniques to be employed will satisfy the requirements.* Procedures for the techniques shall be submitted to the department in writing and approved by the department in writing prior to being employed. [*emphasis added*]

Ameren Missouri recognizes that, if they choose to "...utilize techniques other than those listed as satisfactory compliance in the design and operation..." of the utility waste landfill, they must "...demonstrate to the department in advance that the techniques to be employed will satisfy the requirements..."

The Missouri Department of Natural Resources' rules for utility waste landfills (UWL) stipulate in 10 CSR 80-11.010(4)(B)6 that:

> If the base of the landfill liner will be in contact with groundwater, the applicant shall demonstrate to the department's satisfaction that the groundwater will not adversely impact the liner.

In addition, 10 CSR 80-11.010(8)(B)1.C requires that the plans shall include:

> Groundwater elevation and proposed separation between the lowest point of the lowest cell and the predicted maximum water table elevation;

The Ameren Sioux Power Plant UWL (Solid Waste Disposal Area Operating Permit No. 0918301) is located between the Mississippi and the Missouri Rivers approximately 12 miles upstream of their confluence at the easternmost tip of St. Charles County. The landfill is being developed within the alluvium between the two rivers. The Detailed Site Investigation (DSI) completed in 2005 to 2006 identified the groundwater in the alluvium as an unconfined aquifer that is primarily influenced by the levels of water flowing in the Mississippi and the Missouri Rivers. At the time the DSI was completed, the maximum observed water table elevation was el. 417, based upon the 12 months of piezometer readings made for the DSI [reference DSI Figures 21 through 32 (monthly projected groundwater table maps); Table 6 (groundwater elevation data); and Appendix 12 (measured groundwater piezometer hydrographs)]. The bottom of clay liner, outside of the sumps and collection trenches, varies between el. 420 and el. 428. Abnormally high river levels in 2009, 2010 and 2011 have resulted in the maximum water table elevation exceeding the maximum elevation documented in the DSI. Subsequently, it is now known that the base of the Sioux UWL will be intermittently in contact with groundwater. In accordance with 10 CSR 80-11.010(1), this document has been prepared to demonstrate that the groundwater intermittent contact will not adversely impact the compacted clay liner, per 10 CSR 80-11.010(4)(B)6.

It is the objective of this report to provide the technical and regulatory basis for:

- demonstrating the impacts of an intermittent high groundwater table (GWT) on the approved composite bottom liner (specifically the bottom compacted clay liner and the HDPE membrane liner on top of the compacted clay liner) are negligible;
- evaluating the environmental impact of this site condition on the projected use of the UWL; and
- demonstrating that the characteristics of the compacted clay liner and the proper design of the UWL will continue to function as designed in compliance with the intent of the 10 CSR 80-11.010 to minimize environmental hazards and comply with applicable groundwater and surface water quality standards and requirements throughout the life and post-closure of the UWL.

Section 2.0 of this report provides a summary discussion of the technical basis of the structural and hydraulic engineering properties of compacted clay liners (CCL) and the potential impact to CCLs from intermittent contact with groundwater in the protection of surface water and groundwater quality. Section 3.0 provides an overview of the impact to the environmental protections provided to surface water and groundwater by the utility waste landfill's CCL under intermittent contact with the unconfined groundwater. Finally, Section 4.0 identifies the specific requirements of 10 CSR 80-11.010 that potentially require demonstration of satisfactory compliance with the requirements of the Utility Waste Landfill design and operational standards.

2.0 TECHNICAL BASIS

In the 1980's through the mid-1990's, compacted clay liners and composite liners were the subject of significant research and technical discussion due to increasing regulatory requirements on industrial and municipal landfills. The base of knowledge regarding compacted clay liner was established on a national level and the technical requirements were widely adopted as 'state of the art' Missouri's current utility waste landfill requirements were adopted in the mid-1990's and closely follow the prevailing technical basis for compacted clay liners. Although the Sioux UWL utilizes a two-foot thick composite liner system (compacted clay liner overlain by a flexible membrane liner), an intermittent high groundwater table will first come in contact with the bottom of the compacted clay liner. Therefore, the focus of the technical discussion is on the lower compacted clay liner, not the upper flexible membrane liner.

The dry cell disposal area is 86.5 acres in size and is divided into five distinct internal drainage zones ranging in size from approximately 11 to 22 acres each. The lowest point of each drainage area is designed to be el. 422 (top of composite liner), while the highest point of each drainage area is approximately el. 430 (top of composite liner). The majority of the UWL bottom is designed to have a minimum 1% slope (1 foot of rise per 100 feet of run) and includes a 'blanket drain' as a part of the leachate collection system. In addition to the 'blanket drain', each distinct drainage zone includes a 6-inch diameter collection pipe running generally perpendicular to the outside edge of the landfill at a 0.5% slope (0.5 feet of rise per 100 feet of run). Each pipe is approximately of 700 to 800 feet in length). Additionally, each collection pipe discharges into a small leachate sump (approximate size 50 feet by 40 feet) that is generally 3.5 to 4 feet deeper than the lowest point of the disposal cell in order to allow leachate to drain by gravity and accumulate in the sump in sufficient quantities to utilize a level activated pump to intermittently remove the leachate after it accumulates a sufficient volume.

Although the sumps are 3.5 to 4 feet lower than the lowest point of the disposal cell, at approximately 2000 sq. ft. each, the five sumps represent less than 0.25 acres of area, or less than 0.3% of the entire dry disposal acreage. Additionally, the sumps are gravel filled and are expected to have one to three feet of water in them under normal operating conditions. Therefore, the focus of the technical discussion is on the lowest point of the lowest cell, or el. 420 (bottom of two foot thick compacted clay liner).

2.1 Requirements of Compacted Clay Liner

The compacted clay liner must have the following characteristics (10 CSR 80-11.010(6)(B)):

1) For a composite liner, includes a lower component that consists of at least a 2-foot layer of compacted soil with a hydraulic conductivity (k) of no more than 1×10^{-5} cm/sec., and compacted to 95% of standard Proctor (ASTM D699) maximum dry unit weight ($\gamma_{d,max}$) with the moisture content at the time of compaction between optimum moisture content (w_{opt}) and 4% above w_{opt}, "or within other ranges of density and moisture such that are shown to provide for the liner to have a $k \leq 1\times10^{-5}$ cm/sec."

2) The soils used for the compacted clay liner shall have the following minimum specifications:
   A. Be classified as low plastic clay (CL), high plastic clay (CH) or sandy clay (SC).
   B. Have more than 30% particle sizes by weight passing U.S. #200 sieve (0.075mm).
   C. Have an Atterberg liquid limit (LL) $\geq$ 20%
   D. Have an Atterberg plasticity index (PI) $\geq$ 10%.

Daniel and Koerner (1993) reported that the degree of saturation of clay liners placed with this criteria ranges from 71% to 98%, and averages 85%. That is, the voids in the soil matrix may still contain some air as well as water. If the GWT is above the bottom liner for a long enough time, then could the compacted clay liner become saturated and what are the potential ramifications of the compacted clay liner becoming saturated? However, Frank et al (2005) reported that a compacted clay liner which had been under 0.31m of water for 14 years did not become fully saturated. The report theorized that this is due to the very high capillary stresses in the matrix of the compacted clay which could not be overcome by high external hydrostatic pressure. Therefore, the internal properties of the compacted clay liner were not affected.

The proposed design of the cells for the Sioux UWL has a clay liner with a maximum hydraulic conductivity of $1\text{x}10^{-7}$ cm/sec, which provides an additional factor of safety that the hydraulic conductivity will not exceed the required maximum even if changes to the clay liner could occur.

2.2 Frequency of High Groundwater Table at Sioux Site

As identified in the DSI, the GWT elevation at the site results from an interaction of the water levels of the Missouri and Mississippi Rivers. Historic river levels for both the Mississippi and the Missouri Rivers were obtained from the U.S. Army Corps of Engineers for the DSI for the Sioux UWL. Approximately 232 mean monthly river levels are available for the period from January 1987 through April 2006. Readings from the piezometers were compared to the levels of the Mississippi River and the Missouri River. As stated above, the highest groundwater table that was observed during the time of the DSI (2005-2006) was el. 417. Based upon the piezometer readings during the 12-month study for the DSI, the DSI concluded that the level of the Missouri River controls the level of the groundwater at the UWL site. This is because the Mississippi River is controlled by Lock and Dam No. 26 resulting in a relatively stable river level, whereas the Missouri River is an open river, resulting in highly variable river levels.

The proposed bottom of the clay liner for the future cells will generally be between about el. 420 to el. 430. The bottom of the clay liner at the lowest point will be in the sumps at approximately el. 416.4. The groundwater level readings made for the Detailed Site Investigation and subsequently showed that after prolong periods of high Missouri River levels (on the order of months such as occurred in 2007 and 2008) the groundwater levels at the Sioux UWL site do approach the same elevation as the river along the southern parts of the landfill. There is considerable delay, or time lag, between a change in the river level and the response of the groundwater levels, demonstrated by the observations in the DSI and well documented in hydrologic publications. Therefore, assuming that the groundwater level is the same as the Missouri River level in the following analyses is conservative. In reality, a significant change in the groundwater level below the Sioux UWL will only occur after a long period of high river levels. Comparing the daily Missouri River level at the site between January 2007 and November 2008, the river level exceeded el. 420 on 219 of the 700 days, or about 31.3% of the days. The river level exceeded el. 428 on 50 days or about 7.1%. Therefore, the majority of the compacted clay liner will only infrequently be in contact with the groundwater.

