# Sikeston CCR Surface Impoundment

# Demonstration for a Site-Specific Alternate to Initiation of Closure Deadline

## Sikeston Board of Municipal Utilities

Sikeston Power Station

Project No. 122575

Revision 0
November 13, 2020

# Sikeston CCR Surface Impoundment

# Demonstration for a Site-Specific Alternate to Initiation of Closure Deadline

Prepared for

Sikeston Board of Municipal Utilities
Sikeston Power Station

Project No. 122575
Sikeston, MO

Revision 0
November 13, 2020

Prepared by

Burns & McDonnell Engineering Company, Inc.
Kansas City, Missouri

# INDEX AND CERTIFICATION

## Sikeston Board of Municipal Utilities
## Sikeston CCR Surface Impoundment

## Demonstration for a Site-Specific Alternate to Initiation of Closure Deadline

### Report Index

### Certification

I hereby certify, as a Professional Engineer in the State of Missouri, that the information in this document was assembled under my direct personal charge. This report is not intended or represented to be suitable for reuse by the Sikeston Board of Municipal Utilities or others without specific verification or adaptation by the Engineer. I hereby certify that this Sikeston CCR Surface Impoundment Closure Deadline Extension Demonstration was prepared in accordance with standard engineering practices, and, based on my knowledge, information, and belief, the content of this Demonstration when developed in November 2020 is true and meets the requirements of 40 CFR § 257.103(f)(1).

Steven Hibbard, P.E.
(MO License No. 2015017004)

Date: 11/13/2020

STEVEN
HIBBARD
NUMBER
PE-2015017004

# TABLE OF CONTENTS

# LIST OF ABBREVIATIONS

| **Abbreviation** | **Term/Phrase/Name** |
|---|---|
| AACE | Association for the Advancement of Cost Engineering |
| ASD | Alternate Source Demonstration |
| B&W | Babcock & Wilcox |
| BMcD | Burns & McDonnell |
| CCR | Coal Combustion Residual |
| CFR | Code of Federal Regulations |
| CSC | Compact Submerged Conveyors |
| ELG Rule | Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category |
| EPA | Environmental Protection Agency |
| Gredell Engineering | Gredell Engineering Resources, Inc. |
| GWPS | Groundwater Protection Standards |
| MAX-LP | Mechanical Ash Extractor - Low Profile |
| RCRA | Resource Conservation and Recovery Act |
| SAP | Sampling and Analysis Plan |
| SGC | Submerged Grind Conveyor |
| Sikeston | Sikeston Power Station |
| SBMU | Sikeston Board of Municipal Utilities |
| SSI(s) | Statistically Significant Increases |
| SSL(s) | Statistically Significant Levels |
| UCC | United Conveyor Corporation |

# 1.0 EXECUTIVE SUMMARY

The Sikeston Board of Municipal Utilities (SBMU) was created in 1931 and is charged with the development, purchase, production of and distribution of utility services to approximately 16,318 citizens (about 8,700 commercial, residential, or industrial accounts) of the City of Sikeston in southeast Missouri. SBMU fulfills this mission with respect to electricity by producing power at the Sikeston facility. The facility sells the excess power to other nearby communities in southeast Missouri, including Columbia (120,000-150,000 people), Carthage (15,000-20,000 people), Fulton (13,000 people), and West Plains (10,000 people). This document serves as SBMU's Demonstration for a Site-Specific Alternate to Initiation of Closure Deadline for the CCR surface impoundment known as the Scrubber Sludge/Bottom Ash Pond (Bottom Ash Pond) at the Sikeston Power Station (Sikeston) under the Coal Combustion Residual (CCR) Rule, 40 CFR Part 257, Subpart D. Under this request, the impoundment would continue to receive CCR and non-CCR wastestreams until conversion to a "dry" bottom ash handling system and redirection of other low volume wastestreams are complete. Specifically, to continue operation of Sikeston, SBMU must be allowed additional time to complete the following activities in order to cease routing flow to the Bottom Ash Pond:

- Cease sluicing of bottom ash, economizer, and pyrites to the Bottom Ash Pond by installing a compact submerged conveyor, storage bunker, and ancillary equipment by May 1, 2023.
- Reroute non-CCR wastestreams, boiler blowdown and oil water separator effluent to the existing Process Water Pond by April 29, 2022.
- Reroute non-CCR wastestream, cooling tower blowdown, effluent to a new Low Volume Waste Pond (LVWW) or the existing Process Water Pond by October 15, 2023.

As certified herein, the Bottom Ash Pond is in compliance with all the requirements of the CCR Rule and will remain in compliance until closure of the Surface Impoundment is completed. Regular compliance activities, including required groundwater monitoring and reporting, are continuing, and all required documents have been placed into the facility's Operating Record and posted on the publicly available website. The Bottom Ash Pond is currently in detection monitoring.

Consequently, because of the demonstrated lack of available alternate disposal capacity before April 11, 2021, as well as the compliance status of the Bottom Ash Pond and SBMU's diligent and good faith efforts, SBMU respectfully requests a site-specific alternate deadline of May 1, 2023 if the project scope does not require construction of a Low Volume Wastewater (LVWW) Treatment Pond, with an alternate deadline of October 13, 2023, should the scope include the LVWW Pond.

# 2.0 INTRODUCTION

On April 17, 2015, the Environmental Protection Agency (EPA) issued the federal Coal Combustion Residuals (CCR) Rule, 40 CFR Part 257, Subpart D, to regulate the disposal of CCR materials generated at coal-fired electric generating units. The rule is being administered under Subtitle D of the Resource Conservation and Recovery Act (RCRA, 42 U.S.C. §6901 *et seq*.).

On August 28, 2020, the EPA Administrator issued revisions to the CCR Rule that require all unlined surface impoundments to cease receipt of CCR and non-CCR waste and initiate closure by April 11, 2021, unless the source requests an alternative deadline and EPA approves a new deadline. 40 C.F.R. § 257.101(a)(1) (85 Fed. Reg. 53,516, 53,561 (Aug. 28, 2020)). Specifically, owners and operators of a CCR surface impoundment may seek and obtain an alternative closure deadline by demonstrating that there is currently no alternate 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). Any extensions granted cannot extend past October 15, 2023, except an extension can be granted until October 15, 2024, if the impoundment qualifies as an “eligible unlined CCR surface impoundment” as defined by the rule. 40 C.F.R. § 257.103(f)(1)(vi). 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.

This document serves as SBMU’s Demonstration for a Site-Specific Alternate to Initiation of Closure Deadline pursuant to 40 C.F.R. § 257.103(f)(1) for the Bottom Ash Pond at the Sikeston Power Plant (Sikeston), located near Sikeston, Missouri. The Bottom Ash Pond qualifies as an “eligible unlined CCR surface impoundment” as defined under 40 C.F.R. § 257.53.

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 wastestream must continue to be managed in that CCR surface impoundment because it was technical 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:

- A written narrative discussing the options considered both on and off-site to obtain alternative capacity for each CCR and/or non-CCR wastestreams, 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:
  - An in-depth analysis of the site and any site-specific conditions that led to the decision to select the alternative capacity being developed;
  - An analysis of the adverse impact to plant operations if the CCR surface impoundment in question is no longer available for use; and
  - 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.
- A detailed schedule of the fastest technically feasible time to complete the measures necessary for alternate capacity to be available including a visual timeline representation. The visual timeline must clearly show all of the following:
  - How each phase and the steps within that phase interact with or are dependent on each other and the other phases;
  - All of the steps and phases that can be completed concurrently;
  - The total time needed to obtain the alternative capacity and how long each phase and step within each phase will take; and
  - At a minimum, the following phases: engineering and design, contractor selection, equipment fabrication and delivery, construction, and start up and implementation.
- A narrative discussion of the schedule and visual timeline representation, which must discuss the following:
  - Why the length of time for each phase and step is needed and a discussion of the tasks that occur during the specific step;
  - Why each phase and step shown on the chart must happen in the order it is occurring;
  - The tasks that occur during each of the steps within the phase; and
  - Anticipated worker schedules.

- A narrative discussion of the progress the owner or operator has made to obtain alternative capacity for the CCR and/or non-CCR wastestreams. 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 third criterion above has been met, 40 C.F.R. § 257.103(f)(1)(iv)(B) requires the owner or operator to submit the following information:

- 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;
- 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.
- Constituent concentrations, summarized in table form, at each groundwater monitoring well monitored during each sampling event;
- A description of site hydrogeology including stratigraphic cross-sections;
- Any corrective measures assessment conducted as required at § 257.96;
- Any progress reports on corrective action remedy selection and design and the report of final remedy selection required at § 257.97(a);
- The most recent structural stability assessment required at § 257.73(d); and
- The most recent safety factor assessment required at § 257.73(e).

# 3.0 WORKPLAN

To demonstrate that the criteria in 40 C.F.R. § 257.103(f)(1)(i) and (ii) have been met, the following is a workplan consisting of the elements required by § 257.103(f)(1)(iv)(A). Specifically, this workplan documents that there is no alternative capacity available on or off-site for each of the CCR and/or non-CCR wastestreams that SBMU plans to continue to manage in the Bottom Ash Pond and discusses the options considered for obtaining alternative disposal capacity. As discussed in more detail below, **SBMU has elected to convert to dry ash handling at Sikeston.** The workplan provides a detailed schedule for the conversion 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 convert to dry handling and an analysis of the adverse impact to plant operations if Sikeston were no longer able to use the Bottom Ash Pond.

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

SBMU owns and operates Sikeston, a single-unit (the Unit), 235-megawatt coal-fired facility located in Sikeston, Missouri. Sikeston has two active CCR surface impoundments: the Fly Ash Pond and the Bottom Ash Pond. SBMU converted to a dry fly ash handling system as part of a fuel conversion in 1998. At the initial issuance of the CCR Rule, the Fly Ash Pond was considered an inactive impoundment; however, when the inactive impoundment provisions were vacated in 2016, SBMU decided to continue to utilize the Fly Ash Pond for disposal of the dry fly ash generated onsite that could not be hauled offsite for beneficial use. SBMU will cease utilizing the Fly Ash Pond by April 11, 2021 and thereafter dispose of any excess dry fly ash offsite. By ceasing use of the Fly Ash Pond and commencing closure efforts within the time required by the CCR Rule, SBMU will be minimizing its CCR storage footprint at the plant. Therefore, this extension request pertains exclusively to the Bottom Ash Pond.

The Bottom Ash Pond receives both CCR and non-CCR wastestreams. The pond was constructed between 1978 and 1979 during the initial development of the power plant and put into operation in 1981. It is approximately 61 acres in size with a storage volume of 333 acre-feet. While the impoundment is considered unlined per the requirements of the CCR Rule, it meets all location restriction requirements and the required safety factors. The pond is deemed to be a significant hazard facility. A groundwater monitoring system was developed for the Bottom Ash Pond in 2016-2017, and the CCR Unit remains in detection monitoring. A site plan can be found in Appendix A, and the impoundments are also shown on the site water balance diagram in Appendix B.

### 3.1.1 CCR Wastestreams

SBMU evaluated each CCR wastestream placed in the Bottom Ash Pond at Sikeston. For the reasons discussed below in Table 3-1, the following CCR wastestreams must continue to be placed in the Bottom Ash Pond due to lack of alternative capacity both on and off-site.

**Table 3-1: Sikeston CCR Wastestreams**

| CCR Wastestream | Flow (MGD) | Description | SBMU Notes |
|---|---|---|---|
| Fly Ash | N/A (Dry Handled) | Pneumatically conveyed and collected dry and disposed offsite or for beneficial use, if marketable | For normal operation fly ash will continue to be handled dry using the current system. |
| Bottom Ash | 1.39 | Bottom ash is currently sluiced to the Bottom Ash Pond (via a purge from the circulating water system that is equivalent to cooling tower blowdown), where it is either removed for beneficial use or remains for disposal. The sluice water is drained from the Bottom Ash Pond to the Process Waste Pond and is discharged via Outfall 003. | This wastestream will be eliminated prior to May 1, 2023. A new dry bottom ash system (CSC) will be installed. The dry ash from the CSC system will be collected and sent offsite for beneficial use or transported to a nearby landfill. SBMU is currently evaluating an option for when bottom ash cannot go to beneficial use. |
| Economizer Ash | Included in bottom ash flow | Sluiced to the Bottom Ash Pond with bottom ash | This wastestream will be eliminated prior to May 1, 2023. A new dry economizer ash system will be installed, and the material will either be conveyed to the bottom ash system or the fly ash system. Dry ash will be collected and sent offsite to be used for beneficial use or transported to an offsite landfill. SBMU is currently evaluating an option for when bottom ash cannot go to beneficial use. |
| Mill Rejects also known as Pyrites (non-CCR but handled with CCR wastestreams) | Included in bottom ash flow | Commingled with bottom ash and sluiced via pipe to the Bottom Ash Pond | This wastestream will be eliminated prior to May 1, 2023. A new mill rejects handling system will be installed. The material will be sluiced to the existing bottom ash hopper and commingled with bottom ash before being dewatered and handled dry for beneficial use or transported to landfill. SBMU is currently evaluating an option for when bottom ash cannot go to beneficial use. |

### 3.1.2 Non-CCR Wastestreams

SBMU evaluated each non-CCR wastestream placed in the Bottom Ash Pond at Sikeston. For the reasons discussed below in Table 3-2, each of the following non-CCR wastestreams must continue to be placed in the Bottom Ash Pond due to lack of alternative capacity both on and off-site.

**Table 3-2: Sikeston Non-CCR Wastestreams**

| Non-CCR Wastestream | Flow (MGD) | Description | SBMU Notes |
|---|---|---|---|
| Boiler Blowdown Tank | 0.05 | Collects flow from multiple sources, boiler blowdown is pumped to the Bottom Ash Pond. | This wastestream will be rerouted to the Process Waste prior to April 29, 2022. |
| Oil Water Separator | 0.06 (Intermittent) | Collects flow from multiple sources, the Oil Water Separator is pumped to the Bottom Ash Pond. | This wastestream will be rerouted to the Process Waste Pond prior to April 29, 2022. |
| Cooling Tower Blowdown | 1.39 (Intermittent) | Collects from the cooling tower and is pumped partially through the Boiler blowdown but also used as the main bottom ash system water source. | This flow cannot be rerouted until bottom ash sluicing operations have ceased. This wastestream is the primary contributor of iron in the Plant's discharge stream and the driver in the potential need for a new pond. This wastestream will be rerouted by May 1, 2023 if a new LVWW pond is not required will be rerouted prior to the requested October 13, 2023 site specific deadline to initiate closure. |

The existing site water balance is included in Appendix B of this Demonstration.

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

The plant has adequate space available for the installation of a compact submerged conveyor system and has selected this solution as the preferred alternative for compliance with the ELG and CCR rules. As shown on the site plan in Appendix A, areas of the site not occupied with critical infrastructure are limited in footprint. The remaining impoundments onsite (the Fly Ash Pond and Process Waste Pond) are not or will not be authorized to receive CCR sluice flows. Consequently, in order to continue to operate and generate electricity, Sikeston must continue to use the Bottom Ash Pond for treatment of both CCR and non-CCR wastestreams until the plant can be retrofitted with a dry bottom ash handling system and modifications can be made to support handling non-CCR process flows. Non-CCR process flows, specifically cooling tower blowdown, may require the addition of a new LVWW pond. Preliminary sampling has indicated the cooling tower blowdown is a significant contributor of iron to the Plant's NPDES outfall and currently requires chemical feed to precipitate out the iron in the bottom ash pond. Additional sampling and chemical feed analysis is required and currently on-going to determine if a new LVWW pond is required to facilitate the iron removal to maintain compliance with the NPDES permit after the bottom ash pond is removed from the process or if NPDES permit limits can be managed in the Plant's existing Process Water Pond. As EPA acknowledged in the preamble of the 2015 rule, it is not possible for sites that sluice CCR material to an impoundment to eliminate the impoundment and dispose of the material offsite. See 80 Fed. Reg. 21,301, 21,423 (Apr. 17, 2015) ("[W]hile it is possible to transport dry ash off-site to [an] alternate disposal facility that is simply not feasible for wet-generated CCR. Nor can facilities immediately convert to dry handling systems."). The conditions at Sikeston satisfy the demonstration requirement in § 257.103(f)(1)(i)(A) because there is no alternate capacity on-site or off-site for the storage of wet CCR.

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

As described in Sections 3.1.1, 3.1.2, and 3.1.3 of this demonstration, in order to continue to operate, generate electricity, and comply with both the CCR Rule and the discharge permit conditions, Sikeston must continue to use the Bottom Ash Pond for treatment of both CCR and non-CCR wastestreams until alternate disposal capacity can be developed. If the Bottom Ash Pond were removed from service on April 11, 2021, Sikeston would be required to cease operation during the conversion of the units because it would otherwise not be in compliance with EPA regulations administered under RCRA and the Clean Water Act.

If SBMU were to discontinue unit operation from April 2021 until completion of the conversion project, there would be substantial repercussions. Presently, the SBMU Unit provides electricity to the City of Sikeston and the neighboring municipalities of Columbia, Carthage, Fulton, and West Plains under a power purchase contract. The SBMU Unit also provides electricity via contract to a joint municipal pool of cities.[1] These cities were not offered contract extensions by Associated Electric, Inc. (AECI), and they chose to form an independent power pool as their best option to supply power to their

---

[1] The cities in the pool include the predominantly rural communities of Monett, Mount Vernon, Seymour, Mansfield, Richland, St. Robert, Cabool, Houston, Willow Springs, Newburg, Mountain View, Salem, Cuba, Sullivan, and Steelville.

cities. The SBMU Unit is their primary electricity source with other provider contracts used to supplement the SBMU resource. SBMU uses the income collected from the sale of power generated by the Unit and the end use customers in the City to make its continuing bond payments for the Unit, to purchase power for the City when the Unit is in outage, and to partially or wholly finance large Facility projects, such as this CCR project.

Due to the current arrangements in place, the following injurious and substantial consequences would occur if SBMU does not receive an extension:

- SBMU's capability to provide electricity to the City would be significantly harmed. When the Unit is not operating, it is not able to provide power to the City, nor can it generate income to allow the City to purchase power from other providers. The City has limited emergency funds. These reserves cannot cover the purchase of power on a long-term basis without income from the Unit. It is significant that SBMU only owns one unit as an asset, which limits its ability to have collateral for loans and bonds. Further, SBMU is hampered with only one unit because it cannot simply turn to other units to generate electricity when the Unit is offline, unlike multiple unit generating systems. In summary, if Unit were on furlough for several years, SBMU would not be able to provide power from the Unit to the City due to the loss of generation. SBMU would lose purchase power sales because its long-term contracts with other municipalities would be voided due to lack of performance. SBMU projects that it would not be able to gather enough revenue to purchase power for the City and make its bond payments. In addition, SMBU would not have the revenue to pursue this retrofit project, as discussed in more detail *infra* without continued Unit operation. The overall financial impacts to SBMU and its communities would be substantial.[2] The income stream from the Unit is essential so that SBMU can pursue the environmental projects required for the ELG and CCR Rules and close the impoundments. Without it, power supply to the City would be jeopardized, and SBMU would likely default on its bond payments.
- The Carthage, Missouri area would suffer hardship due to transmission system constraints. The SBMU Unit serves the rural town of Carthage in the southwestern portion of the state. SBMU is under a long-term contract with Carthage to provide the town with power from the Unit. There are transmission system constraints in that area of the grid due to the flow design and/or capacity of the circuits. We understand that the constraints limit Carthage's options for power purchases. If SBMU were not able to provide power to Carthage for a long period of time in the

---

[2] SBMU recognizes that the CCR rule does not allow EPA to consider costs when evaluating the best option for alternative capacity. However, these overall financial impacts of Unit furlough can be considered because they are separate from the alternative capacity decision-making process.

> future, the options of the town to obtain power would be limited. Its emergency peaking generation resources would fall short of customer demand because this generation was not intended as supply for more than several days. Carthage would be placed in an elevated state of operating that would require special actions to ensure coverage of the City load, including more regular use of emergency generation and/or special purchases, if either were available. SBMU's Unit is an essential local power generation resource to enable this portion of the state to meet its power demands without undue hardship.

SMBU asks EPA to consider the dramatic impacts SBMU would face if the extension is not granted. To continue operation of Sikeston, SBMU must be allowed additional time to complete the following activities to cease routing flow to the Bottom Ash Pond:

- Cease sluicing of bottom ash, economizer, and pyrites to the Bottom Ash Pond by installing a compact submerged conveyor, storage bunker, and ancillary equipment.
- Reroute all remaining non-CCR wastestreams to a new LVWW Pond or the existing Process Water Pond.

### 3.1.5 Options Considered Both On and Off-Site to Obtain Alternative Capacity

The options considered for alternative disposal capacity of the wastestreams currently routed to the Bottom Ash Pond are summarized in Table 3-3. For additional details on the CCR and non-CCR wastestreams, please refer to Table 3-1 and Table 3-3, respectively.

**Table 3-3: Alternatives for Disposal Capacity**

| Alternative Capacity Technology | Average Time (Months)[3] | Feasible at Sikeston? | Selected? | SBMU Notes |
|---|---|---|---|---|
| Conversion to dry handling | 33.8 | Yes | Yes | SBMU approved a dry bottom ash conversion in July 2020. The CSC system is currently under design. SBMU expects to complete this project in a total of 31 months. SBMU's time estimate, discussed in detail in Table 3-5, is marginally shorter than average. |

---

[3] From Table 3, See 85 Fed. Reg. at 53,534

| Alternative Capacity Technology | Average Time (Months)[3] | Feasible at Sikeston? | Selected? | SBMU Notes |
|---|---|---|---|---|
| Non-CCR wastewater basin | 23.5 | Yes | Yes | SBMU is currently completing a water sampling effort to determine constituent levels in the non-CCR wastestreams. Completion of the sampling effort and preliminary engineering will determine if a new LVWW pond is required for the cooling tower blowdown or if all of the non-CCR wastestreams can be managed in the existing Process Water Pond. Reroute of the non-CCR wastestreams to the existing Process Water Pond, excluding cooling tower blowdown, can be completed within 17 months. Since the cooling tower blowdown is the primary contributor to the ash sluice water, this reroute cannot be performed until bottom ash sluicing is ceased and will require 29-35 months to complete due to that schedule. |
| Wastewater Treatment Facility | 22.3 | N/A | N/A | Wastestreams may be able to be managed by the existing Process Water Pond, so that a new wastewater treatment facility would not be needed. If wastestreams cannot be managed in this way, the Wastewater Treatment Facility would require similar duration as a new LVWW pond because SBMU's external financing would delay equipment purchase for this option; therefore, if needed, a new LVWW pond is the preferred solution. |
| New CCR surface impoundment | 31 | No | No | A new CCR impoundment alone would not achieve compliance with the ELG rules, and SBMU believes this solution would take longer to permit and construct than the requested duration for the dry ash handling conversion. |
| Retrofit of a CCR surface impoundment | 29.8 | Yes | No | Dry ash handling systems and retrofit of a CCR surface impoundment have a similar compliance timeline. However, the clear benefit to selecting a dry ash handling system for this site is compliance with both CCR and ELG. A retrofit does not allow for compliance with ELG without additional recycle equipment, which would extend the overall compliance duration required for SBMU. |
| Multiple technology system | 39.1 | Yes | Yes | Non-CCR wastestreams (following redirection of the wastestreams) will be managed in new or existing basins. Dry handling of the ash streams will address the necessary compliance needs on the fastest feasible schedule for the site. |

| Alternative Capacity Technology | Average Time (Months)[3] | Feasible at Sikeston? | Selected? | SBMU Notes |
|---|---|---|---|---|
| Temporary treatment system | Variable; Not defined as applied to this site | No | No | This approach is not preferred because it is temporary and cannot realistically provide the required non-CCR wastewater storage capacity to replace the residence time and treatment capacity required of the the Bottom Ash Pond.[4] It also will not achieve compliance with both the CCR and ELG rules[5]. Rerouting flow to a temporary treatment system would require similar modifications to those required to reroute to the existing Process Water Pond or new LVWW pond, and SBMU has chosen to devote resources to completion of the selected project scope rather than a temporary solution. Further, these systems are not proven for CCR management in the industry. |

### 3.1.6 Approach to Obtain Alternative Capacity

SBMU plans to convert to dry handling of CCR at Sikeston. In February 2020, SBMU hired Burns & McDonnell (BMcD) to evaluate potential options for compliance with the Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category (ELG Rule).

**Table 3-4: Dry Handling Alternatives Considered for CCR waste streams**

| System | Technology | Practicability or Feasibility for Sikeston |
|---|---|---|
| Bottom Ash | Under boiler Drag Chain Conveyor System or CSC System | Feasible |
| Bottom Ash | Remote Drag Chain Conveyor System | Feasible. Challenging to add remote pumps and power supply for recirculation not required with other options. |
| Bottom Ash | Dry Belt/Tray Conveying System | Feasible |

---

[4] If Sikeston were to consider alternative temporary solutions to allow for the primary ash pond to be removed from service, such a measure would require the use of approximately 132 frac tanks to provide storage capacity for the daily bottom ash sluicing flow (1.39 million gallons). These tanks would require significant site development for containment measures and significant interconnecting piping which would propose an unacceptable amount of potential for leaks. Furthermore, assuming a solids content of 1% in the comingled wastestreams, approximately 2 of these frac tanks would need to be removed and replaced each day.

[5] Storing flows in temporary tanks for offsite disposal is not feasible at SBMU. The majority of the non-CCR wastestreams are comprised of the cooling tower blowdown flow, which is the primary contributor to the bottom ash sluice flow. The ELG rules (at 40 C.F.R. § 423.16(g)(1)) will soon forbid the discharge of bottom ash transport water to publicly owned treatment works (including the waters comingled with the bottom ash transport water). Consequently, there are no feasible offsite-disposal options for the wet-generated wastestreams at SBMU.

| System | Technology | Practicability or Feasibility for Sikeston |
|---|---|---|
| Bottom Ash | Pneumatic Conveying System | Feasible |
| Bottom Ash | Vibratory Conveying System | Not Practicable; highly intensive labor efforts required and no longer industry standard practice for bottom ash. |
| Bottom Ash | Remote Settling Basins | Not Practicable; highly intensive labor efforts required and both water balance and safety concerns. Challenging to add remote pumps and power supply for recirculation not required with other options. |
| Bottom Ash | Remote Dewatering Bins | Not Practicable; highly intensive labor and efforts required and no longer industry standard practice for bottom ash (replaced by remote conveyors) |

In May 2020, BMcD completed an initial review of scope, indicative cost estimates, and preliminary implementation schedule for the site modifications required to install the CSC technology for bottom ash handling to comply to the CCR Rule and the ELG Rule. Of the feasible under boiler options presented in Table 3-4, CSC technology is expected to have the shortest plant outage requirement because it will not require removal and replacement of the current bottom ash hoppers. The CSC system will likely have a shorter equipment lead time and require a shorter outage time than other dry alternatives. For this and the factors summarized in Table 3-3, SBMU has selected this technology for implementation at Sikeston for compliance with the pending ELG rule requirements to eliminate discharge of ash transport water. During the installation of the CSC system, the Bottom Ash Pond will need to receive CCR and/or non-CCR wastestreams similar to the existing configuration; however, once all waste streams have been eliminated or rerouted, the Bottom Ash Pond can be removed from service and closed.

As part of the review, BMcD received potential equipment layouts and budgetary quotes from both Babcock & Wilcox (B&W) for the Submerged Grind Conveyor (SGC) system and United Conveyor Corporation (UCC) for the Mechanical Ash Extractor - Low Profile (MAX-LP) system. The new CSC system would replace the boiler hopper ash sluicing system. During operation, bottom ash falls from the boiler into the hopper and is routed through the crusher. The crushed ash is removed by the conveyor, which consists of a chain with metal flight bars that drags ash along the bottom of the conveyor to the inclined “dewatering” section. The dewatering section contains a chain conveyor that pulls bottom ash up an inclined ramp while water gravity drains back into the CSC. The inclined ramp drops dewatered ash into a three-walled bottom ash bunker. Typically, ash collects in the bunker and is loaded into haul trucks with a front-end loader. Alternatively, the bunker can be configured so that haul trucks can back into the bunker and accept ash directly.

Economizer ash and pyrites typically require a separate system. Economizer ash will likely be pneumatically conveyed using the existing fly ash vacuum system to route the ash from the existing economizer hoppers to the fly ash silos in a dry condition, thus eliminating the use of ash transport water. The economizer ash could potentially be handled by a series of dry flight conveyors that route the ash from the existing economizer hoppers to the CSC in a dry condition, but additional testing is under development to confirm the marketability of the ash when mixed with bottom ash or fly ash. Existing pyrites piping will be rerouted from the pyrites holding tank to the bottom ash hopper and comingled with the bottom ash. The sluice water for pyrites is not considered ash transport water and are considered pre-combustion waste (i.e. not CCR).

Seal trough and hopper makeup to the existing boiler will be maintained using the existing service water connections. Discharge from these systems, and overflow from the pyrites sluice cycles, continue to be removed by the existing bottom ash hopper overflow via the pyrites holding/overflow tank and underground gravity drain to the Coal/Limestone Run-Off Pond. This non-CCR overflow is classified as quench water rather than transport water and may also be conveyed to a process pond.

Per the BMcD review, conversion to a dry bottom ash handling system such as the CSC at Sikeston would include the following general scope:

- Install one submerged conveyor and two new clinker grinders directly beneath the boiler hoppers to capture, dewater, and convey bottom ash to a nearby bunker for the unit.
- Install a new concrete bunker equipped with drainage trenches to route any contact stormwater or excess quench water to a new sump which will be pumped back to the overflow tank.
- Sluice pyrites to the existing under-boiler hoppers and then transfer to the bunker (within the CSC) along with the bottom ash.
- Discharge overflow water from the bottom ash hopper through the existing overflow to the existing pyrites holding/overflow tank and then reuse for normal hopper operation, slope flushing, and pyrites sluicing through the existing ash hopper service pumps.
- Excess quench water from the overflow tank will go out the existing tank overflow to the Process Waste Pond or be rerouted to the boiler building drain system.

- Economizer ash will be handled dry with the existing fly ash system.
- Ash from the bottom ash bunker will be transported offsite by truck for beneficial use or disposal, similar to current operations for fly ash.

SBMU plans to move forward with installation of the B&W SGC or UCC MAX-LP system, depending on the results of a competitive bid event.

BMcD noted in their review that SBMU is implementing a sampling program to identify treatment requirements for the remaining LVWW streams to determine a path forward for redirecting non-CCR wastestreams away from the Bottom Ash Pond to support pond closure. If no additional treatment is required for these streams, they could be rerouted and discharged through the Process Waste Pond. If additional treatment (chemical feed and additional residence time) is required, SBMU will need to construct a new LVWW pond (or potentially repurpose part of the existing Bottom Ash Pond as a LVWW pond) to handle and treat cooling tower blowdown to meet the NPDES permit limits, particularly iron, prior to discharge via the Process Waste Pond.

### 3.1.7 Technical Infeasibility of Obtaining Alternative Capacity prior to April 11, 2021

Based on the foregoing facts, SBMU cannot cease all CCR and non-CCR wastestreams and initiate closure of the Bottom Ash Pond until the wet-to-dry ash handling conversion is complete and non-CCR wastestreams are rerouted. The Bottom Ash Pond is an eligible surface impoundment not previously subject to closure. Prior to issuance of the Final ELG Rule and Final CCR closure remand revisions, SBMU commissioned a study to place itself in a position to recommend an alternative to the SBMU Board. As described in detail in Section 2.1.6, SBMU will pursue a bottom ash conversion, as a result of this study. SBMU is developing specifications to procure the necessary long-lead equipment items early in 2021. This work is in progress but has not yet completed. The conversion is forecasted to be completed in the late Spring of 2023 as part of that year’s scheduled outage. Non-CCR wastestream reroutes are forecasted to be completed in April 2022 and October 2023, if a LVWW pond is necessary. Consequently, it is not possible to implement the measures discussed above by April 11, 2021.

The conditions at Sikeston demonstrate that no alternative disposal capacity is available on-site or off-site, satisfying the requirement of 40 CFR § 257.103(f)(1)(i), and SBMU respectfully requests a site-specific extension of the deadline to initiate closure of the Bottom Ash Pond until the date on which those actions are expected to be completed.

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

SBMU is requesting an alternative site-specific deadline of October 13, 2023 to cease receipt of CCR wastestreams in the primary ash pond and initiate closure of that CCR Unit. The schedule for developing alternative disposal capacity is described in more detail in Section 3.3. The milestones for progress are summarized in Table 3-5, below. SBMU believes this represents the fastest technically feasible timeframe for compliance at Sikeston. Moreover, the project duration of approximately 31 months from the current stage of scope development (including laser scanning and development of technical specifications for the procurement of the major equipment) until startup of the dry ash handling system is comparable to the average dry ash conversion timeline identified by EPA in the final Part A rule. See Table 3, 85 Fed. Reg. at 53,534. Based on the schedule, SBMU targets installation of the dry bottom ash handling system in the Unit outage planned in the Spring of 2023. With a one unit system, SBMU must take outages when demand is not at its peak during the shoulder months. As explained *infra*, SBMU schedules its annual outages in the spring due to maintenance schedules and lower customer demand.

**Table 3-5: Compliance Project Progress Milestones**

| Year or Progress Reporting Period | Status | Milestone Description | SBMU Notes |
|---|---|---|---|
| 2020 | On Schedule | Detection Monitoring Program and review of alternatives. | The bottom ash, economizer, fly ash, and pyrites wastestreams will be eliminated in the scheduled major outage in Spring of 2023. |
| 2020 | On Schedule | Front End Engineering Design (FEED) study and detailed scope development and specifications for dry bottom ash equipment. Sampling program initiated to determine if LVWW pond is needed | |
| January-March 2021 | On Schedule | Complete Sampling Program to determine if LVWW pond is necessary; Begin work on MDNR/USACE permits if LVWW pond is required | |
| April 30, 2021 | On Schedule | Award LNTP for dry bottom ash equipment. | Detailed design for conveyors and BOP systems, fabrication release, and initiation of permitting activities |

| Year or Progress Reporting Period | Status | Milestone Description | SBMU Notes |
|---|---|---|---|
| October 31, 2021 | On Schedule | Awarded FNTP for dry bottom ash equipment; start fabrication of dry bottom ash equipment. | |
| April 30, 2022 | On Schedule | Prepare detailed design to construct LVWW pond, if necessary; MDNR/USACE permits for LVWW pond complete; Continue fabrication of dry bottom ash equipment. | |
| June-October 2022 | On Schedule | Issue bids for LVWW Pond construction contracts, obtain pricing, review bids, and prepare notice of award | After June 2022, SBMU will be able to pursue a private loan with financial institutions to cover the remainder of the project. SBMU will work on financing concurrently with these tasks. |
| October 31, 2022 | On Schedule | Award construction contracts, perform site preparation activities (including necessary underground relocation), and initiate bunker construction. Site Prep and LVWW Pond construction commences. | Allows contractors to procure necessary commodities to support pre-outage construction before the Spring 2023 major outage. At this juncture, SBMU anticipates receiving the bulk of financing to enable it to have the funds in place to award the contract. |
| April 30, 2023 | On Schedule | Completion of dry bottom ash conversion and re-route of non-CCR wastestreams. Removal of CCR material from existing CCR pond, if required.[6] | Normal flows of CCR wastewater to the Bottom Ash Pond will cease by this date because the Unit will be in outage. Punchlist items will be underway. The new dry ash handling system will be installed therefore SBMU will no longer need CCR disposal capacity upon completion of the dry conversion. |
| October 31, 2023 | On Schedule | Completion of the new LVWW pond, if required. | If required, non-CCR wastestreams will be routed to new LVWW Pond assuming the Process Water Pond cannot serve this function, as described in Table 3-2. SMBU will no longer routing wastestreams to the Bottom Ash Pond. |

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

The required visual timeline representation of the schedule is included in Appendix C of this demonstration and described further in Section 3.3, below.

---

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

The third section for the workplan is a "detailed narrative of the schedule and the timeline discussing all the necessary phases and steps in the workplan, 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 workplan 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

Outage: The primary activity impacting the project schedule is the outage time required for installation of the dry bottom ash handling system. There is a significant amount of work that is scheduled to take place during the unit outage, including removing the existing ash sluicing equipment, installing the new ash and pyrites handling equipment, completing piping ties, completing electrical ties, and performing startup of the new equipment and tuning of the ash and pyrites handling systems. SBMU has an outage scheduled for the spring of each year. It is not feasible to procure the necessary equipment to meet the spring or a fall 2022 outage[7] based on the steps required for internal project approvals/funding, financing, the permitting efforts required for the project, or the lead time required for the equipment (which has not yet been bid but typically takes 9-12 months at a minimum). The current schedule in Appendix C is focused on completion of the design, delivery of the equipment, and completion of pre-outage construction in advance of the Spring 2023 outage.

Financing: As a municipality, SBMU faces unique financial constraints. SBMU's only asset to leverage for loans and bonds is the Unit at the Facility. The Unit is already encumbered under a current bond instrument that will not expire until June 1, 2022. SBMU has no other assets to use as collateral for additional financing until after that date. Without another option, SBMU must self-finance the initial portion of the project until existing bond payments are complete. SBMU is bound by its annual budgets. These budgets are based on the monies flowing in from customer rate payers and sales of electricity to other municipalities. From past experience, SBMU projects that it can self-finance up to $2,000,000 per year from its operating budget for this project. Once the existing bond payments are complete on June 1,

---

[7] Even if the equipment became available in Fall 2022, SBMU's outages are scheduled in the spring due to ongoing maintenance schedules for the Unit, such as the boiler chem clean. With only a single unit, adding or skipping outages presents challenges for the SBMU because it has no ability to shift generation to another unit.

2022, SBMU can use the unencumbered assets as collateral for a bank loan to complete the project. It is estimated that the external financing will require 90-120 days and must be complete prior to entering into contracts to complete the constructions. For purposes of the timeline, SBMU assumes 90 days for financing; however, SBMU may be required to seek additional time if required by a financial institution. SBMU's financing constraints will cause the project work to be conducted in increments, beginning with engineering and equipment procurement, to position SBMU to expeditiously complete the project from June 2022-October 2023. The bulk of expenses must occur no earlier than the second half of 2022.

SBMU has extensively studied its financial portfolio to identify other project financing alternatives, as SBMU is aware that EPA has challenged utilities to pursue financing and approvals as expeditiously as possible. EPA stated in the preamble to the Final Rule that the goal "is to identify capacity that can be obtained in the shortest feasible time" and pushed utilities to pursue faster financing options that are available and within the facility's control. 85 Fed. Reg. at 53529. However, SBMU was not able to identify another option given its limited asset portfolio. In fact, the dedicated annual resources identified in this Request pushes the municipality to its limits. In short, other faster financing options do not exist for the Facility. SBMU notes that these financial constraints have not impacted the selection of the preferred alternative identified in Sections 3.1.5 and 3.1.6, as required by the Rule in Section 257.103(f)(1)(i). The only impact is on the front-end timing of the Project.

Design, Procurement, and Permitting Activities: SBMU has hired BMcD to prepare an Association for Advancement of Cost Engineering (AACE) Class 3 Budgetary and FEED Study to develop preliminary engineering, a Level 2 schedule, and budgetary cost data to support owner review of the proposed dry bottom ash conversion project. This effort typically requires three months to get firm quotes from equipment suppliers and budgetary quotes from local subcontractors and will include laser scanning to identify interferences and firm up project scope. Following budget review and Financial Year (FY) 2021 budget approval for the project based on the FEED Study budget, SBMU will award the contract for the bottom ash equipment engineering.

The balance of plant (BOP) design will continue following issue of the bottom ash equipment bid package and will include procuring site survey and pilot trenching services to support detailed engineering while the equipment vendor prepares the initial submittals for their scope of supply. Once these submittals are approved, the vendor may start with fabrication, and the engineer may complete the detailed design effort based on this information. SBMU and BMcD have estimated this fabrication time at about 9 months after budget approval and approval of vendor submittals, but that will depend on the status of the shop space available with the suppliers due to market demand at the time of award.

The BOP engineer will prepare bid documents for site preparation and below-grade construction, above-grade mechanical/structural construction, and above-grade electrical construction. These contracts will be prepared following award of the CSC package since procurement of the CSC equipment will have the longest lead time and the design for these construction packages will hinge on the submittals received from the CSC vendor. The current schedule includes a total of six months for this design based on BMcD experience with similar projects, including overlapping activities of three months for civil and underground design, three months for structural design of the bunkers and mechanical design (including pipe routing and development of specifications for contractor-supplied materials), and three months for electrical design, including cable tray and conduit routing, lighting plans, grounding plans, etc. SBMU has included two weeks to review, address comments, and issue each contract, and this overlaps as the last three weeks of the total 6-month duration shown for engineering. The construction packages can be issued and awarded concurrently as allowed by the design process and will include a six-week bid period and eight-week selection period. This includes time to review bids, short-list the bidders, interview the short-listed firms, identify the preferred contractor, and negotiate the terms and conditions for the work. The award of these contracts will be awarded as required to meet pre-outage construction schedule requirements. The bid and award of the construction contracts will be performed concurrently with acquiring the necessary permits for this project and must be completed as necessary to support the pre-outage construction. These construction contracts will purchase balance of plant items and commodities such as structural steel, piping, valves, raceway, cable, and other commodities as necessary to support the construction, and these pre-planning and mobilization activities are included in advance of the pre-outage construction period.

Construction Activities: The durations shown on the project are estimates by BMcD. They are based on an average work schedule of five days per week with 10 work hours per day, subject to delays in procuring and delivering new equipment and construction labor. BMcD notes the final time durations in this estimate consider acceleration of construction during limited periods. However long-term overtime and weekend work has been counterproductive on other projects of similar scope, leading to worker fatigue, safety concerns, and unacceptable results. The anticipated scope of work is listed below:

- Consultant/surveyor(s) shall perform and transmit data from site survey (six weeks) and pilot trenching scope (six weeks).
- Contractors shall mobilize to the site as required per the schedule.
- Site Prep and Below Ground Construction Contractor shall complete site preparation and below-grade construction (e.g. utility reroutes, laydown, and parking areas as well as any road improvements required). This activity is expected to take one and a half months.

- Above Ground Mechanical/Structural Contractor shall perform structural excavation, bunker construction, and conveyor support foundations. This must be completed before mechanical erection can begin. This activity is expected to take two months.
- Above Ground Mechanical/Structural Contractor shall install CSC system (estimated at four months of pre-outage work, followed by one month of work during the available outage duration) to include:
  - Receipt of equipment from equipment vendor
  - Installation of support steel and platforms to provide access for the new conveyors.
  - Installation of new submerged conveyors and clinker grinders. Portions outside the unit can be installed before the outage, but the grinders and the conveyors under the hopper will be required to be installed during the major outage.
  - New dry flight conveyors to capture economizer ash and route it to the new CSC system.
  - New bunker sump pumps and piping to route any contact stormwater or excess quench water to the boiler sump.
  - An overflow tank and pumps to allow for the pyrites to be sluiced into the boiler hopper and commingled with the bottom ash.
- The Electrical Contractor will install new electrical equipment (if new motor control centers are required), cable tray, conduit, and cable in accessible areas prior to the outage, as well as install new lighting at the bunker area. During the outage, the Electrical Contractor will terminate the power feeds and finish routing to new equipment following behind the Mechanical Contractor. The current schedule shows two months of pre-outage electrical work and the electrical contractor should finish prior to the end of the unit outage.

Sikeston is currently pursuing a sampling program to determine whether the plant can discharge into the Process Waste Pond. This program entails review of chemical constituents and specifically whether iron effluent requirements can be met. Sikeston will complete three (3) rounds of sampling and analysis to make a final determination, which is anticipated in the first quarter of 2021. If a LVWW pond is necessary, the LVWW pond engineering contract will be prepared in spring 2021. The design basis will be established during a 3-month preliminary design period to inform the same budget approval process outlined for the conveyor system. Following this preliminary design effort, the geotechnical investigation required to inform the berm design and stability analysis for the new pond will be performed and dam permit drawings as well as NPDES permit modification documents will be prepared to assist in obtaining approval from the Missouri Department of Natural Resources and the United States Army Corps of Engineers. This process is estimated to take 6 months to perform the geotechnical investigation and prepare the permit drawings, followed by 6 months to acquire the necessary permits. The detailed design of the new impoundment will not finalize until the permits are received, and this will be followed by a six-week bid period and six-week selection period for the pond construction contract. Following the selection period, a LNTP will be issued to the contractor for pre-planning, procurement, and mobilization. Following securement of external financing, a FNTP will be issued to the contractor to allow construction to begin. The pond construction contractor would have the following general scope (with details to be confirmed during the design phase):

- Contractor will install temporary pond divider structure within the Bottom Ash Pond to isolate the new LVWW pond development area (three to four months).
- Contractor will remove CCR material and any impacted underlying soils from the LVWW pond footprint and consolidate this material in the active Bottom Ash Pond area (two to three months).
- Contractor will construct a permanent pond divider berm (two to three months).
- Contractor will proceed with construction of the LVWW pond, including installing a composite liner system (eight weeks), protective cover (six weeks), and riprap on side slopes (four weeks).
- Contractor will extend existing sluice piping (which Sikeston will continue to use for non-CCR wastestreams such as cooling tower blowdown) to discharge to the new LVWW pond (three weeks).
- Startup and commissioning of new LVWW pond (three weeks).

Once construction of the new LVWW pond and bottom ash handling system are complete, SBMU can begin closing the Bottom Ash Pond. Throughout construction, SBMU will provide ongoing schedule updates in the required semi-annual progress reports as required by the CCR Rule.

## 3.4 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 [of the workplan] 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 workplan 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. The Revised Rule requires a narrative description "of the progress the owner or operator has made to obtain alternative capacity for the CCR and/or non-CCR wastestreams." 40 CFR § 257.103(f)(1)(iv)(A)(4).

Prior to the 2018 *USWAG* decision, SBMU had no indication that the CCR Units, including the Bottom Ash Pond at Sikeston, would be forced to close because the Units had been in detection monitoring. The *USWAG* court vacated 40 CFR § 257.101, which allows unlined impoundments to remain open until proven to impact groundwater and remanded that provision back to EPA. The Court provided little instruction to EPA on remand, leaving sources with considerable regulatory uncertainty. In November 2019, EPA proposed changes to the closure provisions of CCR rule and published those potential changes in the Federal Register in December 2019.

It is important to acknowledge that until EPA's promulgation of final closure rules, utilities such as SBMU, experienced regulatory uncertainty. In addition to CCR Rule uncertainty, SBMU was also waiting to proceed on a bottom ash conversion until the ELG rules for bottom ash transport water were finalized. As a small municipal entity, SBMU cannot initiate large or complex compliance projects based on proposed regulations or court cases with unclear impacts to the facility.

Prior to August 2020, SBMU closely followed CCR and ELG judicial and regulatory developments. Regardless of the regulatory uncertainty from August 2018 to August 2020, SBMU took the following steps to position itself to be ready to recommend an alternative to the SBMU Board:

- SBMU performed internal analyses of regulatory options by completion of a remaining useful life evaluation and revising its Integrated Resources Plan, which are critical to any comprehensive, meaningful evaluation of future sustainability;
- SBMU investigated options for compliance strategies for ELG and CCR. SBMU conducted visits to several sites to review and evaluate three potential dry ash handling technologies by examining the technical feasibility, operational hurdles, and operational "lessons learned" at those facilities;
- SBMU investigated potential alternative capacity options for wet CCR already stored at the site, including options to use or sell the ash for beneficial reuse;

In 2020, SBMU commissioned BMcD to perform an analysis of CCR compliance options for the facility. Based on the proposed rule changes SBMU has evaluated alternatives and selected a preferred bottom ash conversion scenario as described herein. SBMU is in the process of procuring design services to support project development, procurement of the new conveyor system, and detailed design of the ash handling and pond modification projects.

In summary, SBMU has made considerable progress toward creating alternative disposal capacity for the CCR and non-CCR waste streams at Sikeston. The conceptual design has been evaluated and the technical solution for compliance has been identified. As part of this process the equipment suppliers provided budgetary quotes and activities to identify potential interferences. BMcD reviewed the information received from the vendors to complete the preliminary design and develop the overall project scope and AACE Class 4 estimate. The remaining activities are provided in Appendix B and summarized in Table 3-5.

# 4.0 DOCUMENTATION AND CERTIFICATION 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 the Bottom Ash Pond at Sikeston is in compliance with the CCR Rule.

## 4.1 Owner's Certification of Compliance - § 257.103(f)(1)(iv)(B)(1)

In accordance with 40 C.F.R. § 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 CCR surface impoundments at Sikeston, the Bottom Ash Pond 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. Sikeston's CCR compliance website is up-to-date and contains all the necessary documentation and notification postings.

**SIKESTON BOARD OF MUNICIPAL UTILITIES**

Mark E. McGill

Mark E. McGill
(Printed Name)

Plant Manager
(Title)

11/13/2020
(Date)

## 4.2 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), SBMU has attached the following items to this demonstration:

- Map(s) of groundwater monitoring well locations in relation to the CCR unit (Attachment D1)
- Well construction diagrams and drilling logs for all groundwater monitoring wells (Attachment D2)

- Maps that characterize the direction of groundwater flow accounting for seasonal variations (Attachment D3)

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

The two (2) CCR surface impoundments at the Sikeston Power Station are monitored by independent groundwater monitoring systems installed in accordance with § 257.91. Each groundwater monitoring system remains in detection monitoring. In 2020, Sikeston performed successful alternate source demonstrations to account for statistically significant increases (SSI) of certain Appendix III constituents. The SSIs were attributed to alternate sources. A table summarizing constituent concentrations at each groundwater monitoring well from May 18, 2017 to July 21, 2020 is included as Attachment D4. Attachment D4 also includes the most recent alternate source demonstration (dated August 2020) for the Bottom Ash Pond and the Fly Ash Pond (dated September 2020). The most recent annual groundwater monitoring annual reports for the bottom ash pond and the fly ash pond can be found on Sikeston's public website at http://www.sikestonpower.com/bottom-ash-pond.php and http://www.sikestonpower.com/fly-ash-pond.php, respectively.

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

A stratigraphic cross-section of the site is included as Attachment D5.

## 4.5 Groundwater Program Requirements Not Applicable to Sites in Detection Monitoring

Section 257.103(f)(1)(iv)(B)(5)-(6) require that a facility provide its Corrective Measures Assessment and Remedy Selection Progress Reports. The Sikeston Bottom Ash Pond is in detection monitoring. As a result, these requirements do not apply.

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

Pursuant to § 257.73(d), the initial structural stability assessment report for the Bottom Ash Pond was prepared in October 2016 and is included as Attachment D6. As required for compliance, another stability assessment will be completed in 2021.

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

Pursuant to § 257.73(e), the initial safety factor assessment report for the Bottom Ash Pond was prepared in October 2016 and is included as Attachment D7. As required for compliance, another stability assessment will be completed in 2021.

# 5.0 CONCLUSION

Based upon the information submitted in this demonstration, the Bottom Ash Pond at Sikeston qualifies for the site-specific alternate deadline for the initiation of closure as allowed by 40 C.F.R. § 257.103 – Alternate Closure Requirements and specifically 40 C.F.R. § 257.103(f)(1) – Site Specific Alternate to Initiation of Closure Deadline.

Therefore, SBMU requests that EPA approve the demonstration for the Bottom Ash Pond thereby granting an alternate deadline of May 1, 2023 if the dry bottom ash conversion project scope does not require construction of a LVWW Treatment Pond, with an alternate deadline of October 13, 2023, should the scope include the LVWW Treatment Pond. As discussed previously, this date is subject to delays, such as securing external financing, issues in procuring and delivering new bottom ash handling equipment, unanticipated weather, or work force delays. SBMU will update EPA on the project and any potential schedule impacts as part of the semi-annual progress reports required at 40 CFR § 257.103(f)(1)(ix).

# APPENDIX A – SITE PLAN

BURNS McDONNELL

date 5/19/2020

designed A. MYERS

**SIKESTON BMU**

SIKESTON POWER STATION
SITE PLAN

project 122575

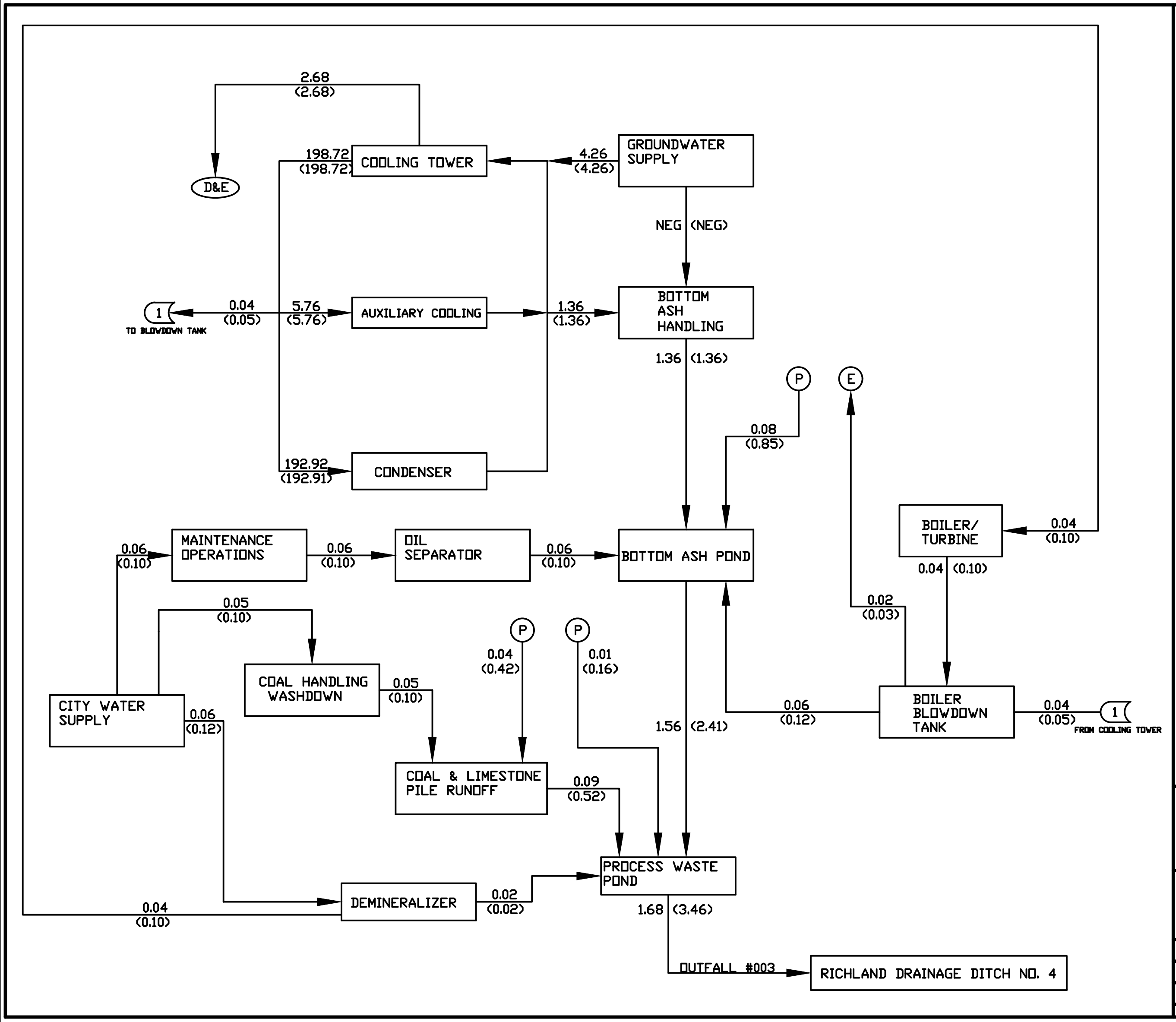
contract -

dwg **FIGURE 1**

6/26/2020

Z:\Clients\ENR\SikestonBMU\122575_BAConvStudy\Design\Civil\Dwgs\Sketches\Figure 1.dgn

# APPENDIX B – WATER BALANCE



Flows in million gallons per day (MGD)

0.00 = Average day

(0.00) = Max Month

P = Net precipitaion (precip minus evaporation)

E = Evaporation

D&E = Drift and evaporation

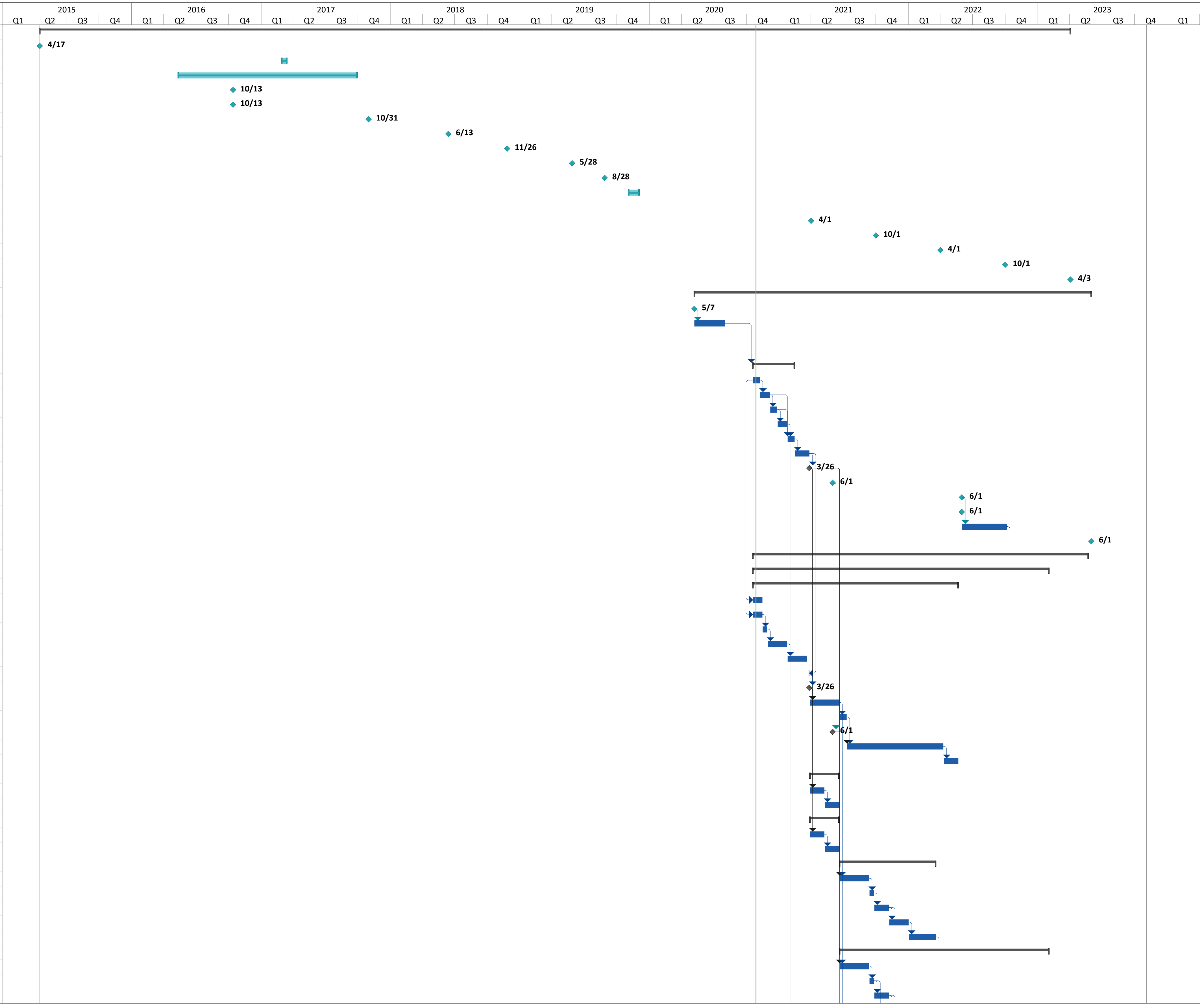
# PROCESS FLOW DIAGRAM

SIKESTON POWER STATION
UNIT NO. 1
Board of Municipal Utilities

DATE: 11/04/2020

# APPENDIX C – SCHEDULE

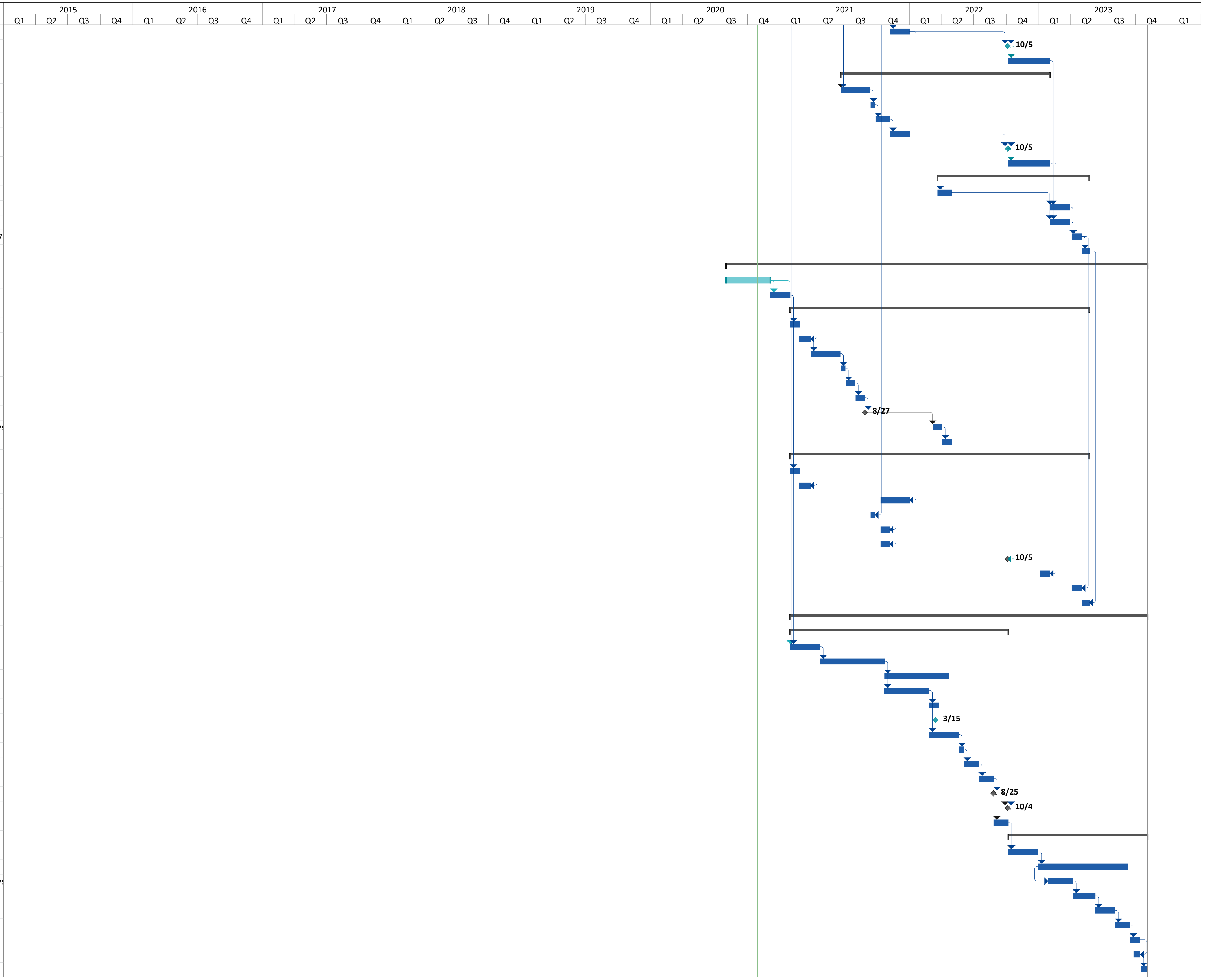
| ID | Task Name | Duration | Start | Finish | Predecessors |
|---|---|---|---|---|---|
| 1 | **CCR Compliance Efforts** | **2076 days** | **Fri 4/17/15** | **Mon 4/3/23** | |
| 2 | Final CCR Rule Published in Federal Register | 0 days | Fri 4/17/15 | Fri 4/17/15 | |
| 3 | Installed Groundwater Monitoring Wells | 10 days | Tue 2/28/17 | Mon 3/13/17 | |
| 4 | Background Groundwater Sampling | 360 days | Thu 5/12/16 | Wed 9/27/17 | |
| 5 | Completed Liner Documentation | 0 days | Thu 10/13/16 | Thu 10/13/16 | |
| 6 | Prepared Surface Impoundment History of Construction | 0 days | Thu 10/13/16 | Thu 10/13/16 | |
| 7 | First Detection Monitoring Samples | 0 days | Tue 10/31/17 | Tue 10/31/17 | |
| 8 | Assessment Monitoring Program - First Round | 0 days | Wed 6/13/18 | Wed 6/13/18 | |
| 9 | Assessment Monitoring Program - Second Round | 0 days | Mon 11/26/18 | Mon 11/26/18 | |
| 10 | Assessment Monitoring Program - Third Round | 0 days | Tue 5/28/19 | Tue 5/28/19 | |
| 11 | Assessment Monitoring Program - Fourth Round | 0 days | Wed 8/28/19 | Wed 8/28/19 | |
| 12 | EPA Published Proposed Draft ELG Rule and CCR Holistic Approach to Closure Part A Rule | 21 days | Mon 11/4/19 | Mon 12/2/19 | |
| 13 | Semi-Annual Progress Report #1 | 0 days | Thu 4/1/21 | Thu 4/1/21 | |
| 14 | Semi-Annual Progress Report #2 | 0 days | Fri 10/1/21 | Fri 10/1/21 | |
| 15 | Semi-Annual Progress Report #3 | 0 days | Fri 4/1/22 | Fri 4/1/22 | |
| 16 | Semi-Annual Progress Report #4 | 0 days | Sat 10/1/22 | Sat 10/1/22 | |
| 17 | Semi-Annual Progress Report #5 | 0 days | Mon 4/3/23 | Mon 4/3/23 | |
| 18 | **Bottom Ash Conversion - Engineering** | **800 days** | **Thu 5/7/20** | **Thu 6/1/23** | |
| 19 | BMcD Issue Draft Screening Level ELG Assessment | 0 days | Thu 5/7/20 | Thu 5/7/20 | |
| 20 | Sikeston BMU Review Alternatives, Select Preferred Option, and Prepare Demonstration for Site-Specific Alternate to Intiation of Closure Deadline | 62 days | Thu 5/7/20 | Fri 7/31/20 | 19 |
| 21 | **AACE Class 3 Budgetary and Feed Study** | **85 days** | **Mon 10/19/20** | **Fri 2/12/21** | **20** |
| 22 | Perform Laser Scan & Transmit Results | 15 days | Mon 10/19/20 | Fri 11/6/20 | |
| 23 | Update Initial Vendor Budget Quotes | 20 days | Mon 11/9/20 | Fri 12/4/20 | 22 |
| 24 | Local Subcontractor Budget Quotes | 15 days | Mon 12/7/20 | Fri 12/25/20 | 23 |
| 25 | Water Balance Investigation | 20 days | Mon 12/28/20 | Fri 1/22/21 | 24 |
| 26 | Finalize Estimate and Report | 15 days | Mon 1/25/21 | Fri 2/12/21 | 25,23,24 |
| 27 | Sikeston BMU Annual Budget Approval | 30 days | Mon 2/15/21 | Fri 3/26/21 | 26 |
| 28 | Engineering FNTP | 0 days | Fri 3/26/21 | Fri 3/26/21 | 27 |
| 29 | FY 2021 Start | 0 days | Tue 6/1/21 | Tue 6/1/21 | |
| 30 | FY 2022 Start | 0 days | Wed 6/1/22 | Wed 6/1/22 | |
| 31 | Existing Bond Payment Complete | 0 days | Wed 6/1/22 | Wed 6/1/22 | |
| 32 | Secure External Financing for Construction | 90 days | Wed 6/1/22 | Tue 10/4/22 | 30 |
| 33 | FY 2023 Start | 0 days | Thu 6/1/23 | Thu 6/1/23 | |
| 34 | **CCR WASTESTREAMS** | **676 days** | **Mon 10/19/20** | **Mon 5/22/23** | |
| 35 | **Bottom Ash Conversion - Procurement** | **597 days** | **Mon 10/19/20** | **Tue 1/31/23** | |
| 36 | **Compact Submerged Conveyor System** | **415 days** | **Mon 10/19/20** | **Fri 5/20/22** | |
| 37 | Develop Technical Specification | 20 days | Mon 10/19/20 | Fri 11/13/20 | 22SS |
| 38 | Develop Commercial Terms | 20 days | Mon 10/19/20 | Fri 11/13/20 | 22SS |
| 39 | Issue Bid Package | 10 days | Mon 11/16/20 | Fri 11/27/20 | 38 |
| 40 | Bid Period | 40 days | Mon 11/30/20 | Fri 1/22/21 | 39 |
| 41 | Bid Evaluation | 40 days | Mon 1/25/21 | Fri 3/19/21 | 40 |
| 42 | 2021 Budget Presentation to Board | 1 day | Fri 3/26/21 | Fri 3/26/21 | 27FF |
| 43 | Award LNTP CSC Contract | 0 days | Fri 3/26/21 | Fri 3/26/21 | 42 |
| 44 | Issue Vendor Submittals | 60 days | Mon 3/29/21 | Fri 6/18/21 | 43 |
| 45 | Review and Approve Submittals | 15 days | Mon 6/21/21 | Fri 7/9/21 | 44 |
| 46 | Award FNTP CSC Contract (After FY 2021 Start) | 0 days | Tue 6/1/21 | Tue 6/1/21 | 29 |
| 47 | Conveyor Fabrication | 195 days | Mon 7/12/21 | Fri 4/8/22 | 45,46 |
| 48 | Delivery Window | 30 days | Mon 4/11/22 | Fri 5/20/22 | 47 |
| 49 | **Site Survey** | **60 days** | **Mon 3/29/21** | **Fri 6/18/21** | |
| 50 | Bid/Negotiate/Award | 30 days | Mon 3/29/21 | Fri 5/7/21 | 28 |
| 51 | Perform & Transmit | 30 days | Mon 5/10/21 | Fri 6/18/21 | 50 |
| 52 | **Pilot Trenching** | **60 days** | **Mon 3/29/21** | **Fri 6/18/21** | |
| 53 | Bid/Negotiate/Award | 30 days | Mon 3/29/21 | Fri 5/7/21 | 28 |
| 54 | Perform & Transmit | 30 days | Mon 5/10/21 | Fri 6/18/21 | 53 |
| 55 | **Site Prep & B/G Constuction** | **195 days** | **Mon 6/21/21** | **Fri 3/18/22** | |
| 56 | Develop Drawings and Specs | 60 days | Mon 6/21/21 | Fri 9/10/21 | 28,44 |
| 57 | Issue Bid Package | 10 days | Mon 9/13/21 | Fri 9/24/21 | 56 |
| 58 | Bid Period | 30 days | Mon 9/27/21 | Fri 11/5/21 | 57 |
| 59 | Bid Evaluation/Award | 40 days | Mon 11/8/21 | Fri 12/31/21 | 58 |
| 60 | Pre-Plan, Procure, and Mobilize | 55 days | Mon 1/3/22 | Fri 3/18/22 | 59 |
| 61 | **A/G Mechanical/Structural Constuction** | **422 days** | **Mon 6/21/21** | **Tue 1/31/23** | |
| 62 | Develop Drawings and Specs | 60 days | Mon 6/21/21 | Fri 9/10/21 | 44,28 |
| 63 | Issue Bid Package | 10 days | Mon 9/13/21 | Fri 9/24/21 | 62 |
| 64 | Bid Period | 30 days | Mon 9/27/21 | Fri 11/5/21 | 63 |



Project: Sikeston CCR Surface Impoundment
Extension Demonstration
Date: Wed 10/28/20

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Task | ▬ | Summary | ⎴ | External Milestone | ◆ | Inactive Summary | ⎴ | Manual Summary Rollup | ▬ | Finish-only | ] | Manual Progress | ▬ |
| Split | ······ | Project Summary | ⎴ | Inactive Task | ▭ | Manual Task | ▬ | Manual Summary | ⎴ | Deadline | ⇩ | | |
| Milestone | ◆ | External Tasks | ▬ | Inactive Milestone | ◇ | Duration-only | ▬ | Start-only | [ | Progress | ▬ | | |

| ID | Task Name | Duration | Start | Finish | Predecessors |
|---|---|---|---|---|---|
| 65 | Bid Evaluation | 40 days | Mon 11/8/21 | Fri 12/31/21 | 64 |
| 66 | Award (after FY 2022 Budget Approval) | 0 days | Wed 10/5/22 | Wed 10/5/22 | 65,32 |
| 67 | Pre-Plan, Procure, and Mobilize | 85 days | Wed 10/5/22 | Tue 1/31/23 | 66 |
| 68 | **A/G Electrical Constuction** | **422 days** | **Mon 6/21/21** | **Tue 1/31/23** | |
| 69 | Develop Drawings and Specs | 60 days | Mon 6/21/21 | Fri 9/10/21 | 44,28 |
| 70 | Issue Bid Package | 10 days | Mon 9/13/21 | Fri 9/24/21 | 69 |
| 71 | Bid Period | 30 days | Mon 9/27/21 | Fri 11/5/21 | 70 |
| 72 | Bid Evaluation | 40 days | Mon 11/8/21 | Fri 12/31/21 | 71 |
| 73 | Award | 0 days | Wed 10/5/22 | Wed 10/5/22 | 72,32 |
| 74 | Pre-Plan, Procure, and Mobilize | 85 days | Wed 10/5/22 | Tue 1/31/23 | 73 |
| 75 | **Bottom Ash Conversion - Construction & Startup** | **306 days** | **Mon 3/21/22** | **Mon 5/22/23** | |
| 76 | Site Prep & B/G Constuction | 30 days | Mon 3/21/22 | Fri 4/29/22 | 60 |
| 77 | A/G Pre-Outage Mech/Struct Construction | 40 days | Wed 2/1/23 | Tue 3/28/23 | 67,76 |
| 78 | A/G Pre-Outage Elect Construction | 40 days | Wed 2/1/23 | Tue 3/28/23 | 74,76 |
| 79 | 2023 Outage | 20 days | Tue 4/4/23 | Mon 5/1/23 | 78FS+4 days,7 |
| 80 | Final Walkdown & Punchlist | 15 days | Tue 5/2/23 | Mon 5/22/23 | 79 |
| 81 | **NON-CCR WASTESTREAMS** | **850 days** | **Sat 8/1/20** | **Fri 11/3/23** | |
| 82 | Water Sampling Program | 90 days | Sat 8/1/20 | Thu 12/3/20 | |
| 83 | Water Balance Investigation | 40 days | Fri 12/4/20 | Thu 1/28/21 | 82 |
| 84 | **Boiler Blowdown/Oil Water Separator** | **602 days** | **Fri 1/29/21** | **Mon 5/22/23** | |
| 85 | Preliminary Design | 20 days | Fri 1/29/21 | Thu 2/25/21 | 83 |
| 86 | Sikeston BMU Annual Budget Approval | 23 days | Wed 2/24/21 | Fri 3/26/21 | 27FF |
| 87 | Develop Drawings and Specs | 60 days | Mon 3/29/21 | Fri 6/18/21 | 86 |
| 88 | Issue Bid Package | 10 days | Mon 6/21/21 | Fri 7/2/21 | 87 |
| 89 | Bid Period | 20 days | Mon 7/5/21 | Fri 7/30/21 | 88 |
| 90 | Bid Evaluation | 20 days | Mon 8/2/21 | Fri 8/27/21 | 89 |
| 91 | Award | 0 days | Fri 8/27/21 | Fri 8/27/21 | 90 |
| 92 | Pre-Plan, Procure, Mobilize | 20 days | Mon 3/7/22 | Fri 4/1/22 | 91FS+135 days |
| 93 | 2022 Outage | 20 days | Mon 4/4/22 | Fri 4/29/22 | 92 |
| 94 | **Cooling Tower Blowdown (IF LVWW NOT REQUIRED)** | **602 days** | **Fri 1/29/21** | **Mon 5/22/23** | |
| 95 | Preliminary Design | 20 days | Fri 1/29/21 | Thu 2/25/21 | 83 |
| 96 | Sikeston BMU Annual Budget Approval | 23 days | Wed 2/24/21 | Fri 3/26/21 | 27FF |
| 97 | Develop Drawings and Specs | 60 days | Mon 10/11/21 | Fri 12/31/21 | 65FF |
| 98 | Issue Bid Package | 10 days | Mon 9/13/21 | Fri 9/24/21 | 63FF |
| 99 | Bid Period | 20 days | Mon 10/11/21 | Fri 11/5/21 | 64FF |
| 100 | Bid Evaluation | 20 days | Mon 10/11/21 | Fri 11/5/21 | 58FF |
| 101 | Award | 0 days | Wed 10/5/22 | Wed 10/5/22 | 66FF |
| 102 | Pre-Plan, Procure, Mobilize | 20 days | Wed 1/4/23 | Tue 1/31/23 | 74FF |
| 103 | 2023 Outage | 20 days | Tue 4/4/23 | Mon 5/1/23 | 79FF |
| 104 | Final Walkdown & Punchlist | 15 days | Tue 5/2/23 | Mon 5/22/23 | 80FF |
| 105 | **Cooling Tower Blowdown (IF LVWW POND REQUIRED)** | **721 days** | **Fri 1/29/21** | **Fri 11/3/23** | |
| 106 | **LVWW Pond Design** | **440 days** | **Fri 1/29/21** | **Thu 10/6/22** | |
| 107 | Preliminary Design | 60 days | Fri 1/29/21 | Thu 4/22/21 | 25,82,83 |
| 108 | Geotech Investigation/Permit Drawing Development | 130 days | Fri 4/23/21 | Thu 10/21/21 | 107 |
| 109 | Permitting with MDNR/USACE | 130 days | Fri 10/22/21 | Thu 4/21/22 | 108 |
| 110 | Detailed Design | 90 days | Fri 10/22/21 | Thu 2/24/22 | 108 |
| 111 | Develop Budget Estimate | 20 days | Fri 2/25/22 | Thu 3/24/22 | 110 |
| 112 | 2022 FY Budget Presentation to Board | 0 days | Tue 3/15/22 | Tue 3/15/22 | |
| 113 | Develop Drawings and Specs | 60 days | Fri 2/25/22 | Thu 5/19/22 | 110 |
| 114 | Issue Bid Package | 10 days | Fri 5/20/22 | Thu 6/2/22 | 113 |
| 115 | Bid Period | 30 days | Fri 6/3/22 | Thu 7/14/22 | 114 |
| 116 | Bid Evaluation | 30 days | Fri 7/15/22 | Thu 8/25/22 | 115 |
| 117 | Award LNTP | 0 days | Thu 8/25/22 | Thu 8/25/22 | 116 |
| 118 | Award FNTP | 0 days | Tue 10/4/22 | Tue 10/4/22 | 117,32 |
| 119 | Pre-Plan, Procure, and Mobilize | 30 days | Fri 8/26/22 | Thu 10/6/22 | 117 |
| 120 | **LVWW Pond Construction & Startup** | **281 days** | **Fri 10/7/22** | **Fri 11/3/23** | |
| 121 | Site Prep & Sheet Pile Wall Installation | 60 days | Fri 10/7/22 | Thu 12/29/22 | 119,118 |
| 122 | Dewatering | 180 days | Fri 12/30/22 | Thu 9/7/23 | 121 |
| 123 | Remove CCR & Underlying Soil from Portion of Pond Bottom | 50 days | Fri 1/27/23 | Thu 4/6/23 | 122SS+20 days |
| 124 | Build Divider Berm Construction | 45 days | Fri 4/7/23 | Thu 6/8/23 | 123 |
| 125 | Install Composite Liner System | 40 days | Fri 6/9/23 | Thu 8/3/23 | 124 |
| 126 | Install Protective Cover | 30 days | Fri 8/4/23 | Thu 9/14/23 | 125 |
| 127 | Install Riprap on Pond Slopes | 20 days | Fri 9/15/23 | Thu 10/12/23 | 126 |
| 128 | Reroute Piping to new LVWW Pond | 15 days | Mon 9/25/23 | Fri 10/13/23 | 127FF+1 day |
| 129 | Final Walkdown & Punchlist | 15 days | Mon 10/16/23 | Fri 11/3/23 | 128 |

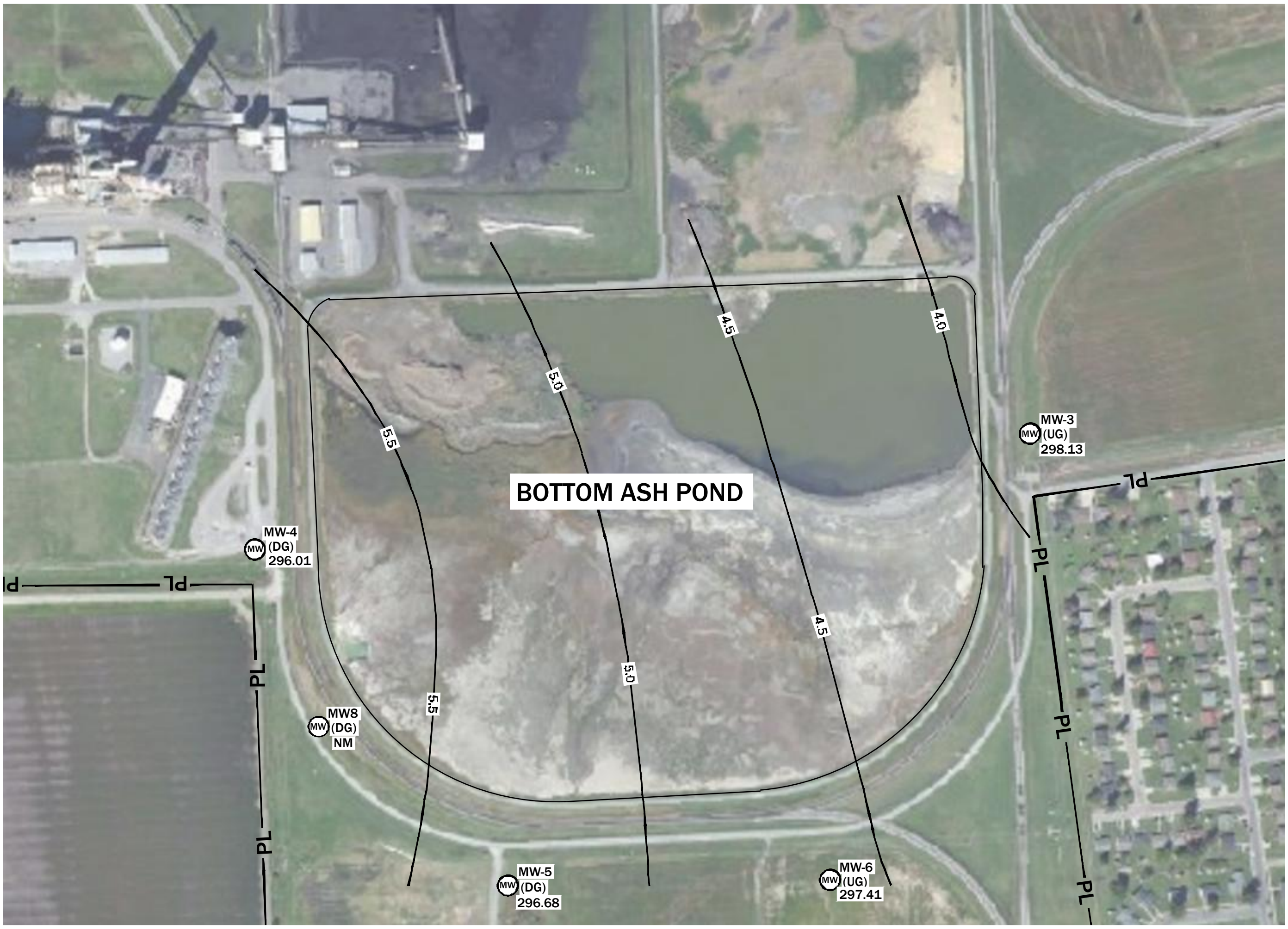


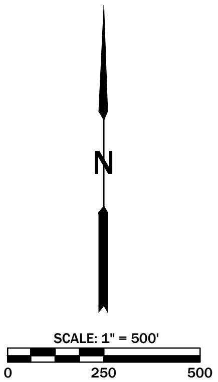
Project: Sikeston CCR Surface Impoundment
Extension Demonstration
Date: Wed 10/28/20

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Task | ▬ | Summary | ┌─┐ | External Milestone | ◆ | Inactive Summary | ┌─┐ | Manual Summary Rollup | ▬ | Finish-only | ] | Manual Progress | ─ |
| Split | ⋯⋯ | Project Summary | ┌─┐ | Inactive Task | ▭ | Manual Task | ▬ | Manual Summary | ┌─┐ | Deadline | ⇩ | | |
| Milestone | ◆ | External Tasks | ▬ | Inactive Milestone | ◇ | Duration-only | ▬ | Start-only | [ | Progress | ─ | | |

# APPENDIX D – COMPLIANCE DOCUMENTS

# ATTACHMENT D1 – GROUNDWATER MONITORING WELL LOCATIONS





**LEGEND**

| | |
|---|---|
| PROPERTY LINE (APPROXIMATE) | ——PL—— |
| VERTICAL SEPARATION ISOPACH (BASED ON 5-12-16 MEASUREMENTS) | —— 5.0 —— |
| NOT MEASURED | NM |
| MONITORING WELL | MW |
| UP GRADIENT MONITORING LOCATION | UG |
| DOWN GRADIENT MONITORING LOCATION | DG |

**NOTES:**

1. IMAGE PROVIDED BY BING MAPS.
2. MONITORING WELL LOCATIONS/ELEVATIONS SURVEYED BY BOWEN ENGINEERING & SURVEYING.
3. GROUNDWATER ELEVATION MEASUREMENTS BY GREDELL ENGINEERING RESOURCES ON 5-12-16.
4. MAP DEVELOPMENT BASED ON CONTOURS GENERATED BY SURFER® SOFTWARE.