Comparing the daily Missouri River level at the site between August 2005 and December 2006, the river level exceeded el. 416.4 on 15 of the 518 days, or about 3% of the days. Comparing the daily Missouri River level at the site between January 2007 and November 2008, the river level exceeded el. 416.4 on 349 of the 700 days, or about 50% of the days. Overall between August 2005 and November 2008, the Missouri River level at the site exceeded el. 416.4 about 30% of the days. Therefore, the GWT may be in contact with the bottom of the clay liner at the sumps intermittently when prolong periods of high river levels occur.

In addition, Reitz & Jens obtained daily readings from the St. Charles gage from 1900 through 1982. Assuming a difference in elevation between the St. Charles gage and the groundwater at the site of 11.5 feet to 13.4 feet, the groundwater levels would be at or above the bottom of the lowest part of the clay liner outside of the sumps (el. 420) between 17% and 25% of the time, and between 2.6% and 3.8% for the majority of the landfill where the bottom of the clay liner is at el. 428. The groundwater levels would be at or above the bottom of the clay liner at the sumps between 35% and 50%. The Missouri River gage readings from 1900 through 1982 are similar to the data from the Detailed Site Investigation and subsequent readings (2005 through 2008), but show a much lower frequency of contact with the clay liner.

2.3 Potential Technical Impacts of a High Groundwater Table

The potential impacts of a GWT that is above the bottom compacted clay liner are:

1. potential swelling of the compacted clay liner, particularly if the clay is high plastic (CH),
2. hydrostatic uplift against the bottom of the compacted clay liner,
3. potential loss of shear strength of the compacted clay liner,
4. potential decrease in the stability of slopes,
5. constructability of a compacted clay liner in a high groundwater table, and
6. long-term performance of composite liner system.

2.3.1 Potential Swelling

High plastic clay (i.e. "CH" with a LL above 50%) has a tendency to swell when the clay is at low moisture content. When a relatively dry, expansive clay is exposed to free water, then the clay will swell if it is not confined by a large pressure. The weight of the CCP in the UWL confines the clay liner and therefore reduces this swell potential. Swelling would increase the void ratio of the clay and could result in a larger hydraulic conductivity. This is particularly true of clays containing montmorillonite, such as Bentonite. The clay that is found in the vicinity of the UWL is composed of kaolinite and illite, which are much less expansive. The LL of illite is generally in the range of 60 to 120%, and the PL is generally in the range of 35 to 60%. The LL of kaolinite is generally in the range of 30 to 110%, and the PL is generally in the range of 25 to 40% (Mitchell, 1976). Two consolidation tests were performed on the natural high plastic clay at the site. These are reported in the "Detailed Site Investigation." The 2 samples had LL of 91% and 94%, and swelled 0.2% and 0.4%, respectively, when inundated at a confining pressure of 0.625 TSF. This confirms that the clay has a low to moderate swell potential.

Composite samples of the clay liner material were compacted in Reitz & Jens' laboratory for hydraulic conductivity tests for the approval of the clay material. The first step in the hydraulic conductivity test is to saturate the sample at a low confining pressure (ASTM D0584). Thus, any swelling that may occur would do so in the test cell, and the hydraulic conductivity that is subsequently measured would already be affected by any swelling. The hydraulic conductivities measured in the laboratory were in the range of $1x10^{-7}$ cm/sec. to $1x10^{-9}$ cm/sec. Therefore, laboratory testing on the clay liner material already took into account any swell potential.

2.3.2 Hydrostatic Uplift

A flood condition surrounding the UWL would impose a hydrostatic uplift pressure on the bottom of the composite liner. Unless the groundwater level rises above the surrounding ground surface – i.e. a flood condition – then there is no hydrostatic uplift pressure. This uplift pressure in an empty cell is only resisted by the weight of the composite liner, specifically the clay. If a gravel layer is used for the leachate collection system, then the weight of the gravel layer also resists the uplift pressure. To maintain a factor of safety of 1.5 against upward displacement of the liner, the 2 feet of clay can resist an upward pressure equal to about 2.5 feet of water. This equivalent water pressure increases to about 3.8 feet if an additional 12-inches of nominally compacted gravel is included. This potential risk is addressed in the Construction Permit Application and is addressed with operational procedures. Dry cells will be filled with fly ash from the existing ponds upon completion to counter any hydrostatic uplift. If the top of the waste in the dry cells is at the level of the surrounding flood or within 2.5 feet below that level, then we know that the clay liner is not in danger of failure due to the hydrostatic uplift pressure.

2.3.3 Loss of Shear Strength

The shear strength of a soil has 2 components: the effective cohesion (c') and the effective internal friction angle (ø'). Unless there is some cementation in the soil matrix, the cohesive shear strength is actually very small at very low confining pressures (Terzaghi, Peck, Mesri, 1996). Saturation of a soil will reduce its shear strength, primarily due to the loss of negative pore pressures, and the impact of the increase in pore pressure during shearing. Therefore, ø' is the critical shear strength property which may impact the stability of the exterior slopes of the CCP. Consolidated-undrained (C-U) triaxial compression tests with pore pressure measurements were run on representative composite clay samples. These were reported in our geotechnical engineering report for the Construction Permit Application. The first step in the C-U test is to ensure that the sample is saturated (ASTM D4767). Thus, the impact of potential saturation is already incorporated in the measurement of ø'. A ø' of 21° was measured on compacted high plastic clay liner material, and 27° on compacted low plastic clay. The stability of the interior UWL slopes is controlled by the friction angle (δ) between the clay liner and the textured HDPE liner because this is the plane with the lowest shear resistance. Therefore, a δ of 15°, which was measured in the lab, was used for the liner in the stability analyses. Therefore, the possible impact of saturation of the compacted clay liner if it could occur is not an issue because the saturated properties were used in the analyses for the UWL.

2.3.4 Stability of Slopes

A groundwater level that is at the ground surface results in the minimum factor of safety for the global stability of any slope because of the reduction in effective confining stress in the natural soils beneath and beyond the toe of the berm. The internal stability of the waste is not affected by the external groundwater level because the waste is isolated from the groundwater by the liner. Some of the cases of global stability of the waste slope and perimeter berm that were analyzed used long-term shear strength properties (c' and ø') and an assumed exterior water level at el. 438. So, the issue of high groundwater levels, or flooding, has been considered in the stability analyses reported in the Construction Permit Application, including under seismic load and liquefaction potential.

2.3.5 Constructability of Clay Liner in a High Groundwater Table

A high groundwater table does interfere with the excavation to the final subgrade of the bottom liner, where necessary, and with the compaction of the clay liner. The subgrade will be soft and will tend to pump and rut. It would not be possible to compact the clay liner, nor to install the HDPE liner without damaging the clay liner. Once the groundwater level is about 2 or 3 feet below the subgrade, then it is possible to construct the bottom liner in accordance with the project specifications. So, a high groundwater adversely affects the construction schedule and costs, which must be addressed at the time of construction; but not the quality or performance of the bottom liner for the reasons presented in the preceding sections.

2.3.6 Long-term Performance of Composite Liner System

The types of clays used in construction of the liner, and the methods of construction, preclude any negative impacts of infrequent high groundwater levels on the long-term performance of the composite liner system. Also, the long-term properties which were used in the analyses for the UWL, and the various extreme conditions which were considered (i.e. flooding or earthquake) take into consideration adverse conditions which may occur during the operating life and post closure performance. Only one potential impact of an intermittent, high GWT on the bottom liner could not be mitigated by the design and construction of the UWL – the hydrostatic uplift pressure. However, this impact has been addressed through operational requirements of the UWL, as discussed under Item 2.3.2. It is further noted that this is a short-term risk in that the potential impact is only present until the top of the waste in the dry cells reach a level that is 2.5 feet below the potential surrounding flood level, which is el. 435.5.

3.0 ENVIRONMENTAL PROTECTION OF A UTILITY WASTE LANDFILL

As stated in 10 CSR 80-11.010 (1) General Provisions, "The rule sets forth requirements and the method of satisfactory compliance to ensure that the design, construction and operation of utility waste landfills will protect the public health, prevent nuisances and meet applicable environmental standards…". The individual subsections 10 CSR 80-11.010 imply that the Missouri Solid Waste Management Law and Rules, as they relate to utility waste, are promulgated primarily to prevent the construction and operation of solid waste disposal areas from negatively impacting the surface waters, groundwater and air, in particular, typically monitored within a specific zone of impact surrounding the solid waste disposal area. The following sections discuss the environmental protections provided by the Sioux UWL, as currently approved and proposed to be designed and operated using both the gypsum stack disposal process and the dry disposal process. The focus of this section is on the protection of groundwater quality and surface water quality, because the performance of the CCL does not have a direct impact on air quality.

3.1 Groundwater Quality Protection

Protection of groundwater quality is a primary objective of regulatory design and operating requirements for utility waste disposal areas. Liners, leachate collection systems, and final cover systems all focus on: keeping the waste materials relatively dry; minimizing the quantity of leachate formed by the disposal area; containing the leachate within the disposal area; and collecting and removing the leachate from the disposal area for further treatment and ultimate disposal outside of the disposal area environment. With regard to groundwater in intermittent contact with the utility waste landfill liner, the critical issues are: the continued structural integrity of the liner, both as the base of the landfill and as a component of the composite liner; and the hydraulic performance of the CCL component of the liner to serve its intended function of containing the leachate within the disposal area. The discussion of specific, potential technical impacts to the landfill design in Section 2.0 demonstrate that the structural integrity and the hydraulic performance of the CCL component are not impacted by groundwater in intermittent contact with the utility waste landfill liner. Therefore, the CCL component's functions of providing a structural base for the landfill and of containing leachate within the disposal area are not diminished.