SIKESTON POWER STATION
LOCATION RESTRICTIONS - PLACEMENT ABOVE THE UPPERMOST AQUIFIER

**GREDELL Engineering Resources, Inc.**

ENVIRONMENTAL ENGINEERING LAND - AIR - WATER
1505 East High Street Telephone: (573) 659-9078
Jefferson City, Missouri Facsimile: (573) 659-9079
MO CORP. ENGINEERING LICENSE NO. E-2001001669-D

FIGURE 4 - VERTICAL SEPARATION ISOPACH MAP

| DATE | SCALE | PROJECT NAME | REVISION |
|---|---|---|---|
| 10/2018 | AS NOTED | SIKESTON | |
| DRAWN | APPROVED | FILE NAME | SHEET # |
| CP | MCC | LOCATION RESTRICTION | 1 OF 1 |

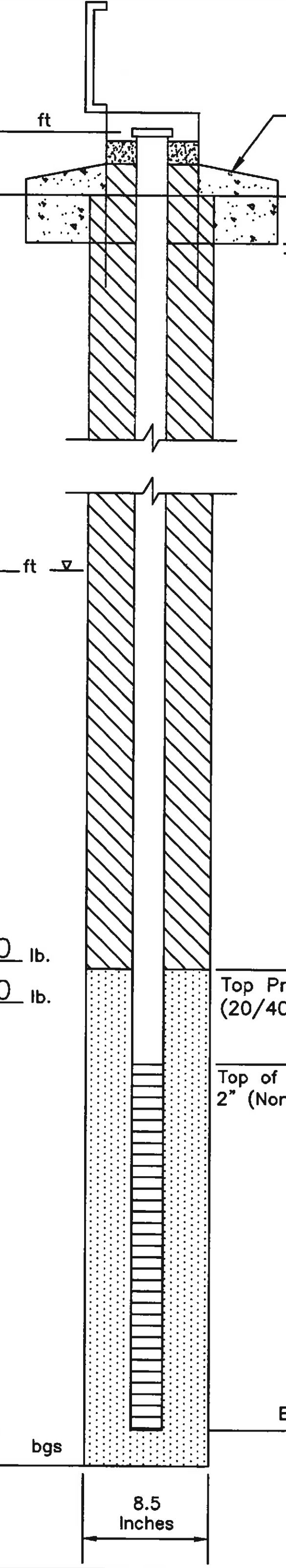
M:\Share\CADDFiles\SIKESTON\LOCATION RESTRICTIONS\MAX HIGH WATER TABLE MAP.dwg, FIGURE 4 - VERTICAL SEPARATION ISOCAH MAP, 10/9/2018 2:03:05 PM

# ATTACHMENT D2 – WELL CONSTRUCTION DOCUMENTS

# ATTACHMENT D2

# GROUNDWATER MONITORING SYSTEM – BOTTOM ASH POND

# MONITORING WELL CONSTRUCTION DIAGRAMS
# AND
# DRILLING LOGS



Top Casing Elev: 308.55 ft

Ground Surface Elev: 306.11 ft

Top Bentonite (Slurry) Seal 304.1 ft

Top Groundwater: 298.13 ft

**Well Construction Quantities:**

1. Primary Filter Sand – 80 lb.
2. Bentonite – 300 lb.

Top Primary Filter Pack 284.0 ft
(20/40 Sand/Natural Formation):

Top of Screen (10 – Slot): 281.5 ft
2" (Nominal) Schedule 40 PVC ( 10 ft Length)

**Coordinates**

N: 381130.00
E: 1079946.62

Base Sump: 37.21' btoc / Elev: 271.34 ft

Bottom Hole Depth: 35.5' bgs

**TPZ-3/ MW-3**

**PIEZOMETER 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 Piezometer Completed: 4-26-16

**SBMU - Sikeston Power Station**

**Site Characterization - NPDES Compliance**

| DATE | SCALE | DRAWN BY: | APPROVED BY: |
|---|---|---|---|
| 11/2016 | N.T.S. | AJK | MCC |

M:\Share\CADDFiles\SIKESTON\DSI\PIEZOMETER CONSTRUCTION DIAGRAMS 2016.dwg, TPZ-3, 11/4/2016 3:30:02 PM

**GREDELL Engineering Resources, Inc.**

# BORING LOG TPZ-3/MW-3

**NPDES Site Characterization**
**Sikeston, MO**

**CLIENT:** SBMU-SPS

**LOCATION:** See Plan of Boring Locations
**G.S. ELEVATION:** 306.1 **T.O.C. ELEVATION:** 308.55
**NORTHING:** 381130.00 **EASTING:** 1079946.62

| DEPTH (FEET) | ELEVATION | WELL CONSTRUCTION DIAGRAM | WATER TABLE | GRAPHIC LOG | SAMPLE TYPE | PERCENT RECOVERY | DESCRIPTION | FACIES I.D. | LITHOLOGY | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | CLAY | SILTY CLAY | SILT | VF SAND | F SAND | M SAND | C SAND | VC SAND | SM GRAVEL | LG GRAVEL |
| 0 | 306 | | | | | | SILTY SAND: Very dark brown (10YR 2/2), some clay, with roots. | | | | | | | | | | | |
| 2 | 304 | | | | | 88 | SAND: Dark yellowish brown (10YR 4/6), fine-grained sand, few silt and very fine-grained sand, strong brown (7.5YR 5/8) staining or mottling, few 1/4 inch-diameter cemented concretions. | | | | | | | | | | | |
| 4 | 302 | | | | | | | | | | | | | | | | | |
| 6 | 300 | | | | | | SAND: Dark yellowish brown (10YR 4/6), fine-grained sand, few very fine-grained sand, trace medium-grained sand, round. | | | | | | | | | | | |
| 8 | 298 | | | | | 67 | | | | | | | | | | | | |
| 10 | 296 | | | | | | SAND: Dark yellowish brown (10YR 3/4), fine-grained sand, trace medium-grained sand, trace coarse-grained sand, round. | | | | | | | | | | | |

**DRILLING CO.:** Smith & Company
**DRILLER:** F. Deken
**LOGGED BY:** Ken Ewers, R.G.
**DATE DRILLED:** 4-26-2016
**START TIME:** 0832 4-26-2016
**END TIME:** 0940 4-26-2016
**BOREHOLE DIA.:** 8.5 in.

*STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.*

**NOTES:** Offset boring developed on 5-9-2016 for SPT sampling.

**WATER LEVELS:** DURING DRILLING NA FEET
AFTER DRILLING: 298.13 FEET
DATE: 5-12-2016
**PIEZOMETER:** INSTALLED AT +/- 34.8 FEET
**VERTICAL DATUM:** NAVD 1988
**HORIZONTAL DATUM:** NAD 1983
**WEATHER:** 71 degrees, wind south 10 MPH, sunny.

Date Printed: 8/23/2017

# GREDELL Engineering Resources, Inc.

# BORING LOG TPZ-3/MW-3

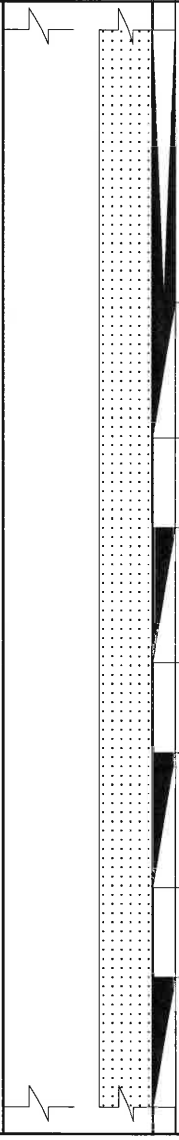
**NPDES Site Characterization**
**Sikeston, MO**

**CLIENT:** SBMU-SPS

**LOCATION:** See Plan of Boring Locations

**G.S. ELEVATION:** 306.1 **T.O.C. ELEVATION:** 308.55

**NORTHING:** 381130.00 **EASTING:** 1079946.62



| DEPTH (FEET) | ELEVATION | PERCENT RECOVERY | DESCRIPTION | FACIES I.D. | LITHOLOGY | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | CLAY | SILTY CLAY | SILT | VF SAND | F SAND | M SAND | C SAND | VC SAND | SM GRAVEL | LG GRAVEL |
| 12 | 294 | | | | | | | | | | | | | |
| | | 70 | | | | | | | | | | | | |
| 14 | 292 | | | | | | | | | | | | | |
| | | 100 | SAND: Brown (10YR 5/3), fine- to medium-grained sand, round to sub-round; trace silt, medium dense. | | | | | | | | | | | |
| 16 | 290 | | | | | | | | | | | | | |
| | | | SAND: Brown (10YR 5/3), fine- to medium-grained sand, trace medium-to coarse-grained sand, round to sub-round, medium dense. | | | | | | | | | | | |
| 18 | 288 | 72 | | | | | | | | | | | | |
| | | | SAND: Brown (10YR 5/3), fine-grained sand, medium dense. | | | | | | | | | | | |
| 20 | 286 | 78 | | | | | | | | | | | | |
| | | | SAND: Brown (10YR 5/3), fine-grained sand, medium dense, few reddish laminae underlain by black laminae. | | | | | | | | | | | |
| 22 | 284 | | | | | | | | | | | | | |
| | | 83 | SAND: Brown (10YR 4/3), fine-grained sand, trace medium- to coarse-grained sand, trace very coarse lignite, medium dense. | | | | | | | | | | | |

**DRILLING CO.:** Smith & Company
**DRILLER:** F. Deken
**LOGGED BY:** Ken Ewers, R.G.
**DATE DRILLED:** 4-26-2016
**START TIME:** 0832 4-26-2016
**END TIME:** 0940 4-26-2016
**BOREHOLE DIA.:** 8.5 in.

*STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.*

**NOTES:** Offset boring developed on 5-9-2016 for SPT sampling.

**WATER LEVELS:** DURING DRILLING NA FEET
AFTER DRILLING: 298.13 FEET
DATE: 5-12-2016

**PIEZOMETER:** INSTALLED AT +/- 34.8 FEET

**VERTICAL DATUM:** NAVD 1988
**HORIZONTAL DATUM:** NAD 1983
**WEATHER:** 71 degrees, wind south 10 MPH, sunny.

Date Printed: 8/23/2017

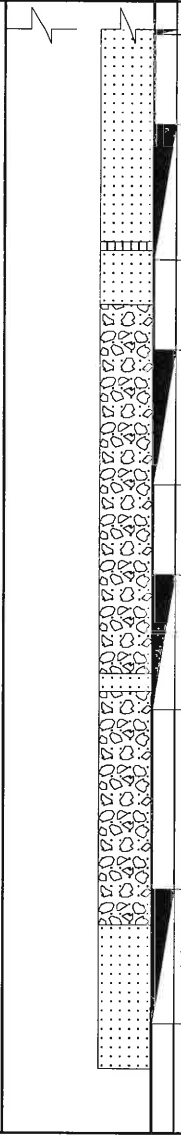
**GREDELL Engineering Resources, Inc.**

# BORING LOG TPZ-3/MW-3

**NPDES Site Characterization**
**Sikeston, MO**

**CLIENT:** SBMU-SPS

**LOCATION:** See Plan of Boring Locations
**G.S. ELEVATION:** 306.1 **T.O.C. ELEVATION:** 308.55
**NORTHING:** 381130.00 **EASTING:** 1079946.62



| | | | | | LITHOLOGY | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (FEET) | ELEVATION | PERCENT RECOVERY | DESCRIPTION | FACIES I.D. | CLAY | SILTY CLAY | SILT | VF SAND | F SAND | M SAND | C SAND | VC SAND | SM GRAVEL | LG GRAVEL |
| 24 | 282 | | | | | | | | | | | | | |
| 26 | 280 | 83 | SAND: Brown (10YR 4/3), medium-grained sand, few fine-grained sand, trace coarse-grained sand, trace woody (incipient) lignite, loose. | | | | | | | | | | | |
| | | | SILT: Very dark brown (10YR 2/2), well sorted, loose. | | | | | | | | | | | |
| 28 | 278 | 89 | SAND: Brown (10YR 4/3), medium-grained sand, few fine-grained sand, trace coarse-grained sand, trace woody (incipient) lignite, loose. | | | | | | | | | | | |
| | | | SAND: Dark brown (10YR 3/3), medium- to coarse-grained sand, little small and large gravel, little coarse-grained sand, medium dense, poorly sorted, sand is round to sub-round, gravel is sub-round to angular. | | | | | | | | | | | |
| 30 | 276 | 89 | SAND: Grayish brown (10YR 5/2), Coarse-grained sand, little small and large gravel, sub-round to sub-angular; little medium- to fine-grained sand, sub-round, loose to medium dense, poorly sorted. | | | | | | | | | | | |
| 32 | 274 | | SAND: Grayish brown (10YR 5/2) fine- to medium-grained sand, loose. | | | | | | | | | | | |
| | | | SAND: Grayish brown (10YR 5/2), Coarse-grained sand, little small and large gravel, sub-round to sub-angular; little medium- to fine-grained sand, sub-round; loose to medium dense, poorly sorted. | | | | | | | | | | | |
| 34 | 272 | 100 | SAND: Grayish brown (10YR 5/2) fine- to medium-grained sand, little medium-grained sand, few lignite-rich laminae, trace very fine-grained sand, round, medium dense. | | | | | | | | | | | |
| | | | Boring Terminated at 35.5 feet in SAND. | | | | | | | | | | | |

**DRILLING CO.:** Smith & Company
**DRILLER:** F. Deken
**LOGGED BY:** Ken Ewers, R.G.
**DATE DRILLED:** 4-26-2016
**START TIME:** 0832 4-26-2016
**END TIME:** 0940 4-26-2016
**BOREHOLE DIA.:** 8.5 in.

*STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.*

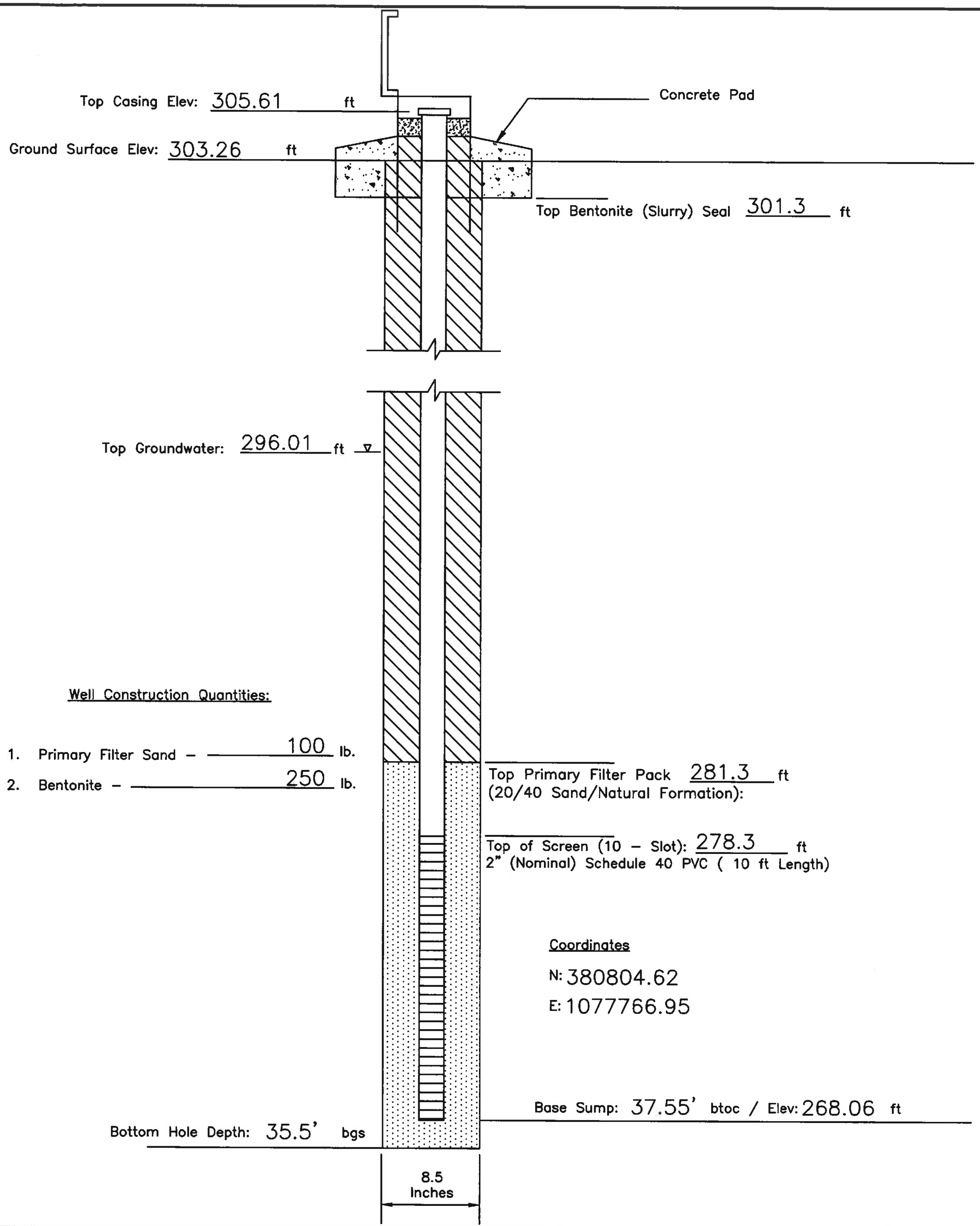
**NOTES:** Offset boring developed on 5-9-2016 for SPT sampling.

**WATER LEVELS:** DURING DRILLING NA FEET
AFTER DRILLING: 298.13 FEET
DATE: 5-12-2016

**PIEZOMETER:** INSTALLED AT +/- 34.8 FEET

**VERTICAL DATUM:** NAVD 1988
**HORIZONTAL DATUM:** NAD 1983
**WEATHER:** 71 degrees, wind south 10 MPH, sunny.

Date Printed: 8/23/2017



Top Casing Elev: 305.61 ft

Ground Surface Elev: 303.26 ft

Top Bentonite (Slurry) Seal 301.3 ft

Top Groundwater: 296.01 ft ▽

**Well Construction Quantities:**

1. Primary Filter Sand – 100 lb.
2. Bentonite – 250 lb.

Top Primary Filter Pack 281.3 ft
(20/40 Sand/Natural Formation):

Top of Screen (10 – Slot): 278.3 ft
2" (Nominal) Schedule 40 PVC ( 10 ft Length)

**Coordinates**

N: 380804.62
E: 1077766.95

Base Sump: 37.55' btoc / Elev: 268.06 ft

Bottom Hole Depth: 35.5' bgs

## TPZ-4/
## MW-4

## PIEZOMETER CONSTRUCTION DIAGRAM

## GREDELL Engineering Resources, Inc.

ENVIRONMENTAL ENGINEERING

LAND AIR WATER

Date Piezometer Completed:
4-27-16

**SBMU - Sikeston Power Station**

Site Characterization - NPDES Compliance

1505 East High Street
Jefferson City, Missouri 65101

Telephone: (573) 659-9078
Facsimile: (573) 659-9079

| DATE | SCALE | DRAWN BY: | APPROVED BY: |
|---|---|---|---|
| 11/2016 | N.T.S. | AJK | MCC |

M:\Share\CADDFiles\SIKESTON\DS\PIEZOMETER CONSTRUCTION DIAGRAMS 2016.dwg, TPZ-4, 11/4/2016 3:30:02 PM

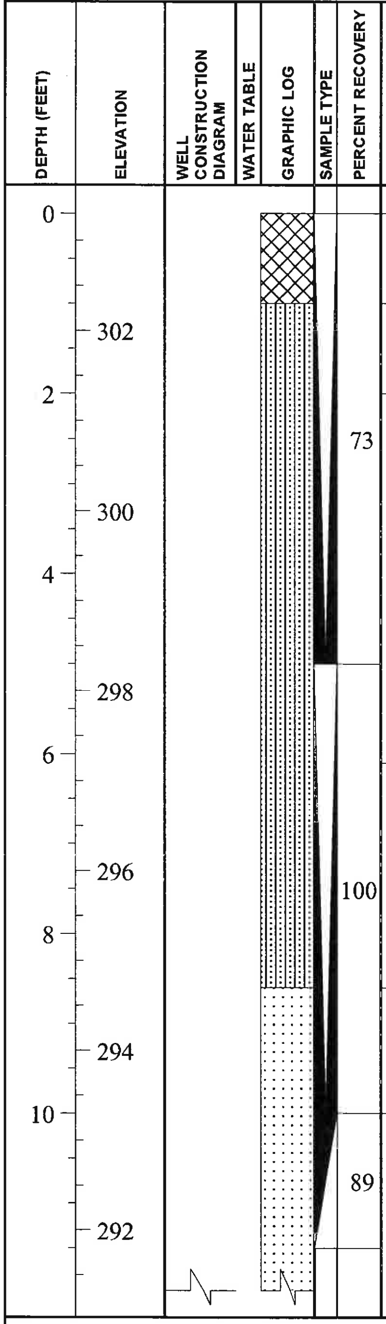
# GREDELL Engineering Resources, Inc.

# BORING LOG TPZ-4/MW-4

**NPDES Site Characterization**
**Sikeston, MO**

**CLIENT:** SBMU-SPS

**LOCATION:** See Plan of Boring Locations
**G.S. ELEVATION:** 303.3 **T.O.C. ELEVATION:** 305.61
**NORTHING:** 380804.62 **EASTING:** 1077766.95



| DESCRIPTION | FACIES I.D. |
|---|---|
| FILL: Crushed stone. | |
| SILTY SAND: Brown (7.5YR 4/4), fine-grained sand, some silt, trace medium-grained sand, round, gradational lower contact. | |
| SILTY SAND: Brown (7.5YR 4/4), fine- to medium-grained sand, some silt, round. | |
| SILTY SAND: Dark gray (7.5YR 4/1), fine-grained sand, some silt, few 1-inch thick lenses of clayey silt, few laminae of sandy silt. | |
| SAND: Brown (7.5YR 5/4), fine- to medium-grained sand, trace small gravel, trace coarse-grained sand, round. | |
| SAND: Brown (10YR 5/3), medium-grained sand, round to sub-round; trace silt, trace coarse-grained sand, sub-round; medium dense. | |

| LITHOLOGY | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CLAY | SILTY CLAY | SILT | VF SAND | F SAND | M SAND | C SAND | VC SAND | SM GRAVEL | LG GRAVEL |

**DRILLING CO.:** Smith & Company
**DRILLER:** F. Deken
**LOGGED BY:** Ken Ewers, R.G.
**DATE DRILLED:** 4-26-2016
**START TIME:** 1610 4-26-2016
**END TIME:** 0838 4-27-2016
**BOREHOLE DIA.:** 8.5 in.

*STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.*

**NOTES:** Offset boring developed on 5-10-2016 for SPT sampling.

**WATER LEVELS:** DURING DRILLING NA FEET
AFTER DRILLING: 296.01 FEET
DATE: 5-12-2016
**PIEZOMETER:** INSTALLED AT +/- 35.2 FEET
**VERTICAL DATUM:** NAVD 1988
**HORIZONTAL DATUM:** NAD 1983
**WEATHER:** 71 degrees, wind south 10 MPH, sunny.

# GREDELL Engineering Resources, Inc.

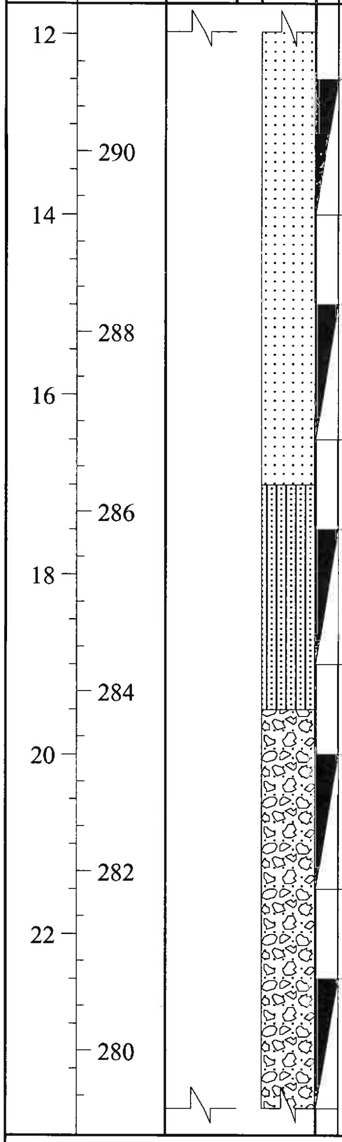
# BORING LOG TPZ-4/MW-4

**NPDES Site Characterization**
**Sikeston, MO**

**CLIENT: SBMU-SPS**

**LOCATION:** See Plan of Boring Locations
**G.S. ELEVATION:** 303.3 **T.O.C. ELEVATION:** 305.61
**NORTHING:** 380804.62 **EASTING:** 1077766.95

DEPTH (FEET) | ELEVATION | WELL CONSTRUCTION DIAGRAM | WATER TABLE | GRAPHIC LOG | SAMPLE TYPE | PERCENT RECOVERY | DESCRIPTION | FACIES I.D. | LITHOLOGY: CLAY, SILTY CLAY, SILT, VF SAND, F SAND, M SAND, C SAND, VC SAND, SM GRAVEL, LG GRAVEL



| PERCENT RECOVERY | DESCRIPTION |
|---|---|
| 50 | SAND: Brown (10YR 5/3), medium-grained sand, round to sub-round; trace silt, trace coarse-grained sand, sub-round; trace small gravel, sub-round; medium dense. |
| 100 | SAND: Brown (10YR 5/3), medium-grained sand, round to sub-round; trace silt, trace coarse-grained sand, sub-round; trace small gravel, sub-round; medium dense, few 1-inch thick dark gray silty lenses |
| | SAND: Gray (10YR 5/1), medium-grained sand, few silt, trace fine-grained sand, medium dense. |
| 83 | SILTY SAND: Dark gray (10YR 4/1), fine-grained sand, some silt, few medium-grained sand, round, medium dense; few 1/2 inch-thick silt lenses; black lamination at 17.5 feet. |
| 89 | SAND: Grayish brown (10YR 5/2), medium-grained sand, round to sub-round; few small gravel, angular; few coarse sand, angular; medium dense. |
| 50 | SAND: Grayish brown (10YR 5/2), medium-grained sand, round; some fine-grained sand, round; few small gravel, very angular; trace coarse-grained sand, medium dense. |

**DRILLING CO.:** Smith & Company
**DRILLER:** F. Deken
**LOGGED BY:** Ken Ewers, R.G.
**DATE DRILLED:** 4-26-2016
**START TIME:** 1610 4-26-2016
**END TIME:** 0838 4-27-2016
**BOREHOLE DIA.:** 8.5 in.

*STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.*

**NOTES:** Offset boring developed on 5-10-2016 for SPT sampling.

**WATER LEVELS:** DURING DRILLING NA FEET
AFTER DRILLING: 296.01 FEET
DATE: 5-12-2016

**PIEZOMETER:** INSTALLED AT +/- 35.2 FEET

**VERTICAL DATUM:** NAVD 1988
**HORIZONTAL DATUM:** NAD 1983
**WEATHER:** 71 degrees, wind south 10 MPH, sunny.

Date Printed: 8/23/2017

# GREDELL Engineering Resources, Inc.

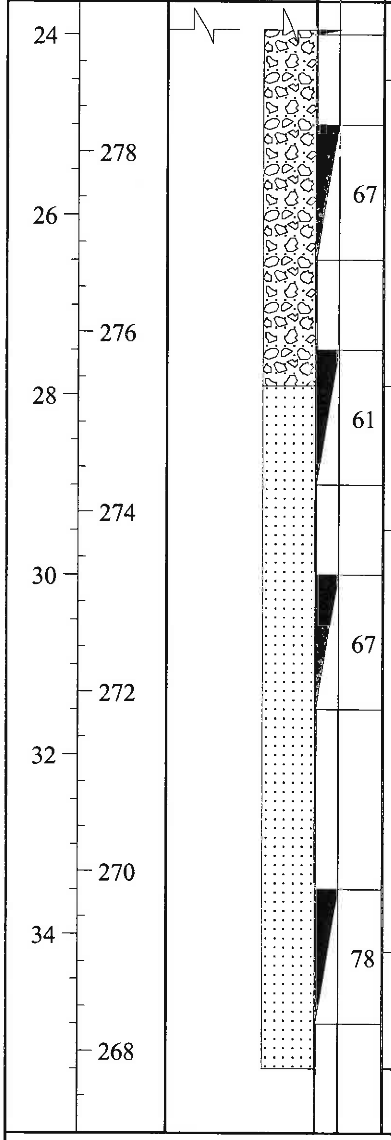
# BORING LOG TPZ-4/MW-4

**NPDES Site Characterization**
**Sikeston, MO**

**CLIENT:** SBMU-SPS

**LOCATION:** See Plan of Boring Locations
**G.S. ELEVATION:** 303.3 **T.O.C. ELEVATION:** 305.61
**NORTHING:** 380804.62 **EASTING:** 1077766.95

| DEPTH (FEET) | ELEVATION | WELL CONSTRUCTION DIAGRAM | WATER TABLE | GRAPHIC LOG | SAMPLE TYPE | PERCENT RECOVERY | DESCRIPTION | FACIES I.D. | LITHOLOGY: CLAY | SILTY CLAY | SILT | VF SAND | F SAND | M SAND | C SAND | VC SAND | SM GRAVEL | LG GRAVEL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|



SAND: Dark grayish brown (10YR 4/2), coarse-grained sand, some medium-grained sand, few very coarse-grained sand, few small gravel, medium dense, poorly sorted. Sands are round, gravel is round to sub-angular.

SAND: Grayish brown (10YR 5/2), fine-grained sand, few silt and very fine-grained sand, few medium-grained sand, round to sub-round, trace coarse-grained sand, medium dense.

SAND: Gray (10YR 5/1), medium-grained sand, few very fine-grained sand and silt, trace coarse-grained sand, round to sub-round, medium dense.

SAND: Gray (10YR 5/1), medium-grained sand, few very fine-grained sand and silt, trace coarse-grained sand, round to sub-round, trace 1-inch diameter lignite, medium dense.

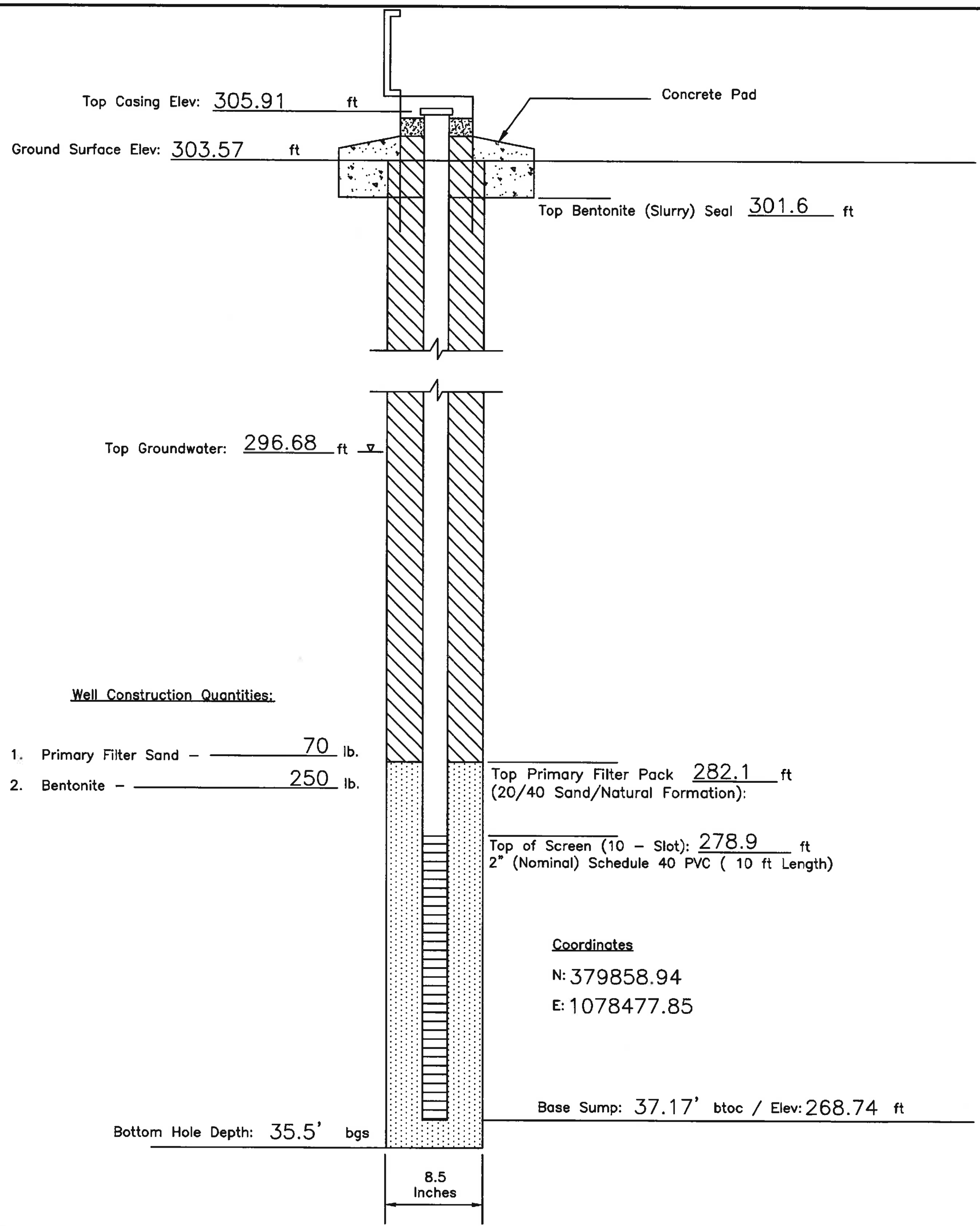
Boring Terminated at 35.5 feet in SAND.

**DRILLING CO.:** Smith & Company
**DRILLER:** F. Deken
**LOGGED BY:** Ken Ewers, R.G.
**DATE DRILLED:** 4-26-2016
**START TIME:** 1610 4-26-2016
**END TIME:** 0838 4-27-2016
**BOREHOLE DIA.:** 8.5 in.

*STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.*

**NOTES:** Offset boring developed on 5-10-2016 for SPT sampling.

**WATER LEVELS:** DURING DRILLING NA FEET
AFTER DRILLING: 296.01 FEET
DATE: 5-12-2016
**PIEZOMETER:** INSTALLED AT +/- 35.2 FEET
**VERTICAL DATUM:** NAVD 1988
**HORIZONTAL DATUM:** NAD 1983
**WEATHER:** 71 degrees, wind south 10 MPH, sunny.



Top Casing Elev: 305.91 ft

Ground Surface Elev: 303.57 ft

Top Bentonite (Slurry) Seal 301.6 ft

Top Groundwater: 296.68 ft

**Well Construction Quantities:**

1. Primary Filter Sand – 70 lb.
2. Bentonite – 250 lb.

Top Primary Filter Pack 282.1 ft
(20/40 Sand/Natural Formation):

Top of Screen (10 – Slot): 278.9 ft
2" (Nominal) Schedule 40 PVC ( 10 ft Length)

**Coordinates**

N: 379858.94
E: 1078477.85

Base Sump: 37.17' btoc / Elev: 268.74 ft

Bottom Hole Depth: 35.5' bgs

M:\Share\CADDFiles\SIKESTON\DS\PIEZOMETER CONSTRUCTION DIAGRAMS 2016.dwg, TPZ-5, 11/4/2016 3:30:02 PM

**TPZ-5/**
**MW-5**

Date Piezometer Completed:
4-26-16

## PIEZOMETER CONSTRUCTION DIAGRAM

**SBMU - Sikeston Power Station**

Site Characterization - NPDES Compliance

**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 | SCALE | DRAWN BY: | APPROVED BY: |
|---|---|---|---|
| 11/2016 | N.T.S. | AJK | MCC |

# GREDELL Engineering Resources, Inc.

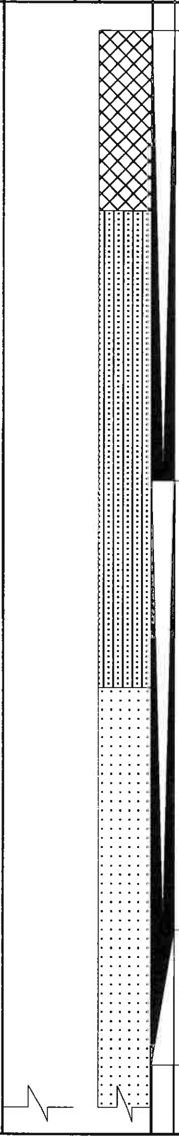
# BORING LOG TPZ-5/MW-5

**NPDES Site Characterization**
**Sikeston, MO**

**CLIENT:** SBMU-SPS

**LOCATION:** See Plan of Boring Locations
**G.S. ELEVATION:** 303.6 **T.O.C. ELEVATION:** 305.91
**NORTHING:** 379858.94 **EASTING:** 1078477.85

| DEPTH (FEET) | ELEVATION | PERCENT RECOVERY | DESCRIPTION | FACIES I.D. | LITHOLOGY: CLAY | SILTY CLAY | SILT | VF SAND | F SAND | M SAND | C SAND | VC SAND | SM GRAVEL | LG GRAVEL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | FILL - Asphalt, gravel, aggregate. | | | | | | | | | | | |
| | 302 | | | | | | | | | | | | | |
| 2 | | 80 | SILTY SAND: Dark yellowish brown (10YR 4/4), fine-grained sand, some silt, reddish brown staining/mottling. | | | | | | | | | | | |
| | 300 | | | | | | | | | | | | | |
| 4 | | | SILTY SAND: Gray (10YR 5/1), fine-grained sand, some silt. | | | | | | | | | | | |
| | 298 | | SILTY SAND: Gray (10YR 5/1), fine-grained sand, some silt and clay, reddish brown stained root molds. | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | |
| | 296 | 78 | SAND: Brown (10YR 5/3), fine-grained sand, some very fine-grained sand, little silt, loose. | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | |
| | 294 | | | | | | | | | | | | | |
| 10 | | 100 | SAND: Yellowish brown (10YR 5/6), fine- to medium-grained, trace coarse-grained sand, round, medium dense. | | | | | | | | | | | |
| | 292 | | | | | | | | | | | | | |



**DRILLING CO.:** Smith & Company
**DRILLER:** F. Deken
**LOGGED BY:** Ken Ewers, R.G.
**DATE DRILLED:** 4-26-2016
**START TIME:** 1405 4-26-2016
**END TIME:** 1435 4-26-2016
**BOREHOLE DIA.:** 8.5 in.

*STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.*

**NOTES:** Offset boring developed on 5-10-2016 for SPT sampling.

**WATER LEVELS:** DURING DRILLING NA FEET
AFTER DRILLING: 296.68 FEET
DATE: 5-12-2016
**PIEZOMETER:** INSTALLED AT +/- 34.8 FEET
**VERTICAL DATUM:** NAVD 1988
**HORIZONTAL DATUM:** NAD 1983
**WEATHER:** 70 degrees, wind south 10 MPH, sunny.