3.2 Surface Water Quality Protection

Regarding groundwater in intermittent contact with the utility waste landfill liner, the continued structural integrity and hydraulic performance of the CCL component of the liner to serve its intended function of containing the leachate within the disposal area indirectly relates to the protection of surface water quality at the Sioux UWL. The design and construction of berms around the perimeter of each disposal cell to prevent inundation of the utility waste during future Mississippi River or Missouri River flood events are the primary design protection of surface water quality at the Sioux UWL. The proposed operational plan to contain all stormwater runoff generated inside of the perimeter berms and reuse it for scrubber make-up water provides the primary operational protection of surface water quality. The design and operation of the primary stormwater management systems are not directly impacted by groundwater in intermittent contact with the utility waste landfill liner.

4.0 DEMONSTRATION OF COMPLIANCE WITH 10 CSR 80-11.010

The 'dry tomb' landfill concept seeks to avoid permanent placement of waste below the groundwater table, in part, to avoid a direct connection to groundwater through a liner leak and to avoid the long-term infiltration of groundwater into the landfill that would require additional post closure care in the form of increased leachate removal and disposal. The design of the Sioux UWL does not propose to permanently place waste below the groundwater table. This statement is supported by the original Detailed Site Investigation for the UWL. In addition, the technical discussions in Section 2.0 of this report support Ameren Missouri's position that the intermittent contact of the CCL with groundwater does not impact the ability of the CCL to satisfactorily meet the requirements of 10 CSR 80-11.010 (Chapter 11, Utility Waste Landfill). This results in Ameren Missouri proposing the use of techniques other than those listed in 10 CSR 80-11.010 as satisfactory compliance in the design and operation of the utility waste disposal area. As previously stated, this report provides a demonstration to the Missouri Department of Natural Resources Solid Waste Management Program that the site conditions at the Sioux UWL, coupled with the engineering design and operational details, are acceptable from both a technical and regulatory perspective.

The rule format for Chapter 11 generally includes one section for each specific topic, each followed by three subsections [(A) Requirement; (B) Satisfactory Compliance – Design; and (C) Satisfactory Compliance – Operations]. Section 4.1 identifies the design and/or operational methods of the currently approved and proposed design and operating concept of the Sioux UWL that require demonstration that the overall requirements of Chapter 11, Utility Waste Landfill, are met for the site conditions and current design at the Sioux UWL.

4.1 Design/Operational Considerations Relative to Unique Sioux UWL Site Conditions

The following sections of the Missouri Solid Waste Management Rules have been identified for specific summary discussion as a conclusion to the demonstration that the Sioux UWL meets the minimum requirements of the Missouri Solid Waste Management Rules. The design and/or operational issues identified are listed below, followed by the regulatory REQUIREMENT [emphasis added] as identified in the appropriate section or subsections and the specific design and/or operational methods specified by Chapter 11. Finally, reference is made to the overall of specific technical issues provided in Section 2.0 that support the proposed deviation from the specified design and/or operational method. In review, the critical points of Section 2.0 are summarized below:

- Studies have shown that clay liners do not become saturated even when continuously submerged for years due to the very high internal capillary stresses. Therefore the internal properties of the clay liner are unlikely to be affected by intermittent contact with groundwater;

- The compacted clay liner for the Sioux UWL is designed to have a maximum hydraulic conductivity of $1x10^{-7}$ cm/sec, which provides an added safety factor that the maximum hydraulic conductivity of $1x10^{-5}$ cm/sec required by regulation will not be exceeded;
- The onsite clays that will be used for construction of the clay liner have a low swell potential, and the measured hydraulic conductivity already allowed for any potential swelling at low confining pressures;
- The infrequent threat of adverse hydrostatic uplift will be addressed through the operation of the UWL;
- The shear strength properties of the clay soils used in the stability analyses were obtained from laboratory measurements of saturated samples. Therefore, any potential decrease in shear strength is considered in the current design; and
- The structural stability analyses of the perimeter berms and exterior slopes of the UWL considered the possible worst-case condition of a groundwater table at the ground surface. Therefore, this condition is considered in the current design.

4.1.1 INTERMITTENT GROUNDWATER CONTACT WITH LANDFILL LINER.

Regulatory Citation and Requirement:

10 CSR 80-11.010(4) Site Selection.
(A) Requirement. Site selection and utilization shall include a study and evaluation of geologic and hydrologic conditions and soils at the proposed utility waste landfill and an evaluation of the environmental effect upon the projected use of the completed utility waste landfill. Applications for utility waste landfill construction permits received on or after the effective date of this rule shall document compliance with all applicable siting restriction requirements contained in paragraphs (4)(B)1. through 5. of this rule.

Regulatory Design and/or Operational Techniques:

(B)6. If the base of the landfill liner will be in contact with groundwater, the applicant shall demonstrate to the department's satisfaction that the groundwater will not adversely impact the liner.

(B)7. Owners/operators of proposed utility waste landfills shall demonstrate how adverse geologic and hydrologic conditions may be altered or compensated for via surface water drainage diversion, underdrains, sumps, and other structural components. All alterations of the site shall be detailed in the plans. Precipitation, evapotranspiration and climatological conditions shall be considered in site selection and design.

(B)8. The results of the detailed site investigation report will be the basis to determine if a secondary liner, such as a geomembrane, or a leachate collection system is mandatory to ensure that there is no environmental impact from the landfill. Owner/operators of proposed utility waste landfills shall make a demonstration based on the following:

A. An evaluation of the physical and/or chemical characteristics of the waste; and

B. Documentation through modeling, testing, or other research data proving that the quality of groundwater underlying the proposed site will not be affected and that there is no potential for migration of fluids from the utility waste landfill.

Discussion of Alternative Design:

This report provides additional, specific discussion of technical information indirectly required by this regulation relative to the intermittent contact of the CCL component of the composite liner that supplements the previously submitted documents, as recently requested by SWMP staff. As outlined in the details of Section 2.0, the design of the utility waste landfill for the Sioux Plant Utility Waste Landfill anticipates the potential for saturated clays and saturated insitu base conditions, as well as the potential impact of high groundwater table conditions intermittently caused by fluctuating river levels (primarily the Missouri River). No additional design alternatives or changes are considered necessary, as supported by the supplemental information.

Compliance with Regulatory Requirement:

The approved Construction Permit Application and the pending Permit Modification request address the site selection and utilization requirements, including a study and evaluation of geologic and hydrologic conditions and soils at the proposed utility waste landfill and an evaluation of the environmental effect upon the projected use of the completed utility waste landfill. The technical discussion in Section 2.0 provides additional 'demonstration' relative to the site-specific design with regard to the intermittent contact of the CCL component of the composite liner that supplements the previously submitted documents.

Based on the conclusions of this report, no additional design or operational changes are necessary to demonstrate that the geologic and hydrologic conditions referenced in 10 CSR 80-11.010(4), Site Selection, (specifically, the intermittent contact of small portions of the bottom of the landfill liner) are necessary to prove that the quality of groundwater underlying the proposed site will not be affected and that there is no increased potential for migration of fluids from the Sioux UWL. The liner and leachate collection requirements are further discussed in previous and subsequent portions of this report.

4.1.2. IMPACT OF DSI RESULTS ON LINER AND LEACHATE COLLECTION SYSTEM DESIGN.

Regulatory Citation and Requirement:

10 CSR 80-11.010(5) Design
(A) Requirement. Plans, addendums, as-built drawings, or other documents which describe the design, construction, operation, or closure of a utility waste landfill or which request an operating permit modification for the utility waste landfill shall be prepared or approved by a professional engineer. These documents shall be stamped or sealed by the professional engineer and submitted to the department for review and approval.

Regulatory Design Requirements:

(A)3. Owners/operators of utility waste landfills shall demonstrate how adverse geologic and hydrologic conditions may be altered or compensated for via surface water drainage diversion, underdrains, sumps, and other structural components. All alterations of the site shall be detailed in the plans.

> *A. Precipitation, evapotranspiration and climatological conditions shall be considered in site selection and design.*

B. Engineering plans and specifications that have computer model attached to them shall list the limitations and assumptions of each model used in the application.

(A)4. Plans for stability analyses for all stages of construction shall include:

A. Settlement and bearing capacity analyses shall be performed on the in-place foundation material beneath the disposal area. The effect of foundation material settlement on the liner and leachate collection shall be evaluated;

B. Stability analyses shall be performed on all liner and leachate system components;

C. Leachate collection pipe material and drainage media shall be analyzed to demonstrate that these components possess structural strength to support maximum loads imposed by overlying waste materials and equipment;

D. Waste mass stability analyses shall be performed on the disposal area at final waste grade conditions and at intermediate slope conditions; and

E. Stability analyses shall be performed on all final cover system components, including an evaluation of the effect of waste settlement on the final cover system components, side slope liner system components, surface water management system components and gas migration system components.