Date Printed: 8/23/2017

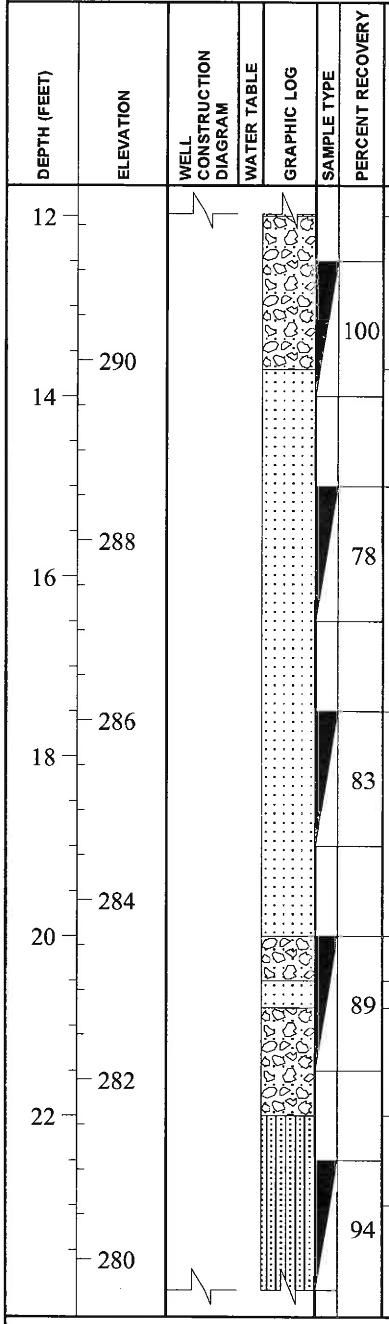
**GREDELL Engineering Resources, Inc.**

# BORING LOG TPZ-5/MW-5

**NPDES Site Characterization**
**Sikeston, MO**

**CLIENT: SBMU-SPS**

**LOCATION:** See Plan of Boring Locations
**G.S. ELEVATION:** 303.6 **T.O.C. ELEVATION:** 305.91
**NORTHING:** 379858.94 **EASTING:** 1078477.85



| PERCENT RECOVERY | DESCRIPTION | FACIES I.D. | CLAY | SILTY CLAY | SILT | VF SAND | F SAND | M SAND | C SAND | VC SAND | SM GRAVEL | LG GRAVEL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | SAND: Brown (10YR 5/3), medium- to coarse-grained sand, few fine-grained sand, few coarse-grained sand, few small gravel, angular to round, medium dense, poorly sorted. | | | | | | | | | | | |
| | SAND: Brown (10YR 5/3), medium-grained sand, few fine-grained sand, round to sub-round, medium dense. | | | | | | | | | | | |
| 78 | SAND: Brown (10YR 5/3), medium-grained sand, few fine-grained sand, trace coarse-grained sand, trace small gravel, round to sub-round, medium dense. | | | | | | | | | | | |
| 83 | SAND: Brown (10YR 5/3), medium-grained sand, few fine-grained sand, trace small gravel, round to sub-round, few 1/2 inch-thick interbeds of medium- to coarse-grained sand, medium dense. | | | | | | | | | | | |
| 89 | SAND: Brown (10YR 5/3), medium- to coarse-grained sand, few coarse-grained sand, few small gravel, round to sub-angular, medium dense. | | | | | | | | | | | |
| | SAND: Brown (10YR 5/3), fine-grained sand with thin beds of lignite. | | | | | | | | | | | |
| 94 | SAND: Brown (10YR 5/3), medium- to coarse-grained sand, few coarse-grained sand, few small gravel, round to sub-angular, medium dense. | | | | | | | | | | | |
| | SAND: Brown (10YR 5/2), fine-grained sand, few silt and very fine-grained sand, round, | | | | | | | | | | | |

**DRILLING CO.:** Smith & Company
**DRILLER:** F. Deken
**LOGGED BY:** Ken Ewers, R.G.
**DATE DRILLED:** 4-26-2016
**START TIME:** 1405 4-26-2016
**END TIME:** 1435 4-26-2016
**BOREHOLE DIA.:** 8.5 in.

*STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.*

**NOTES:** Offset boring developed on 5-10-2016 for SPT sampling.

**WATER LEVELS:** DURING DRILLING NA FEET
AFTER DRILLING: 296.68 FEET
DATE: 5-12-2016
**PIEZOMETER:** INSTALLED AT +/- 34.8 FEET
**VERTICAL DATUM:** NAVD 1988
**HORIZONTAL DATUM:** NAD 1983
**WEATHER:** 70 degrees, wind south 10 MPH, sunny.

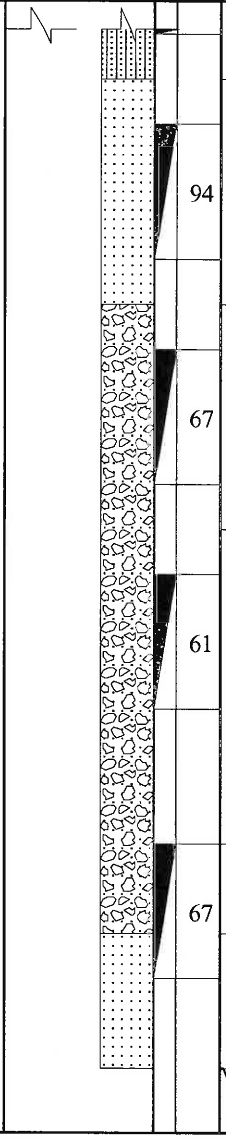
Date Printed: 8/23/2017

# BORING LOG TPZ-5/MW-5

**NPDES Site Characterization**
**Sikeston, MO**

**CLIENT:** SBMU-SPS

**LOCATION:** See Plan of Boring Locations
**G.S. ELEVATION:** 303.6 **T.O.C. ELEVATION:** 305.91
**NORTHING:** 379858.94 **EASTING:** 1078477.85



LITHOLOGY: CLAY | SILTY CLAY | SILT | VF SAND | F SAND | M SAND | C SAND | VC SAND | SM GRAVEL | LG GRAVEL

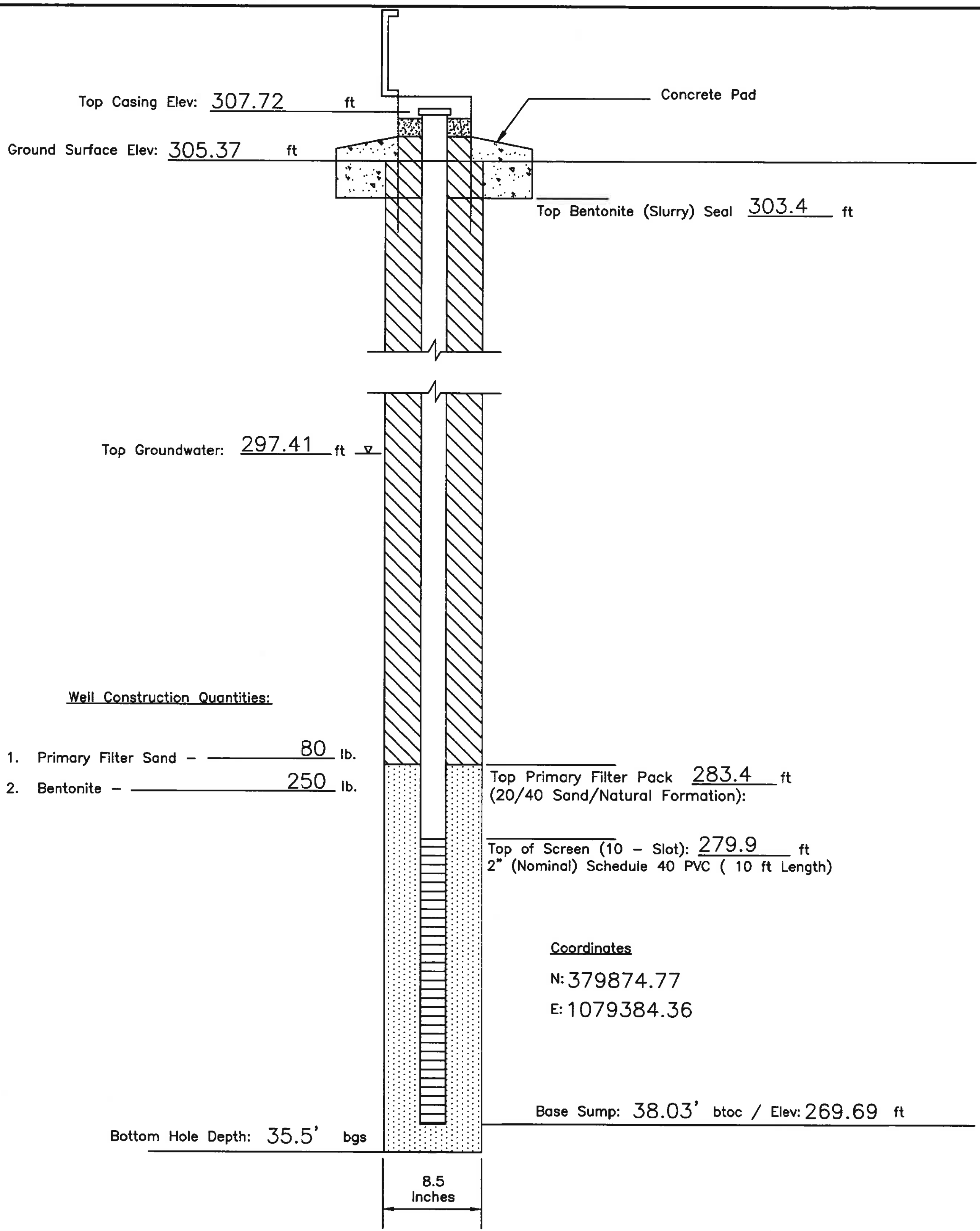
| DEPTH (FEET) | ELEVATION | PERCENT RECOVERY | DESCRIPTION | FACIES I.D. |
|---|---|---|---|---|
| 24 | | | medium dense. | |
| | | | - dark gray (10YR 4/1). | |
| | 278 | 94 | SAND: Grayish brown (10YR 5/2), fine- to medium-grained sand, round to sub-round; trace coarse-grained sand, trace silt, trace small gravel, coarse sand and gravel is angular to sub-angular, medium dense. | |
| 26 | | | | |
| | 276 | 67 | SAND: Grayish brown (10YR 5/2), fine- to medium-grained sand, round to sub-round; few coarse-grained sand, few small gravel, coarse sand and gravel is angular to sub-round, medium dense, poorly sorted. | |
| 28 | | | | |
| | 274 | 61 | SAND: Brown (10YR 5/3), coarse- to very coarse-grained sand, few small gravel, few medium sand, round to angular, medium dense. | |
| 30 | | | | |
| | 272 | | | |
| 32 | | | | |
| | 270 | 67 | SAND: Brown (10YR 5/3), coarse- to very coarse-grained sand, little small gravel, few medium- to coarse-grained sand, sub-round to sub-angular, medium dense. | |
| 34 | | | SAND: Grayish brown (10YR 5/2), medium-grained sand, few fine-grained sand, trace small gravel, trace coarse-grained sand, round to sub-round, medium dense. | |
| | 268 | | Boring Terminated at 35.5 feet in SAND. | |

**DRILLING CO.:** Smith & Company
**DRILLER:** F. Deken
**LOGGED BY:** Ken Ewers, R.G.
**DATE DRILLED:** 4-26-2016
**START TIME:** 1405 4-26-2016
**END TIME:** 1435 4-26-2016
**BOREHOLE DIA.:** 8.5 in.

*STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.*

**NOTES:** Offset boring developed on 5-10-2016 for SPT sampling.

**WATER LEVELS:** DURING DRILLING NA FEET
AFTER DRILLING: 296.68 FEET
DATE: 5-12-2016
**PIEZOMETER:** INSTALLED AT +/- 34.8 FEET
**VERTICAL DATUM:** NAVD 1988
**HORIZONTAL DATUM:** NAD 1983
**WEATHER:** 70 degrees, wind south 10 MPH, sunny.



Top Casing Elev: 307.72 ft

Ground Surface Elev: 305.37 ft

Top Bentonite (Slurry) Seal 303.4 ft

Top Groundwater: 297.41 ft

**Well Construction Quantities:**

1. Primary Filter Sand – 80 lb.
2. Bentonite – 250 lb.

Top Primary Filter Pack 283.4 ft
(20/40 Sand/Natural Formation):

Top of Screen (10 – Slot): 279.9 ft
2" (Nominal) Schedule 40 PVC ( 10 ft Length)

**Coordinates**

N: 379874.77
E: 1079384.36

Base Sump: 38.03' btoc / Elev: 269.69 ft

Bottom Hole Depth: 35.5' bgs

TPZ-6/
MW-6

PIEZOMETER
CONSTRUCTION
DIAGRAM

Date Piezometer
Completed:
4-26-16

SBMU - Sikeston Power Station

Site Characterization - NPDES Compliance

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 11/2016
SCALE N.T.S.
DRAWN BY: AJK
APPROVED BY: MCC

M:\Share\CADDFiles\SIKESTON\DS\PIEZOMETER CONSTRUCTION DIAGRAMS 2016.dwg, TPZ-6, 11/4/2016 3:30:02 PM

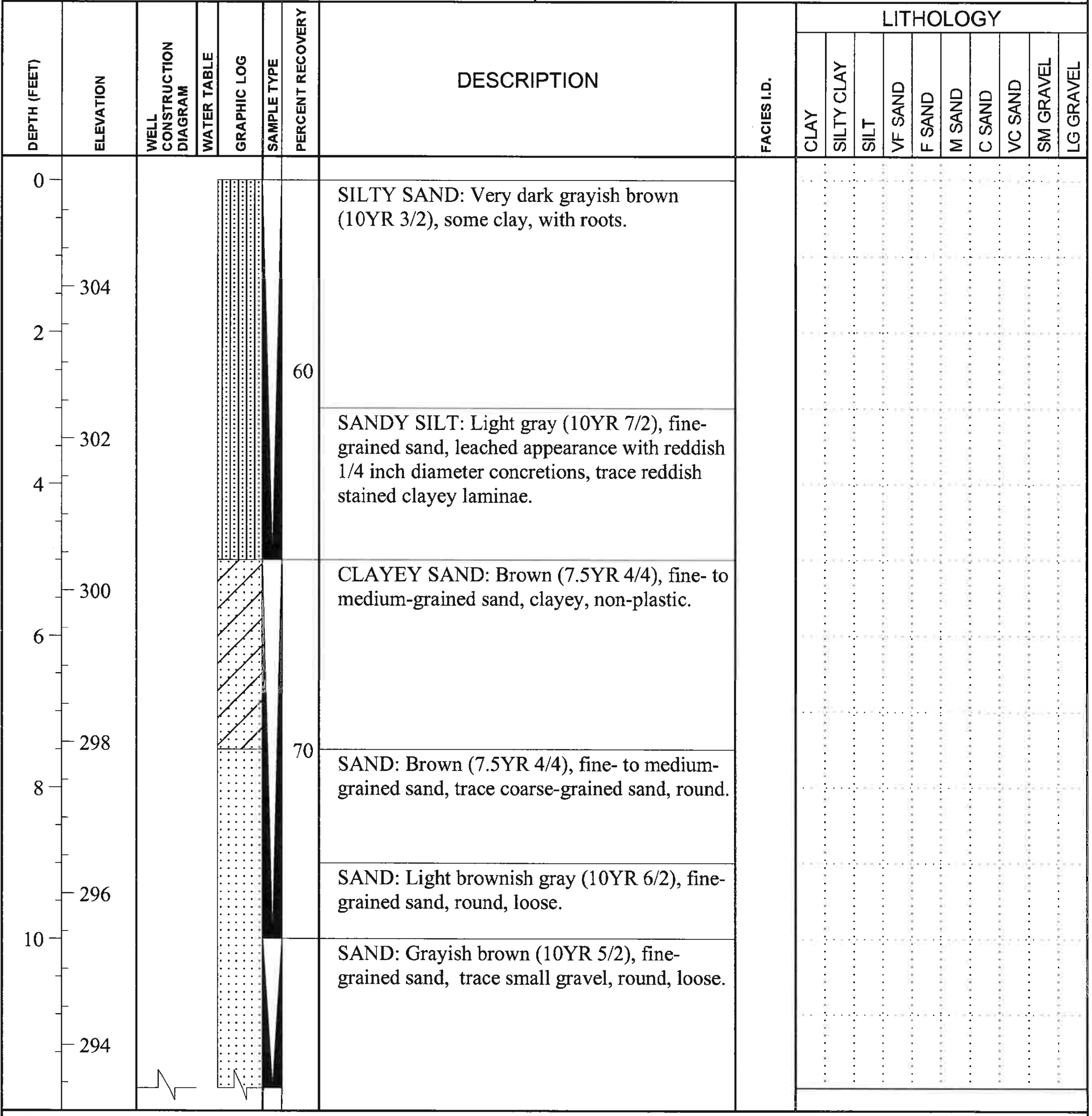
**GREDELL Engineering Resources, Inc.**

# BORING LOG TPZ-6/MW-6

**NPDES Site Characterization**
**Sikeston, MO**

**CLIENT:** SBMU-SPS

**LOCATION:** See Plan of Boring Locations
**G.S. ELEVATION:** 305.4 **T.O.C. ELEVATION:** 307.72
**NORTHING:** 379874.77 **EASTING:** 1079384.36



SILTY SAND: Very dark grayish brown (10YR 3/2), some clay, with roots.

SANDY SILT: Light gray (10YR 7/2), fine-grained sand, leached appearance with reddish 1/4 inch diameter concretions, trace reddish stained clayey laminae.

CLAYEY SAND: Brown (7.5YR 4/4), fine- to medium-grained sand, clayey, non-plastic.

SAND: Brown (7.5YR 4/4), fine- to medium-grained sand, trace coarse-grained sand, round.

SAND: Light brownish gray (10YR 6/2), fine-grained sand, round, loose.

SAND: Grayish brown (10YR 5/2), fine-grained sand, trace small gravel, round, loose.

**DRILLING CO.:** Smith & Company
**DRILLER:** F. Deken
**LOGGED BY:** Ken Ewers, R.G.
**DATE DRILLED:** 4-26-2016
**START TIME:** 1106 4-26-2016
**END TIME:** 1239 4-26-2016
**BOREHOLE DIA.:** 8.5 in.

*STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.*

**NOTES:** Offset boring developed on 5-10-2016 for SPT sampling.

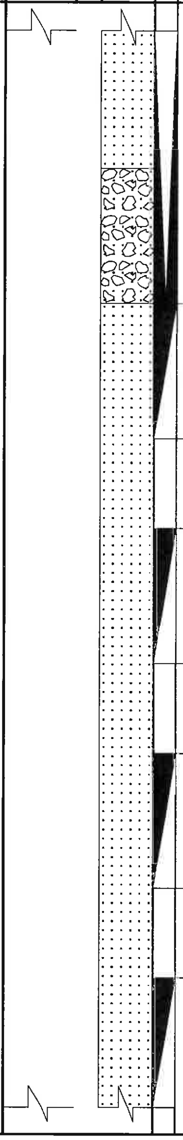
**WATER LEVELS:** DURING DRILLING NA FEET
AFTER DRILLING: 297.41 FEET
DATE: 5-12-2016
**PIEZOMETER:** INSTALLED AT +/- 35.7 FEET
**VERTICAL DATUM:** NAVD 1988
**HORIZONTAL DATUM:** NAD 1983
**WEATHER:** 75 degrees, wind south 7 MPH, sunny.

Date Printed: 8/23/2017

**NPDES Site Characterization**
**Sikeston, MO**

**CLIENT:** SBMU-SPS

**LOCATION:** See Plan of Boring Locations
**G.S. ELEVATION:** 305.4 **T.O.C. ELEVATION:** 307.72
**NORTHING:** 379874.77 **EASTING:** 1079384.36



| DEPTH (FEET) | ELEVATION | PERCENT RECOVERY | DESCRIPTION | FACIES I.D. |
|---|---|---|---|---|
| 12 | | | | |
| | | 57 | SAND: Grayish brown (10YR 5/2), fine- to medium-grained sand, trace small gravel, round, loose. | |
| | 292 | | | |
| 14 | | | SAND: Grayish brown (10YR 5/2), medium- to coarse-grained sand, little fine-grained sand, few small gravel, few coarse sand, trace large gravel, sub-round, poorly sorted. | |
| | 290 | 100 | SAND: Grayish brown (10YR 5/2), fine- to medium-grained sand, trace coarse-grained sand, trace small gravel, round to sub-round, very loose. | |
| 16 | | | | |
| | 288 | | SAND: Brown (10YR 5/3), fine-grained sand, trace silt and very fine-grained sand, round to sub-round, medium dense. | |
| 18 | | 94 | | |
| | 286 | | | |
| 20 | | 83 | SAND: Brown (10YR 4/3), fine-grained sand, trace silt and very fine-grained sand, few lignite, round to sub-round, medium dense. | |
| | 284 | | | |
| 22 | | | SAND: Dark grayish brown (10YR 4/2), fine- to medium-grained sand, trace silt and very fine-grained sand, trace coarse-grained sand, round to sub-round, medium dense. | |
| | 282 | 67 | | |

| LITHOLOGY | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CLAY | SILTY CLAY | SILT | VF SAND | F SAND | M SAND | C SAND | VC SAND | SM GRAVEL | LG GRAVEL |

**DRILLING CO.:** Smith & Company
**DRILLER:** F. Deken
**LOGGED BY:** Ken Ewers, R.G.
**DATE DRILLED:** 4-26-2016
**START TIME:** 1106 4-26-2016
**END TIME:** 1239 4-26-2016
**BOREHOLE DIA.:** 8.5 in.

*STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.*

**NOTES:** Offset boring developed on 5-10-2016 for SPT sampling.

**WATER LEVELS:** DURING DRILLING NA FEET
AFTER DRILLING: 297.41 FEET
DATE: 5-12-2016
**PIEZOMETER:** INSTALLED AT +/- 35.7 FEET
**VERTICAL DATUM:** NAVD 1988
**HORIZONTAL DATUM:** NAD 1983
**WEATHER:** 75 degrees, wind south 7 MPH, sunny.

Date Printed: 8/23/2017

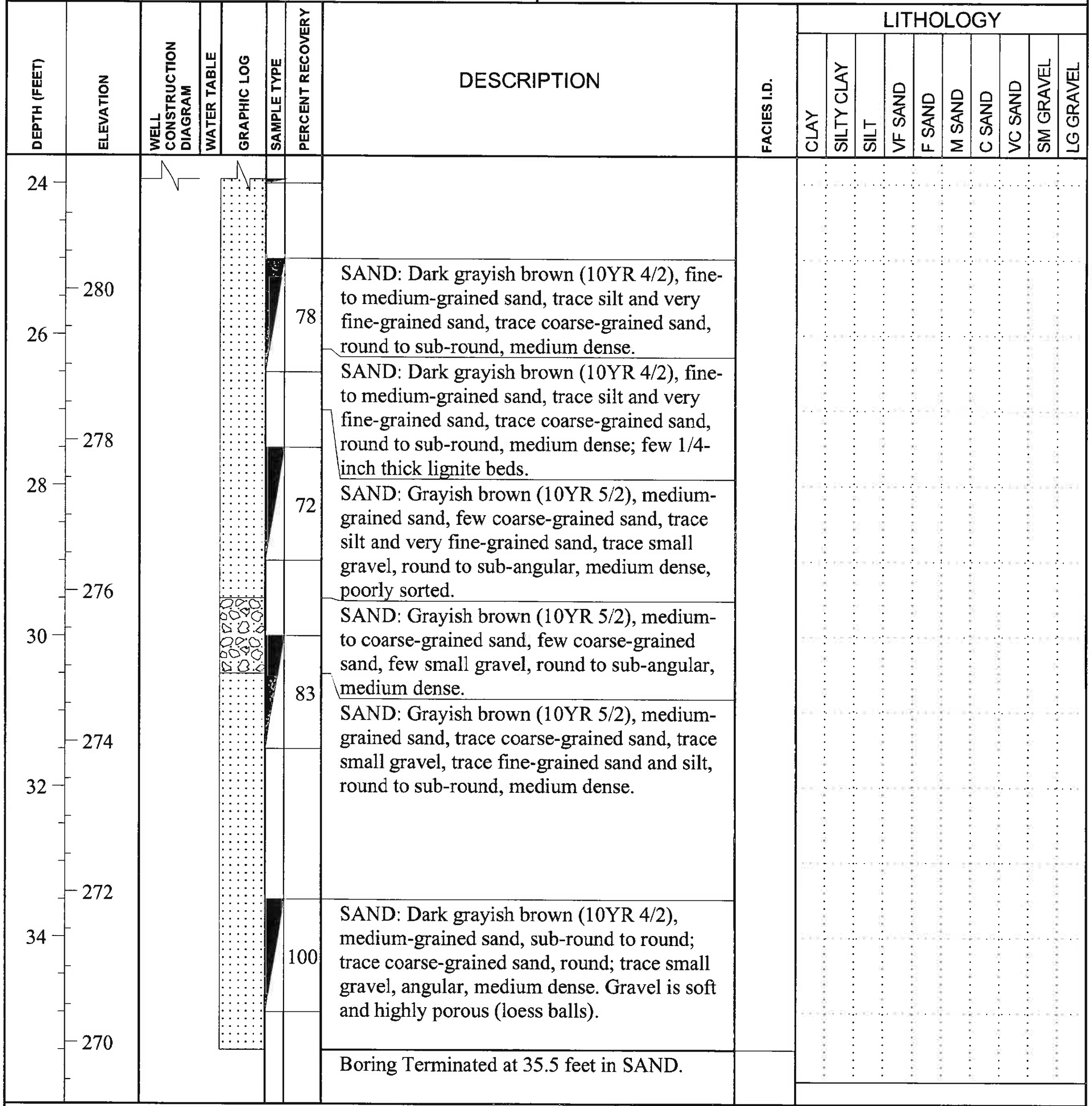
# GREDELL Engineering Resources, Inc.

# BORING LOG TPZ-6/MW-6

**NPDES Site Characterization**
**Sikeston, MO**

**CLIENT:** SBMU-SPS

**LOCATION:** See Plan of Boring Locations
**G.S. ELEVATION:** 305.4 **T.O.C. ELEVATION:** 307.72
**NORTHING:** 379874.77 **EASTING:** 1079384.36



SAND: Dark grayish brown (10YR 4/2), fine- to medium-grained sand, trace silt and very fine-grained sand, trace coarse-grained sand, round to sub-round, medium dense.

SAND: Dark grayish brown (10YR 4/2), fine- to medium-grained sand, trace silt and very fine-grained sand, trace coarse-grained sand, round to sub-round, medium dense; few 1/4-inch thick lignite beds.

SAND: Grayish brown (10YR 5/2), medium-grained sand, few coarse-grained sand, trace silt and very fine-grained sand, trace small gravel, round to sub-angular, medium dense, poorly sorted.

SAND: Grayish brown (10YR 5/2), medium- to coarse-grained sand, few coarse-grained sand, few small gravel, round to sub-angular, medium dense.

SAND: Grayish brown (10YR 5/2), medium-grained sand, trace coarse-grained sand, trace small gravel, trace fine-grained sand and silt, round to sub-round, medium dense.

SAND: Dark grayish brown (10YR 4/2), medium-grained sand, sub-round to round; trace coarse-grained sand, round; trace small gravel, angular, medium dense. Gravel is soft and highly porous (loess balls).

Boring Terminated at 35.5 feet in SAND.

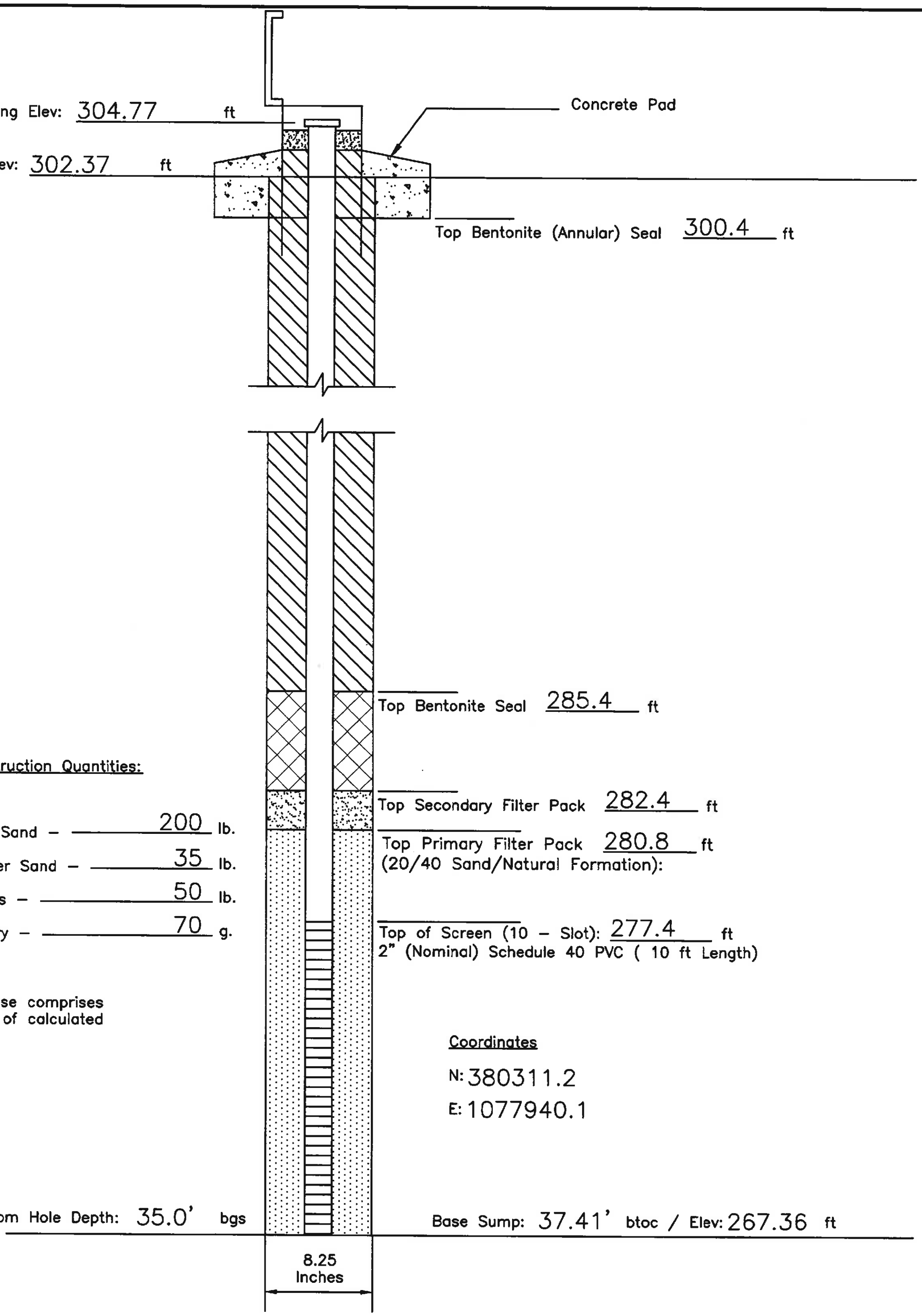
**DRILLING CO.:** Smith & Company
**DRILLER:** F. Deken
**LOGGED BY:** Ken Ewers, R.G.
**DATE DRILLED:** 4-26-2016
**START TIME:** 1106 4-26-2016
**END TIME:** 1239 4-26-2016
**BOREHOLE DIA.:** 8.5 in.

*STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.*

**NOTES:** Offset boring developed on 5-10-2016 for SPT sampling.

**WATER LEVELS:** DURING DRILLING NA FEET
AFTER DRILLING: 297.41 FEET
DATE: 5-12-2016
**PIEZOMETER:** INSTALLED AT +/- 35.7 FEET
**VERTICAL DATUM:** NAVD 1988
**HORIZONTAL DATUM:** NAD 1983
**WEATHER:** 75 degrees, wind south 7 MPH, sunny.

Date Printed: 8/23/2017



Top Casing Elev: 304.77 ft

Ground Surface Elev: 302.37 ft

Top Bentonite (Annular) Seal 300.4 ft

Top Bentonite Seal 285.4 ft

Top Secondary Filter Pack 282.4 ft

Top Primary Filter Pack 280.8 ft
(20/40 Sand/Natural Formation):

Top of Screen (10 – Slot): 277.4 ft
2" (Nominal) Schedule 40 PVC ( 10 ft Length)

Bottom Hole Depth: 35.0' bgs

Base Sump: 37.41' btoc / Elev: 267.36 ft

Well Construction Quantities:

| | | | |
|---|---|---|---|
| 1. | Primary Filter Sand – | 200 | lb. |
| 2. | Secondary Filter Sand – | 35 | lb. |
| 2. | Bentonite Chips – | 50 | lb. |
| 2. | Bentonite Slurry – | 70 | g. |

Remarks:
Natural sand collapse comprises approximately 60% of calculated sand volume.

Coordinates

N: 380311.2
E: 1077940.1

**MW-8**

**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 Well Completed: 4-19-17

**SBMU - Sikeston Power Station**

**Groundwater Monitoring & Sampling Plan**

DATE 9/2017

SCALE N.T.S.

DRAWN BY: AJK

APPROVED BY: MCC

**GREDELL Engineering Resources, Inc.**

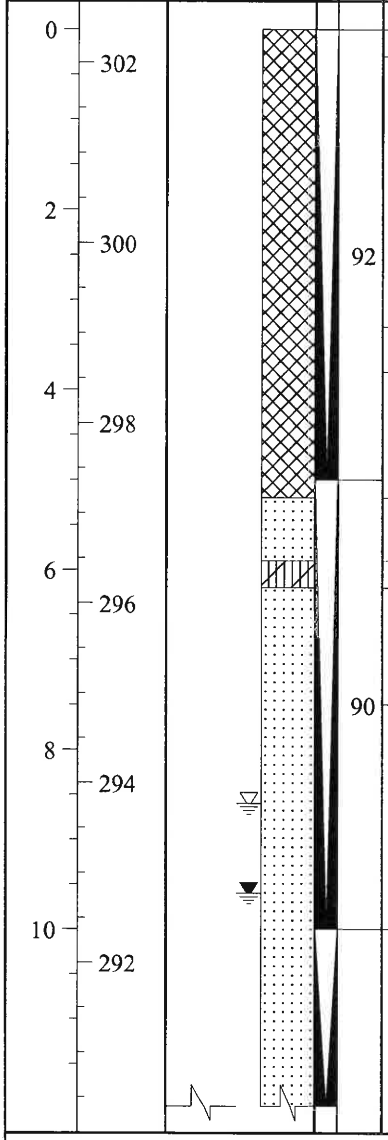
# BORING LOG MW-8

**CCR Rule Compliance**
**1551 W. Wakefield Ave., Sikeston, MO**

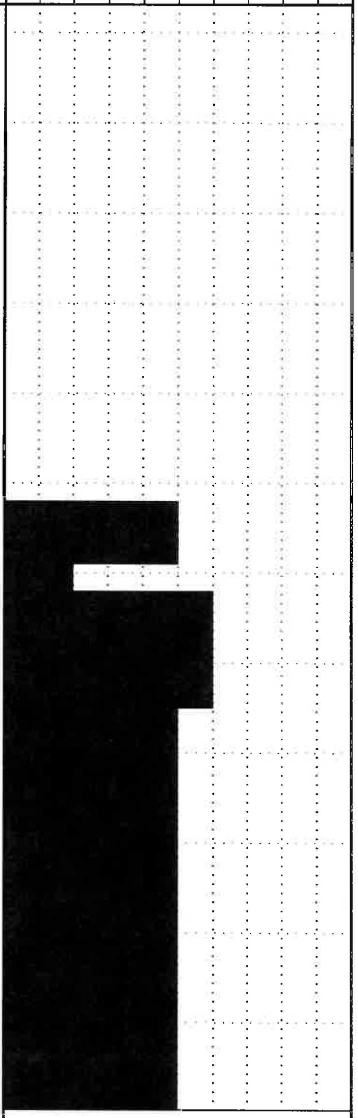
**CLIENT:** SBMU Sikeston Power Station

**LOCATION:** See Plan of Boring Locations
**G.S. ELEVATION:** 302.37 **T.O.C. ELEVATION:** 304.77
**NORTHING:** 380311.20 **EASTING:** 1077940.08

DEPTH (FEET) | ELEVATION | WELL CONSTRUCTION DIAGRAM | WATER TABLE | GRAPHIC LOG | SAMPLE TYPE | PERCENT RECOVERY | DESCRIPTION | FACIES I.D. | LITHOLOGY: CLAY, SILTY CLAY, SILT, VF SAND, F SAND, M SAND, C SAND, VC SAND, SM GRAVEL, LG GRAVEL



| PERCENT RECOVERY | DESCRIPTION |
|---|---|
| 92 | FILL: Grass/Sandy Silt; Very dark brown (10YR 2/2), wet, roots. |
| | FILL: Sand; Dark yellowish brown (10YR 4/6), moist, loose, fine-grained. |
| | - fine-grained, dark yellowish brown (10YR 4/2). |
| | FILL: Silt; Black (N 2.5/), moist, firm, low plasticity, trace clay, trace very fine-grained sand, wood fragment. |
| 90 | SAND: Dark grayish brown (10YR 4/2) and dark yellowish brown (10YR 3/6), moist, fine-grained, loose. |
| | SILT, SOME CLAY: Black (N 2.5/), moist, firm, medium plasticity, trace roots (peat-like). |
| | SAND: Strong brown (10YR 4/6), moist, loose, fine- to medium-grained, black lignite interbedding. |
| | - very fine- to fine-grained sand, trace medium- and coarse-grained sand, very dark greenish gray (10Y 3/1), trace silt. |
| | - trace fine gravel. |



| | | | |
|---|---|---|---|
| **DRILLING CO.:** | Bulldog Drilling, Inc. | **WATER LEVELS:** | DURING DRILLING 8.6 FEET |
| **DRILLER:** | Chad Dutton | | AFTER DRILLING: 9.6 FEET |
| **LOGGED BY:** | Travis Doll | | DATE: 04-19-17 |
| **DATE DRILLED:** | 04-19-17 | **PIEZOMETER:** | INSTALLED AT +/- 37.41 FEET |
| **START TIME:** | 0901 | **VERTICAL DATUM:** | NAD 1983 |
| **END TIME:** | 1108 | **HORIZONTAL DATUM:** | NAVD 1988 |
| **BOREHOLE DIA.:** | 8.25" | **WEATHER:** | Warm, 75°F, Mostly Sunny, 5 MPH S. Wind, Humid |

*STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.*

**NOTES:**

Date Printed: 8/23/2017

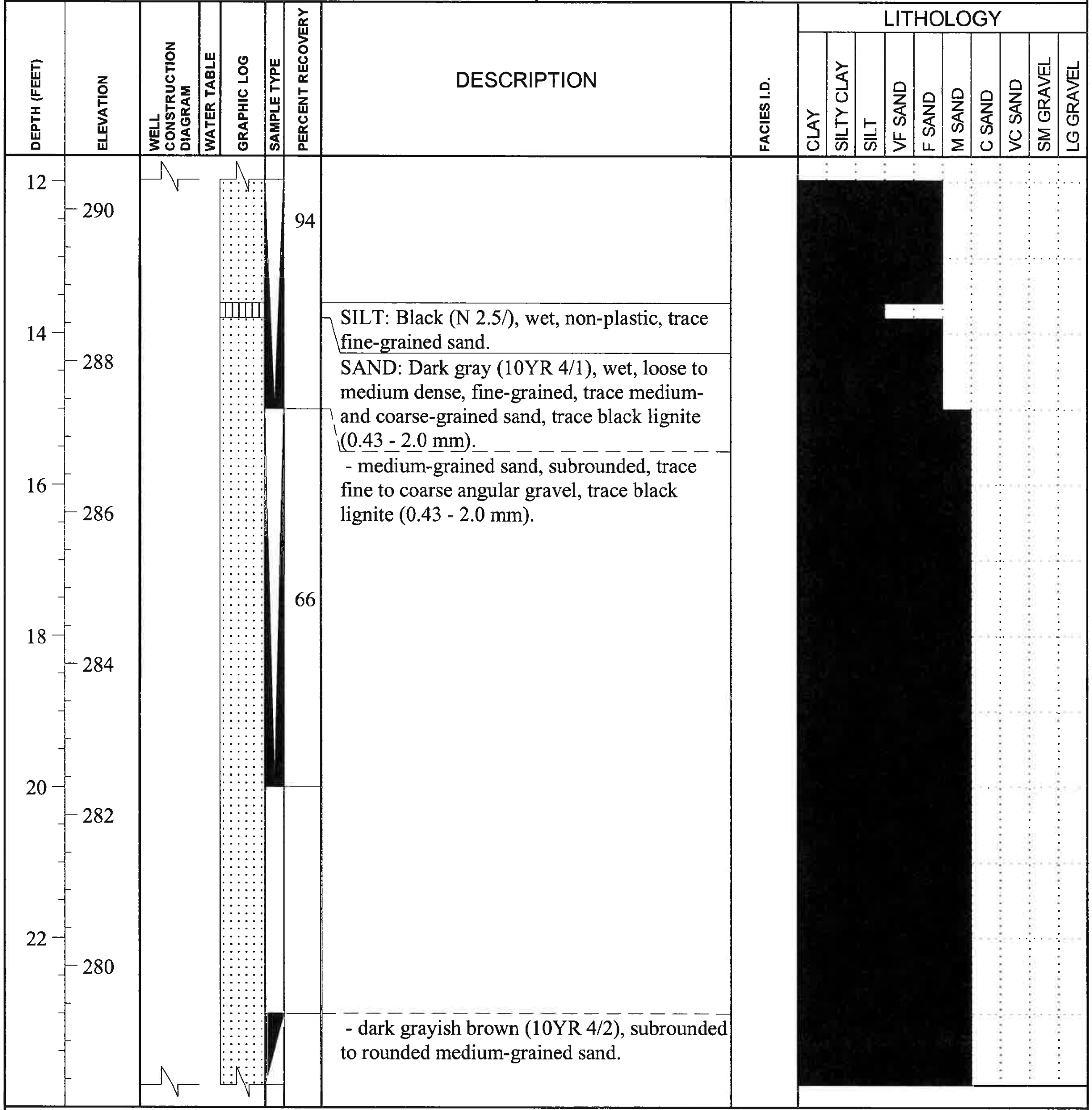
**GREDELL Engineering Resources, Inc.**

# BORING LOG MW-8

**CCR Rule Compliance**
**1551 W. Wakefield Ave., Sikeston, MO**

**CLIENT: SBMU Sikeston Power Station**

**LOCATION:** See Plan of Boring Locations
**G.S. ELEVATION:** 302.37 **T.O.C. ELEVATION:** 304.77
**NORTHING:** 380311.20 **EASTING:** 1077940.08



SILT: Black (N 2.5/), wet, non-plastic, trace fine-grained sand.