Discussion of Alternative Design:

The Detailed Site Investigation (DSI) required by 10 CSR 80-2.015 addressed the precipitation, evapotranspiration and climatological conditions considered in original site selection and design. This included groundwater table elevations and the relationship of the Mississippi River and Missouri River levels to the groundwater table. Subsequent to the DSI, additional data has been obtained through routine groundwater detection monitoring and presented to MDNR relative to the relationship of the river levels to groundwater table elevations. No new models or calculations have been provided, but reference to previously submitted analysis has been made, but this report provides additional technical discussion of this information. In addition, the models and calculations submitted previously addressed all stages of construction and operation of the Sioux UWL.

This report provides additional technical discussion relative to the intermittent contact of the CCL component of the composite liner that supplements the previously submitted documents. As outlined in detail in Section 2.0, the current design and operation of the utility waste landfill for the Sioux Plant Utility Waste Landfill anticipates the potential for saturated clays and saturated insitu base conditions, as well as the potential impact of high groundwater table conditions intermittently caused by fluctuating river levels (primarily the Missouri River). No additional design alternatives or changes are believed necessary to address 10 CSR 80-11.010 (5).

Compliance with Regulatory Requirement:

In compliance with 10 CSR 80-11.010 (5), Design, this demonstration report has been prepared by professional engineers, has been reviewed and approved by a professional engineer and bears the signature and seal of the principal design engineer.

4.1.3. LANDFILL LINER SEPARATION FROM GROUNDWATER.

Regulatory Citation and Requirement:

10 CSR 80-11.010(8) Water Quality.
(A) Requirement. The location, design, construction and operation of the utility waste landfill shall minimize environmental hazards and shall conform to applicable ground and surface water quality standards and requirements. Applicable standards are federal, state or local standards and requirements that are legally enforceable.

Regulatory Design Requirements:

(B)1. Plans shall include

C. Groundwater elevation and proposed separation between the lowest point of the lowest cell and the predicted maximum water table elevation;

Discussion of Alternative Design:

This report provides current, updated information relative to the proposed separation between the lowest point of the lowest cell and the predicted maximum water table elevation. In addition, it further evaluates the potential impact of the intermittent contact of the CCL component of the composite liner. No additional design alternatives or changes are believed necessary to address 10 CSR 80-11.010 (8).

Compliance with Regulatory Requirement:

The content of this demonstration report support the conclusion that the regulatory requirement is met. The proposed design, construction and operation of the utility waste landfill shall minimize environmental hazards and shall conform to applicable ground and surface water quality standards and requirements.

4.1.4. DESIGN AND OPERATION OF LINER SYSTEM.

Regulatory Citation and Requirement:

10 CSR 80-11.010(10) Liner Systems.
(A) Requirement. A liner shall be placed on all surfaces to minimize the migration of leachate from the utility waste landfill.

Regulatory Design Requirements:

(B)1. For a composite liner a lower component that consists of at least a two-foot (2') layer of compacted soil with a hydraulic conductivity of no more than 1 x 10^{-5} cm/sec. A compacted soil liner at a minimum shall be constructed of six to eight-inch (6-8") lifts, compacted to ninety-five percent (95%) of standard Proctor density with the moisture content between optimum moisture content and four percent (4%) above the optimum moisture content, or within other ranges of density and moisture such that are shown to provide for the liner to have a hydraulic conductivity no more than 1 x 10^{-5} cm/sec. For a

single compacted clay liner a component that consists of at least a two-foot (2') layer of compacted soil with a hydraulic conductivity of no more than 1 x 10^{-7} cm/sec. A compacted soil liner at a minimum shall be constructed of six to eight-inch (6-8") lifts, compacted to ninety-five percent (95%) of standard Proctor density with the moisture content between optimum moisture content and four percent (4%) above the optimum moisture content, or within other ranges of density and moisture such that are shown to provide for the liner to have a hydraulic conductivity of no more than 1 x 10^{-7} cm/sec. The design shall include a detailed explanation of the construction techniques and equipment necessary to achieve ninety-five percent (95%) of the standard Proctor density under field conditions. The design also shall include QA/QC procedures to be followed during construction of the liner. The composite liner and the compacted clay liner shall be protected from the adverse effects of desiccation or freeze/thaw cycles after construction, but prior to placement of waste. Traffic shall be routed so as to minimize the detrimental impact on the constructed liner prior to placement of waste. The soils used for this purpose shall meet the following minimum specifications:

A. *Be classified under the Unified Soil Classification Systems as CL, CH, or SC (ASTM Test D2487-85);*
B. *Allow more than thirty percent (30%) passage through a No. 200 sieve (ASTM Test D1140);*
C. *Have a liquid limit equal to or greater than twenty (20) (ASTM Test D4318-84);*
D. *Have a plasticity index equal to or greater than ten (10) (ASTM Test D4318-84); and*
E. *Have a coefficient of permeability equal to or less than 1 x 10^{-7} cm/sec for the compacted clay liner and 1 x 10^{-5} cm/sec for the composite liner when compacted to ninety-five percent (95%) of standard Proctor density with the moisture content between optimum moisture content and four percent (4%) above the optimum moisture content, when tested by using a flexible wall permeameter (ASTM D-5084) or other procedures approved by the department;*

Alternative Design:

The proposed utility waste disposal area will utilize a composite liner that will consist of a 60-mil HDPE geomembrane liner underlain by two-feet of compacted clay liner with a hydraulic conductivity equal to or less than of 1 x 10-7 cm/sec. This composite liner was proposed in the original Construction Permit application and included in the current Permit Modification request with the understanding that it significantly exceeded the performance of the minimum design standards and performance of the two liner options prescribed in 10 CSR 80-11.010 (10). Ameren Missouri proactively chose this design to minimize the migration of leachate from the utility waste disposal area.

Compliance with Regulatory Requirement:

The regulatory requirement is met and exceeded by the Sioux UWL proposed composite liner design. This report demonstrates that the intermittent contact of groundwater with the CCL component of the composite liner will not impact the CCL's design, function or performance.

4.2 Impact on the Pending Construction Permit Modification Request

Prior to the submittal of this demonstration, Ameren Missouri prepared a complete design and operational details for required by Chapter 11, Utility Waste Landfill, for the modification of Solid Waste Disposal Area Operating Permit No. 091830. The original request to modify the permit was made in June 2010 and the review of the technical details is near completion. and requested that the proposed utility waste disposal area. Following the review and acceptance of this demonstration by MDNR, this demonstration will be incorporated into the approved engineering report and plans required to be maintained throughout the operating life and post closure care as required by the Solid Waste Disposal Area Operating Permit.

5.0 REFERENCES

ASTM D4767, "Standard Test Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils."

ASTM D5084, "Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter."

Daniel, David E. and Robert M. Koerner (1993) Quality Assurance and Quality Control for Waste Containment Facilities, EPA/600/R-93/182.

Detailed Geologic and Hydrologic Site Investigation Report for AmerenUE Sioux Power Plant Proposed Utility Waste Disposal Area, St. Charles County, Missouri, dated August 2006 by GREDELL Engineering Resources, Inc. and Reitz & Jens, Inc.

Timothy E. Frank, Ivan G. Krapac, Timothy D. Stark and Geoffrey D. Strack (2005), "Long-Term Behavior of Water Content and Density in an Earthen Liner," Journal of Geotechnical and Geoenvironmental Engineering, ASCE, Vol. 131, No. 6, June.

Mitchell, James K. (1976). Fundamentals of Soil Behavior. John Wiley & Sons, New York, 386 p.

MDNR and Stark, Timothy D. (1997). Draft Technical Guidance Document on Static and Seismic Slope Stability for Solid Waste Containment Facilities. Solid Waste Management Program, Division of Environmental Quality, Missouri Department of Natural Resources, Jefferson City, MO, 96 p.

Terzaghi, Karl, Ralph B. Peck, Gholamreza Mesri (1996). Soil Mechanics in Engineering Practice, 3rd Edition. John Wiley & Sons, New York, 549 p.

Attachment 10

Structural Integrity Criteria & Safety Factor Assessment

STRUCTURAL INTEGRITY CRITERIA & HYDROLOGIC/ HYDRAULIC CAPACITY ASSESSMENT SIOUX ENERGY CENTER

Sioux Energy Center
8501 North State Route 94
West Alton, MO 63386

Contents

STRUCTURAL INEGRITY CRITERIA & HYDROLOGIC/ HYDRAULIC CAPACITY ASSESSMENT - SIOUX ENERGY CENTER

I. Introduction

Ameren Missouri has evaluated the Sioux Energy Center's ("Sioux") surface impoundments in accordance with the operating and design criteria set forth below:

§257.71, Liner Design Criteria;
§257.73(c)(1), History of Construction;
§257.73(a)(2), Periodic Hazard Potential Classification;
§257.73(d)(1), Periodic Structural Stability Assessment;
§257.73(e)(1), Periodic Safety Factor Assessment;
§257.82, Initial Hydrologic and Hydraulic Capacity Requirements; and

For this initial assessment, Ameren Missouri retained the engineering firm Reitz & Jens, Inc. to evaluate Sioux's active surface impoundments to determine whether such units conform to good engineering practices[1] with respect to the following criteria: liner design criteria; hazard potential classification; structural stability assessment; safety factor assessment; and initial hydrologic and hydraulic capacity requirements. Such criteria will be reassessed every five years until such time as the units are closed in accordance with regulatory requirements. Engineering calculations, diagrams modeling, and work papers supporting this assessment have been placed in the facility's operating record.

II. Background

A. Active Ponds

Sioux currently utilizes three (3) surface impoundments for the management of process waters along with bottom and fly ash, and gypsum from the facility's flue gas desulfurization system (FGD). Such impoundments occupy approximately 149 acres and are identified as follows*: SCPA (Bottom Ash Pond); SCPB (Fly Ash Pond)*; and *SCPC (Cell 1)*. The facility also uses a Recycle Pond to manage stormwater and discharge waters from SCPC, but such impoundment does not collect or manage CCR and is not subject to 40 CFR §257 requirements.

SCPA was built as part of the original design of the Sioux facility in 1967. Earthen material excavated from SCPA was used to construct the embankment dam and for plant fill. The SCPA is bound to the east and northeast by plant fill. The pond receives process water used to sluice bottom ash, and flow from the plant combined drained sump (CDS). The CDS collects stormwater from an area of approximately 46.1 acres. The pond currently receives only bottom ash, but for approximately twenty-five years managed both fly and bottom ash. The southern half of the pond is filled to capacity with a mixture of bottom and fly ash. Decant water from SCPA is ponded in the

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[1] Based on engineering codes, widely accepted standards, or a practice widely recommended through the industry. See *40 CFR 25.53, Definitions*.

northwest portion of the pond before discharge via an NPDES outfall into an unclassified waterway, a backwater to the Mississippi River located west of SPCA. Nearly all of the bottom ash currently produced is beneficially used.

SCPB was constructed in 1994, and receives process water used to sluice fly ash and stormwater runoff from an area of approximately 27 acres which includes the coal pile. The pond is lined with HDPE and stores fly ash. Decant water ponds in the southern portion of the SCPB before discharge to the Mississippi River via backwaters that are unclassified waterways. The perimeter embankment was constructed of compacted earth fill.

SCPC was placed into service in 2010, and receives process water used to sluice gypsum. The impoundment stores gypsum and discharges decant water into the Recycle Pond. Water collected in the Recycle Pond is returned to the plant for reuse. The impoundment is formed by a compacted earth fill ring dam that is capped by 2 feet of impervious clay and HDPE liner. SCPC is regulated as a dam by the MDNR and subject to Missouri Solid Waste regulations and requirements.

The location of the Sioux Energy Center is depicted on Figure 1, United States Geological Services (USGS) topographical quadrangle map. Various design and operational features of the CCR units, including water flow path, is set forth on Figures 2 and 3.

B. Embankment Levee

Embankment dams surround all of Sioux's impoundments. The area impounded by SCPA is approximately 49 acres, and the length of the embankment dam is 6,700 feet. The embankment has a maximum dam height of 27 feet, a minimum crest width of 10 feet, 2 horizontal (H) to 1 vertical (V) upstream slopes, and 2H and 2.5H to 1V downstream slopes. Portions of the downstream and upstream slopes have been armored with riprap.

SCPB has an area of 62 acres, and the length of the embankment dam is 7,900 feet. The embankment has a maximum dam height of 22 feet, minimum crest width of 20 feet, 3H to 1V upstream slopes, and 2H and 3H to 1V downstream slopes. The pond is bound to the north and east by plant fill. The embankment section is thickened to the south by a railroad embankment, and to the west by the plant access road.

SCPC has an area of 37.5 acres, and the length of the embankment dam is 5,200 feet. The embankment currently has a maximum dam height of 24 feet, minimum crest width of 12 feet, and 3H to 1V upstream and downstream slopes. Portions of the downstream slopes have been armored with riprap.

III. Structural Integrity Assessment

A. Liner Design Criteria – 40 CFR §257.71

For existing CCR surface impoundments constructed with liner systems, an owner/operator of such units must determine if such liner complies with the specified design and performance standards. At

Sioux, both SCPB and SCPC were constructed with a liner system. SCPA is unlined. SCPB has 60 MIL HDPE liner on the slopes and 40 MIL HDPE liner on the bottom. The existing liner system does not satisfy the required design criteria set forth in *40 CFR 257.71* in that it does not have a 2-foot layer of compacted soil with hydraulic conductivity of no more than 1×10^{-7} cm/sec. The existing liner for SCPC consists of two feet of compacted soil with a hydraulic conductivity of $1\text{x}10^{-7}$ cm/sec which is overlain by 80 MIL HDPE; the liner system satisfies the required design criteria set forth in 40 CFR 257.71.

1. Engineering Certification – Liner Design Criteria for Existing CCR Surface Impoundments

The existing CCR surface impoundments SCPA, SCPB and SCPC at the Sioux Energy Center were evaluated to determine if they were constructed with a liner which meets the requirements of §257.71, Liner Design Criteria for Existing CCR Surface Impoundments. The SCPA and SCPB existing liner system does not have a 2-foot layer of compacted soil with hydraulic conductivity of no more than 1×10^{-7} cm/sec. The SCPC existing liner consists of two feet of compacted soil with a hydraulic conductivity of $1\text{x}10^{-7}$ cm/sec which is overlain by an 80 MIL HDPE liner.

CCR Unit	Existing liner meets requirements of 40 CFR 257.71
SCPA (Bottom Ash Pond)	No
SCPB (Fly Ash Pond)	No
SCPC	Yes

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B. Periodic Hazard Potential Classification – 40 CFR §257.73(a)(2)

Every five (5) years, an owner or operator of a coal combustion residual ("CCR") unit must update the hazard potential of CCR units and certify the results by a qualified professional engineer. The classification categories are based upon criteria established by the Federal Emergency Management Agency (FEMA) and range as follows: *low hazard potential, significant hazard potential, and high hazard potential.* The FEMA classification system categorizes a dam based on the probability of loss of human life and the impacts on economic, environmental, and lifeline facilities should the dam fail. The specific categories are defined as follows:

> *(1) High hazard potential CCR surface impoundment means a diked surface impoundment where failure or mis-operation will probably cause loss of human life.*
>
> *(2) Significant hazard potential CCR surface impoundment means a diked surface impoundment where failure or mis-operation results in no probable loss of human life, but can cause economic loss, environmental damage, disruption of lifeline facilities, or impact other concerns.*
>
> *(3) Low hazard potential CCR surface impoundment means a diked surface impoundment where failure or mis-operation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the surface impoundment owner's property.*

All of the active ponds at Sioux are classified as having a *low hazard potential* because any structural failure would not be expected to cause a loss of human life.

- **SCPA** - Failure of the Bottom Ash Pond would result in the release of water and CCR into unclassified waterways. The failure of the impoundment is not expected to cause a loss of human life, and the economic, environmental and lifeline losses are expected to be low and generally limited to the owner.

- **SCPB -** Failure of the Fly Ash Pond would result in the release of water and CCR into the surrounding Ameren property and/or unclassified waterways. The failure of the impoundment is not expected to cause a loss of human life, and the economic, environmental and lifeline losses are expected to be low and generally limited to the owner.

- **SCPC -** Failure of SCPC would result in the release of water and CCR into the surrounding Ameren property and adjacent agricultural fields. The failure of the impoundment is not expected to cause a loss of human life, and the economic, environmental and lifeline losses are expected to be low and generally limited to the owner.

Since none of the active impoundments are classified as *high or significant potential hazards*, an emergency action plan does not need to be prepared. The hazard classification of these units must be re-evaluated every five (5) years.

1. Engineering Certification – Periodic Hazard Potential Classification

The 2015 Periodic Hazard Potential Classification Assessment was conducted for active CCR surface impoundments SCPA (Bottom Ash Pond), SCPB (Fly Ash Pond), and SCPC (Cell 1) at the Sioux Energy Center was conducted in accordance with the requirements of 40 CFR 257.73(a). These CCR surface impoundments are low hazard potential because failure of the impoundment is not expected to cause a loss of human life, and the economic, environmental and lifeline losses are expected to be low and generally limited to the owner. The hazard potential classification was completed in general accordance with *Federal Guidelines for Dam Safety: Hazard Potential Classification for Dams* by the Federal Emergency Management Agency (January 2004). The engineering support for this certification has been placed in the operating record.

CCR Unit	Hazard Potential Classification
SCPA (Bottom Ash Pond)	Low
SCPB (Fly Ash Pond	Low
SCPC (Cell 1)	Low

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C. Periodic Structure Stability Assessment – 40 CFR §257.73(d)

The owner or operator of a CCR unit must inspect and certify that the design construction, operation and maintenance of a CCR unit are in accordance with good engineering practices. Such engineering assessment includes the following: stable foundations and abutments; slope protection to protect against surface erosion, wave action, and adverse effects of sudden drawdown; berm compaction is sufficient to withstand the range of loading conditions, including low pool of an adjacent water body or sudden drawdown; adequately vegetated slopes and surrounding areas; adequate spillway capacity, operation and maintenance; spillways constructed, operated, and maintained to adequately manage the design flow event; and structural integrity and functionality of hydraulic structures underlying the base of CCR unit or passing through the dike.

SCPA upstream slopes subjected to wave loading are armored with riprap and the downstream slopes have a vegetative cover or are armored with riprap. The upstream slopes for SCPB and SCPC are overlain with an HDPE liner and the downstream slopes are vegetated or armored with riprap. Vegetative management protocols are set forth in the Operations and Maintenance Procedures and have been implemented so as to minimize erosion while facilitating the visibility of slopes during inspections.