SAND: Dark gray (10YR 4/1), wet, loose to medium dense, fine-grained, trace medium- and coarse-grained sand, trace black lignite (0.43 - 2.0 mm).

- medium-grained sand, subrounded, trace fine to coarse angular gravel, trace black lignite (0.43 - 2.0 mm).

- dark grayish brown (10YR 4/2), subrounded to rounded medium-grained sand.

**DRILLING CO.:** Bulldog Drilling, Inc.
**DRILLER:** Chad Dutton
**LOGGED BY:** Travis Doll
**DATE DRILLED:** 04-19-17
**START TIME:** 0901
**END TIME:** 1108
**BOREHOLE DIA.:** 8.25"

*STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.*

**NOTES:**

**WATER LEVELS:** DURING DRILLING 8.6 FEET
AFTER DRILLING: 9.6 FEET
DATE: 04-19-17
**PIEZOMETER:** INSTALLED AT +/- 37.41 FEET
**VERTICAL DATUM:** NAD 1983
**HORIZONTAL DATUM:** NAVD 1988
**WEATHER:** Warm, 75°F, Mostly Sunny, 5 MPH S. Wind, Humid

Date Printed: 8/23/2017

**GREDELL Engineering Resources, Inc.**

# BORING LOG MW-8

**CCR Rule Compliance**

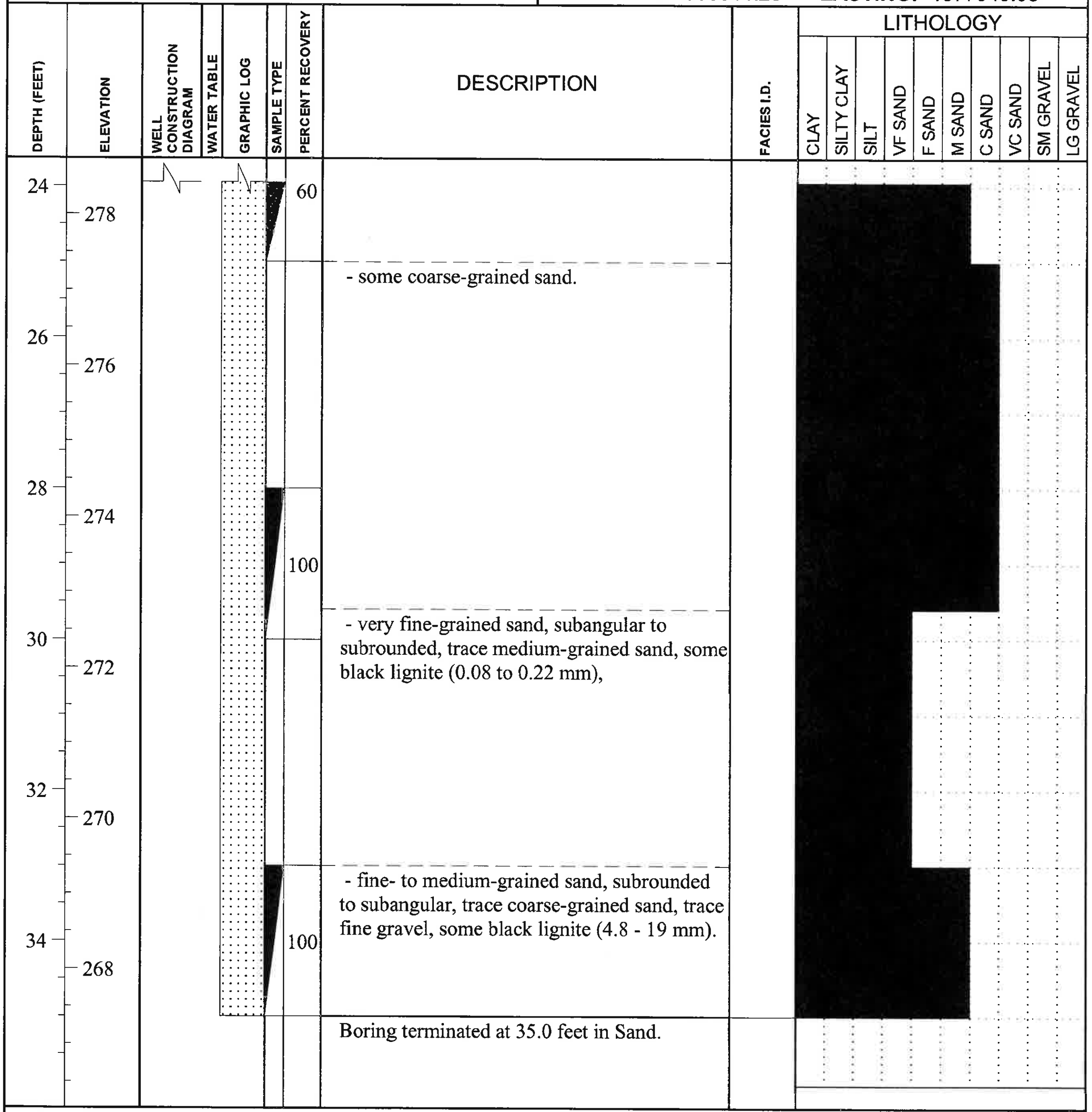
**1551 W. Wakefield Ave., Sikeston, MO**

**CLIENT:** SBMU Sikeston Power Station

**LOCATION:** See Plan of Boring Locations

**G.S. ELEVATION:** 302.37 **T.O.C. ELEVATION:** 304.77

**NORTHING:** 380311.20 **EASTING:** 1077940.08



- some coarse-grained sand.

- very fine-grained sand, subangular to subrounded, trace medium-grained sand, some black lignite (0.08 to 0.22 mm),

- fine- to medium-grained sand, subrounded to subangular, trace coarse-grained sand, trace fine gravel, some black lignite (4.8 - 19 mm).

Boring terminated at 35.0 feet in Sand.

**DRILLING CO.:** Bulldog Drilling, Inc.
**DRILLER:** Chad Dutton
**LOGGED BY:** Travis Doll
**DATE DRILLED:** 04-19-17
**START TIME:** 0901
**END TIME:** 1108
**BOREHOLE DIA.:** 8.25"

*STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.*

**NOTES:**

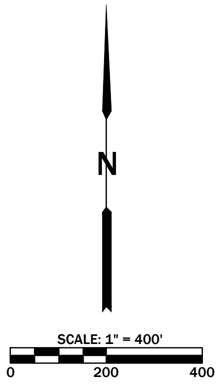
**WATER LEVELS:** DURING DRILLING 8.6 FEET
AFTER DRILLING: 9.6 FEET
DATE: 04-19-17

**PIEZOMETER:** INSTALLED AT +/- 37.41 FEET

**VERTICAL DATUM:** NAD 1983
**HORIZONTAL DATUM:** NAVD 1988
**WEATHER:** Warm, 75°F, Mostly Sunny, 5 MPH S. Wind, Humid

Date Printed: 8/23/2017

# ATTACHMENT D3 – GROUNDWATER FLOW MAPS



**LEGEND**

| | |
|---|---|
| PROPERTY LINE | —PL— |
| GROUNDWATER CONTOUR | ——— |
| PROPOSED MONITORING WELL | (MW) |
| UP GRADIENT MONITORING LOCATION | UG |
| DOWN GRADIENT MONITORING LOCATION | DG |
| GENERAL FLOW DIRECTION | ◄—— |

**NOTES:**

1. IMAGE PROVIDED BY BING MAPS.
2. MONITORING WELL LOCATIONS, CASING ELEVATIONS & UNDERGROUND CULVERT ELEVATIONS SURVEYED BY BOWEN ENGINEERING & SURVEYING.
3. GROUNDWATER ELEVATIONS MEASURED BY SIKESTON POWER STATION STAFF ON OCTOBER 31, 2017.
4. MAP DEVELOPMENT BASED ON CONTOURS GENERATED BY SURFER® SOFTWARE.
5. RANGE OF GROUNDWATER FLOW GRADIENT AS DETERMINED BY SURFER® SOFTWARE 0.0003 FT./FT. TO 0.001 FT./FT.

| WELL ID | GROUNDWATER ELEVATION | CASING ELEVATION | NORTHING | EASTING |
|---|---|---|---|---|
| MW-3 | 295.22 | 308.55 | 381130.00 | 1079946.62 |
| MW-4 | 293.11 | 305.61 | 380804.62 | 1077766.95 |
| MW-5 | 293.65 | 305.91 | 379858.94 | 1078477.85 |
| MW-6 | 294.41 | 307.72 | 379874.77 | 1079384.36 |
| MW-8 | 293.20 | 304.77 | 380311.20 | 1077940.08 |

THE GEOLOGIST WHO REVIEWED AND APPROVED THIS REPORT ASSUMES RESPONSIBILITY ONLY FOR GEOLOGIC INTERPRETATIONS OF DATA APPEARING ON THE PAGE AND DISCLAIMS PURSUANT TO SECTION 256.456 RSMO ANY RESPONSIBILITY FOR ALL OTHER PLANS, SPECIFICATIONS, ESTIMATES, REPORTS OR OTHER DOCUMENTS OR INSTRUMENTS NOT PREPARED UNDER THE SUPERVISION OF THE GEOLOGIST RELATING TO OR INTENDED TO BE USED FOR ANY PART OR PARTS OF THE PROJECT TO WHICH THIS FIGURE REFERS.

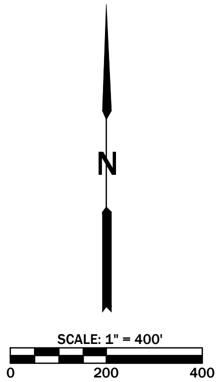
# FIGURE 1
# GROUNDWATER CONTOUR MAP
# OCTOBER 31, 2017

## SIKESTON POWER STATION
## BOTTOM ASH POND
## 2017 ANNUAL GROUNDWATER MONITORING & CORRECTIVE ACTION REPORT

| SURVEYED | DESIGNED | DRAWN | CHECKED | APPROVED | DATE | SCALE | PROJECT NAME | FILE NAME | SHEET # |
|---|---|---|---|---|---|---|---|---|---|
| NA | NA | AJK | KE | MCC | 11/2017 | AS NOTED | SIKESTON/GWMAP/BAP | GWCONT BAP 10-2017 | 1 OF 1 |

**GREDELL Engineering Resources, Inc.**
ENVIRONMENTAL ENGINEERING LAND - AIR - WATER
1505 East High Street Telephone: (573) 659-9078
Jefferson City, Missouri Facsimile: (573) 659-9079
MO CORP. ENGINEERING LICENSE NO. E-2001001669-D

M:\Share\CADDFiles\SIKESTON\GROUNDWATER MAP\BAP\GW CONT MAP BAP 10-2017.dwg, GW CONT MAP BAP, 1/2/2018 11:30:16 AM



**LEGEND**

| | |
|---|---|
| PROPERTY LINE | —PL— |
| GROUNDWATER CONTOUR | —— |
| MONITORING WELL | (MW) |
| UP GRADIENT MONITORING LOCATION | UG |
| DOWN GRADIENT MONITORING LOCATION | DG |
| GENERAL FLOW DIRECTION | ← |

**NOTES:**

1. IMAGE PROVIDED BY BING MAPS.
2. MONITORING WELL LOCATIONS, CASING ELEVATIONS & UNDERGROUND CULVERT ELEVATIONS SURVEYED BY BOWEN ENGINEERING & SURVEYING.
3. GROUNDWATER ELEVATIONS MEASURED BY SIKESTON POWER STATION STAFF ON JUNE 13, 2018.
4. MAP DEVELOPMENT BASED ON CONTOURS GENERATED BY SURFER® SOFTWARE.
5. RANGE OF GROUNDWATER FLOW GRADIENT AS DETERMINED BY SURFER® SOFTWARE 0.0004 FT./FT. TO 0.001 FT./FT.

| WELL ID | GROUNDWATER ELEVATION | CASING ELEVATION | NORTHING | EASTING |
|---|---|---|---|---|
| MW-3 | 297.33 | 308.55 | 381130.00 | 1079946.62 |
| MW-4 | 294.93 | 305.61 | 380804.62 | 1077766.95 |
| MW-5 | 295.60 | 305.91 | 379858.94 | 1078477.85 |
| MW-6 | 296.47 | 307.72 | 379874.77 | 1079384.36 |
| MW-8 | 295.02 | 304.77 | 380311.20 | 1077940.08 |

THE GEOLOGIST WHO REVIEWED AND APPROVED THIS REPORT ASSUMES RESPONSIBILITY ONLY FOR GEOLOGIC INTERPRETATIONS OF DATA APPEARING ON THE PAGE AND DISCLAIMS PURSUANT TO SECTION 256.456 RSMO ANY RESPONSIBILITY FOR ALL OTHER PLANS, SPECIFICATIONS, ESTIMATES, REPORTS OR OTHER DOCUMENTS OR INSTRUMENTS NOT PREPARED UNDER THE SUPERVISION OF THE GEOLOGIST RELATING TO OR INTENDED TO BE USED FOR ANY PART OR PARTS OF THE PROJECT TO WHICH THIS FIGURE REFERS.

FIGURE 1
GROUNDWATER CONTOUR MAP
JUNE 13, 2018

SIKESTON POWER STATION
BOTTOM ASH POND
2018 ANNUAL GROUNDWATER
MONITORING & CORRECTIVE
ACTION REPORT

| SURVEYED | DESIGNED | DRAWN | CHECKED | APPROVED | DATE | SCALE | PROJECT NAME | FILE NAME | SHEET # |
|---|---|---|---|---|---|---|---|---|---|
| NA | NA | CP | KE | MCC | 12/2018 | AS NOTED | SIKESTON/GWMAP/BAP | GWCONT BAP 06-2018 | 1 OF 1 |

**GREDELL Engineering Resources, Inc.**
ENVIRONMENTAL ENGINEERING LAND - AIR - WATER
1505 East High Street Telephone: (573) 659-9078
Jefferson City, Missouri Facsimile: (573) 659-9079
MO CORP. ENGINEERING LICENSE NO. E-2001001669-D

M:\Share\CADDFiles\SIKESTON\GROUNDWATER MAP\BAP\GW CONT MAP BAP 06-2018.dwg, GW CONT MAP BAP, 1/9/2019 10:45:35 AM

LEGEND

PROPERTY LINE —PL—

GROUNDWATER CONTOUR ——

MONITORING WELL (MW)

UP GRADIENT MONITORING LOCATION UG

DOWN GRADIENT MONITORING LOCATION DG

GENERAL FLOW DIRECTION ◄——

NOTES:
1. IMAGE PROVIDED BY BING MAPS.
2. MONITORING WELL LOCATIONS, CASING ELEVATIONS & UNDERGROUND CULVERT ELEVATIONS SURVEYED BY BOWEN ENGINEERING & SURVEYING.
3. GROUNDWATER ELEVATIONS MEASURED BY SIKESTON POWER STATION STAFF ON NOVEMBER 26, 2018.
4. MAP DEVELOPMENT BASED ON CONTOURS GENERATED BY SURFER® SOFTWARE.
5. RANGE OF GROUNDWATER FLOW GRADIENT AS DETERMINED BY SURFER® SOFTWARE 0.0003 FT./FT. TO 0.0009 FT./FT.

| WELL ID | GROUNDWATER ELEVATION | CASING ELEVATION | NORTHING | EASTING |
|---|---|---|---|---|
| MW-3 | 295.63 | 308.55 | 381130.00 | 1079946.62 |
| MW-4 | 293.76 | 305.61 | 380804.62 | 1077766.95 |
| MW-5 | 294.27 | 305.91 | 379858.94 | 1078477.85 |
| MW-6 | 294.91 | 307.72 | 379874.77 | 1079384.36 |
| MW-8 | 293.88 | 304.77 | 380311.20 | 1077940.08 |

THE GEOLOGIST WHO REVIEWED AND APPROVED THIS REPORT ASSUMES RESPONSIBILITY ONLY FOR GEOLOGIC INTERPRETATIONS OF DATA APPEARING ON THE PAGE AND DISCLAIMS PURSUANT TO SECTION 256.456 RSMO ANY RESPONSIBILITY FOR ALL OTHER PLANS, SPECIFICATIONS, ESTIMATES, REPORTS OR OTHER DOCUMENTS OR INSTRUMENTS NOT PREPARED UNDER THE SUPERVISION OF THE GEOLOGIST RELATING TO OR INTENDED TO BE USED FOR ANY PART OR PARTS OF THE PROJECT TO WHICH THIS FIGURE REFERS.

## FIGURE 2
## GROUNDWATER CONTOUR MAP
## NOVEMBER 26, 2018

SIKESTON POWER STATION
BOTTOM ASH POND
2018 ANNUAL GROUNDWATER
MONITORING & CORRECTIVE
ACTION REPORT

| SURVEYED | DESIGNED | DRAWN | CHECKED | APPROVED | DATE | SCALE | PROJECT NAME | FILE NAME | SHEET # |
|---|---|---|---|---|---|---|---|---|---|
| NA | NA | CP | KE | MCC | 12/2018 | AS NOTED | SIKESTON/GWMAP/BAP | GWCONT BAP 11-2018 | 1 OF 1 |

**GREDELL Engineering Resources, Inc.**
ENVIRONMENTAL ENGINEERING LAND - AIR - WATER
1505 East High Street Telephone: (573) 659-9078
Jefferson City, Missouri Facsimile: (573) 659-9079
MO CORP. ENGINEERING LICENSE NO. E-2001001669-D

M:\Share\CADDFiles\SIKESTON\GROUNDWATER MAP\BAP\GW CONT MAP BAP 11-2018.dwg, GW CONT MAP BAP, 1/9/2019 10:46:29 AM

N

SCALE: 1" = 400'

0 200 400

**LEGEND**

| | |
|---|---|
| PROPERTY LINE | —PL— |
| GROUNDWATER CONTOUR | —— |
| MONITORING WELL | (MW) |
| UP GRADIENT MONITORING LOCATION | UG |
| DOWN GRADIENT MONITORING LOCATION | DG |
| GENERAL FLOW DIRECTION | ← |

**NOTES:**

1. IMAGE PROVIDED BY BING MAPS.
2. MONITORING WELL LOCATIONS, CASING ELEVATIONS & UNDERGROUND CULVERT ELEVATIONS SURVEYED BY BOWEN ENGINEERING & SURVEYING.
3. GROUNDWATER ELEVATIONS MEASURED BY SIKESTON POWER STATION STAFF ON MAY 28, 2019.
4. MAP DEVELOPMENT BASED ON CONTOURS GENERATED BY SURFER® SOFTWARE.
5. RANGE OF HYDRAULIC GRADIENT AS DETERMINED BY SURFER® SOFTWARE 0.0005 FT./FT. TO 0.001 FT./FT.

| WELL ID | GROUNDWATER ELEVATION | CASING ELEVATION | NORTHING | EASTING |
|---|---|---|---|---|
| MW-3 | 298.95 | 308.55 | 381130.00 | 1079946.62 |
| MW-4 | 296.01 | 305.61 | 380804.62 | 1077766.95 |
| MW-5 | 296.80 | 305.91 | 379858.94 | 1078477.85 |
| MW-6 | 297.91 | 307.72 | 379874.77 | 1079384.36 |
| MW-8 | 296.16 | 304.77 | 380311.20 | 1077940.08 |

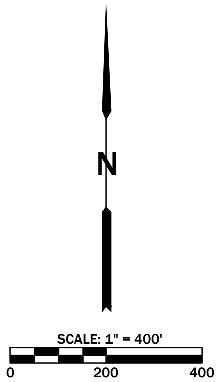
THE GEOLOGIST WHO REVIEWED AND APPROVED THIS REPORT ASSUMES RESPONSIBILITY ONLY FOR GEOLOGIC INTERPRETATIONS OF DATA APPEARING ON THE PAGE AND DISCLAIMS PURSUANT TO SECTION 256.456 RSMO ANY RESPONSIBILITY FOR ALL OTHER PLANS, SPECIFICATIONS, ESTIMATES, REPORTS OR OTHER DOCUMENTS OR INSTRUMENTS NOT PREPARED UNDER THE SUPERVISION OF THE GEOLOGIST RELATING TO OR INTENDED TO BE USED FOR ANY PART OR PARTS OF THE PROJECT TO WHICH THIS FIGURE REFERS.

## FIGURE 2
## GROUNDWATER CONTOUR MAP
## MAY 28, 2019

SIKESTON POWER STATION
BOTTOM ASH POND
2020 ANNUAL GROUNDWATER
MONITORING & REPORT

| SURVEYED | DESIGNED | DRAWN | CHECKED | APPROVED | DATE | SCALE | PROJECT NAME | FILE NAME | SHEET # |
|---|---|---|---|---|---|---|---|---|---|
| NA | NA | CP | GE | MCC | 1/2020 | AS NOTED | SIKESTON/GWMAP/BAP | GWCONT BAP 05-2019 | 1 OF 1 |

**GREDELL Engineering Resources, Inc.**
ENVIRONMENTAL ENGINEERING LAND - AIR - WATER
1505 East High Street Telephone: (573) 659-9078
Jefferson City, Missouri Facsimile: (573) 659-9079
MO CORP. ENGINEERING LICENSE NO. E-2001001669-D



**LEGEND**

| | |
|---|---|
| PROPERTY LINE | —PL— |
| GROUNDWATER CONTOUR | —— |
| MONITORING WELL | MW |
| UP GRADIENT MONITORING LOCATION | UG |
| DOWN GRADIENT MONITORING LOCATION | DG |
| GENERAL FLOW DIRECTION | ◄—— |

**NOTES:**

1. IMAGE PROVIDED BY BING MAPS.
2. MONITORING WELL LOCATIONS, CASING ELEVATIONS & UNDERGROUND CULVERT ELEVATIONS SURVEYED BY BOWEN ENGINEERING & SURVEYING.
3. GROUNDWATER ELEVATIONS MEASURED BY SIKESTON POWER STATION STAFF ON AUGUST 28, 2019.
4. MAP DEVELOPMENT BASED ON CONTOURS GENERATED BY SURFER® SOFTWARE.
5. RANGE OF HYDRAULIC GRADIENT AS DETERMINED BY SURFER® SOFTWARE 0.0004 FT./FT. TO 0.001 FT./FT.

| WELL ID | GROUNDWATER ELEVATION | CASING ELEVATION | NORTHING | EASTING |
|---|---|---|---|---|
| MW-3 | 297.55 | 308.55 | 381130.00 | 1079946.62 |
| MW-4 | 294.81 | 305.61 | 380804.62 | 1077766.95 |
| MW-5 | 295.47 | 305.91 | 379858.94 | 1078477.85 |
| MW-6 | 296.51 | 307.72 | 379874.77 | 1079384.36 |
| MW-8 | 294.91 | 304.77 | 380311.20 | 1077940.08 |

THE GEOLOGIST WHO REVIEWED AND APPROVED THIS REPORT ASSUMES RESPONSIBILITY ONLY FOR GEOLOGIC INTERPRETATIONS OF DATA APPEARING ON THE PAGE AND DISCLAIMS PURSUANT TO SECTION 256.456 RSMO ANY RESPONSIBILITY FOR ALL OTHER PLANS, SPECIFICATIONS, ESTIMATES, REPORTS OR OTHER DOCUMENTS OR INSTRUMENTS NOT PREPARED UNDER THE SUPERVISION OF THE GEOLOGIST RELATING TO OR INTENDED TO BE USED FOR ANY PART OR PARTS OF THE PROJECT TO WHICH THIS FIGURE REFERS.

# FIGURE 1
# GROUNDWATER CONTOUR MAP
# AUGUST 28, 2019

## SIKESTON POWER STATION
## BOTTOM ASH POND
## 2019 ANNUAL GROUNDWATER
## MONITORING & REPORT

| SURVEYED | DESIGNED | DRAWN | CHECKED | APPROVED | DATE | SCALE | PROJECT NAME | FILE NAME | SHEET # |
|---|---|---|---|---|---|---|---|---|---|
| NA | NA | CP | GE | MCC | 1/2020 | AS NOTED | SIKESTON/GWMAP/BAP | GWCONT BAP 08-2019 | 1 OF 1 |

**GREDELL Engineering Resources, Inc.**
ENVIRONMENTAL ENGINEERING LAND - AIR - WATER
1505 East High Street Telephone: (573) 659-9078
Jefferson City, Missouri Facsimile: (573) 659-9079
MO CORP. ENGINEERING LICENSE NO. E-2001001669-D

O:\CADDFiles\SIKESTON\GROUNDWATER MAP\BAP\GW CONT MAP BAP 08-2019.dwg, GW CONT MAP BAP, 1/10/2020 9:02:15 AM

# ATTACHMENT D4 – GROUNDWATER MONITORING RESULTS

# Sikeston Board of Municipal Utilities
# Sikeston Power Station
# Bottom Ash Pond Scott County, Missouri
## CCR Groundwater Data Base

| | | | | Field Parameters | | | | | Appendix III Monitoring Constituents (Detection) | | | | | | | Appendix IV Monitoring Constituents (Assessment) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Duplicate Collected? | Date | Monitoring Purpose | Spec. Cond. | Temp. | ORP | D.O. | Turbidity | pH | Chloride | Fluoride | Sulfate | TDS | Boron | Calcium | Antimony | Arsenic | Barium | Beryllium | Cadmium | Chromium | Cobalt | Lead | Lithium | Mercury | Molybdenum | Selenium | Thallium | Radium 226 and 228 (Combined) |
| ID | | | | µmhos/cm | °C | mV | mg/L | NTU | S.U. | mg/L | mg/L | mg/L | mg/L | ug/L | mg/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | pCi/L |
| Federal MCL | | | | | | | | | | None | 4.0 | None | None | None | None | 6 | 10 | 2000 | 4 | 5 | 100 | 6 | 15 | 40 | 2 | 100 | 50 | 2 | 5 |
| **MW-3 (UG)** | | 11/30/2016 | Background | 254.0 | 15.75 | -27.1 | 0.41 | 37.28 | 7.1 | 2.3 | 0.438 | 26 | 160 | 18 | 24 | <3.0 | 1.5 | 96 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 1.668 |
| | Yes | 1/24/2017 | Background | 226.4 | 16.52 | -8.4 | 0.39 | 4.46 | 6.9 | 2.0 | 0.261 | 30 | 130 | 12 | 21 | <3.0 | 1.2 | 120 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.677(ND) |
| | | 2/22/2017 | Background | 226.6 | 16.47 | 9.7 | 0.36 | 3.56 | 6.9 | 1.9 | 0.290 | 26 | 120 | 33 | 22 | <3.0 | 1.0 | 120 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.460(ND) |
| | | 3/20/2017 | Background | 212.1 | 17.07 | 33.7 | 0.43 | 6.61 | 6.7 | 1.8 | 0.286 | 21 | 170 | 22 | 19 | <3.0 | <1.0 | 110 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.277(ND) |
| | | 4/27/2017 | Background | 223.2 | 15.35 | 9.2 | 0.57 | 2.69 | 6.7 | 2.0 | 0.257 | 28 "Q4" | 140 | 54 | 20 | <3.0 | <1.0 | 110 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | 9.9 | <1.0 | <1.0 | -0.030(ND) |
| | | 5/17/2017 | Background | 224.9 | 17.68 | 26.8 | 0.45 | 12.59 | 6.6 | 1.5 | <0.250 | 21 | 130 | 19 | 17 | <3.0 | <1.0 | 120 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | 0.40 | <1.0 | <1.0 | <1.0 | 0.844(ND) |
| | Yes | 6/8/2017 | Background | 217.9 | 16.73 | 18.2 | 0.49 | 2.61 | 6.7 | 1.7 | 0.276 | 22 | 160 | 20 | 19 | <3.0 | <1.0 | 110 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | -0.469(ND) |
| | | 7/13/2017 | Background | 243.8 | 19.02 | 5.5 | 0.39 | 4.79 | 6.7 | 2.2 | 0.256 | 19 | 160 | 18 | 20 | <3.0 | <1.0 | 100 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.715(ND) |
| | Yes | 10/31/2017 | Detection | 246.2 | 16.74 | 12.4 | 0.65 | 7.47 | 6.6 | 2.0 | 0.331 | 20 | 140 | 27 | 19 | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) |
| | | 6/13/2018 | Detection | 194.2 | 17.19 | 42.3 | 0.42 | 7.57 | 6.6 | 1.3 | 0.291 | 17 | 130 | 23 | 20 | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) |
| | | 11/26/2018 | Det/ASD/Bkg | 194.9 | 15.05 | 49.8 | 0.47 | 2.23 | 6.5 | 1.5 | 0.301/0.316 | 18 | 100 | 23 | 17 | <3.0 | <1.0 | 101 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.641(ND) |
| | | 2/5/2019 | ASD/Bkg | 205.0 | 14.49 | 46.9 | 0.49 | 1.92 | 6.5 | 1.5 | 0.342/<0.250 | 20 | 160 | 22 | 17 | <3.0 | <1.0 | 100 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.383 |
| | | 5/28/2019 | Det/ASD/Bkg | 218.4 | 16.42 | 32.2 | 0.82 | 9.69 | 6.4 | 1.3 | <0.250 | 20 | - | 51 | 17 | <3.0 | <1.0 | 110 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.916(ND) |
| | | 7/23/2019 | Det/ASD/Bkg | 203.0 | 16.58 | 71.0 | 0.88 | 4.96 | - | - | - | - | 140 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | 8/28/2019 | ASD/Bkg | 207.4 | 16.97 | 75.6 | 0.89 | 4.02 | 6.4 | 1.1 | <0.250 | 18 | 140 | 35 | 15 | <3.0 | <1.0 | 110 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <20 | <0.20 | <1.0 | <1.0 | <1.0 | 0.881(ND) |
| | | 11/4/2019 | Det/ASD/Bkg | 202.3 | 16.60 | 63.2 | 0.70 | 4.22 | 6.4 | 1.4 | <0.250 | 18 | 130 | 37 | 15 | <3.0 | <1.0 | 110 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <20 | <0.20 | <1.0 | <1.0 | <1.0 | 0.128(ND) |
| | | 2/18/2020 | Det/ASD/Bkg | 207.6 | 14.17 | 58.6 | 1.22 | 6.34 | 6.4 | 1.3 | <0.250 | 21 | 140H | 27 | 16 | <3.0 | <1.0 | 110 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <20 | <0.20 | <1.0 | <1.0 | <1.0 | 0.341(ND) |
| | | 3/30/2020 | | 199.3 | 14.87 | 61.2 | 1.20 | 6.01 | 6.4 | - | - | - | 180 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | 7/21/2020 | ASD/Bkg | 197.8 | 16.87 | -40.4 | 8.42 | 3.43 | 6.5 | 1.0 | <0.250 | 15 | 140 | 21 | 18 | <3.0 | <1.0 | 85 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <20 | <0.20 | <1.0 | <1.0 | <1.0 | 0.857(ND) |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **MW-4 (DG)** | | 11/30/2016 | Background | 575.6 | 17.51 | -108.3 | 0.48 | 0.61 | 7.5 | 18 | 0.259 | 140 | 390 | 1400 | 89 | <3.0 | <1.0 | 41 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.572(ND) |
| | | 1/24/2017 | Background | 543.7 | 17.00 | -105.2 | 0.50 | 0.48 | 7.5 | 15 | <0.250 | 120 | 290 | 880 | 79 | <3.0 | <1.0 | 46 | <2.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.7031(ND) |
| | | 2/22/2017 | Background | 554.0 | 17.95 | -115.3 | 0.51 | 1.19 | 7.5 | 13 | <0.250 | 97 | 320 | 1500 | 78 | <3.0 | <1.0 | 51 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.550(ND) |
| | | 3/20/2017 | Background | 562.8 | 18.58 | -108.8 | 0.69 | 1.70 | 7.4 | 12 | <0.250 | 94 | 350 | 1400 | 72 | <3.0 | <1.0 | 53 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | 1.3 | <1.0 | <1.0 | <1.0 | 1.036 |
| | Yes | 4/27/2017 | Background | 536.9 | 17.25 | -129.6 | 0.91 | 2.38 | 7.4 | 14 | <0.250 | 99 | 300 | 1300 | 74 | <3.0 | <1.0 | 50 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.210(ND) |
| | Yes | 5/17/2017 | Background | 554.9 | 17.90 | -115.5 | 0.63 | 3.02 | 7.4 | 14 | <0.250 | 96 | 320 | 1200 | 71 | <3.0 | <1.0 | 66 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.774(ND) |
| | | 6/8/2017 | Background | 509.7 | 18.24 | -122.9 | 0.86 | 0.84 | 7.4 | 12 | <0.250 | 86 | 340 | 1100 | 61 | <3.0 | <1.0 | 45 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.464(ND) |
| | | 7/13/2017 | Background | 575.5 | 19.46 | -115.2 | 0.52 | 1.43 | 7.4 | 13 | <0.250 | 88 | 300 | 1200 | 79 | <3.0 | <1.0 | 52 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 1.086(ND) |
| | | 10/31/2017 | Detection | 525.8 | 18.35 | -118.1 | 0.63 | 1.07 | 7.3 | 17 | <0.250 | 83 | 290 | 1400 | 67 | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) |
| | | 6/13/2018 | Detection | 511.5 | 18.92 | -120.7 | 0.44 | 18.50 | 7.3 | 14 | <0.250 | 86 | 290 | 1200 | 80 | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) |
| | Yes | 11/26/2018 | Det/ASD/Bkg | 468.0 | 16.07 | -101.8 | 0.53 | 1.01 | 7.4 | 8.8 | <0.250 | 54 | 260 | 1100 | 64 | <3.0 | <1.0 | 77 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.523(ND) |
| | | 2/5/2019 | ASD/Bkg | 761.0 | 15.62 | -97.5 | 0.52 | 2.58 | 7.3 | 33 | <0.250/<0.250 | 140 | 420 | 1100 | 100 | <3.0 | <1.0 | 110 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | 1.7 | <1.0 | <1.0 | 1.188 |
| | | 5/28/2019 | Det/ASD/Bkg | 581.7 | 18.65 | -108.5 | 0.37 | 3.30 | 7.3 | 11 | <0.250 | 75 | - | 980 | 70 | <3.0 | <1.0 | 81 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | 3.5 | <1.0 | <1.0 | 1.46(ND) |
| | | 7/23/2019 | Det/ASD/Bkg | 615.2 | 18.88 | -105.2 | 0.43 | 0.36 | - | - | - | - | 340 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | 8/28/2019 | ASD/Bkg | 645.4 | 19.60 | -101.7 | 0.40 | 2.31 | 7.2 | 18 | <0.250 | 110 | 300 | 1100 | 83 | <3.0 | <1.0 | 89 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <20 | <0.20 | 4.2 | <1.0 | <1.0 | 0.921(ND) |
| | | 11/4/2019 | Det/ASD/Bkg | 657.7 | 18.52 | -104.2 | 0.50 | 0.96 | 7.2 | 2.1 | <0.250 | 120 | 400 | 1200 | 89 | <3.0 | <1.0 | 96 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <20 | <0.20 | 4.0 | <1.0 | <1.0 | 0.794(ND) |
| | | 2/18/2020 | Det/ASD/Bkg | 526.9 | 14.49 | -87.6 | 0.63 | 1.60 | 7.4 | 11 | <0.250 | 66 | 290H | 930 | 67 | <3.0 | <1.0 | 72 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <20 | <0.20 | 5.1 | <1.0 | <1.0 | 1.12(ND) |
| | | 3/30/2020 | | 520.6 | 16.45 | -91.1 | 0.35 | 19.51 | 7.4 | - | - | - | 300 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | 7/21/2020 | ASD/Bkg | 550.7 | 19.75 | -145.6 | 5.06 | 6.49 | 7.2 | 14 | <0.250 | 86 | 290 | 920 | 76 | <3.0 | <1.0 | 81 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <20 | <0.20 | 7.0 | <1.0 | <1.0 | 1.606 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Appendix 6
Prepared by: KAE
Checked by: MCC