The engineering team visually inspected the interior and exterior embankment slopes of the active surface impoundments, and reviewed pertinent geotechnical data. Reitz & Jens visually inspected berm foundations for signs of instability. None were observed. In addition, hydraulic structures (i.e. spillways, overflow pipes and ditches) were inspected to confirm proper maintenance and operation. No significant deficiencies of the structures were observed. (Some of the piping was under water and not available for visible inspection.) Recommended and ongoing activities include general maintenance (i.e. erosion repair, vegetation removal, animal control, seeding for vegetative cover) and monitoring (e.g. spillways, submerged piping, pond levels, wet areas near berms, and installation of staff gauge to maintain pool levels).

1. Engineering Certification – Periodic Structural Stability Assessment

The 2015 Initial Periodic Structural Stability Assessment was conducted for the active CCR surface impoundments SCPA (Bottom Ash Pond), SCPB (Fly Ash Pond), and SCPC (Cell 1) at the Sioux Energy Center. The structural stability assessment was completed in general accordance with 40 CFR Part §257.73(d)(1). Assessment of all three CCR Units found no structural stability deficiencies, no significant issues with the current operations and maintenance, and that the design and construction are adequate, however some corrective measures were recommended. The engineering support for this certification has been placed in the operating record.

Requirement	SCPA	SCPB	SCPC
Initial periodic assessment was completed in general accordance with the requirements of 40 CFR Part §257.73(d)(1)	Yes	Yes	Yes

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D. Safety Factor Assessment – 40 CFR §257.73(e)

All active CCR units must have calculated Factors of Safety (FOS) that meet or exceed the following designated values:

Table 1

Loading Conditions	Minimum FOS
Maximum Storage Pool	1.50
Maximum Surcharge Pool	1.40
Seismic	1.00
Liquefaction	1.20

Reitz & Jens performed stability analysis on the active CCR surface impoundments and calculated the following values:

Table 2

Ponds	Maximum Storage Pool (FOS)	Maximum Surcharge Pool (FOS)	Seismic (FOS)	Liquefaction (FOS)
SCPA	1.50	1.42	1.12	1.26
SCPB	2.78	2.78	2.11	3.45
SCPC	2.14	2.14	1.27	1.33

The calculated factors of safety for the critical cross-section at each CCR unit identified above **meet or *exceed*** the minimum factors of safety for each loading condition required by 40 CFR §257.73(e).

1. Engineering Certification – Safety Factor Assessment

The 2015 Periodic Safety Factor Assessment was conducted for the active CCR surface impoundments SCPA (Bottom Ash Pond), SCPB (Fly Ash Pond), and SCPC (Cell 1) at the Sioux Energy Center. The Periodic Safety Factor Assessment for each active CCR Unit at the Sioux Energy Center shows that the critical cross section for these Units meet or exceed the minimum factors of safety specified in 40 CFR Part §257.73(e)(1) as summarized below. The engineering support for this certification has been placed in the operating record.

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

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E. Hydrologic and Hydraulic Capacity Requirements - 40 CFR §257.82

Flood control system plans must be adequate to manage the inflow from a designated flood event. Such plans must be updated and verified every five (5) years. The inflow design flood control system must adequately manage flow into the CCR unit during and following the peak discharge from the design flood event.

Pertinent data regarding the active surface impoundments is set forth below:

Table 3

CCR Unit	Maximum Surface Area (acres)	Levee Crest Elevation (feet)	Crest Length (feet)	Normal Pool Elevation (feet)	Maximum Surcharge Pool[2] (feet)	Upstream Slope Steepness (H:V)	Downstream Slope Steepness (H:V)
SCPA	49.0	442.5	6,700	438.0	440.25	2H:1V	2H:1V & 2.5H:1V
SCPB	62.0	441.5	7,900	439.2	441.0	3H:1V	2H:1 to 3H:1V
SCPC	37.5	446.0	5,200	441.1	441.9	3H:1V	3H:1V

Reitz & Jens performed a modeling analysis using the 100-year flood event for low hazard potential surface impoundments as the design flood as required by 40 CFR §257.82(a)(3)(iii). The hydrologic and hydraulic modeling analysis assumed rainfall of 7.21 inches[3] as an estimated 24-hour, 100-year precipitation event. Flow paths and spillway discharge locations are depicted on Figure 2. SCPA and SCPB discharge into unclassified waterways through Outfalls #002 and #006, respectively. The NPDES permit number for the outfalls is MO-0000353. SCPC discharges into the Recycle Pond, and water from the Recycle Pond is recirculated back to the plant for reuse.

For SCPA, the peak water levels during a 100-year precipitation event reach elevation 440.01 feet, 2.5 feet **below** the low point on the crest of the pond. The pool level should return to within 0.1 feet of normal within 48 hours. Maximum flow through the outlet works was modelled as 42.52 cfs. Assuming the valves are open at the start of the event, the peak pool level during the 100-year precipitation event for SCPB is 440.91 feet, or approximately 0.6 feet **below** the low point on the crest. The pool level should return to within 0.1 feet of normal within 50 hours. Maximum flow through the outlet works was modelled as 16.72 cfs. The total volume of stormwater from the 24-hour, 100-year precipitation event and 24 hours of normal process water flow raise the level of SCPC to elevation 441.9 feet assuming there is no flow through the spillway. The peak pool level is 3.1 feet below the crest of the emergency spillway.

Provided that the outlet works remain functional, the facility's inflow design control system adequately manages flow through the CCR units during and following a 100-year flood event as required by 40 CFR §257.82. Outlet works and spillways should be maintained in proper condition to ensure normal pool elevation and to lower pool levels if necessary. The CCR in the ponds will be managed so that the available storage is more than that assumed in the hydrologic and hydraulic models.

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[3] Huff, F.A. and J.R. Angel. (1992). "Rainfall Frequency Atlas of the Midwest." Bulletin 71, Midwestern Climate Center and Illinois State Water Survey.

F. Inflow Design Flood Control System Capacity Plan

The initial inflow design flood control system has been evaluated for the SCPA, SCPB and SCPC at the Sioux Energy Center. Based on the hydrologic and hydraulic capacity calculations, the inflow control system for these ponds can adequately handle and discharge the 100-Year design flood event. *Specifically, 2.5 feet of freeboard exists in SCPA, 0.6 feet in SCPB and 4.1 feet in SCPC.* So as to properly maintain such inflow storage capacity, the following measures of the *Inflow Design Flood Control System Plan* have been incorporated into the Operations and Maintenance Manual and should be observed:

- **SCPA** - normal pool elevation should be maintained no higher than elevation 438.0 feet to maintain a maximum surcharge pool at elevation 440.25 feet.
- **SCPB** - normal pool elevation should be maintained no higher than elevation 439.2 feet to maintain a maximum surcharge pool at elevation 441.0 feet.
- **SCPC** - normal pool elevation should be maintained no higher than elevation 441.1 feet to maintain a maximum surcharge pool at elevation 441.9 feet.
- If the water levels exceed the maximum surcharge pool elevations, special inspections by the Dam Safety Group of the primary spillways should be completed, and temporary measures implemented to prevent the water from overtopping the Pond embankments until the primary spillways are functioning as designed. Such measures could include cessation of generation, the addition of fill, sandbags, pumps, siphons etc.
- Prior to the next scheduled evaluation of the Periodic Inflow Design Flood Control System Plan, topographic surveys should be completed on the interior of all active ponds to confirm the necessary water storage is available.
- Staff gage readings should be recorded during weekly inspections to confirm the assumed normal pool elevations.

1. Engineer's Certification – Hydrologic and Hydraulic Capacity

The initial inflow design flood control system plan was completed for the active CCR surface impoundments SCPA (Bottom Ash Pond), SCPB (Fly Ash Pond), and SCPC (Cell 1) at the Sioux Energy Center. The initial inflow design flood control system plan was completed in general accordance with 40 CFR Part §257(e)(1) using the 100-year design flood for low hazard potential CCR surface impoundments.

Requirement	SCPA	SCPB	SCPC
The initial inflow design flood control system plan meet the requirements of 40 CFR Part §257.82	Yes	Yes	Yes

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IV. Construction Summary – *40 CFR 257.73(c)*

The Sioux Energy Center is located along the Mississippi River, approximately 14 miles upstream of the confluence with the Missouri River. The Mississippi River is immediately to the north of the CCR units and the Missouri River is about 1 mile to the south of the Sioux Energy Center. Poeling Lake, which connects to the Mississippi River, is located immediately to the west of the SCPB and SCPA. Outfalls from the SCPA and SCPB discharge into unclassified waterways. The Mississippi River has a watershed area of approximately 170,000 square miles at the site and the Missouri River has a watershed area of approximately 500,000 square miles at their confluence. The Sioux Energy Center does not receive stormwater run-on from areas outside of the facility.

A. Owner and Operator

The CCR Units at the Sioux Energy Center are owned and operated by Ameren Missouri. The Sioux Energy Center plant personnel have the primary responsibility for CCR unit operation. The Sioux Energy Center is located at 8501 North State Route 94, West Alton, Missouri 63386. The Ameren Missouri Dam Safety Group performs CCR unit inspections, and reviews all updates to the Operations and Maintenance Manual.

B. SCPA (Bottom Ash Pond) (1967)

SCPA is an unlined impoundment constructed in 1967 as part of the original design of the facility. The pond was excavated so as to raise the elevation of the power plant building and to construct a perimeter embankment around SCPA. Flow from the pond is routed through an outlet structure and discharged through a 30-inch diameter conduit. The outlet structure is reinforced concrete, with a reinforced concrete weir and steel bulkhead on the upstream side. The bulkhead has an orifice with a manually operated sluice gate. Flow to the structure is through a 24-inch diameter HDPE pipe and an opening cut in a large diameter, galvanized, corrugated steel skimmer. The outlet channel discharges into unclassified waterways. The outfall is located approximately 0.4 miles upstream of the Mississippi River. The estimated maximum depth of CCR in the pond is 45 feet.

1. Foundation and Abutment Geology

The typical foundation profile consists of an uppermost stratum of clay to silty clay that is firm to stiff, and approximately 7 to 15 feet thick. In the southern portion of the pond the uppermost stratum is silty sand. The clay is generally underlain by 4 to 7 feet of loose to medium-dense silty sand. Poorly graded sand is encountered generally at a depth of about 20 feet below the natural ground surface beneath the silty sand. The sand is intermittently fine to coarse and medium-dense to dense. The sand extends to bedrock, and typically becomes coarser with depth, with gravel, cobbles and boulders encountered in the deeper sands near the interface with bedrock. In the vicinity of the SCPA, bedrock is encountered at a depth of about 105 to 110 feet below the original ground surface.

2. Embankment Material

Embankment fill generally consists of compacted layers with varying amounts of clay, silt and sand that were excavated from the incised portion of the pond. Fill material is generally soft to firm or loose to medium-dense. All or portions of the downstream slopes along the south, southwest, northwest and north embankments are armored with riprap to provide stability and erosion protection.

3. 2009 Spillway Modification

The original spillway consisted of a reinforced concrete structure with a concrete weir and concrete or wooden stoplogs on the upstream side, and a corrugated steel skimmer. In 2009, the stoplogs were removed and replaced with a steel frame (bulkhead) and manually operated stainless steel sluice gate. The gate is used to restrict flow through an orifice in the steel frame that has a width of 2.5 feet and height of 2 feet. The invert of the orifice is at el. 429 and the top of the steel frame is at el. 440.

4. *2009 Riprap Armor Slopes*

Riprap armor was installed on approximately 750 lineal feet of the southwest and approximately 630 feet of the north downstream slopes, and on approximately 570 lineal feet on the north upstream slope. On the downstream slope the riprap was installed from the toe to about half-way up the embankment. Riprap was large stone with a median size of approximately 18 inches.

5. *2012 Stability Berm, Rock Wedge and Inverted Filter*

In 2012, Ameren Missouri constructed an approximately 620 lineal feet riprap stability berm along the toe of the north side of the pond. The berm has a minimum width of 17 feet and thickness of 4 feet. At the same time, a rock wedge was constructed on the adjacent drainage channel slope over approximately 160 lineal feet. The rock wedge was designed with a maximum steepness of 2H to 1V and a minimum thickness of 3 feet. An inverted filter was also installed along the downstream toe at the northeast corner of the perimeter berm. The inverted filter consists of two, 2 foot layers of filter media that is armored with 4 feet of riprap. The riprap armor is keyed in 2 feet at the downstream toe.

6. *2012 Combined Sump Discharge*

In 2012, the CDS outlet was relocated and moved south approximately 400 feet on the east side of the SCPA.

7. *2015 Embankment Modifications and Slurry Wall Addition*

The downstream slope along the southwest and south perimeter berms was flattened to a 2.5H to 1V slope and armored with riprap. Ten inches of riprap was placed from the shoulder to the downstream toe of the embankment. The riprap has a maximum size of 10 inches and a predominate size of 6 inches. A geotextile fabric was placed under the riprap along the length of the embankment slope. In addition, a ditch with 2H to 1V sideslopes was cut in the CCR on the upstream side of the embankment. A slurry cutoff wall was also constructed through the crest of the embankment in the northeast corner of the perimeter berm. The slurry wall extends to a minimum depth of 40 feet below the embankment crest. A 3-foot thick clay cap was constructed above the slurry wall. The slurry wall extends approximately 300 lineal feet along the northeast perimeter embankment.

C. SCPB (Fly Ash Pond) (1994)

In 1994, Ameren Missouri constructed a lined impoundment to manage fly ash and coal pile stormwater runoff. The pond was incised to a bottom elevation of approximately 422 feet, and has 60-mil HDPE liner on the side slopes and 40-mil HDPE liner on the bottom. The water level is controlled by an upturned 18” HDPE pipe inlet. The discharge pipe is regulated by two motor operated butterfly valves. The HDPE pipe penetrates the southern half of the west perimeter embankment and discharges decant water into unclassified waterways and into the Mississippi River. The estimated maximum depth of CCR in the pond is 40 feet.

1. Foundation and Abutment Geology

The uppermost stratum is firm to stiff clay with a thickness of about 8 to 10 feet. The clay is underlain by silty sand and then poorly graded sand. The consistency of the silty sand and sand is medium dense and medium dense to dense, respectively. The silty sand stratum is generally 11 to 13 feet thick. The sand is fine to coarse, and intermittently silty and gravely. The sand extends to limestone bedrock, which is encountered at a depth of about 120 feet beneath the original ground surface.

2. Embankment Material

Embankment fill generally consists of compacted layers of clays, silts and sands that were excavated from the incised portion of the pond. Fill material is generally firm to stiff or medium dense. The upstream and downstream slopes are 3H to 1V, except where the embankment section has been widened by adjacent improvements. In the locations where the embankment has been widened the downstream slopes can vary from 2H to 1V and 3H to 1V.

3. 2010 Riprap Placement

In 2010, Ameren Missouri placed riprap on the downstream slopes in the northwest part of the pond. The segment armored has not been thickened by adjacent improvements. The riprap was placed to help prevent future erosion from occurring on the slopes.

4. Gypsum Slurry Piping Fill

In 2010, and in order to facilitate new piping used to transport gypsum slurry to SCPC, fill was placed adjacent to the embankment near the southeast corner of the pond. The fill is compacted fly ash with a soil cap and was placed adjacent to and on the downstream slope at a steepness of about 3H to 1V.

5. 2012 Planned Solar Panel Fill Area

As part of a beneficial use project, an area adjacent to the east perimeter berm was filled with compacted ash to an elevation near the top of the embankment. The area filled was approximately 17 acres, and included a storm drainage system. The area was developed for potential solar power generation, but to date additional site development has not occurred.

D. SCPC (Cell 1) (2010)

The SCPC was placed into service in 2010 to manage gypsum created as a byproduct from Sioux's FGD. The gypsum slurry is pumped to SCPC where it is managed for long-term or permanent storage. The pond does not receive any additional stormwater run-off outside its bounded area. The gypsum slurry discharges into the cell at the approximate midpoint of the east embankment. The gypsum settles out into the pond and the decant water flows into the Recycle Pond through a set of triple box culverts. SCPC and the Recycle Pond are separated by an embankment. Triple box culverts connect SCPC with the Recycle Pond, and the culverts control the maximum water level in SCPC to el. 441. SCPC also has an emergency spillway on the west side of the impoundment. The bottom and side slopes of SCPC are lined with 80-mil HDPE liner, which was constructed over 24 inches of compacted, impervious clay. Riprap armor was placed from the downstream toe to about the mid-height of the embankment along the south and west berms in SCPC. The estimated maximum depth of CCR in the pond is 20 feet.

1. *Foundation and Abutment Geology*

The uppermost stratum is generally clays and silty clays with scattered seams and layers of low plastic silt, underlain by silts. The thickness of these fine-grain deposits ranged from 0 to 24 feet, but generally between about 5 to 10 feet. Clay soils are almost all high plastic. The fine-grain soils are firm to stiff, with undrained cohesive shear strengths of 500 psf to over 2000 psf.

The upper fine-grain soils are underlain by sandy silts, silty fine sands, and fine sands, generally to a depth of 30 feet. These upper sandy soils are generally loose to medium-dense. The upper sandy soils are underlain by fine to coarse, poorly graded sands and well-graded sands, with some silty sands and gravelly sands at greater depths. Limestone bedrock is at a depth of about 115 feet. The lower sands generally ranged from medium dense to very dense, increasing in density with increasing depth.

2. *Embankment Material*

Embankment fill consists of compacted layers of clay and silt with varying amounts of sand. Fill material was compacted to an average of 100% of the maximum dry unit weight determined from the Standard Proctor Moisture-Density Test (ASTM D698). Fill placement was monitored and moisture-density tests were obtained during construction. The upstream and downstream slopes have a steepness of 3H to 1V. Riprap armor was placed from the downstream toe to about the mid-height of the embankment along the south and west berms. The crest elevation of the embankment for SCPC is approximately elevation 446 feet.

The bottom of SCPC and the upstream slopes are covered with 2 feet of compacted clay liner that has a maximum hydraulic conductivity of 1×10^{-7} cm/sec. Clay for the liner was obtained on site. The compaction criteria for the clay liner was developed using the “Daniel Method.” Fill placement was monitored and moisture-density tests were obtained during construction.

E. Surveillance, Maintenance and Repair of the CCR Units

The Sioux Fly Ash and Bottom Ash Pond Embankment, and Cells 1 & 4A and Recycle Pond Operations and Maintenance Manuals outline objectives, responsibilities, and procedures for Ameren personnel who are responsible for the management of the Sioux CCR units. The embankments of the CCR units are visually inspected weekly by Ameren plant operations staff. Ameren Missouri Dam Safety Group personnel perform annual inspections and periodic inspections[4] or assessments with plant operations staff. In addition, the Ameren Missouri Dam Safety Group may conduct unannounced safety inspections.