# Sikeston Board of Municipal Utilities
# Sikeston Power Station
# Bottom Ash Pond Scott County, Missouri
## CCR Groundwater Data Base

| | | | | Field Parameters | | | | | Appendix III Monitoring Constituents (Detection) | | | | | | | Appendix IV Monitoring Constituents (Assessment) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well ID | Duplicate Collected? | Date | Monitoring Purpose | Spec. Cond. | Temp. | ORP | D.O. | Turbidity | pH | Chloride | Fluoride | Sulfate | TDS | Boron | Calcium | Antimony | Arsenic | Barium | Beryllium | Cadmium | Chromium | Cobalt | Lead | Lithium | Mercury | Molybdenum | Selenium | Thallium | Radium 226 and 228 (Combined) |
| | | | | µmhos/cm | °C | mV | mg/L | NTU | S.U. | mg/L | mg/L | mg/L | mg/L | ug/L | mg/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | pCi/L |
| Federal MCL | | | | | | | | | | None | 4.0 | None | None | None | None | 6 | 10 | 2000 | 4 | 5 | 100 | 6 | 15 | 40 | 2 | 100 | 50 | 2 | 5 |
| **MW-5 (DG)** | Yes | 11/30/2016 | Background | 808.3 | 16.20 | -48.7 | 0.50 | 1.24 | 7.0 | 16 | 0.255 | 230 | 560 | 470 | 96 | <3.0 | <1.0 | 84 | <1.0 | <1.0 | <4.0 | 4.3 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 1.844 |
| | | 1/24/2017 | Background | 745.3 | 16.24 | -37.6 | 0.58 | 0.72 | 6.9 | 15 | <0.250 | 270 | 470 | 480 | 120 | <3.0 | <1.0 | 91 | <1.0 | <1.0 | <4.0 | 5.2 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.827(ND) |
| | | 2/22/2017 | Background | 717.8 | 17.75 | -50.5 | 0.36 | 3.43 | 7.0 | 11 | <0.250 | 170 | 420 | 470 | 100 | <3.0 | <1.0 | 83 | <1.0 | <1.0 | <4.0 | 3.6 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.130(ND) |
| | Yes | 3/20/2017 | Background | 737.9 | 17.78 | -36.5 | 0.72 | 2.16 | 6.9 | 11 | <0.250 | 170 | 480 | 320 | 99 | <3.0 | <1.0 | 76 | <1.0 | <1.0 | <4.0 | 4.4 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.538(ND) |
| | | 4/27/2017 | Background | 777.3 | 16.07 | -58.8 | 0.69 | 5.20 | 6.8 | 12 | <0.250 | 460 | 480 | 490 | 120 | <3.0 | <1.0 | 87 | <1.0 | <1.0 | <4.0 | 4.8 | <1.0 | <10 | <0.20 | 3.0 | <1.0 | <1.0 | 1.676 |
| | | 5/17/2017 | Background | 760.1 | 17.81 | -56.0 | 0.46 | 5.35 | 6.8 | 11 | <0.250 | 200 | 440 | 5700 | 240 | <3.0 | 1.8 | 180 | <1.0 | <1.0 | 16 | 5.3 | 6.3 | <10 | 0.24 | <1.0 | <1.0 | <1.0 | 1.739 |
| | | 6/8/2017 | Background | 678.3 | 17.72 | -58.6 | 0.69 | 1.89 | 6.8 | 11 | <0.250 | 180 | 480 | 360 | 97 | <3.0 | <1.0 | 77 | <1.0 | <1.0 | <4.0 | 3.9 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.869(ND) |
| | | 7/13/2017 | Background | 799.0 | 19.19 | -82.0 | 1.08 | 17.49 | 7.0 | 10 | <0.250 | 190 | 430 | 320 | 110 | <3.0 | <1.0 | 81 | <1.0 | <1.0 | <4.0 | 3.8 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.767(ND) |
| | | 10/31/2017 | Detection | 591.8 | 17.45 | -77.6 | 0.85 | 3.17 | 6.9 | 13 | <0.250 | 88 | 310 | 280 | 72 | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) |
| | | 6/13/2018 | Detection | 756.4 | 18.28 | -55.6 | 0.84 | 1.91 | 6.8 | 11 | <0.250 | 240 | 480 | 370 | 130 | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) |
| | | 11/26/2018 | Det/ASD/Bkg | 836.4 | 14.90 | -27.0 | 0.51 | 0.38 | 6.7 | 17 | <0.250 | 230 | 520 | 420 | 120 | <3.0 | <1.0 | 98 | <1.0 | <1.0 | <4.0 | 6.2 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 1.336 |
| | Yes | 2/5/2019 | ASD/Bkg | 845.6 | 15.22 | -23.7 | 0.41 | 0.71 | 6.7 | 15 | 0.272/<0.250 | 200 | 480 | 450 | 120 | <3.0 | <1.0 | 83 | <1.0 | <1.0 | <4.0 | 5.7 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 1.01(ND) |
| | Yes | 5/28/2019 | Det/ASD/Bkg | 861.1 | 18.31 | -59.1 | 0.60 | 3.71 | 6.9 | 10 | <0.250 | 190 | - | 280 | 110 | <3.0 | <1.0 | 81 | <1.0 | <1.0 | <4.0 | 2.6 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 1.70(ND) |
| | | 7/23/2019 | Det/ASD/Bkg | 806.9 | 18.66 | -44.9 | 0.81 | 1.34 | - | - | - | - | 480 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Yes | 8/28/2019 | ASD/Bkg | 848.4 | 18.49 | -42.2 | 0.64 | 0.82 | 6.8 | 16 | <0.250 | 190 | 480 | 410 | 110 | <3.0 | <1.0 | 88 | <1.0 | <1.0 | <4.0 | 4.6 | <1.0 | <20 | <0.20 | <1.0 | <1.0 | <1.0 | 0.641(ND) |
| | Yes | 11/4/2019 | Det/ASD/Bkg | 729.9 | 18.03 | -55.8 | 0.77 | 2.65 | 6.8 | 3.2/3.3 | <0.250 | 15/15 | 440/420 | 420/420 | 99/99 | <3.0 | <1.0 | 72/73 | <1.0 | <1.0 | <4.0 | 2.6/2.3 | <1.0 | <20 | <0.20 | <1.0 | <1.0 | <1.0 | 0.537(ND)/(ND) |
| | Yes | 2/18/2020 | Det/ASD/Bkg | 871.7 | 14.05 | -45.2 | 0.81 | 0.88 | 6.8 | 15/15 | <0.250 | 210/220 | 520H/420H | 400/410 | 110/120 | <3.0 | <1.0 | 82/85 | <1.0 | <1.0 | <4.0 | 4.3/3.9 | <1.0 | <20 | <0.20 | <1.0 | <1.0 | <1.0 | 0.949(ND)/(ND) |
| | Yes | 3/30/2020 | | 750.4 | 15.84 | -49.7 | 0.62 | 2.90 | 6.8 | - | - | - | 450/460 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | 7/21/2020 | ASD/Bkg | 816.5 | 18.35 | -102.9 | 4.37 | 5.36 | 6.8 | 14 | <0.250 | 210 | 470 | 330 | 110 | <3.0 | <1.0 | 79 | <1.0 | <1.0 | <4.0 | 2.9 | <1.0 | <20 | <0.20 | <1.0 | <1.0 | <1.0 | 0.963(ND) |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **MW-6 (UG)** | | 11/30/2016 | Background | 369.0 | 16.39 | -49.4 | 0.85 | 0.84 | 6.9 | 2.8 | 0.331 | 36 | 200 | 36 | 45 | <3.0 | 4.3 | 190 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 1.532 |
| | | 1/24/2017 | Background | 358.9 | 16.29 | -44.8 | 0.66 | 0.26 | 6.9 | 2.4 | <0.250 | 43 | 200 | 27 | 41 | <3.0 | 5.7 | 220 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.948(ND) |
| | Yes | 2/22/2017 | Background | 352.5 | 17.20 | -42.2 | 0.81 | 15.27 | 6.9 | 2.1 | 0.269 | 32 | 160 | 59 | 40 | <3.0 | 6.4 | 210 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.685(ND) |
| | | 3/20/2017 | Background | 360.8 | 16.90 | 24.9 | 0.36 | 9.70 | 6.7 | 2.1 | <0.250 | 31 | 240 | 37 | 39 | <3.0 | 5 | 160 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.577(ND) |
| | | 4/27/2017 | Background | 331.5 | 15.71 | -50.9 | 0.39 | 8.35 | 6.7 | 2.3 | <0.250 | 34 | 170 | 36 | 38 | <3.0 | 3.2 | 180 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 1.243(ND) |
| | | 5/17/2017 | Background | 323.2 | 17.65 | -71.5 | 0.45 | 7.13 | 6.8 | 1.8 | <0.250 | 30 | 170 | 35 | 30 | <3.0 | 4.9 | 190 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 1.173(ND) |
| | | 6/8/2017 | Background | 326.7 | 17.50 | -53.0 | 0.33 | 3.86 | 6.7 | 1.7 | <0.250 | 29 | 180 | 38 | 36 | <3.0 | 4.6 | 190 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.893(ND) |
| | | 7/13/2017 | Background | 396.8 | 19.68 | -84.0 | 0.72 | 2.17 | 7.0 | 1.6 | <0.250 | 28 | 180 | 31 | 40 | <3.0 | 5.8 | 200 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.575(ND) |
| | | 10/31/2017 | Detection | 359.6 | 17.57 | -57.9 | 0.71 | 1.48 | 6.7 | 1.7 | 0.303 | 29 | 170 | 41 | 38 | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) |
| | Yes | 6/13/2018 | Detection | 345.4 | 17.59 | -44.0 | 0.40 | 13.24 | 6.7 | 2.3 | <0.250 | 32 | 160 | 43 | 41 | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) |
| | Yes | 11/26/2018 | Det/ASD/Bkg | 375.3 | 15.04 | -37.6 | 1.07 | 1.66 | 6.7 | 1.5 | 0.313/0.290 | 29 | 180 | 46 | 36 | <3.0 | 5.5 | 210 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.946(ND) |
| | | 2/5/2019 | ASD/Bkg | 384.7 | 14.86 | -33.9 | 0.56 | 2.68 | 6.7 | 1.6 | 0.338/<0.250 | 27 | 160 | 44 | 40 | <3.0 | 3.9 | 190 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.589 |
| | | 5/28/2019 | Det/ASD/Bkg | 418.2 | 16.93 | -48.2 | 0.34 | 7.15 | 6.7 | 2.5 | <0.250 | 30 | - | 52 | 40 | <3.0 | 3.2 | 190 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 1.28(ND) |
| | | 7/23/2019 | Det/ASD/Bkg | 419.3 | 17.64 | -59.8 | 0.51 | 2.03 | - | - | - | - | 180 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | 8/28/2019 | ASD/Bkg | 442.2 | 17.67 | -65.4 | 0.66 | 1.15 | 6.7 | 1.0 | <0.250 | 24 | 200 | 54 | 44 | <3.0 | 3.6 | 210 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <20 | <0.20 | <1.0 | <1.0 | <1.0 | 0.380(ND) |
| | | 11/4/2019 | Det/ASD/Bkg | 388.3 | 17.62 | -48.1 | 0.38 | 1.68 | 6.7 | 1.4 | 0.319 | 22 | 210 | 47 | 43 | <3.0 | 4.7 | 190 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <20 | <0.20 | <1.0 | <1.0 | <1.0 | 1.10(ND) |
| | | 2/18/2020 | Det/ASD/Bkg | 390.3 | 14.54 | -54.5 | 0.81 | 5.79 | 6.7 | 1.7 | <0.250 | 24 | 170H | 40 | 41 | <3.0 | 2.4 | 180 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <20 | <0.20 | <1.0 | <1.0 | <1.0 | 1.26 |
| | | 3/30/2020 | | 391.0 | 15.17 | -53.6 | 0.67 | 3.99 | 6.7 | - | - | - | 230 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | 7/21/2020 | ASD/Bkg | 415.1 | 17.64 | -100.2 | 4.54 | 3.48 | 6.7 | <1.0 | <0.250 | 22 | 220 | 46 | 43 | <3.0 | 3.1 | 190 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <20 | <0.20 | <1.0 | <1.0 | <1.0 | 1.461(ND) |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Appendix 6
Prepared by: KAE
Checked by: MCC

# Sikeston Board of Municipal Utilities
# Sikeston Power Station
# Bottom Ash Pond Scott County, Missouri
## CCR Groundwater Data Base

| | | | | Field Parameters | | | | | Appendix III Monitoring Constituents (Detection) | | | | | | | Appendix IV Monitoring Constituents (Assessment) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Duplicate Collected? | Date | Monitoring Purpose | Spec. Cond. | Temp. | ORP | D.O. | Turbidity | pH | Chloride | Fluoride | Sulfate | TDS | Boron | Calcium | Antimony | Arsenic | Barium | Beryllium | Cadmium | Chromium | Cobalt | Lead | Lithium | Mercury | Molybdenum | Selenium | Thallium | Radium 226 and 228 (Combined) |
| ID | | | | µmhos/cm | °C | mV | mg/L | NTU | S.U. | mg/L | mg/L | mg/L | mg/L | ug/L | mg/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | pCi/L |
| Federal MCL | | | | | | | | | | None | 4.0 | None | None | None | None | 6 | 10 | 2000 | 4 | 5 | 100 | 6 | 15 | 40 | 2 | 100 | 50 | 2 | 5 |
| **MW-8 (DG)** | | 5/18/2017 | Background | 662.5 | 17.58 | -89.4 | 0.29 | 2.39 | 7.2 | 46 | <0.250 | 100 | 340 | 400 | 74 | <3.0 | <1.0 | 86 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 1.067 |
| | | 6/9/2017 | Background | 678.2 | 17.90 | -108.5 | 0.31 | 0.47 | 7.2 | 43 | <0.250 | 110 | 380 | 520 | 92 | <3.0 | <1.0 | 86 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.839(ND) |
| | Yes | 7/13/2017 | Background | 661.5 | 18.57 | -107.1 | 0.23 | 1.20 | 7.3 | 36 | <0.250 | 89 | 320 | 430 | 87 | <3.0 | <1.0 | 74 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 1.034(ND) |
| | Yes | 8/3/2017 | Background | 665.7 | 19.06 | -108.4 | 0.24 | 0.98 | 7.2 | 37 | <0.250 | 89 | 330 | 490 | 80 | <3.0 | <1.0 | 74 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.681(ND) |
| | Yes | 8/15/2017 | Background | 594.9 | 18.56 | -88.7 | 0.38 | 0.99 | 7.2 | 36 | <0.250 | 83 | 320 | 530 | 75 | <3.0 | <1.0 | 68 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.906(ND) |
| | Yes | 8/30/2017 | Background | 644.2 | 18.62 | -91.3 | 0.29 | 1.18 | 7.2 | 41 | <0.250 | 96 | 290 | 510 | 88 | <3.0 | <1.0 | 75 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.805(ND) |
| | | 9/14/2017 | Background | 707.9 | 18.52 | -90.1 | 0.48 | 0.67 | 7.1 | 53 | <0.250 H | 110 | 370 | 510 | 86 | <3.0 | <1.0 | 77 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | 12 | <0.20 | <1.0 | <1.0 | <1.0 | 0.314(ND) |
| | | 9/27/2017 | Background | 764.0 | 19.11 | -89.6 | 0.30 | 0.58 | 7.1 | 50 | <0.250 | 120 | 420 | 480 | 92 | <3.0 | <1.0 | 80 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.594(ND) |
| | | 10/31/2017 | Detection | 698.1 | 17.99 | -96.3 | 0.38 | 0.94 | 7.1 | 45 | <0.250 | 110 | 380 | 540 | 86 | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) |
| | | 6/13/2018 | Detection | 788.8 | 18.34 | -99.1 | 0.23 | 4.80 | 7.1 | 65 | <0.250 | 150 | 430 | 520 | 120 | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) |
| | | 7/10/2018 | Re-sample | 899.4 | 18.52 | -94.2 | 0.35 | 2.69 | 7.1 | 68 | (NA) | 140 | (NA) | (NA) | 120 | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) |
| | | 7/10/2018 | Re-sample/DUP | 899.4 | 18.52 | -94.2 | 0.35 | 2.69 | 7.1 | 71 | (NA) | 150 | (NA) | (NA) | 120 | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) | (NA) |
| | | 11/26/2018 | Det/ASD/Bkg | 662.1 | 15.08 | -77.6 | 0.35 | 2.88 | 7.2 | 45 | <0.250 | 100 | 320 | 500 | 94 | <3.0 | <1.0 | 77 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 1.635 |
| | | 2/5/2019 | ASD/Bkg | 839.7 | 14.72 | -76.0 | 0.30 | 2.66 | 7.1 | 71 | 0.260/<0.250 | 140 | 390 | 550 | 110 | <3.0 | <1.0 | 85 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.490(ND) |
| | | 5/28/2019 | Det/ASD/Bkg | 836.6 | 18.25 | -90.6 | 0.29 | 4.89 | 7.1 | 53 | <0.250 | 130 | - | 540 | 100 | <3.0 | <1.0 | 85 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.907(ND |
| | | 7/23/2019 | Det/ASD/Bkg | 819.5 | 19.34 | -90.7 | 0.30 | 1.39 | - | - | - | - | 480 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | 7/23/2019 | Re-sample | 819.5 | 19.34 | -90.7 | 0.30 | 1.39 | - | - | - | - | 420 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | 8/28/2019 | ASD/Bkg | 769.1 | 19.38 | -90.0 | 0.25 | 1.25 | 7.1 | 55 | <0.250 | 110 | 360 | 460 | 93 | <3.0 | <1.0 | 84 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <20 | <0.20 | <1.0 | <1.0 | <1.0 | 0.492(ND) |
| | | 11/4/2019 | Det/ASD/Bkg | 729.8 | 18.39 | -80.0 | 0.29 | 0.86 | 7.1 | 2.0 | <0.250 | 4.5 | 400 | 480 | 98 | <3.0 | <1.0 | 77 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <20 | <0.20 | <1.0 | <1.0 | <1.0 | 1.078(ND) |
| | | 2/18/2020 | Det/ASD/Bkg | 747.9 | 13.49 | -75.7 | 0.29 | 0.69 | 7.2 | 53 | <0.250 | 110 | 420H | 480 | 93 | <3.0 | <1.0 | 77 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <20 | <0.20 | <1.0 | <1.0 | <1.0 | 1.00(ND) |
| | | 3/30/2020 | | 840.0 | 15.71 | -82.4 | 0.20 | 7.48 | 7.1 | - | - | - | 480 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | 4/8/2020 | Re-sample | 784.0 | 16.56 | -89.4 | 0.21 | 8.33 | 7.1 | - | - | - | 480/330 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Yes | 7/21/2020 | ASD/Bkg | 673.7 | 19.33 | -130.8 | 2.91 | 3.56 | 7.1 | 50 | <0.250 | 100 | 420 | 470 | 89 | <3.0 | <1.0 | 69 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <20 | <0.20 | <1.0 | <1.0 | <1.0 | 1.295(ND) |

Notes:

1. All data transcribed from analytical lab data sheets or field notes.
2. Less than (<) symbol denotes concentration not detected at or above reportable limits.
3. (ND) denotes Radium 226 and 228 (combined) concentration not detected above minimum detectable concentration.
4. (NA) denotes analysis not conducted, or not available at time of report.
5. Background monitoring per USEPA 40 CFR 257.93.
6. Detection monitoring per USEPA 40 CFR 257.94.
7. Assessment monitoring per USEPA 40 CFR 257.95.
8. Federal MCL = Maximum Contaminant Level per CFR 40 Subchapter D Part 141 subpart G Section 141.62 & 141.66, or Part 257 subpart D Section 257.95(h)(2).
9. ASD = Sampling conducted based on recommendations in Alternate Source Demonstration dated September 26, 2018

1505 East High Street
Jefferson City, Missouri 65101
Telephone (573) 659-9078
Facsimile (573) 659-9079

**GREDELL Engineering Resources, Inc.**

# Sikeston Board of Municipal Utilities
# Sikeston Power Station
# Detection Monitoring Program for Bottom Ash Pond
# Alternate Source Demonstration

*Prepared for:*

BMU
Sikeston
Board of Municipal Utilities

**Sikeston Power Station**
**1551 West Wakefield Avenue**
**Sikeston, MO 63801**

THOMAS R. GREDELL
08-06-2020
NUMBER
PE-021137

MIKEL C. CARLSON
8-6-20
RG 0126

August 2020

# PROFESSIONAL ENGINEER'S CERTIFICATION

40 CFR 257.94(e)(2) Alternate Source Demonstration

I, Thomas R. Gredell, P.E., a professional engineer licensed in the State of Missouri, hereby certify in accordance with 40 CFR 257.94(e)(2) to the accuracy of the alternate source demonstration described in the following report for the Sikeston Board of Municipal Utilities, Sikeston Power Station, Bottom Ash Pond CCR unit. The report demonstrates that the statistically significant increase of total dissolved solids in MW-8 resulted from an analytical false positive and is attributable to an alternate source and not evidence of a release from the Bottom Ash Pond. This demonstration successfully meets the requirements of 40 CFR 257.94(e) as found in federal regulation 40 CFR 257, Subpart D – Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments. In addition, the demonstration was made using EPA Unified Guidance (Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance: EPA 530/R-09-007) and generally accepted methods.

Name: Thomas R. Gredell, P.E.

Signature:

Date: 08-06-2020

Registration Number: PE-021137
State of Registration: Missouri

THOMAS R. GREDELL
NUMBER
PE-021137

# Sikeston Board of Municipal Utilities
# Sikeston Power Station
# Detection Monitoring Program for Bottom Ash Pond - Total Dissolved Solids in MW-8 Alternate Source Demonstration

**August 2020**

## Table of Contents

## List of Figures

## List of Tables

## List of Appendices

# 1.0 INTRODUCTION

This Alternate Source Demonstration Report has been prepared to address the results of the semi-annual sampling event initiated on February 18, 2020 at the Sikeston Board of Municipal Utilities (SBMU) Sikeston Power Station's (SPS) Bottom Ash Pond, a coal combustion residual (CCR) surface impoundment. Following receipt of final analytical data, it was apparent that an error resulted in delayed analysis for Total Dissolved Solids (TDS) and hold time exceedance. As a consequence, resampling of TDS in all five monitoring wells was conducted on March 30, 2020. Following receipt of final analytical data from that event, statistical analysis was performed by GREDELL Engineering Resources, Inc. (Gredell Engineering) for the parameters listed in Appendix III to Part 257 – Constituents for Detection Monitoring. The results of the statistical evaluation suggested one apparent statistically significant increase (SSI) for TDS in monitoring well MW-8. In response, resampling was conducted at MW-8 on April 8, 2020. This sampling event including collection of a duplicate, and replicate analysis of the primary sample by the analytical laboratory. Results from this event were ambiguous. As a consequence, SBMU-SPS requested that Gredell Engineering conduct a critical evaluation of the analytical results and develop an alternate source demonstration if warranted.

As stated in §257.94(e)(2), an owner or operator may demonstrate that a source other than the CCR unit caused the apparent SSI over background levels for a constituent. The owner or operator must complete the written demonstration within 90 days of detecting an apparent SSI over background levels to include obtaining a certification from a qualified professional engineer verifying the accuracy of the information in the report. If a successful demonstration is completed within the 90-day period, the owner of the CCR unit may continue with a detection monitoring program. The owner or operator must also include the certified demonstration in the annual groundwater monitoring and corrective action report required by §257.90(e).

Gredell Engineering has completed an evaluation of the groundwater sampling events, analytical data results, and other potential factors, for the SBMU SPS Bottom Ash Pond groundwater monitoring well system to determine if an alternate source is the cause of the apparent SSI in MW-8. This report presents the results of that evaluation and includes supporting documentation.

# 2.0 OBSERVATIONS AND DATA COLLECTION

The Bottom Ash Pond groundwater monitoring well system consists of five wells, designated MW-3, MW-4, MW-5, MW-6, and MW-8 (Figure 1). Monitoring wells MW-3, MW-4, MW-5, and MW-6 were installed in April 2016, and sampled on an approximate monthly basis beginning in November 2016 and ending in July 2017 to establish a background data base. Monitoring well MW-8 was installed in April 2017, and was sampled at an increased frequency beginning in May 2017 and ending in September 2017. Additional information regarding these wells is available in the Bottom Ash Pond monitoring well design, installation, and development report (Gredell Engineering, 2017a).

The results of the eight independent background sampling events were evaluated in accordance with §257.93, and intra-well analysis using prediction limits was selected as the statistical analysis approach for detection monitoring (Gredell Engineering, 2018a). Following receipt of final analytical data reports from the contract laboratory, the reported concentration for each detection monitoring constituent from each well is compared to its respective prediction limit. If a concentration exceeds the respective prediction limit for a particular constituent well pair, or is outside the predicted range (in the case of pH), SSI over background is suspected.

The SPS conducted its semiannual detection groundwater sampling event for the Bottom Ash Pond on February 18, 2020. The contracted laboratory received the samples on February 20, 2020, but did not prepare and analyze the samples for TDS until February 27, 2020. The analytical method used for TDS (Standard Method (SM) 2540C) has a seven day hold time. Accordingly, the TDS results were qualified with an "H" flag because analysis was conducted nine days after sample collection. Due to the qualified data, the Bottom Ash Pond monitoring system was re-sampled for TDS on March 30, 2020. Final TDS results were received on April 7, 2020. However, the TDS result for the sample collected at MW-8 appeared elevated with respect to the prediction limit. Consequently, MW-8 was re-sampled on April 8, 2020 and both field duplicate and laboratory replicate analyses were performed by the analytical laboratory. Final results for the April 8, 2020 event were received on May 14, 2020.

The following table summarizes the primary and duplicate sample TDS results for the February, March, and April sampling events. Relative Percent Differences (RPDs) between results are also listed where applicable.

### Table 1 – TDS and Relative Percent Difference Results - 2020

| Sampling Date | Sample Location | TDS (mg/L) | Dup (mg/L) | RPD (%) |
|---|---|---|---|---|
| 2/18/2020 | MW-8 | 420 H | N/A | N/A |
| | MW-5 | 520 H | 420 H | 21.3 |
| 3/30/2020 | MW-8 | 480 | N/A | N/A |
| 4/8/2020 | MW-8 | 480 | 330 | 37.0 |
| | MW-8 Lab Replicate | 430 | N/A | N/A |

N/A = Not Prepared or Analyzed
H = Sample Analyzed After Hold Time Exceeded
MW-8 Prediction Limit = 448 mg/L

The table indicates that the original TDS result in MW-8, while qualified due to hold time exceedance, did not exceed the 448 mg/L prediction limit. However, due to the hold time exceedance, it was considered necessary to re-sample MW-8 and obtain TDS results within the method-specified hold time of seven days. This subsequent result was reported at 480 mg/L or 32 mg/L (7%) above the predicted limit value of 448 mg/L. Review of Laboratory Quality Control Report documents associated with these samples show that matrix spike duplicates (MSDs) for TDS were 8% to 9% higher than the source concentrations. These elevated MSD concentrations are more than sufficient to demonstrate that the reported value of 480 mg/L is within the range of laboratory variability and that the result is a false positive relative to the predicted limit value.

The initial result for the April 8, 2020 sampling was also reported as 480 mg/L, but the TDS concentration in the sample duplicate was reported as 330 mg/L, which is a 37% difference in the reproducibility in results. Moreover, the lab replicate prepared by the analytical laboratory by drawing a second aliquot from the initial sample collected on April 8th had a reported TDS concentration of 430 mg/L. Both the sample duplicate and lab replicate results are below the predicted limit value of 448 mg/L, again providing evidence that the initial sample result is a false-positive.

Inherent variability in the analytical method used for TDS (SM 2540C) is also evidenced by the following observations:

- February 18, 2020: A comparison of the field duplicate to the original sample collected at MW-5 results in an RPD of 21.3% (Table 1). Additionally, the RPD for the laboratory prepared MSD for TDS was reported as 13% (Appendix 1; Page 11). Both reported levels of variability exceed the percentage required (7%) to trigger a false positive for TDS in MW-8.
- March 30, 2020: The RPDs for the laboratory prepared MSDs (DUP1 and DUP2) for TDS were reported as 8% and 9% higher than their respective sources (Appendix 2; Page 4). These percentages are greater than the variability necessary to trigger a false positive for TDS in MW-8 (7%).

April 8, 2020: The lab replicate result (430 mg/L) documents 11% variability in laboratory analysis method (Table 1) and suggests that the 480 mg/L value for the primary sample is a false positive for TDS in MW-8. The RPD for TDS between the primary MW-8 sample and the field duplicate (Table 1) suggests 37% variability between two samples collected consecutively from the effluent stream. While 11% of the 37% may be accounted for with laboratory variability, the remaining 26% it attributed to variability in well performance (yellow “flakes” discussed below). Collectively, this 37% variability is over five times the amount (7%) required to trigger a false positive for TDS in MW-8.

Following review of the field sampling notes, it was also noted that a well performance issue is apparent each time MW-8 was purged. This was recorded in the field sampling logs as the intermittent appearance of yellow “flakes” entrained in the purge water. These flakes are consistent with bacterial fouling that periodically dislodges from the well casing and migrates into the effluent or sample during purging or sampling, respectively. Identical observations were previously noted in MW-8 during the June 2018 sampling event and resulted in elevated analytical results (Gredell Engineering, 2019). The previous bacterial fouling was rectified by well redevelopment conducted consistent with Groundwater Monitoring Sampling and Analysis Plan (Gredell Engineering, 2018b).

# 3.0 SUMMARY OF DATA ANALYSIS AND FINDINGS

The U.S. Environmental Protection Agency (USEPA) provides Unified Guidance for statistical analysis of groundwater monitoring data (USEPA, 2009). This Unified Guidance document was reviewed to assess the validity of the apparent SSIs. Chapter 4 of the Unified Guidance discusses groundwater monitoring programs and statistical analysis of the associated data. A key component of statistical analysis is "*to determine whether or not the increase is actually due to a contaminant release*". Several of these considerations are pertinent to the data associated with the Bottom Ash Pond groundwater monitoring well system and for that reason are listed below.

1. Chapter 4, page 4-8: *Is the result a false positive? That is, were the data tested simply an unusual sample of the underlying population triggering an SSI? Generally, this can be evaluated with repeat sampling.*
2. Chapter 4, page 4-9: *Have there been changes in well performance over time?*
3. Chapter 4, page 4-11: *Were there calibration problems, e.g., drift in instrumentation?*
4. Chapter 4, page 4-11: *Were there "spikes" or unusually high values on certain sampling events (either for one constituent among many wells or related analytical constituents) that would suggest laboratory error?*

Each of these considerations were used to evaluate the background data and the validity of the apparent SSI for TDS in MW-8. The results of this evaluation are discussed below.

**Unified Guidance Consideration 1**

The suspicion that the March 30, 2020 results are a false positive was considered and, as suggested by Unified Guidance, was evaluated with repeat sampling. In this case a primary sample and a duplicate were collected from MW-8 on April 8, 2020.The primary sample was also replicated by the analytical laboratory by independently analyzing two aliquots for TDS. These results are presented in Table 1 and indicate substantial variability relative to the magnitude of prediction limit exceedance (32 mg/L) by the 480 mg/L result

**Unified Guidance Consideration 2**

Each time MW-8 was sampled (February, March, and April, 2020), yellow flakes were observed in the effluent intermittently during purging. These observations suggest a well performance issue in the form of bacterial fouling being released during pumping. Similar observations were noted in June 2018 and were associated with elevated levels of Calcium, Chloride, and Sulfate. As a consequence of these observations, MW-8 was redeveloped, which successfully mitigated the well fouling and associated elevated constituent concentrations until the February 2020 sampling event.

The recurrence of bacterial fouling in MW-8 and the intermittent release of yellow flakes during purging and sampling provides additional explanation for the variability in TDS results. Not all samples would contain consistent proportions of the suspended yellow flakes. Consequently, variable amounts of this material may pass through the 1.5 micron filter used during preparation of the samples for laboratory analysis. Further, differing proportions of yellow flake remaining after filtration may explain the difference in TDS results between the primary sample collected on April 8, 2020 and the laboratory replicate (Table 1). It may also explain the higher degree of variability between the primary sample and the sample duplicate in MW-8 (37.0% RPD), where well performance issues were apparent, relative to the RPD between the primary sample and sample duplicate from MW-5 (21.3%), where well performance issues were not apparent.

**Unified Guidance Consideration 3**

Analytical Laboratory Quality Control documentation was reviewed to assess if instrument drift occurred that could account for the reported TDS results. The Matrix Spike Duplicate RPDs suggest that, during the analysis of the March samples, the laboratory instruments were reporting concentrations 8% to 9% higher than the source concentrations. However, the reported TDS concentration in MW-8 in March (480 mg/L) exceeded the prediction limit (448 mg/L) by only 7%.

Additionally, SM 2540C procedures were reviewed relative to the TNI/NELAP Proficiency Testing acceptance limits for laboratory accreditation to assess acceptable error ranges using this method of analysis. The laboratory senior project manager was contacted and provided documentation for Proficiency Testing, which involves analysis of a (blind) standard. In order to secure TNI/NELAP accreditation for TDS analysis, the analytical result reported by the laboratory using the (blind) standard must be within +/-45 mg/L of the assigned value to be considered within acceptance limits. This range in results necessary to achieve accreditation is more than adequate to demonstrate that apparent SSI for TDS in MW-8 is a false positive.

**Unified Guidance Consideration 4**

The initial result for TDS in MW-8 (February 2020), while analyzed outside hold time, was below the prediction limit and was consistent with historical results collected between May 2017 and November 2019. However, the March 2020 sampling results yielded an unusually high TDS value for this well that was above the prediction limit. In response, the possibility of sampling and/or laboratory error was then evaluated by sampling the well again in April 2020. A primary sample and sample duplicate were collected. In addition, a lab replicate of the primary sample was analyzed to assess inherent variability in the analysis of TDS for this well. Reported results from these three samples varied from 330 mg/L to 480 mg/L

The results described above suggest a degree of variability that could be related to a false positive “spike” in values. While a false positive stemming from laboratory analysis is referred to as a “laboratory error” the connotation is misleading if the variability that resulted in the false positive is within the required acceptance limits for national accreditation. Similarly, although a false positive stemming from sample collection is referred to as “sampling error”, it should not be viewed as a reflection on the field technician if the proper sampling procedures are followed. In these cases, the false positive for TDS during the March 2020 sampling exceeded the prediction limit by 32 mg/L, which is within the acceptable tolerances for the laboratory method SM 2540C accreditation (+/-45 mg/L), and the variation apparent in the three analyses completed for the April 2020 sampling event was 150 mg/L.

# 4.0 CONCLUSIONS AND RECOMMENDATIONS

Gredell Engineering concludes that the apparent SSI of TDS in MW-8 is a false positive and is attributable to an alternate source and not evidence of a release from the Bottom Ash Pond. The following supports this conclusion:

- Analytical results for TDS in MW-8 during the February, March, and April sampling are highly variable, with three of the results below the prediction limit and two of the results above the prediction limit. Groundwater sample analytical results for TDS demonstrated that considerable variability is inherent in the field sampling method and the laboratory analytical method used.
- Laboratory prepared MSDs for TDS are 8% to 9% higher than their respective sources and are greater than the variability necessary to trigger a false positive for TDS in MW-8 (7%).
- TNI/NELAP Proficiency Testing acceptance limits for laboratory accreditation using SM 2540C are +/- 45 mg/L for TDS. This nationally accepted range in tolerance limits is greater than the range in values between the prediction limit and reported values.
- A recurrence of bacterial fouling in MW-8 is evidenced by the observation of yellow flakes intermittently appearing in the effluent during purging and sampling. Variable proportions of this material in samples collected during the February, March, and April 2020 sampling can cause interferences during analysis and result in excessive drift or variability in reported TDS values.

Based on these conclusions, Gredell Engineering recommends the following:

- Continue with semi-annual detection monitoring in accordance with §257.94;
- Re-develop MW-8 to improve well performance.

# 5.0 REFERENCES

Freeze, R.A. and Cherry J.A., 1979, *Groundwater*: Prentice-Hall, Inc. Englewood Cliffs, New Jersey, 604 p.

GREDELL Engineering Resources, Inc., 2017a, Sikeston Power Station Site Characterization for Compliance with Missouri State Operating Permit #MO-0095575. Prepared for Sikeston Board of Municipal Utilities, May 31, 2017.

GREDELL Engineering Resources, Inc., 2017b, Sikeston Power Station Documentation of Monitoring Well Design, Installation & Development for Compliance with 40 CFR 257.91. Prepared for Sikeston Board of Municipal Utilities, October 17, 2017.

GREDELL Engineering Resources, Inc., 2018a, Sikeston Power Station 2017 Annual Groundwater Monitoring and Corrective Action Report for Bottom Ash Pond for Compliance with USEPA 40 CFR 257.90(e). Prepared for Sikeston Board of Municipal Utilities, January 26, 2018.

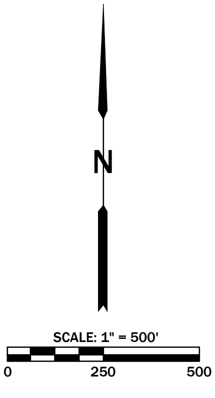
GREDELL Engineering Resources, Inc., 2018b, Sikeston Power Station Groundwater Monitoring Sampling and Analysis Plan. Prepared for Sikeston Board of Municipal Utilities, September 10, 2018.

GREDELL Engineering Resources, Inc., 2019, Sikeston Power Station 2018 Annual Groundwater Monitoring and Corrective Action Report for Bottom Ash Pond for Compliance with USEPA 40 CFR 257.90(e). Prepared for Sikeston Board of Municipal Utilities, January 30, 2019.

Sanitas Statistical Software, © 1992-2020 SANITAS TECHNOLOGIES, Alamosa Colorado 81101-0012.

USEPA, 2009, Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance: EPA 530/R-09-007, Office of Resource Conservation and Recovery, Program Implementation and Information Division, Washington, D.C.

# FIGURES



**LEGEND**

| | |
|---|---|
| PROPERTY LINE (APPROXIMATE) | ——PL—— |
| MONITORING WELL | (MW) |
| UP GRADIENT MONITORING LOCATION | UG |
| DOWN GRADIENT MONITORING LOCATION | DG |

**NOTES:**

1. IMAGE PROVIDED BY BING MAPS.
2. MONITORING WELL LOCATIONS/ELEVATIONS SURVEYED BY BOWEN ENGINEERING & SURVEYING.

# FIGURE 1
# SIKESTON POWER STATION

## GREDELL Engineering Resources, Inc.

ENVIRONMENTAL ENGINEERING LAND - AIR - WATER

1505 East High Street Telephone: (573) 659-9078
Jefferson City, Missouri Facsimile: (573) 659-9079

MO CORP. ENGINEERING LICENSE NO. E-2001001669-D

## BOTTOM ASH POND GROUNDWATER MONITORING WELL SYSTEM

| DATE | SCALE | PROJECT NAME | REVISION |
|---|---|---|---|
| 6/2020 | AS NOTED | SIKESTON | |
| DRAWN | APPROVED | FILE NAME | SHEET # |
| CP | MCC | BAP ASD | 1 OF 1 |

O:\CADDFiles\SIKESTON\BAP ASD.dwg, BOTTOM ASH POND GROUNDWATER MONITORING WELL SYSTEM, 6/12/2020 6:59:44 AM

# APPENDICES

# Appendix 1

## Laboratory Analytical Results and Quality Control Reports – February 2020

PDC Laboratories, Inc.
PROFESSIONAL • DEPENDABLE • COMMITTED

March 16, 2020

Luke St Mary
Sikeston BMU, Sikeston Power Station
1551 W Wakefield
Sikeston, MO 63801

RE: Sikeston Bottom Ash App III and App IV 2019

Dear Luke St Mary:

Please find enclosed the analytical results for the **7** sample(s) the laboratory received on **2/20/20 10:10 am** and logged in under work order **0023536**. All testing is performed according to our current TNI accreditations unless otherwise noted. This report cannot be reproduced, except in full, without the written permission of PDC Laboratories, Inc.

If you have any questions regarding your report, please contact your project manager. Quality and timely data is of the utmost importance to us.

PDC Laboratories, Inc. appreciates the opportunity to provide you with analytical expertise. We are always trying to improve our customer service and we welcome you to contact the Director of Client Services, Lisa Grant, with any feedback you have about your experience with our laboratory at 309-683-1764 or lgrant@pdclab.com.

Sincerely,

Kurt Stepping
Senior Project Manager
(309) 692-9688 x1719
kstepping@pdclab.com

NELAP ACCREDITED TNI LABORATORY

# ANALYTICAL RESULTS

# ANALYTICAL RESULTS

**Sample:** **0023536-01**
**Name:** MW-3
**Matrix:** Ground Water - Grab

**Sampled:** 02/18/20 09:20
**Received:** 02/20/20 10:10
**PO #:** 23573

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **Miscellaneous - PACE Analytical - Greensburg** | | | | | | | | | |
| Radium 226 - subcontracted | -0.0667 | pCi/L | | | 1 | 0.875 | | | 904.0 903.1 |
| Radium 228 - subcontracted | 0.341 | pCi/L | | | 1 | 0.571 | | | 904.0 903.1 |

**Sample:** **0023536-02**
**Name:** MW-6
**Matrix:** Ground Water - Grab

**Sampled:** 02/18/20 10:25
**Received:** 02/20/20 10:10
**PO #:** 23573

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **Miscellaneous - PACE Analytical - Greensburg** | | | | | | | | | |
| Radium 226 - subcontracted | 0.523 | pCi/L | | | 1 | 0.539 | | | 904.0 903.1 |
| Radium 228 - subcontracted | 0.736 | pCi/L | | | 1 | 0.638 | | | 904.0 903.1 |

**Sample:** **0023536-03**
**Name:** MW-5
**Matrix:** Ground Water - Grab

**Sampled:** 02/18/20 11:39
**Received:** 02/20/20 10:10
**PO #:** 23573

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **Miscellaneous - PACE Analytical - Greensburg** | | | | | | | | | |
| Radium 226 - subcontracted | 0.373 | pCi/L | | | 1 | 0.669 | | | 904.0 903.1 |
| Radium 228 - subcontracted | 0.576 | pCi/L | | | 1 | 0.701 | | | 904.0 903.1 |

**Sample:** **0023536-04**
**Name:** MW-8
**Matrix:** Ground Water - Grab

**Sampled:** 02/18/20 12:36
**Received:** 02/20/20 10:10
**PO #:** 23573

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **Miscellaneous - PACE Analytical - Greensburg** | | | | | | | | | |
| Radium 226 - subcontracted | 0.188 | pCi/L | | | 1 | 0.581 | | | 904.0 903.1 |
| Radium 228 - subcontracted | 0.814 | pCi/L | | | 1 | 0.762 | | | 904.0 903.1 |

## ANALYTICAL RESULTS

**Sample:** **0023536-05**
**Name:** MW-4
**Matrix:** Ground Water - Grab

**Sampled:** 02/18/20 14:13
**Received:** 02/20/20 10:10
**PO #:** 23573

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **Miscellaneous - PACE Analytical - Greensburg** | | | | | | | | | |
| Radium 226 - subcontracted | 0.071 | pCi/L | | | 1 | 0.52 | | | 904.0 903.1 |
| Radium 228 - subcontracted | 1.05 | pCi/L | | | 1 | 0.709 | | | 904.0 903.1 |

**Sample:** **0023536-06**
**Name:** FIELD DUPLICATE
**Matrix:** Ground Water - Field Duplicate

**Sampled:** 02/18/20 00:00
**Received:** 02/20/20 10:10
**PO #:** 23573

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **Miscellaneous - PACE Analytical - Greensburg** | | | | | | | | | |
| Radium 226 - subcontracted | 0.291 | pCi/L | | | 1 | 0.541 | | | 904.0 903.1 |
| Radium 228 - subcontracted | 0.936 | pCi/L | | | 1 | 0.696 | | | 904.0 903.1 |

**Sample:** **0023536-07**
**Name:** FIELD BLANK
**Matrix:** Ground Water - Field Blank

**Sampled:** 02/18/20 00:00
**Received:** 02/20/20 10:10
**PO #:** 23573

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **Miscellaneous - PACE Analytical - Greensburg** | | | | | | | | | |
| Radium 226 - subcontracted | 0.115 | pCi/L | | | 1 | 0.691 | | | 904.0 903.1 |
| Radium 228 - subcontracted | 0.693 | pCi/L | | | 1 | 0.626 | | | 904.0 903.1 |

## ANALYTICAL RESULTS

# ANALYTICAL RESULTS

**Sample:** **0023536-01**
**Name:** MW-3
**Matrix:** Ground Water - Grab

**Sampled:** 02/18/20 09:20
**Received:** 02/20/20 10:10
**PO #:** 23573

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **Anions - PIA** | | | | | | | | | |
| Chloride | 1.3 | mg/L | | 02/28/20 08:26 | 1 | 1.0 | 02/28/20 08:26 | LAM | EPA 300.0 REV 2.1 |
| Fluoride | < 0.250 | mg/L | Q1 | 02/21/20 13:41 | 1 | 0.250 | 02/21/20 13:41 | n.a. | EPA 300.0 REV 2.1 |
| Sulfate | 21 | mg/L | | 02/28/20 08:44 | 5 | 5.0 | 02/28/20 08:44 | LAM | EPA 300.0 REV 2.1 |
| **General Chemistry - PIA** | | | | | | | | | |
| Solids - total dissolved solids (TDS) | 140 | mg/L | H | 02/27/20 08:59 | 1 | 26 | 02/27/20 09:26 | cpc | SM 2540C |
| **Total Metals - PIA** | | | | | | | | | |
| Antimony | < 3.0 | ug/L | | 03/03/20 12:27 | 5 | 3.0 | 03/04/20 08:36 | JMW | EPA 6020A |
| Arsenic | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:36 | JMW | EPA 6020A |
| Barium | 110 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:36 | JMW | EPA 6020A |
| Beryllium | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:36 | JMW | EPA 6020A |
| Boron | 27 | ug/L | | 03/11/20 10:06 | 5 | 10 | 03/12/20 08:56 | JMW | EPA 6020A |
| Cadmium | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:36 | JMW | EPA 6020A |
| Calcium | 16000 | ug/L | | 03/03/20 12:27 | 5 | 100 | 03/04/20 08:36 | JMW | EPA 6020A |
| Chromium | < 4.0 | ug/L | | 03/03/20 12:27 | 5 | 4.0 | 03/04/20 08:36 | JMW | EPA 6020A |
| Cobalt | < 2.0 | ug/L | | 03/03/20 12:27 | 5 | 2.0 | 03/04/20 08:36 | JMW | EPA 6020A |
| Lead | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:36 | JMW | EPA 6020A |
| Mercury | < 0.20 | ug/L | | 03/03/20 12:27 | 5 | 0.20 | 03/04/20 08:36 | JMW | EPA 6020A |
| Molybdenum | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:36 | JMW | EPA 6020A |
| Selenium | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:36 | JMW | EPA 6020A |
| Thallium | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:36 | JMW | EPA 6020A |
| Lithium | < 0.020 | mg/L | | 03/03/20 12:27 | 1 | 0.020 | 03/04/20 10:09 | ZSA | EPA 6010B* |