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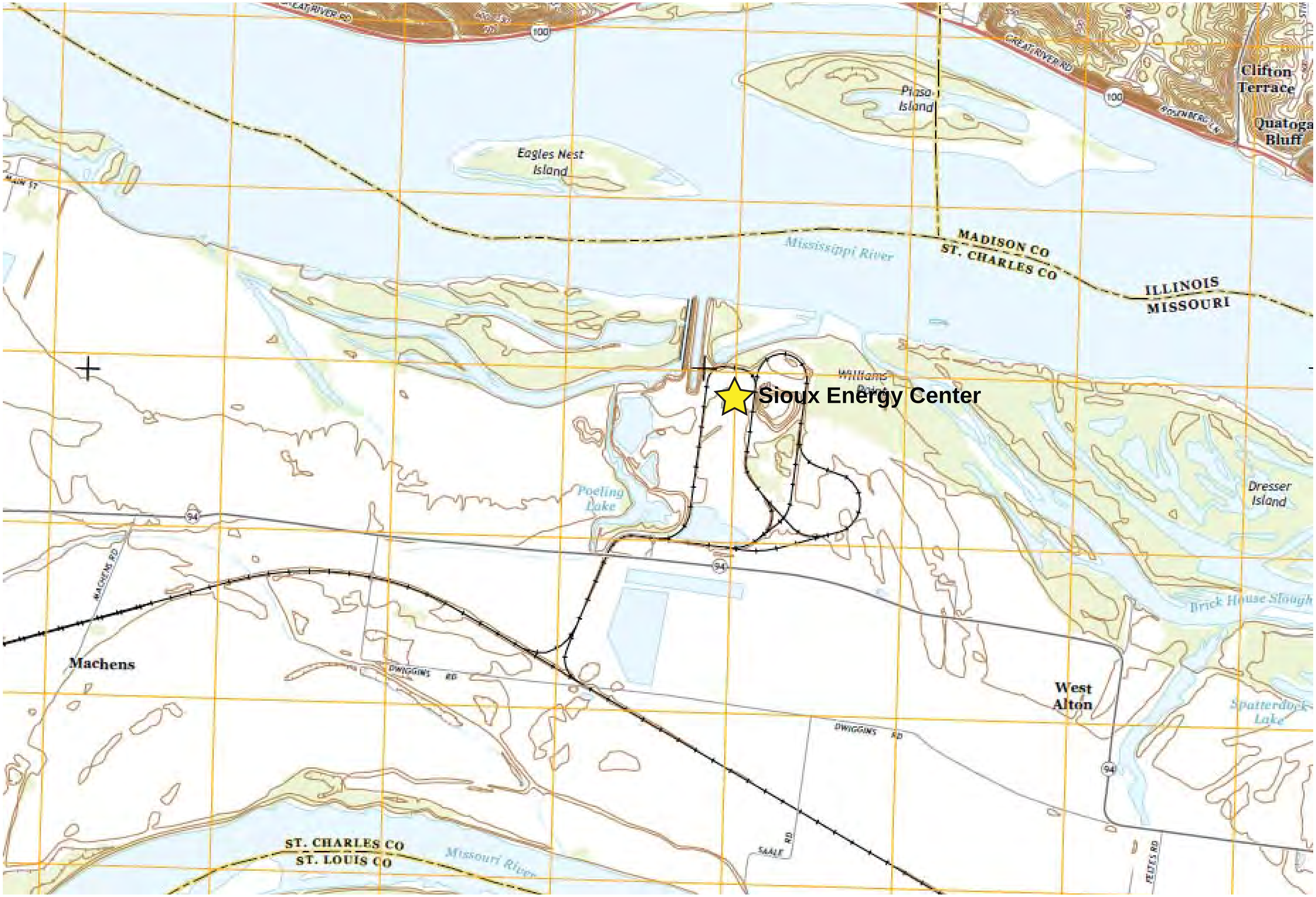
[4] The annual and periodic inspection reports contain the following information: depth of impounded water; storage capacity; modifications from last inspection, if any, CCR depth; volume of impounded water and CCR; changes to the downstream watershed, if any.

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

F. Instrumentation

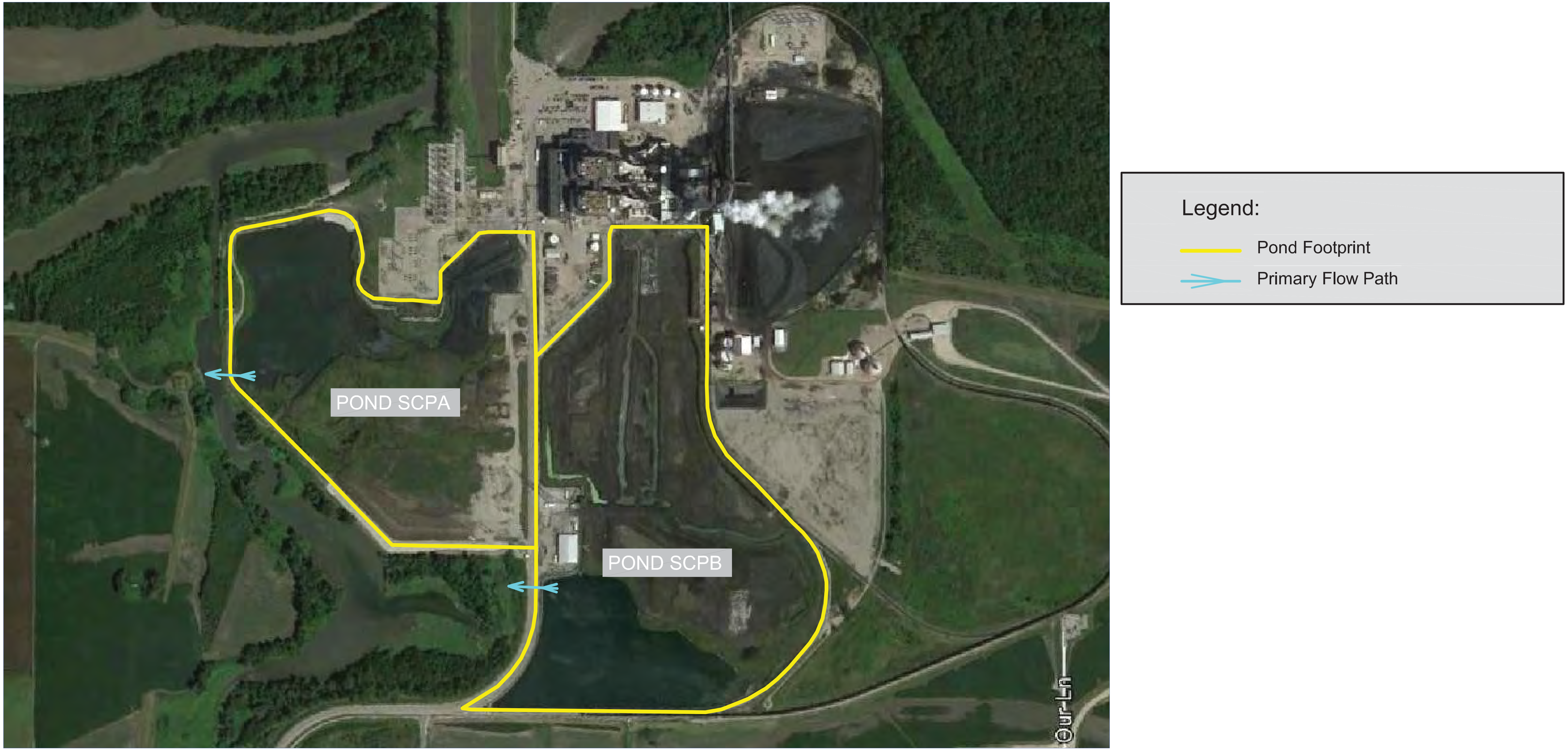
The pool levels in SCPA and SCPB are monitored by staff gages installed at each discharge structure. Pool level readings are documented in weekly inspection reports.



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

REITZ & JENS, INC.

Figure 1



CCR UNIT	MAXIMUM SURFACE ELEVATION (ACRES)	DAM CREST ELEVATION (FEET)	CREST LENGTH (FEET)	NORMAL POOL ELEVATION (FEET)	MAXIMUM SURCHARGE POOL (FEET)	UPSTREAM SLOPE STEEPNESS (H:V)	DOWNSTREAM SLOPE STEEPNESS (H:V)
SCPA	49.0	442.5	6700	438.0	440.3	2H:1V	2H:1V & 2.5H:1V
SCPB	62.0	441.5	7900	439.2	441.0	3H:1V	2H:1V to 3H:1V

Ameren Missouri
Sioux Energy Center
CCR Unit Evaluation
Figure 2 - Operational Data
SCPA & SCPB

CCR UNIT	MAXIMUM SURFACE ELEVATION (ACRES)	DAM CREST ELEVATION (FEET)	CREST LENGTH (FEET)	NORMAL POOL ELEVATION (FEET)	MAXIMUM SURCHARGE POOL (FEET)	UPSTREAM SLOPE STEEPNESS (H:V)	DOWNSTREAM SLOPE STEEPNESS (H:V)
SCPC	37.5	446.0	5200	441.1	441.9	3H:1V	3H:1V

Ameren Missouri
Sioux Energy Center
CCR Unit Evaluation
Figure 3 - Operational Data SCPC