# ANALYTICAL RESULTS

**Sample:** **0023536-02**
**Name:** MW-6
**Matrix:** Ground Water - Grab

**Sampled:** 02/18/20 10:25
**Received:** 02/20/20 10:10
**PO #:** 23573

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **Anions - PIA** | | | | | | | | | |
| Chloride | 1.7 | mg/L | | 02/28/20 09:02 | 1 | 1.0 | 02/28/20 09:02 | LAM | EPA 300.0 REV 2.1 |
| Fluoride | < 0.250 | mg/L | Q3 | 02/21/20 14:36 | 1 | 0.250 | 02/21/20 14:36 | n.a. | EPA 300.0 REV 2.1 |
| Sulfate | 24 | mg/L | | 02/28/20 09:21 | 5 | 5.0 | 02/28/20 09:21 | LAM | EPA 300.0 REV 2.1 |
| **General Chemistry - PIA** | | | | | | | | | |
| Solids - total dissolved solids (TDS) | 170 | mg/L | H | 02/27/20 08:59 | 1 | 26 | 02/27/20 09:26 | cpc | SM 2540C |
| **Total Metals - PIA** | | | | | | | | | |
| Antimony | < 3.0 | ug/L | | 03/03/20 12:27 | 5 | 3.0 | 03/04/20 08:40 | JMW | EPA 6020A |
| Arsenic | 2.4 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:40 | JMW | EPA 6020A |
| Barium | 180 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:40 | JMW | EPA 6020A |
| Beryllium | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:40 | JMW | EPA 6020A |
| Boron | 40 | ug/L | | 03/11/20 10:06 | 5 | 10 | 03/12/20 09:00 | JMW | EPA 6020A |
| Cadmium | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:40 | JMW | EPA 6020A |
| Calcium | 41000 | ug/L | | 03/03/20 12:27 | 5 | 100 | 03/04/20 08:40 | JMW | EPA 6020A |
| Chromium | < 4.0 | ug/L | | 03/03/20 12:27 | 5 | 4.0 | 03/04/20 08:40 | JMW | EPA 6020A |
| Cobalt | < 2.0 | ug/L | | 03/03/20 12:27 | 5 | 2.0 | 03/04/20 08:40 | JMW | EPA 6020A |
| Lead | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:40 | JMW | EPA 6020A |
| Mercury | < 0.20 | ug/L | | 03/03/20 12:27 | 5 | 0.20 | 03/04/20 08:40 | JMW | EPA 6020A |
| Molybdenum | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:40 | JMW | EPA 6020A |
| Selenium | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:40 | JMW | EPA 6020A |
| Thallium | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:40 | JMW | EPA 6020A |
| Lithium | < 0.020 | mg/L | | 03/03/20 12:27 | 1 | 0.020 | 03/04/20 10:11 | ZSA | EPA 6010B* |

# ANALYTICAL RESULTS

**Sample:** **0023536-03**
**Name:** MW-5
**Matrix:** Ground Water - Grab

**Sampled:** 02/18/20 11:39
**Received:** 02/20/20 10:10
**PO #:** 23573

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **Anions - PIA** | | | | | | | | | |
| Chloride | 15 | mg/L | | 02/28/20 09:39 | 5 | 5.0 | 02/28/20 09:39 | LAM | EPA 300.0 REV 2.1 |
| Fluoride | < 0.250 | mg/L | | 02/21/20 16:07 | 1 | 0.250 | 02/21/20 16:07 | n.a. | EPA 300.0 REV 2.1 |
| Sulfate | 210 | mg/L | | 02/28/20 09:57 | 25 | 25 | 02/28/20 09:57 | LAM | EPA 300.0 REV 2.1 |
| **General Chemistry - PIA** | | | | | | | | | |
| Solids - total dissolved solids (TDS) | 520 | mg/L | H | 02/27/20 08:59 | 1 | 26 | 02/27/20 09:26 | cpc | SM 2540C |
| **Total Metals - PIA** | | | | | | | | | |
| Antimony | < 3.0 | ug/L | | 03/03/20 12:27 | 5 | 3.0 | 03/04/20 08:44 | JMW | EPA 6020A |
| Arsenic | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:44 | JMW | EPA 6020A |
| Barium | 82 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:44 | JMW | EPA 6020A |
| Beryllium | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:44 | JMW | EPA 6020A |
| Boron | 400 | ug/L | | 03/11/20 10:06 | 5 | 10 | 03/12/20 09:03 | JMW | EPA 6020A |
| Cadmium | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:44 | JMW | EPA 6020A |
| Calcium | 110000 | ug/L | | 03/03/20 12:27 | 5 | 100 | 03/04/20 08:44 | JMW | EPA 6020A |
| Chromium | < 4.0 | ug/L | | 03/03/20 12:27 | 5 | 4.0 | 03/04/20 08:44 | JMW | EPA 6020A |
| Cobalt | 4.3 | ug/L | | 03/03/20 12:27 | 5 | 2.0 | 03/04/20 08:44 | JMW | EPA 6020A |
| Lead | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:44 | JMW | EPA 6020A |
| Mercury | < 0.20 | ug/L | | 03/03/20 12:27 | 5 | 0.20 | 03/04/20 08:44 | JMW | EPA 6020A |
| Molybdenum | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:44 | JMW | EPA 6020A |
| Selenium | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:44 | JMW | EPA 6020A |
| Thallium | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:44 | JMW | EPA 6020A |
| Lithium | < 0.020 | mg/L | | 03/03/20 12:27 | 1 | 0.020 | 03/04/20 10:12 | ZSA | EPA 6010B* |

# ANALYTICAL RESULTS

**Sample:** **0023536-04**
**Name:** MW-8
**Matrix:** Ground Water - Grab

**Sampled:** 02/18/20 12:36
**Received:** 02/20/20 10:10
**PO #:** 23573

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **Anions - PIA** | | | | | | | | | |
| Chloride | 53 | mg/L | | 02/28/20 10:33 | 25 | 25 | 02/28/20 10:33 | LAM | EPA 300.0 REV 2.1 |
| Fluoride | < 0.250 | mg/L | | 02/21/20 17:02 | 1 | 0.250 | 02/21/20 17:02 | n.a. | EPA 300.0 REV 2.1 |
| Sulfate | 110 | mg/L | | 02/28/20 10:33 | 25 | 25 | 02/28/20 10:33 | LAM | EPA 300.0 REV 2.1 |
| **General Chemistry - PIA** | | | | | | | | | |
| Solids - total dissolved solids (TDS) | 420 | mg/L | H | 02/27/20 08:59 | 1 | 26 | 02/27/20 09:26 | cpc | SM 2540C |
| **Total Metals - PIA** | | | | | | | | | |
| Antimony | < 3.0 | ug/L | | 03/03/20 12:27 | 5 | 3.0 | 03/04/20 08:47 | JMW | EPA 6020A |
| Arsenic | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:47 | JMW | EPA 6020A |
| Barium | 77 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:47 | JMW | EPA 6020A |
| Beryllium | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:47 | JMW | EPA 6020A |
| Boron | 480 | ug/L | | 03/11/20 10:06 | 5 | 10 | 03/12/20 09:21 | JMW | EPA 6020A |
| Cadmium | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:47 | JMW | EPA 6020A |
| Calcium | 93000 | ug/L | | 03/03/20 12:27 | 5 | 100 | 03/04/20 08:47 | JMW | EPA 6020A |
| Chromium | < 4.0 | ug/L | | 03/03/20 12:27 | 5 | 4.0 | 03/04/20 08:47 | JMW | EPA 6020A |
| Cobalt | < 2.0 | ug/L | | 03/03/20 12:27 | 5 | 2.0 | 03/04/20 08:47 | JMW | EPA 6020A |
| Lead | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:47 | JMW | EPA 6020A |
| Mercury | < 0.20 | ug/L | | 03/03/20 12:27 | 5 | 0.20 | 03/04/20 08:47 | JMW | EPA 6020A |
| Molybdenum | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:47 | JMW | EPA 6020A |
| Selenium | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:47 | JMW | EPA 6020A |
| Thallium | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:47 | JMW | EPA 6020A |
| Lithium | < 0.020 | mg/L | | 03/03/20 12:27 | 1 | 0.020 | 03/04/20 10:14 | ZSA | EPA 6010B* |

# ANALYTICAL RESULTS

**Sample:** **0023536-05**
**Name:** MW-4
**Matrix:** Ground Water - Grab

**Sampled:** 02/18/20 14:13
**Received:** 02/20/20 10:10
**PO #:** 23573

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **Anions - PIA** | | | | | | | | | |
| Chloride | 11 | mg/L | | 02/28/20 10:51 | 5 | 5.0 | 02/28/20 10:51 | LAM | EPA 300.0 REV 2.1 |
| Fluoride | < 0.250 | mg/L | | 02/21/20 17:20 | 1 | 0.250 | 02/21/20 17:20 | n.a. | EPA 300.0 REV 2.1 |
| Sulfate | 66 | mg/L | | 02/28/20 11:09 | 25 | 25 | 02/28/20 11:09 | LAM | EPA 300.0 REV 2.1 |
| **General Chemistry - PIA** | | | | | | | | | |
| Solids - total dissolved solids (TDS) | 290 | mg/L | H | 02/27/20 08:59 | 1 | 26 | 02/27/20 09:26 | cpc | SM 2540C |
| **Total Metals - PIA** | | | | | | | | | |
| Antimony | < 3.0 | ug/L | | 03/03/20 12:27 | 5 | 3.0 | 03/04/20 08:51 | JMW | EPA 6020A |
| Arsenic | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:51 | JMW | EPA 6020A |
| Barium | 72 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:51 | JMW | EPA 6020A |
| Beryllium | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:51 | JMW | EPA 6020A |
| Boron | 930 | ug/L | | 03/03/20 12:27 | 5 | 10 | 03/04/20 08:51 | JMW | EPA 6020A |
| Cadmium | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:51 | JMW | EPA 6020A |
| Calcium | 67000 | ug/L | | 03/03/20 12:27 | 5 | 100 | 03/04/20 08:51 | JMW | EPA 6020A |
| Chromium | < 4.0 | ug/L | | 03/03/20 12:27 | 5 | 4.0 | 03/04/20 08:51 | JMW | EPA 6020A |
| Cobalt | < 2.0 | ug/L | | 03/03/20 12:27 | 5 | 2.0 | 03/04/20 08:51 | JMW | EPA 6020A |
| Lead | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:51 | JMW | EPA 6020A |
| Mercury | < 0.20 | ug/L | | 03/03/20 12:27 | 5 | 0.20 | 03/04/20 08:51 | JMW | EPA 6020A |
| Molybdenum | 5.1 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:51 | JMW | EPA 6020A |
| Selenium | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:51 | JMW | EPA 6020A |
| Thallium | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:51 | JMW | EPA 6020A |
| Lithium | < 0.020 | mg/L | | 03/03/20 12:27 | 1 | 0.020 | 03/04/20 10:16 | ZSA | EPA 6010B* |

## ANALYTICAL RESULTS

**Sample:** **0023536-06**
**Name:** FIELD DUPLICATE
**Matrix:** Ground Water - Field Duplicate

**Sampled:** 02/18/20 00:00
**Received:** 02/20/20 10:10
**PO #:** 23573

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **Anions - PIA** | | | | | | | | | |
| Chloride | 15 | mg/L | | 02/28/20 12:04 | 5 | 5.0 | 02/28/20 12:04 | LAM | EPA 300.0 REV 2.1 |
| Fluoride | < 0.250 | mg/L | | 02/21/20 17:39 | 1 | 0.250 | 02/21/20 17:39 | n.a. | EPA 300.0 REV 2.1 |
| Sulfate | 220 | mg/L | | 02/28/20 12:22 | 25 | 25 | 02/28/20 12:22 | LAM | EPA 300.0 REV 2.1 |
| **General Chemistry - PIA** | | | | | | | | | |
| Solids - total dissolved solids (TDS) | 420 | mg/L | H | 02/27/20 08:59 | 1 | 26 | 02/27/20 09:26 | cpc | SM 2540C |
| **Total Metals - PIA** | | | | | | | | | |
| Antimony | < 3.0 | ug/L | | 03/03/20 12:27 | 5 | 3.0 | 03/04/20 08:54 | JMW | EPA 6020A |
| Arsenic | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:54 | JMW | EPA 6020A |
| Barium | 85 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:54 | JMW | EPA 6020A |
| Beryllium | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:54 | JMW | EPA 6020A |
| Boron | 410 | ug/L | | 03/11/20 10:06 | 5 | 10 | 03/12/20 09:24 | JMW | EPA 6020A |
| Cadmium | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:54 | JMW | EPA 6020A |
| Calcium | 120000 | ug/L | | 03/03/20 12:27 | 5 | 100 | 03/04/20 08:54 | JMW | EPA 6020A |
| Chromium | < 4.0 | ug/L | | 03/03/20 12:27 | 5 | 4.0 | 03/04/20 08:54 | JMW | EPA 6020A |
| Cobalt | 3.9 | ug/L | | 03/03/20 12:27 | 5 | 2.0 | 03/04/20 08:54 | JMW | EPA 6020A |
| Lead | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:54 | JMW | EPA 6020A |
| Mercury | < 0.20 | ug/L | | 03/03/20 12:27 | 5 | 0.20 | 03/04/20 08:54 | JMW | EPA 6020A |
| Molybdenum | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:54 | JMW | EPA 6020A |
| Selenium | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:54 | JMW | EPA 6020A |
| Thallium | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:54 | JMW | EPA 6020A |
| Lithium | < 0.020 | mg/L | | 03/03/20 12:27 | 1 | 0.020 | 03/04/20 10:21 | ZSA | EPA 6010B* |

# ANALYTICAL RESULTS

**Sample:** **0023536-07**
**Name:** FIELD BLANK
**Matrix:** Ground Water - Field Blank

**Sampled:** 02/18/20 00:00
**Received:** 02/20/20 10:10
**PO #:** 23573

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **Anions - PIA** | | | | | | | | | |
| Chloride | < 1.0 | mg/L | | 02/28/20 14:29 | 1 | 1.0 | 02/28/20 14:29 | LAM | EPA 300.0 REV 2.1 |
| Fluoride | < 0.250 | mg/L | | 02/21/20 17:57 | 1 | 0.250 | 02/21/20 17:57 | n.a. | EPA 300.0 REV 2.1 |
| Sulfate | < 1.0 | mg/L | | 02/28/20 14:29 | 1 | 1.0 | 02/28/20 14:29 | LAM | EPA 300.0 REV 2.1 |
| **General Chemistry - PIA** | | | | | | | | | |
| Solids - total dissolved solids (TDS) | < 17 | mg/L | H | 02/27/20 08:59 | 1 | 17 | 02/27/20 09:26 | cpc | SM 2540C |
| **Total Metals - PIA** | | | | | | | | | |
| Antimony | < 3.0 | ug/L | | 03/03/20 12:27 | 5 | 3.0 | 03/04/20 08:58 | JMW | EPA 6020A |
| Arsenic | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:58 | JMW | EPA 6020A |
| Barium | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:58 | JMW | EPA 6020A |
| Beryllium | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:58 | JMW | EPA 6020A |
| Boron | < 10 | ug/L | | 03/11/20 10:06 | 5 | 10 | 03/12/20 09:28 | JMW | EPA 6020A |
| Cadmium | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:58 | JMW | EPA 6020A |
| Calcium | < 100 | ug/L | | 03/03/20 12:27 | 5 | 100 | 03/04/20 08:58 | JMW | EPA 6020A |
| Chromium | < 4.0 | ug/L | | 03/03/20 12:27 | 5 | 4.0 | 03/04/20 08:58 | JMW | EPA 6020A |
| Cobalt | < 2.0 | ug/L | | 03/03/20 12:27 | 5 | 2.0 | 03/04/20 08:58 | JMW | EPA 6020A |
| Lead | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:58 | JMW | EPA 6020A |
| Mercury | < 0.20 | ug/L | | 03/03/20 12:27 | 5 | 0.20 | 03/04/20 08:58 | JMW | EPA 6020A |
| Molybdenum | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:58 | JMW | EPA 6020A |
| Selenium | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:58 | JMW | EPA 6020A |
| Thallium | < 1.0 | ug/L | | 03/03/20 12:27 | 5 | 1.0 | 03/04/20 08:58 | JMW | EPA 6020A |
| Lithium | < 0.020 | mg/L | | 03/03/20 12:27 | 1 | 0.020 | 03/04/20 10:23 | ZSA | EPA 6010B* |

# QC SAMPLE RESULTS

| Parameter | Result | Unit | Qual | Spike Level | Source Result | %REC | %REC Limits | RPD | RPD Limit |
|---|---|---|---|---|---|---|---|---|---|
| ***Batch B004627 - IC No Prep - EPA 300.0 REV 2.1*** | | | | | | | | | |
| **Calibration Blank (B004627-CCB1)** | | | | Prepared & Analyzed: 02/21/20 | | | | | |
| Fluoride | 0.00 | mg/L | | | | | | | |
| **Calibration Check (B004627-CCV1)** | | | | Prepared & Analyzed: 02/21/20 | | | | | |
| Fluoride | 4.89 | mg/L | | 5.000 | | 98 | 90-110 | | |
| **Matrix Spike (B004627-MS1)** | **Sample: 0023536-01** | | | Prepared & Analyzed: 02/21/20 | | | | | |
| Fluoride | 1.40 | mg/L | Q1 | 1.500 | 0.210 | 79 | 80-120 | | |
| **Matrix Spike (B004627-MS2)** | **Sample: 0023536-02** | | | Prepared & Analyzed: 02/21/20 | | | | | |
| Fluoride | 1.12 | mg/L | Q1 | 1.500 | ND | 75 | 80-120 | | |
| **Matrix Spike (B004627-MS3)** | **Sample: 0023536-03** | | | Prepared & Analyzed: 02/21/20 | | | | | |
| Fluoride | 1.45 | mg/L | | 1.500 | ND | 97 | 80-120 | | |
| **Matrix Spike Dup (B004627-MSD1)** | **Sample: 0023536-01** | | | Prepared & Analyzed: 02/21/20 | | | | | |
| Fluoride | 1.43 | mg/L | | 1.500 | 0.210 | 81 | 80-120 | 2 | 20 |
| **Matrix Spike Dup (B004627-MSD2)** | **Sample: 0023536-02** | | | Prepared & Analyzed: 02/21/20 | | | | | |
| Fluoride | 1.14 | mg/L | Q2 | 1.500 | ND | 76 | 80-120 | 1 | 20 |
| **Matrix Spike Dup (B004627-MSD3)** | **Sample: 0023536-03** | | | Prepared & Analyzed: 02/21/20 | | | | | |
| Fluoride | 1.46 | mg/L | | 1.500 | ND | 97 | 80-120 | 0.8 | 20 |
| ***Batch B004955 - No Prep - SM 2540C*** | | | | | | | | | |
| **Blank (B004955-BLK1)** | | | | Prepared & Analyzed: 02/27/20 | | | | | |
| Solids - total dissolved solids (TDS) | < 17 | mg/L | | | | | | | |
| **LCS (B004955-BS1)** | | | | Prepared & Analyzed: 02/27/20 | | | | | |
| Solids - total dissolved solids (TDS) | 967 | mg/L | | 1000 | | 97 | 67.9-132 | | |
| **Duplicate (B004955-DUP1)** | **Sample: 0024315-01** | | | Prepared & Analyzed: 02/27/20 | | | | | |
| Solids - total dissolved solids (TDS) | 473 | mg/L | M | | 540 | | | 13 | 5 |
| ***Batch B005170 - IC No Prep - EPA 300.0 REV 2.1*** | | | | | | | | | |
| **Calibration Blank (B005170-CCB1)** | | | | Prepared & Analyzed: 02/28/20 | | | | | |
| Sulfate | 0.00 | mg/L | | | | | | | |
| Chloride | 0.578 | mg/L | | | | | | | |
| **Calibration Check (B005170-CCV1)** | | | | Prepared & Analyzed: 02/28/20 | | | | | |
| Sulfate | 5.19 | mg/L | | 5.000 | | 104 | 90-110 | | |
| Chloride | 5.07 | mg/L | | 5.000 | | 101 | 90-110 | | |
| ***Batch B005306 - SW 3015 - EPA 6020A*** | | | | | | | | | |
| **Blank (B005306-BLK1)** | | | | Prepared: 03/03/20 Analyzed: 03/04/20 | | | | | |
| Antimony | < 3.0 | ug/L | | | | | | | |
| Arsenic | < 1.0 | ug/L | | | | | | | |
| Barium | < 1.0 | ug/L | | | | | | | |
| Beryllium | < 1.0 | ug/L | | | | | | | |
| Boron | 77.4 | ug/L | B | | | | | | |
| Cadmium | < 1.0 | ug/L | | | | | | | |
| Calcium | < 100 | ug/L | | | | | | | |
| Chromium | < 4.0 | ug/L | | | | | | | |
| Cobalt | < 2.0 | ug/L | | | | | | | |

# QC SAMPLE RESULTS

| Parameter | Result | Unit | Qual | Spike Level | Source Result | %REC | %REC Limits | RPD | RPD Limit |
|---|---|---|---|---|---|---|---|---|---|
| ***Batch B005306 - SW 3015 - EPA 6020A*** | | | | | | | | | |
| **Blank (B005306-BLK1)** | | | | Prepared: 03/03/20 Analyzed: 03/04/20 | | | | | |
| Lead | < 1.0 | ug/L | | | | | | | |
| Mercury | < 0.20 | ug/L | | | | | | | |
| Molybdenum | < 1.0 | ug/L | | | | | | | |
| Selenium | < 1.0 | ug/L | | | | | | | |
| Thallium | < 1.0 | ug/L | | | | | | | |
| Lithium | < 0.020 | mg/L | | | | | | | |
| **LCS (B005306-BS1)** | | | | Prepared: 03/03/20 Analyzed: 03/04/20 | | | | | |
| Antimony | 535 | ug/L | | 555.6 | | 96 | 80-120 | | |
| Arsenic | 569 | ug/L | | 555.6 | | 102 | 80-120 | | |
| Barium | 531 | ug/L | | 555.6 | | 96 | 80-120 | | |
| Beryllium | 527 | ug/L | | 555.6 | | 95 | 80-120 | | |
| Boron | 605 | ug/L | | 555.6 | | 109 | 80-120 | | |
| Cadmium | 526 | ug/L | | 555.6 | | 95 | 80-120 | | |
| Calcium | 5580 | ug/L | | 5556 | | 100 | 80-120 | | |
| Chromium | 555 | ug/L | | 555.6 | | 100 | 80-120 | | |
| Cobalt | 560 | ug/L | | 555.6 | | 101 | 80-120 | | |
| Lead | 562 | ug/L | | 555.6 | | 101 | 80-120 | | |
| Mercury | 51.6 | ug/L | | 55.56 | | 93 | 80-120 | | |
| Molybdenum | 545 | ug/L | | 555.6 | | 98 | 80-120 | | |
| Selenium | 581 | ug/L | | 555.6 | | 105 | 80-120 | | |
| Thallium | 533 | ug/L | | 555.6 | | 96 | 80-120 | | |
| Lithium | 0.558 | mg/L | | 0.5556 | | 100 | 80-120 | | |
| **Matrix Spike (B005306-MS1)** | **Sample: 0023672-06** | | | Prepared: 03/03/20 Analyzed: 03/04/20 | | | | | |
| Antimony | 543 | ug/L | | 555.6 | ND | 98 | 75-125 | | |
| Arsenic | 574 | ug/L | | 555.6 | ND | 103 | 75-125 | | |
| Barium | 539 | ug/L | | 555.6 | 10.5 | 95 | 75-125 | | |
| Beryllium | 514 | ug/L | | 555.6 | ND | 93 | 75-125 | | |
| Boron | 851 | ug/L | | 555.6 | 315 | 96 | 75-125 | | |
| Cadmium | 512 | ug/L | | 555.6 | ND | 92 | 75-125 | | |
| Calcium | 292000 | ug/L | | 5556 | 288000 | 77 | 75-125 | | |
| Chromium | 536 | ug/L | | 555.6 | 4.97 | 96 | 75-125 | | |
| Cobalt | 531 | ug/L | | 555.6 | ND | 96 | 75-125 | | |
| Lead | 533 | ug/L | | 555.6 | ND | 96 | 75-125 | | |
| Mercury | 56.0 | ug/L | | 55.56 | ND | 101 | 75-125 | | |
| Molybdenum | 557 | ug/L | | 555.6 | 0.783 | 100 | 75-125 | | |
| Selenium | 581 | ug/L | | 555.6 | ND | 105 | 75-125 | | |
| Thallium | 509 | ug/L | | 555.6 | ND | 92 | 75-125 | | |
| **Matrix Spike Dup (B005306-MSD1)** | **Sample: 0023672-06** | | | Prepared: 03/03/20 Analyzed: 03/04/20 | | | | | |
| Antimony | 539 | ug/L | | 555.6 | ND | 97 | 75-125 | 0.6 | 20 |
| Arsenic | 579 | ug/L | | 555.6 | ND | 104 | 75-125 | 1 | 20 |
| Barium | 544 | ug/L | | 555.6 | 10.5 | 96 | 75-125 | 0.8 | 20 |
| Beryllium | 520 | ug/L | | 555.6 | ND | 94 | 75-125 | 1 | 20 |
| Boron | 865 | ug/L | | 555.6 | 315 | 99 | 75-125 | 2 | 20 |
| Cadmium | 516 | ug/L | | 555.6 | ND | 93 | 75-125 | 0.8 | 20 |

## QC SAMPLE RESULTS

| Parameter | Result | Unit | Qual | Spike Level | Source Result | %REC | %REC Limits | RPD | RPD Limit |
|---|---|---|---|---|---|---|---|---|---|
| ***Batch B005306 - SW 3015 - EPA 6020A*** | | | | | | | | | |
| **Matrix Spike Dup (B005306-MSD1)** | **Sample: 0023672-06** | | | Prepared: 03/03/20 Analyzed: 03/05/20 | | | | | |
| Calcium | 293000 | ug/L | | 5556 | 288000 | 97 | 75-125 | 0.4 | 20 |
| Chromium | 544 | ug/L | | 555.6 | 4.97 | 97 | 75-125 | 2 | 20 |
| Cobalt | 530 | ug/L | | 555.6 | ND | 95 | 75-125 | 0.01 | 20 |
| Lead | 529 | ug/L | | 555.6 | ND | 95 | 75-125 | 0.7 | 20 |
| Mercury | 53.1 | ug/L | | 55.56 | ND | 96 | 75-125 | 5 | 20 |
| Molybdenum | 561 | ug/L | | 555.6 | 0.783 | 101 | 75-125 | 0.7 | 20 |
| Selenium | 592 | ug/L | | 555.6 | ND | 107 | 75-125 | 2 | 20 |
| Thallium | 508 | ug/L | | 555.6 | ND | 91 | 75-125 | 0.2 | 20 |
| ***Batch B006011 - SW 3015 - EPA 6020A*** | | | | | | | | | |
| **Blank (B006011-BLK1)** | | | | Prepared: 03/11/20 Analyzed: 03/12/20 | | | | | |
| Boron | < 10 | ug/L | | | | | | | |
| **LCS (B006011-BS1)** | | | | Prepared: 03/11/20 Analyzed: 03/12/20 | | | | | |
| Boron | 499 | ug/L | | 555.6 | | 90 | 80-120 | | |

# NOTES

Specifications regarding method revisions and method modifications used for analysis are available upon request. Please contact your project manager.

* Not a TNI accredited analyte

## Certifications

CHI - McHenry, IL - 4314-A W. Crystal Lake Road, McHenry, IL 60050
TNI Accreditation for Drinking Water and Wastewater Fields of Testing through IL EPA Accreditation No. 100279
Illinois Department of Public Health Bacterial Analysis in Drinking Water Approved Laboratory Registry No. 17556

PIA - Peoria, IL - 2231 W. Altorfer Drive, Peoria, IL 61615
TNI Accreditation for Drinking Water, Wastewater, Solid and Hazardous Material Fields of Testing through IL EPA Accreditation No. 100230
Illinois Department of Public Health Bacterial Analysis in Drinking Water Approved Laboratory Registry No. 17553
Drinking Water Certifications/Accreditations: Iowa (240); Kansas (E-10338); Missouri (870)
Wastewater Certifications/Accreditations: Arkansas (88-0677); Iowa (240); Kansas (E-10338)
Solid and Hazardous Material Certifications/Accreditations: Arkansas (88-0677); Iowa (240); Kansas (E-10338)

SPIL - Springfield, IL - 1210 Capitol Airport Drive, Springfield, IL 62707
Illinois Department of Public Health Bacterial Analysis in Drinking Water Approved Laboratory Registry No. 17592

SPMO - Springfield, MO - 1805 W Sunset Street, Springfield, MO 65807
USEPA DMR-QA Program

STL - Hazelwood, MO - 944 Anglum Rd, Hazelwood, MO 63042
TNI Accreditation for Wastewater, Solid and Hazardous Material Fields of Testing through KS KDHE Certification No. E-10389
TNI Accreditation for Wastewater, Solid and Hazardous Material Fields of Testing through IL EPA Accreditation No. - Pending
Illinois Department of Public Health Bacterial Analysis in Drinking Water Approved Laboratory, Registry No. 171050
Missouri Department of Natural Resources - Certificate of Approval for Microbiological Laboratory Service - No. 1050

## Qualifiers

| | |
|---|---|
| B | Present in the method blank at 77.4 ug/L. |
| H | Test performed after the expiration of the appropriate regulatory/advisory maximum allowable hold time. |
| M | Analyte failed to meet the required acceptance criteria for duplicate analysis. |
| Q1 | Matrix Spike failed % recovery acceptance limits. The associated blank spike recovery was acceptable. |
| Q2 | Matrix Spike Duplicate failed % recovery acceptance limits. The associated blank spike recovery was acceptable. |
| Q3 | Matrix Spike/Matrix Spike Duplicate both failed % recovery acceptance limits. The associated blank spike recovery was acceptable. |

Certified by: Kurt Stepping, Senior Project Manager

NELAP ACCREDITED TNI LABORATORY

**Pace Analytical Services, LLC**
1638 Roseytown Road - Suites 2,3,4
Greensburg, PA 15601
(724)850-5600

March 11, 2020

Ms. Janet Clutters
PDC Laboratories
2231 W. Altorfer Drive
Peoria, IL 61615

RE: Project: 0023536
Pace Project No.: 30351798

Dear Ms. Clutters:

Enclosed are the analytical results for sample(s) received by the laboratory on February 25, 2020. 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,

Alexis E. Ozoroski
alexis.ozoroski@pacelabs.com
(724)850-5600
Project Manager

Enclosures

cc: Ms. Valerie Bennett, PDC Laboratories
Margie Nobiling, PDC Laboratories

# CERTIFICATIONS

Project: 0023536
Pace Project No.: 30351798

**Pace Analytical Services Pennsylvania**

1638 Roseytown Rd Suites 2,3&4, Greensburg, PA 15601
ANAB DOD-ELAP Rad Accreditation #: L2417
Alabama Certification #: 41590
Arizona Certification #: AZ0734
Arkansas Certification
California Certification #: 04222CA
Colorado Certification #: PA01547
Connecticut Certification #: PH-0694
Delaware Certification
EPA Region 4 DW Rad
Florida/TNI Certification #: E87683
Georgia Certification #: C040
Florida: Cert E871149 SEKS WET
Guam Certification
Hawaii Certification
Idaho Certification
Illinois Certification
Indiana Certification
Iowa Certification #: 391
Kansas/TNI Certification #: E-10358
Kentucky Certification #: KY90133
KY WW Permit #: KY0098221
KY WW Permit #: KY0000221
Louisiana DHH/TNI Certification #: LA180012
Louisiana DEQ/TNI Certification #: 4086
Maine Certification #: 2017020
Maryland Certification #: 308
Massachusetts Certification #: M-PA1457
Michigan/PADEP Certification #: 9991
Missouri Certification #: 235
Montana Certification #: Cert0082
Nebraska Certification #: NE-OS-29-14
Nevada Certification #: PA014572018-1
New Hampshire/TNI Certification #: 297617
New Jersey/TNI Certification #: PA051
New Mexico Certification #: PA01457
New York/TNI Certification #: 10888
North Carolina Certification #: 42706
North Dakota Certification #: R-190
Ohio EPA Rad Approval: #41249
Oregon/TNI Certification #: PA200002-010
Pennsylvania/TNI Certification #: 65-00282
Puerto Rico Certification #: PA01457
Rhode Island Certification #: 65-00282
South Dakota Certification
Tennessee Certification #: 02867
Texas/TNI Certification #: T104704188-17-3
Utah/TNI Certification #: PA014572017-9
USDA Soil Permit #: P330-17-00091
Vermont Dept. of Health: ID# VT-0282
Virgin Island/PADEP Certification
Virginia/VELAP Certification #: 9526
Washington Certification #: C868
West Virginia DEP Certification #: 143
West Virginia DHHR Certification #: 9964C
Wisconsin Approve List for Rad
Wyoming Certification #: 8TMS-L

## SAMPLE SUMMARY

Project: 0023536
Pace Project No.: 30351798

| Lab ID | Sample ID | Matrix | Date Collected | Date Received |
|---|---|---|---|---|
| **30351798001** | **0023536-01** | Water | 02/18/20 09:20 | 02/25/20 09:20 |
| **30351798002** | **0023536-02** | Water | 02/18/20 10:25 | 02/25/20 09:20 |
| **30351798003** | **0023536-03** | Water | 02/18/20 11:39 | 02/25/20 09:20 |
| **30351798004** | **0023536-04** | Water | 02/18/20 12:36 | 02/25/20 09:20 |
| **30351798005** | **0023536-05** | Water | 02/18/20 14:13 | 02/25/20 09:20 |
| **30351798006** | **0023536-06** | Water | 02/18/20 00:00 | 02/25/20 09:20 |
| **30351798007** | **0023536-07** | Water | 02/18/20 00:00 | 02/25/20 09:20 |

## SAMPLE ANALYTE COUNT

Project: 0023536
Pace Project No.: 30351798

| Lab ID | Sample ID | Method | Analysts | Analytes Reported | Laboratory |
|---|---|---|---|---|---|
| **30351798001** | **0023536-01** | EPA 903.1 | MK1 | 1 | PASI-PA |
| | | EPA 904.0 | VAL | 1 | PASI-PA |
| | | Total Radium Calculation | JAL | 1 | PASI-PA |
| **30351798002** | **0023536-02** | EPA 903.1 | MK1 | 1 | PASI-PA |
| | | EPA 904.0 | VAL | 1 | PASI-PA |
| | | Total Radium Calculation | JAL | 1 | PASI-PA |
| **30351798003** | **0023536-03** | EPA 903.1 | MK1 | 1 | PASI-PA |
| | | EPA 904.0 | VAL | 1 | PASI-PA |
| | | Total Radium Calculation | JAL | 1 | PASI-PA |
| **30351798004** | **0023536-04** | EPA 903.1 | MK1 | 1 | PASI-PA |
| | | EPA 904.0 | VAL | 1 | PASI-PA |
| | | Total Radium Calculation | JAL | 1 | PASI-PA |
| **30351798005** | **0023536-05** | EPA 903.1 | MK1 | 1 | PASI-PA |
| | | EPA 904.0 | VAL | 1 | PASI-PA |
| | | Total Radium Calculation | JAL | 1 | PASI-PA |
| **30351798006** | **0023536-06** | EPA 903.1 | MK1 | 1 | PASI-PA |
| | | EPA 904.0 | VAL | 1 | PASI-PA |
| | | Total Radium Calculation | JAL | 1 | PASI-PA |
| **30351798007** | **0023536-07** | EPA 903.1 | MK1 | 1 | PASI-PA |
| | | EPA 904.0 | VAL | 1 | PASI-PA |
| | | Total Radium Calculation | JAL | 1 | PASI-PA |

# PROJECT NARRATIVE

| | |
|---|---|
| Project: | 0023536 |
| Pace Project No.: | 30351798 |

---

**Method:** **EPA 903.1**
**Description:** 903.1 Radium 226
**Client:** PDC Laboratories Inc
**Date:** March 11, 2020

**General Information:**
7 samples were analyzed for EPA 903.1. All samples were received in acceptable condition with any exceptions noted below or on the chain-of custody and/or the sample condition upon receipt form (SCUR) attached at the end of this report.

**Hold Time:**
The samples were analyzed within the method required hold times with any exceptions noted below.

**Method Blank:**
All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

**Laboratory Control Spike:**
All laboratory control spike compounds were within QC limits with any exceptions noted below.

**Matrix Spikes:**
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

**Additional Comments:**

# PROJECT NARRATIVE

| | |
|---|---|
| Project: | 0023536 |
| Pace Project No.: | 30351798 |

---

**Method:** **EPA 904.0**
**Description:** 904.0 Radium 228
**Client:** PDC Laboratories Inc
**Date:** March 11, 2020

**General Information:**
7 samples were analyzed for EPA 904.0. All samples were received in acceptable condition with any exceptions noted below or on the chain-of custody and/or the sample condition upon receipt form (SCUR) attached at the end of this report.

**Hold Time:**
The samples were analyzed within the method required hold times with any exceptions noted below.

**Method Blank:**
All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

**Laboratory Control Spike:**
All laboratory control spike compounds were within QC limits with any exceptions noted below.

**Matrix Spikes:**
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

**Additional Comments:**

# PROJECT NARRATIVE

| | |
|---|---|
| Project: | 0023536 |
| Pace Project No.: | 30351798 |

---

**Method:** **Total Radium Calculation**
**Description:** Total Radium 228+226
**Client:** PDC Laboratories Inc
**Date:** March 11, 2020

**General Information:**
7 samples were analyzed for Total Radium Calculation. All samples were received in acceptable condition with any exceptions noted below or on the chain-of custody and/or the sample condition upon receipt form (SCUR) attached at the end of this report.

**Hold Time:**
The samples were analyzed within the method required hold times with any exceptions noted below.

**Method Blank:**
All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

**Laboratory Control Spike:**
All laboratory control spike compounds were within QC limits with any exceptions noted below.

**Matrix Spikes:**
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

**Additional Comments:**

This data package has been reviewed for quality and completeness and is approved for release.

## ANALYTICAL RESULTS - RADIOCHEMISTRY

Project: 0023536
Pace Project No.: 30351798

**Sample: 0023536-01** **Lab ID: 30351798001** Collected: 02/18/20 09:20 Received: 02/25/20 09:20 Matrix: Water
PWS: Site ID: Sample Type:

| Parameters | Method | Act ± Unc (MDC) Carr Trac | Units | Analyzed | CAS No. | Qual |
|---|---|---|---|---|---|---|
| Radium-226 | EPA 903.1 | **-0.0667 ± 0.392 (0.875)**<br>**C:NA T:78%** | pCi/L | 03/09/20 11:52 | 13982-63-3 | |
| Radium-228 | EPA 904.0 | **0.341 ± 0.289 (0.571)**<br>**C:79% T:92%** | pCi/L | 03/10/20 14:47 | 15262-20-1 | |
| Total Radium | Total Radium Calculation | **0.341 ± 0.681 (1.45)** | pCi/L | 03/11/20 12:13 | 7440-14-4 | |

**Sample: 0023536-02** **Lab ID: 30351798002** Collected: 02/18/20 10:25 Received: 02/25/20 09:20 Matrix: Water
PWS: Site ID: Sample Type:

| Parameters | Method | Act ± Unc (MDC) Carr Trac | Units | Analyzed | CAS No. | Qual |
|---|---|---|---|---|---|---|
| Radium-226 | EPA 903.1 | **0.523 ± 0.415 (0.539)**<br>**C:NA T:93%** | pCi/L | 03/09/20 12:14 | 13982-63-3 | |
| Radium-228 | EPA 904.0 | **0.736 ± 0.373 (0.638)**<br>**C:76% T:92%** | pCi/L | 03/10/20 14:47 | 15262-20-1 | |
| Total Radium | Total Radium Calculation | **1.26 ± 0.788 (1.18)** | pCi/L | 03/11/20 12:13 | 7440-14-4 | |

**Sample: 0023536-03** **Lab ID: 30351798003** Collected: 02/18/20 11:39 Received: 02/25/20 09:20 Matrix: Water
PWS: Site ID: Sample Type:

| Parameters | Method | Act ± Unc (MDC) Carr Trac | Units | Analyzed | CAS No. | Qual |
|---|---|---|---|---|---|---|
| Radium-226 | EPA 903.1 | **0.373 ± 0.424 (0.669)**<br>**C:NA T:90%** | pCi/L | 03/09/20 12:14 | 13982-63-3 | |
| Radium-228 | EPA 904.0 | **0.576 ± 0.372 (0.701)**<br>**C:76% T:92%** | pCi/L | 03/10/20 14:47 | 15262-20-1 | |
| Total Radium | Total Radium Calculation | **0.949 ± 0.796 (1.37)** | pCi/L | 03/11/20 12:13 | 7440-14-4 | |

**Sample: 0023536-04** **Lab ID: 30351798004** Collected: 02/18/20 12:36 Received: 02/25/20 09:20 Matrix: Water
PWS: Site ID: Sample Type:

| Parameters | Method | Act ± Unc (MDC) Carr Trac | Units | Analyzed | CAS No. | Qual |
|---|---|---|---|---|---|---|
| Radium-226 | EPA 903.1 | **0.188 ± 0.325 (0.581)**<br>**C:NA T:88%** | pCi/L | 03/09/20 12:14 | 13982-63-3 | |
| Radium-228 | EPA 904.0 | **0.814 ± 0.431 (0.762)**<br>**C:78% T:84%** | pCi/L | 03/10/20 14:47 | 15262-20-1 | |
| Total Radium | Total Radium Calculation | **1.00 ± 0.756 (1.34)** | pCi/L | 03/11/20 12:13 | 7440-14-4 | |

**Sample: 0023536-05** **Lab ID: 30351798005** Collected: 02/18/20 14:13 Received: 02/25/20 09:20 Matrix: Water
PWS: Site ID: Sample Type:

| Parameters | Method | Act ± Unc (MDC) Carr Trac | Units | Analyzed | CAS No. | Qual |
|---|---|---|---|---|---|---|
| Radium-226 | EPA 903.1 | **0.0706 ± 0.322 (0.520)**<br>**C:NA T:83%** | pCi/L | 03/09/20 12:14 | 13982-63-3 | |
| Radium-228 | EPA 904.0 | **1.05 ± 0.449 (0.709)**<br>**C:74% T:88%** | pCi/L | 03/10/20 14:47 | 15262-20-1 | |

# ANALYTICAL RESULTS - RADIOCHEMISTRY

Project: 0023536
Pace Project No.: 30351798

**Sample: 0023536-05** **Lab ID: 30351798005** Collected: 02/18/20 14:13 Received: 02/25/20 09:20 Matrix: Water
PWS: Site ID: Sample Type:

| Parameters | Method | Act ± Unc (MDC) Carr Trac | Units | Analyzed | CAS No. | Qual |
|---|---|---|---|---|---|---|
| Total Radium | Total Radium Calculation | **1.12 ± 0.771 (1.23)** | pCi/L | 03/11/20 12:13 | 7440-14-4 | |

**Sample: 0023536-06** **Lab ID: 30351798006** Collected: 02/18/20 00:00 Received: 02/25/20 09:20 Matrix: Water
PWS: Site ID: Sample Type:

| Parameters | Method | Act ± Unc (MDC) Carr Trac | Units | Analyzed | CAS No. | Qual |
|---|---|---|---|---|---|---|
| Radium-226 | EPA 903.1 | **0.291 ± 0.344 (0.541)**<br>**C:NA T:87%** | pCi/L | 03/09/20 12:14 | 13982-63-3 | |
| Radium-228 | EPA 904.0 | **0.936 ± 0.425 (0.696)**<br>**C:76% T:87%** | pCi/L | 03/10/20 14:47 | 15262-20-1 | |
| Total Radium | Total Radium Calculation | **1.23 ± 0.769 (1.24)** | pCi/L | 03/11/20 12:13 | 7440-14-4 | |

**Sample: 0023536-07** **Lab ID: 30351798007** Collected: 02/18/20 00:00 Received: 02/25/20 09:20 Matrix: Water
PWS: Site ID: Sample Type:

| Parameters | Method | Act ± Unc (MDC) Carr Trac | Units | Analyzed | CAS No. | Qual |
|---|---|---|---|---|---|---|
| Radium-226 | EPA 903.1 | **0.115 ± 0.357 (0.691)**<br>**C:NA T:96%** | pCi/L | 03/09/20 12:14 | 13982-63-3 | |
| Radium-228 | EPA 904.0 | **0.693 ± 0.369 (0.626)**<br>**C:74% T:86%** | pCi/L | 03/10/20 14:48 | 15262-20-1 | |
| Total Radium | Total Radium Calculation | **0.808 ± 0.726 (1.32)** | pCi/L | 03/11/20 12:13 | 7440-14-4 | |

# QUALITY CONTROL - RADIOCHEMISTRY

Project: 0023536
Pace Project No.: 30351798

---

QC Batch: 385636
QC Batch Method: EPA 903.1
Analysis Method: EPA 903.1
Analysis Description: 903.1 Radium-226
Associated Lab Samples: 30351798001, 30351798002, 30351798003, 30351798004, 30351798005, 30351798006, 30351798007

---

METHOD BLANK: 1868384
Matrix: Water
Associated Lab Samples: 30351798001, 30351798002, 30351798003, 30351798004, 30351798005, 30351798006, 30351798007

| Parameter | Act ± Unc (MDC) Carr Trac | Units | Analyzed | Qualifiers |
|---|---|---|---|---|
| Radium-226 | -0.0938 ± 0.260 (0.615) C:NA T:92% | pCi/L | 03/09/20 11:39 | |

**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 - RADIOCHEMISTRY

Project: 0023536
Pace Project No.: 30351798

---

QC Batch: 385656 Analysis Method: EPA 904.0
QC Batch Method: EPA 904.0 Analysis Description: 904.0 Radium 228
Associated Lab Samples: 30351798001, 30351798002, 30351798003, 30351798004, 30351798005, 30351798006, 30351798007

METHOD BLANK: 1868407 Matrix: Water
Associated Lab Samples: 30351798001, 30351798002, 30351798003, 30351798004, 30351798005, 30351798006, 30351798007

| Parameter | Act ± Unc (MDC) Carr Trac | Units | Analyzed | Qualifiers |
|---|---|---|---|---|
| Radium-228 | 0.540 ± 0.354 (0.663) C:79% T:88% | pCi/L | 03/10/20 14:46 | |

**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: | 0023536 |
| Pace Project No.: | 30351798 |

## 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.

Act - Activity

Unc - Uncertainty: For Safe Drinking Water Act (SDWA) analyses, the reported Unc. Is the calculated Count Uncertainty (95% confidence interval) using a coverage factor of 1.96. For all other matrices (non-SDWA), the reported Unc. is the calculated Expanded Uncertainty (aka Combined Standard Uncertainty, CSU), reported at the 95% confidence interval using a coverage factor of 1.96.

Gamma Spec: The Unc. reported for all gamma-spectroscopy analyses (EPA 901.1), is the calculated Expanded Uncertainty (CSU) at the 95.4% confidence interval, using a coverage factor of 2.0.

(MDC) - Minimum Detectable Concentration

Trac - Tracer Recovery (%)

Carr - Carrier Recovery (%)

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

## LABORATORIES

| | |
|---|---|
| PASI-PA | Pace Analytical Services - Greensburg |

## REPORT OF LABORATORY ANALYSIS

# SUBCONTRACT ORDER
## Transfer Chain of Custody

**PDC Laboratories, Inc.**

**0023536**

**WO# : 30351798**

30351798

**SENDING LABORATORY**

PDC Laboratories, Inc.
2231 W Altorfer Dr
Peoria, IL 61615
(800) 752-6651

**RECEIVING LABORATORY**

PACE Analytical - Greensburg
1638 Roseytown Road - Suites 2,3,4
Greensburg, PA 15601
(724) 850-5600

**Sample:** **0023536-01**
**Name:** MW-3
**Sampled:** 02/18/20 09:20
**Matrix:** Ground Water
**Preservative:** HNO3, pH <2

001

| Analysis | Due | Expires | Comments |
|---|---|---|---|
| 01-Radium 226/228 | 03/02/20 16:00 | 08/16/20 09:20 | |

**Sample:** **0023536-02**
**Name:** MW-6
**Sampled:** 02/18/20 10:25
**Matrix:** Ground Water
**Preservative:** HNO3, pH <2

002

| Analysis | Due | Expires | Comments |
|---|---|---|---|
| 01-Radium 226/228 | 03/02/20 16:00 | 08/16/20 10:25 | |

**Sample:** **0023536-03**
**Name:** MW-5
**Sampled:** 02/18/20 11:39
**Matrix:** Ground Water
**Preservative:** HNO3, pH <2

003

| Analysis | Due | Expires | Comments |
|---|---|---|---|
| 01-Radium 226/228 | 03/02/20 16:00 | 08/16/20 11:39 | |

**Sample:** **0023536-04**
**Name:** MW-8
**Sampled:** 02/18/20 12:36
**Matrix:** Ground Water
**Preservative:** HNO3, pH <2

004

| Analysis | Due | Expires | Comments |
|---|---|---|---|
| 01-Radium 226/228 | 03/02/20 16:00 | 08/16/20 12:36 | |

**Sample:** **0023536-05**
**Name:** MW-4
**Sampled:** 02/18/20 14:13
**Matrix:** Ground Water
**Preservative:** HNO3, pH <2

005

| Analysis | Due | Expires | Comments |
|---|---|---|---|
| 01-Radium 226/228 | 03/02/20 16:00 | 08/16/20 14:13 | |

# SUBCONTRACT ORDER
## Transfer Chain of Custody

#-30351798

**PDC Laboratories, Inc.**

**0023536**

**SENDING LABORATORY**

PDC Laboratories, Inc.
2231 W Altorfer Dr
Peoria, IL 61615
(800) 752-6651

**RECEIVING LABORATORY**

PACE Analytical - Greensburg
1638 Roseytown Road - Suites 2,3,4
Greensburg, PA 15601
(724) 850-5600

**Sample:** 0023536-06
**Name:** FIELD DUPLICATE

**Sampled:** 02/18/20 00:00
**Matrix:** Ground Water
**Preservative:** HNO3, pH <2

006

| Analysis | Due | Expires | Comments |
|---|---|---|---|
| 01-Radium 226/228 | 03/02/20 16:00 | 08/16/20 00:00 | |

**Sample:** 0023536-07
**Name:** FIELD BLANK

**Sampled:** 02/18/20 00:00
**Matrix:** Ground Water
**Preservative:** HNO3, pH <2

007

| Analysis | Due | Expires | Comments |
|---|---|---|---|
| 01-Radium 226/228 | 03/02/20 16:00 | 08/16/20 00:00 | |

**Please email results to Kurt Stepping at kstepping@pdclab.com**

Date Shipped: 2-21-20 Total # of Containers: 7 Sample Origin (State): IL PO #: L4026

Turn-Around Time Requested ☑ NORMAL ☐ RUSH Date Results Needed: ____________

| Relinquished By | Date/Time | Received By | Date/Time |
|---|---|---|---|
| | 2-21-20 11:30 | | 2/25/20 900 |
| | | | |

Sample Temperature Upon Receipt — °C
Sample(s) Received on Ice Y or [✓ N]
Proper Bottles Received in Good Condition [✓ Y] or N
Bottles Filled with Adequate Volume [✓ Y] or N
Samples Received Within Hold Time [✓ Y] or N
Date/Time Taken From Sample Bottle [✓ Y] or N

## Pittsburgh Lab Sample Condition Upon Receipt

**# 30351798**

Pace Analytical

Client Name: PDC Labs

Project #

**Label** ng

**LIMS Login** ng

**Courier:** ☑ Fed Ex ☐ UPS ☐ USPS ☐ Client ☐ Commercial ☐ Pace Other ____

**Tracking #:** 7718 2971 8530

**Custody Seal on Cooler/Box Present:** ☐ yes ☑ no  Seals intact: ☐ yes ☑ no

**Thermometer Used** —  **Type of Ice:** Wet Blue [✓ None]

**Cooler Temperature** **Observed Temp** — °C  Correction Factor: ____ °C  Final Temp: — °C

Temp should be above freezing to 6°C

**pH paper Lot#** 10D2191

**Date and Initials of person examining contents:** ng 2/26/2020

| **Comments:** | Yes | No | N/A | |
|---|---|---|---|---|
| Chain of Custody Present: | ✓ | | | 1. |
| Chain of Custody Filled Out: | ✓ | | | 2. |
| Chain of Custody Relinquished: | ✓ | | | 3. |
| Sampler Name & Signature on COC: | | ✓ | | 4. |
| Sample Labels match COC: | ✓ | | | 5. |
| -Includes date/time/ID Matrix: WT | | | | |
| Samples Arrived within Hold Time: | ✓ | | | 6. |
| **Short Hold Time Analysis (<72hr remaining):** | | ✓ | | 7. |
| **Rush Turn Around Time Requested:** | | ✓ | | 8. |
| Sufficient Volume: | ✓ | | | 9. |
| Correct Containers Used: | ✓ | | | 10. |
| -Pace Containers Used: | | ✓ | | |
| Containers Intact: | ✓ | | | 11. |
| Orthophosphate field filtered | | | ✓ | 12. |
| Hex Cr Aqueous sample field filtered | | | ✓ | 13. |
| Organic Samples checked for dechlorination: | | | ✓ | 14. |
| Filtered volume received for Dissolved tests | | | ✓ | 15. |
| **All containers have been checked for preservation.**<br>exceptions: VOA, coliform, TOC, O&G, Phenolics, Radon, Non-aqueous matrix | ✓ | | | 16. pH<2 |
| All containers meet method preservation requirements. | ✓ | | | Initial when completed: ng<br>Date/time of preservation:<br>Lot # of added preservative: |
| Headspace in VOA Vials ( >6mm): | | ✓ | | 17. |
| Trip Blank Present: | | ✓ | | 18. |
| Trip Blank Custody Seals Present | | | ✓ | |
| **Rad Samples Screened < 0.5 mrem/hr** | ✓ | | | Initial when completed: ng<br>Date: 2/26/2020 |

**Client Notification/ Resolution:**

~~Person Contacted:~~ ____ ~~Date/Time:~~ ____ ~~Contacted By:~~ ____

Comments/ Resolution: ____

☐ **A check in this box indicates that additional information has been stored in ereports.**

**Note:** Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEHNR Certification Office ( i.e. out of hold, incorrect preservative, out of temp, incorrect containers)

*PM review is documented electronically in LIMS. When the Project Manager closes the SRF Review schedule in LIMS. The review is in the Status section of the Workorder Edit Screen.

# CHAIN OF CUSTODY RECORD

**PDC LABORATORIES, INC.**
WWW.PDCLAB.COM

| REGULATORY PROGRAM (CIRCLE): | NPDES |
|---|---|
| MORBCA | RCRA |
| CCDD | TACO: RES OR IND/COMM |

STATE WHERE SAMPLE COLLECTED MO

*ALL HIGHLIGHTED AREAS MUST BE COMPLETED BY CLIENT (PLEASE PRINT)*

① CLIENT: Sikeston Power Station

ADDRESS: 1551 West Wakefield

CITY STATE ZIP: Sikeston, MO 63801

CONTACT PERSON: Ken Ewers/Luke St. Mary

PROJECT NUMBER:

PROJECT LOCATION:

PURCHASE ORDER #:

PHONE NUMBER: Bottom Ash CCR APP III and APP IV

E-MAIL:

DATE SHIPPED:

SAMPLER (PLEASE PRINT): Daniel Dillingham

SAMPLER'S SIGNATURE: Daniel A. Dillingham

MATRIX TYPES:
WW- WASTEWATER
DW- DRINKING WATER
GW- GROUND WATER
WWSL- SLUDGE
NAS- NON AQUEOUS SOLID
LCHT-LEACHATE
OIL-OIL
SO-SOIL
SOL-SOLID

③ ANALYSIS REQUESTED

④ (FOR LAB USE ONLY)
LOGIN # 0023536-7
LOGGED BY:
CLIENT: ______
PROJECT: ______
PROJ. MGR.: ______
CUSTODY SEAL #: ______

| ② SAMPLE DESCRIPTION (UNIQUE DESCRIPTION AS IT WILL APPEAR ON THE ANALYTICAL REPORT) | DATE COLLECTED | TIME COLLECTED | SAMPLE TYPE GRAB | SAMPLE TYPE COMP | MATRIX TYPE | BOTTLE COUNT | PRES CODE CLIENT PROVIDED | RAD 226/228 | F, As, Ba, Be, Cd, Co | Cr, Hg, Li, Mo, Pb | Sb, Se, Ti |  |  |  | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW 3 | 2-18-20 | 0920 | X |  | GW | 3 |  | X | X | X | X |  |  |  |  |
| MW 6 | 2-18-20 | 1025 | X |  | GW | 3 |  | X | X | X | X |  |  |  |  |
| MW 5 | 2-18-20 | 1139 | X |  | GW | 3 |  | X | X | X | X |  |  |  |  |
| MW 8 | 2-18-20 | 1236 | X |  | GW | 3 |  | X | X | X | X |  |  |  |  |
| MW 4 | 2-18-20 | 1413 | X |  | GW | 3 |  | X | X | X | X |  |  |  |  |
| Field Duplicate | 2-18-20 |  | X |  | GW | 3 |  | X | X | X | X |  |  |  |  |
| Field Blank | 2-18-20 |  | X |  | DI | 3 |  | X | X | X | X |  |  |  |  |

CHEMICAL PRESERVATION CODES: 1 – HCL | 2 – H2SO4 | 3 – HNO3 | 4 – NAOH | 5 – NA2S2O3 | 6 – UNPRESERVED | 7 – OTHER

⑤ TURNAROUND TIME REQUESTED (PLEASE CIRCLE) NORMAL RUSH
(RUSH TAT IS SUBJECT TO PDC LABS APPROVAL AND SURCHARGE)
RUSH RESULTS VIA (PLEASE CIRCLE) EMAIL PHONE
EMAIL IF DIFFERENT FROM ABOVE:
PHONE # IF DIFFERENT FROM ABOVE:

DATE RESULTS NEEDED

⑥ *I understand that by initialing this box I give the lab permission to proceed with analysis, even though it may not meet all sample conformance requirements as defined in the receiving facility's Sample Acceptance Policy and the data will be qualified. Qualified data may NOT be acceptable to report to all regulatory authorities.*

PROCEED WITH ANALYSIS AND QUALIFY RESULTS: (INITIALS) ______

| ⑦ RELINQUISHED BY: (SIGNATURE) | DATE / TIME | RECEIVED BY: (SIGNATURE) | DATE / TIME |
|---|---|---|---|
| Ashish Patel | DATE 02-19-20<br>TIME 0830 |  | DATE<br>TIME |
| RELINQUISHED BY: (SIGNATURE) | DATE<br>TIME | RECEIVED BY: (SIGNATURE) | DATE<br>TIME |
| RELINQUISHED BY: (SIGNATURE) | DATE<br>TIME | RECEIVED BY: (SIGNATURE) | DATE 2/20/20<br>TIME ~~1110~~ 1010 |

⑧ COMMENTS: (FOR LAB USE ONLY)

SAMPLE TEMPERATURE UPON RECEIPT 1.7 °C
CHILL PROCESS STARTED PRIOR TO RECEIPT [✓ Y] OR N
SAMPLE(S) RECEIVED ON ICE [✓ Y] OR N
SAMPLE ACCEPTANCE NONCONFORMANT REPORT IS NEEDED Y OR [✓ N]
DATE AND TIME TAKEN FROM SAMPLE BOTTLE ______

# Appendix 2

## Laboratory Analytical Results and Quality Control Reports – March 2020

PDC Laboratories, Inc.
PROFESSIONAL • DEPENDABLE • COMMITTED

April 07, 2020

Luke St Mary
Sikeston BMU, Sikeston Power Station
1551 W Wakefield
Sikeston, MO 63801

RE: Sikeston Bottom Ash App III and App IV 2019

Dear Luke St Mary:

Please find enclosed the analytical results for the **7** sample(s) the laboratory received on **4/1/20 11:00 am** and logged in under work order **0040090**. All testing is performed according to our current TNI accreditations unless otherwise noted . This report cannot be reproduced, except in full, without the written permission of PDC Laboratories, Inc.

If you have any questions regarding your report, please contact your project manager. Quality and timely data is of the utmost importance to us.

PDC Laboratories, Inc. appreciates the opportunity to provide you with analytical expertise. We are always trying to improve our customer service and we welcome you to contact the Director of Client Services, Lisa Grant, with any feedback you have about your experience with our laboratory at 309-683-1764 or lgrant@pdclab.com.

Sincerely,

Kurt Stepping

Kurt Stepping
Senior Project Manager
(309) 692-9688 x1719
kstepping@pdclab.com

NELAP ACCREDITED TNI LABORATORY

ANALYTICAL RESULTS

## ANALYTICAL RESULTS

**Sample:** **0040090-01**
**Name:** MW-3
**Matrix:** Ground Water - Grab

**Sampled:** 03/30/20 08:29
**Received:** 04/01/20 11:00
**PO #:** 23573

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **General Chemistry - PIA** | | | | | | | | | |
| Solids - total dissolved solids (TDS) | 180 | mg/L | | 04/02/20 11:06 | 1 | 26 | 04/02/20 11:06 | CPC | SM 2540C |

**Sample:** **0040090-02**
**Name:** MW-4
**Matrix:** Ground Water - Grab

**Sampled:** 03/30/20 12:49
**Received:** 04/01/20 11:00
**PO #:** 23573

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **General Chemistry - PIA** | | | | | | | | | |
| Solids - total dissolved solids (TDS) | 300 | mg/L | | 04/02/20 11:06 | 1 | 26 | 04/02/20 11:06 | CPC | SM 2540C |

**Sample:** **0040090-03**
**Name:** MW-5
**Matrix:** Ground Water - Grab

**Sampled:** 03/30/20 10:35
**Received:** 04/01/20 11:00
**PO #:** 23573

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **General Chemistry - PIA** | | | | | | | | | |
| Solids - total dissolved solids (TDS) | 450 | mg/L | | 04/02/20 11:06 | 1 | 26 | 04/02/20 11:06 | CPC | SM 2540C |

**Sample:** **0040090-04**
**Name:** MW-6
**Matrix:** Ground Water - Grab

**Sampled:** 03/30/20 09:20
**Received:** 04/01/20 11:00
**PO #:** 23573

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **General Chemistry - PIA** | | | | | | | | | |
| Solids - total dissolved solids (TDS) | 230 | mg/L | | 04/02/20 11:06 | 1 | 26 | 04/02/20 11:06 | CPC | SM 2540C |

# ANALYTICAL RESULTS

**Sample:** **0040090-05**
**Name:** MW-8
**Matrix:** Ground Water - Grab

**Sampled:** 03/30/20 11:51
**Received:** 04/01/20 11:00
**PO #:** 23573

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **General Chemistry - PIA** | | | | | | | | | |
| Solids - total dissolved solids (TDS) | 480 | mg/L | | 04/02/20 11:06 | 1 | 26 | 04/02/20 11:06 | CPC | SM 2540C |

**Sample:** **0040090-06**
**Name:** FIELD DUPLICATE
**Matrix:** Ground Water - Grab

**Sampled:** 03/30/20 00:00
**Received:** 04/01/20 11:00
**PO #:** 23573

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **General Chemistry - PIA** | | | | | | | | | |
| Solids - total dissolved solids (TDS) | 460 | mg/L | | 04/02/20 11:06 | 1 | 26 | 04/02/20 11:06 | CPC | SM 2540C |

**Sample:** **0040090-07**
**Name:** FIELD BLANK
**Matrix:** Ground Water - Grab

**Sampled:** 03/30/20 00:00
**Received:** 04/01/20 11:00
**PO #:** 23573

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **General Chemistry - PIA** | | | | | | | | | |
| Solids - total dissolved solids (TDS) | < 17 | mg/L | | 04/02/20 11:06 | 1 | 17 | 04/02/20 11:06 | CPC | SM 2540C |

# QC SAMPLE RESULTS

| Parameter | Result | Unit | Qual | Spike Level | Source Result | %REC | %REC Limits | RPD | RPD Limit |
|---|---|---|---|---|---|---|---|---|---|
| ***Batch B007813 - No Prep - SM 2540C*** | | | | | | | | | |
| **Blank (B007813-BLK1)** | | | | Prepared & Analyzed: 04/02/20 | | | | | |
| Solids - total dissolved solids (TDS) | < 17 | mg/L | | | | | | | |
| **LCS (B007813-BS1)** | | | | Prepared & Analyzed: 04/02/20 | | | | | |
| Solids - total dissolved solids (TDS) | 1010 | mg/L | | 1000 | | 101 | 67.9-132 | | |
| **Duplicate (B007813-DUP1)** | **Sample: 0035000-05** | | | Prepared & Analyzed: 04/02/20 | | | | | |
| Solids - total dissolved solids (TDS) | 370 | mg/L | M | | 340 | | | 8 | 5 |
| **Duplicate (B007813-DUP2)** | **Sample: 0035000-06** | | | Prepared & Analyzed: 04/02/20 | | | | | |
| Solids - total dissolved solids (TDS) | 350 | mg/L | M | | 320 | | | 9 | 5 |

# NOTES

Specifications regarding method revisions and method modifications used for analysis are available upon request. Please contact your project manager.

* Not a TNI accredited analyte

## Certifications

CHI - McHenry, IL - 4314-A W. Crystal Lake Road, McHenry, IL 60050
TNI Accreditation for Drinking Water and Wastewater Fields of Testing through IL EPA Accreditation No. 100279
Illinois Department of Public Health Bacterial Analysis in Drinking Water Approved Laboratory Registry No. 17556

PIA - Peoria, IL - 2231 W. Altorfer Drive, Peoria, IL 61615
TNI Accreditation for Drinking Water, Wastewater, Solid and Hazardous Material Fields of Testing through IL EPA Accreditation No. 100230
Illinois Department of Public Health Bacterial Analysis in Drinking Water Approved Laboratory Registry No. 17553
Drinking Water Certifications/Accreditations: Iowa (240); Kansas (E-10338); Missouri (870)
Wastewater Certifications/Accreditations: Arkansas (88-0677); Iowa (240); Kansas (E-10338)
Solid and Hazardous Material Certifications/Accreditations: Arkansas (88-0677); Iowa (240); Kansas (E-10338)

SPIL - Springfield, IL - 1210 Capitol Airport Drive, Springfield, IL 62707
Illinois Department of Public Health Bacterial Analysis in Drinking Water Approved Laboratory Registry No. 17592

SPMO - Springfield, MO - 1805 W Sunset Street, Springfield, MO 65807
USEPA DMR-QA Program

STL - Hazelwood, MO - 944 Anglum Rd, Hazelwood, MO 63042
TNI Accreditation for Wastewater, Solid and Hazardous Material Fields of Testing through KS KDHE Certification No. E-10389
TNI Accreditation for Wastewater, Solid and Hazardous Material Fields of Testing through IL EPA Accreditation No. - 200080
Illinois Department of Public Health Bacterial Analysis in Drinking Water Approved Laboratory, Registry No. 171050
Missouri Department of Natural Resources - Certificate of Approval for Microbiological Laboratory Service - No. 1050

## Qualifiers

| | |
|---|---|
| M | Analyte failed to meet the required acceptance criteria for duplicate analysis. |

Certified by: Kurt Stepping, Senior Project Manager

PDC Laboratories, Inc.
P.O. Box 9071 • Peoria, IL 61612-9071
(309) 692-9688 • (800) 752-6651 • FAX (309) 692-9689

# DATA PACKAGE

`

**CLIENT; Sikeston BMU**

**PROJECT: Sikeston Power Station**

**PDC LAB WORKORDER: 0040090**

**DATE ISSUED: April 7, 2020**

# CASE NARRATIVE –

## PDC Work Order 0040090

PDC Laboratories, Inc. received 7 water samples on April 1, 2020 in good condition at our Peoria, IL facility. This sample set was designated as work order 0040090.

| Sample ID's | | Date | |
|---|---|---|---|
| **Field** | **Lab ID** | **Collected** | **Received** |
| MW-3 | 0040090-01 | 3/30/20 | 4/1/20 |
| MW-4 | 0040090-02 | 3/30/20 | 4/1/20 |
| MW-5 | 0040090-03 | 3/30/20 | 4/1/20 |
| MW-8 | 0040090-04 | 3/30/20 | 4/1/20 |
| MW-8 | 0040090-05 | 3/30/20 | 4/1/20 |
| Field Duplicate | 0040090-06 | 3/30/20 | 4/1/20 |
| Field Blank | 0040090-07 | 3/30/20 | 4/1/20 |

**QC Summary:**

**All items met acceptance criteria with the following noted exceptions:**

**TDS: Batch duplicate samples flagged M, outside RPD acceptance criteria**

**Certification**

Signature: Kurt Step

Name: Kurt Stepping

Date: April 7, 2020

Title: Senior Project Manager

**PDC LABORATORIES, INC.**
WWW.PDCLAB.COM

| REGULATORY PROGRAM (Check one:) | | NPDES | ☐ |
|---|---|---|---|
| MORBCA | ☐ | RCRA | ☐ |
| CCDD | ☐ | TACO: RES OR IND/COMM | ☐ |

# CHAIN OF CUSTODY RECORD

STATE WHERE SAMPLE COLLECTED MO

*ALL HIGHLIGHTED AREAS MUST BE COMPLETED BY CLIENT (PLEASE PRINT)*

① CLIENT: SIKESTON BMU POWER STATION

PROJECT NUMBER:

PROJECT LOCATION: BOTTOM ASH TDS ONLY

PURCHASE ORDER #: 23573

ADDRESS: 1551 W WAKEFIELD

PHONE NUMBER: 573.475.3131

E-MAIL: LSTMARY@SBMU.NET

DATE SHIPPED:

CITY STATE ZIP: SIKESTON, MO 63801

SAMPLER (PLEASE PRINT): Daniel Dillingham

SAMPLER'S SIGNATURE: Daniel A. Dillingham

CONTACT PERSON: LUKE ST MARY

MATRIX TYPES:
WW- WASTEWATER
DW- DRINKING WATER
GW- GROUND WATER
WWSL- SLUDGE
NAS- NON AQUEOUS SOLID
LCHT-LEACHATE
OIL-OIL
SO-SOIL
SOL-SOLID

③ ANALYSIS REQUESTED

④ (FOR LAB USE ONLY)
LOGIN # 0040090-07
LOGGED BY: DCW
CLIENT: SIKESTON BMU
PROJECT: BOTTOM ASH TDS ONLY
PROJ. MGR.: KURT
CUSTODY SEAL #:

② SAMPLE DESCRIPTION (UNIQUE DESCRIPTION AS IT WILL APPEAR ON THE ANALYTICAL REPORT)

| SAMPLE DESCRIPTION | DATE COLLECTED | TIME COLLECTED | SAMPLE TYPE GRAB | SAMPLE TYPE COMP | MATRIX TYPE | BOTTLE COUNT | PRES CODE CLIENT PROVIDED | TDS | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| MW-3 | 3-30-20 | 0829 | X | | GW | 1 | | X | |
| MW-4 | 3-30-20 | 1249 | X | | GW | 1 | | X | |
| MW-5 | 3-30-20 | 1035 | X | | GW | 1 | | X | |
| MW-6 | 3-30-20 | 0920 | X | | GW | 1 | | X | |
| MW-8 | 3-30-20 | 1151 | X | | GW | 1 | | X | |
| DUPLICATE WELL | 3-30-20 | | X | | GW | 1 | | X | |
| FIELD BLANK | 3-30-20 | | X | | GW | 1 | | X | |

CHEMICAL PRESERVATION CODES: 1 – HCL | 2 – H2SO4 | 3 – HNO3 | 4 – NAOH | 5 – NA2S2O3 | 6 – UNPRESERVED | 7 – OTHER

⑤ TURNAROUND TIME REQUESTED (PLEASE CHECK) (RUSH TAT IS SUBJECT TO PDC LABS APPROVAL AND SURCHARGE) ☒ NORMAL ☐ RUSH

DATE RESULTS NEEDED

RUSH RESULTS VIA (PLEASE CIRCLE) EMAIL ☐ PHONE ☐

EMAIL IF DIFFERENT FROM ABOVE:

PHONE # IF DIFFERENT FROM ABOVE:

⑥ *I understand that by initialing this box I give the lab permission to proceed with analysis, even though it may not meet all sample conformance requirements as defined in the receiving facility's Sample Acceptance Policy and the data will be qualified. Qualified data may NOT be acceptable to report to all regulatory authorities.*

PROCEED WITH ANALYSIS AND QUALIFY RESULTS: (INITIALS) ______

| ⑦ RELINQUISHED BY: (SIGNATURE) | DATE / TIME | RECEIVED BY: (SIGNATURE) | DATE / TIME |
|---|---|---|---|
| | DATE 3-31-2020<br>TIME 0730 | | DATE<br>TIME |
| RELINQUISHED BY: (SIGNATURE) | DATE<br>TIME | RECEIVED BY: (SIGNATURE) | DATE<br>TIME |
| RELINQUISHED BY: (SIGNATURE) | DATE<br>TIME | RECEIVED BY: (SIGNATURE) | DATE 4/1/20<br>TIME 1100 |

⑧ COMMENTS: (FOR LAB USE ONLY)

SAMPLE TEMPERATURE UPON RECEIPT 1.7 °C

CHILL PROCESS STARTED PRIOR TO RECEIPT [✓ Y] OR N

SAMPLE(S) RECEIVED ON ICE [✓ Y] OR N

SAMPLE ACCEPTANCE NONCONFORMANT REPORT IS NEEDED Y OR [✓ N]

DATE AND TIME TAKEN FROM SAMPLE BOTTLE ______

Qualtrax ID #3219

Page 1 of 1

# Appendix 3

## Laboratory Analytical Results and Quality Control Reports – April 2020

**PDC Laboratories, Inc.**
PROFESSIONAL • DEPENDABLE • COMMITTED

May 14, 2020

Luke St Mary
Sikeston BMU, Sikeston Power Station
1551 W Wakefield
Sikeston, MO 63801

RE: Sikeston NPDES Groundwater

Dear Luke St Mary:

Please find enclosed the analytical results for the **15** sample(s) the laboratory received on **4/10/20 10:00 am** and logged in under work order **0042173**. All testing is performed according to our current TNI accreditations unless otherwise noted. This report cannot be reproduced, except in full, without the written permission of PDC Laboratories, Inc.

If you have any questions regarding your report, please contact your project manager. Quality and timely data is of the utmost importance to us.

PDC Laboratories, Inc. appreciates the opportunity to provide you with analytical expertise. We are always trying to improve our customer service and we welcome you to contact the Director of Client Services, Lisa Grant, with any feedback you have about your experience with our laboratory at 309-683-1764 or lgrant@pdclab.com.

Sincerely,

Kurt Stepping
Senior Project Manager
(309) 692-9688 x1719
kstepping@pdclab.com

NELAP ACCREDITED TNI LABORATORY

## ANALYTICAL RESULTS

# ANALYTICAL RESULTS

**Sample:** **0042173-08**
**Name:** MW-8
**Matrix:** Ground Water - Regular Sample

**Sampled:** 04/08/20 10:55
**Received:** 04/10/20 10:00
**PO #:** 23575

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **General Chemistry - PIA** | | | | | | | | | |
| Solids - total dissolved solids (TDS) | 430 | mg/L | | 04/13/20 13:25 | 1 | 26 | 04/13/20 14:25 | CPC | SM 2540C |

**Sample:** **0042175-01**
**Name:** MW-8
**Matrix:** Ground Water - Regular Sample

**Sampled:** 04/08/20 10:55
**Received:** 04/10/20 10:00
**PO #:** 23573

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **General Chemistry - PIA** | | | | | | | | | |
| Solids - total dissolved solids (TDS) | 480 | mg/L | | 04/13/20 13:25 | 1 | 26 | 04/13/20 14:25 | CPC | SM 2540C |

**Sample:** **0042175-02**
**Name:** FIELD DUPLICATE
**Matrix:** Ground Water - Regular Sample

**Sampled:** 04/08/20 00:00
**Received:** 04/10/20 10:00
**PO #:** 23573

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **General Chemistry - PIA** | | | | | | | | | |
| Solids - total dissolved solids (TDS) | 330 | mg/L | | 04/13/20 13:25 | 1 | 26 | 04/13/20 14:25 | CPC | SM 2540C |

**Sample:** **0042175-03**
**Name:** FIELD BLANK
**Matrix:** Ground Water - Regular Sample

**Sampled:** 04/07/20 00:00
**Received:** 04/10/20 10:00
**PO #:** 23573

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **General Chemistry - PIA** | | | | | | | | | |
| Solids - total dissolved solids (TDS) | < 17 | mg/L | | 04/13/20 13:25 | 1 | 17 | 04/13/20 14:25 | CPC | SM 2540C |

## QC SAMPLE RESULTS

| Parameter | Result | Unit | Qual | Spike Level | Source Result | %REC | %REC Limits | RPD | RPD Limit |
|---|---|---|---|---|---|---|---|---|---|
| ***Batch B008700 - No Prep - SM 2540C*** | | | | | | | | | |
| **Blank (B008700-BLK1)** | | | | Prepared & Analyzed: 04/13/20 | | | | | |
| Solids - total dissolved solids (TDS) | < 17 | mg/L | | | | | | | |
| **LCS (B008700-BS1)** | | | | Prepared & Analyzed: 04/13/20 | | | | | |
| Solids - total dissolved solids (TDS) | 980 | mg/L | | 1000 | | 98 | 67.9-132 | | |
| **Duplicate (B008700-DUP1)** | **Sample: 0041878-04** | | | Prepared & Analyzed: 04/13/20 | | | | | |
| Solids - total dissolved solids (TDS) | 410 | mg/L | | | 430 | | | 5 | 5 |
| **Duplicate (B008700-DUP2)** | **Sample: 0041878-06** | | | Prepared & Analyzed: 04/13/20 | | | | | |
| Solids - total dissolved solids (TDS) | 800 | mg/L | | | 820 | | | 2 | 5 |

## NOTES

Specifications regarding method revisions and method modifications used for analysis are available upon request. Please contact your project manager.

* Not a TNI accredited analyte

## Memos

Revised report. Confirmed that filed duplicate label was put on wrong bottle. Value for -02 corrected to reflect the proper container.

TDS Lab duplicate from seperate login group added.

## Certifications

CHI - McHenry, IL - 4314-A W. Crystal Lake Road, McHenry, IL 60050
TNI Accreditation for Drinking Water and Wastewater Fields of Testing through IL EPA Accreditation No. 100279
Illinois Department of Public Health Bacterial Analysis in Drinking Water Approved Laboratory Registry No. 17556

PIA - Peoria, IL - 2231 W. Altorfer Drive, Peoria, IL 61615
TNI Accreditation for Drinking Water, Wastewater, Solid and Hazardous Material Fields of Testing through IL EPA Accreditation No. 100230
Illinois Department of Public Health Bacterial Analysis in Drinking Water Approved Laboratory Registry No. 17553
Drinking Water Certifications/Accreditations: Iowa (240); Kansas (E-10338); Missouri (870)
Wastewater Certifications/Accreditations: Arkansas (88-0677); Iowa (240); Kansas (E-10338)
Solid and Hazardous Material Certifications/Accreditations: Arkansas (88-0677); Iowa (240); Kansas (E-10338)

SPMO - Springfield, MO - 1805 W Sunset Street, Springfield, MO 65807
USEPA DMR-QA Program

STL - Hazelwood, MO - 944 Anglum Rd, Hazelwood, MO 63042
TNI Accreditation for Wastewater, Solid and Hazardous Material Fields of Testing through KS KDHE Certification No. E-10389
TNI Accreditation for Wastewater, Solid and Hazardous Material Fields of Testing through IL EPA Accreditation No. - 200080
Illinois Department of Public Health Bacterial Analysis in Drinking Water Approved Laboratory, Registry No. 171050
Missouri Department of Natural Resources - Certificate of Approval for Microbiological Laboratory Service - No. 1050

Certified by: Kurt Stepping, Senior Project Manager

PDC Laboratories, Inc.
P.O. Box 9071 • Peoria, IL 61612-9071
(309) 692-9688 • (800) 752-6651 • FAX (309) 692-9689

# DATA PACKAGE

`

**CLIENT; Sikeston BMU**

**PROJECT: Sikeston Power Station**

**PDC LAB WORKORDER: 0042175**

**DATE ISSUED: May 13, 2020**

# CASE NARRATIVE –

# PDC Work Order 0042175

PDC Laboratories, Inc. received 3 water samples on April 10, 2020 in good condition at our Peoria, IL facility. This sample set was designated as work order 0042175.

| Sample ID's | | Date | |
|---|---|---|---|
| **Field** | **Lab ID** | **Collected** | **Received** |
| | | | |
| MW-8 | 0042175-01 | 4/8/20 | 4/10/20 |
| DUPLICATE WELL | 0042175-02 | 4/8/20 | 4/10/20 |
| FIELD BLANK | 0042175-03 | 4/7/20 | 4/10/20 |

**QC Summary:**

All items met acceptance criteria with the following noted exceptions for this revised report:

No exceptions for this report.

Lab duplicate sample for MW-8 shows on report as 0042173-08. Duplicate analysis was performed on same bottle (also used for another monitoring program) in the same analytical batch.

**Certification**

Signature: Kurt Stepping

Name: Kurt Stepping

Date: May 13, 2020

Title: Senior Project Manager

**PDC LABORATORIES, INC.**
WWW.PDCLAB.COM

| REGULATORY PROGRAM (Check one:) | | NPDES | ☐ |
|---|---|---|---|
| MORBCA | ☐ | RCRA | ☐ |
| CCDD | ☐ | TACO: RES OR IND/COMM | ☐ |

# CHAIN OF CUSTODY RECORD

STATE WHERE SAMPLE COLLECTED MO

*ALL HIGHLIGHTED AREAS MUST BE COMPLETED BY CLIENT (PLEASE PRINT)*

① CLIENT: SIKESTON BMU POWER STATION

PROJECT NUMBER:

PROJECT LOCATION: BOTTOM ASH TDS ONLY

PURCHASE ORDER #: 23573

ADDRESS: 1551 W WAKEFIELD

PHONE NUMBER: 573.475.3131

E-MAIL: LSTMARY@SBMU.NET

DATE SHIPPED: 4-9-2020

CITY STATE ZIP: SIKESTON, MO 63801

SAMPLER (PLEASE PRINT): Daniel Dillingham

CONTACT PERSON: LUKE ST MARY

SAMPLER'S SIGNATURE:

MATRIX TYPES:
WW- WASTEWATER
DW- DRINKING WATER
GW- GROUND WATER
WWSL- SLUDGE
NAS- NON AQUEOUS SOLID
LCHT-LEACHATE
OIL-OIL
SO-SOIL
SOL-SOLID

③ ANALYSIS REQUESTED

④ (FOR LAB USE ONLY)
LOGIN # 004275-03
LOGGED BY: DCW
CLIENT: SIKESTON BMU
PROJECT: BOTTOM ASH TDS ONLY
PROJ. MGR.: KURT
CUSTODY SEAL #:

| ② SAMPLE DESCRIPTION (UNIQUE DESCRIPTION AS IT WILL APPEAR ON THE ANALYTICAL REPORT) | DATE COLLECTED | TIME COLLECTED | SAMPLE TYPE GRAB | SAMPLE TYPE COMP | MATRIX TYPE | BOTTLE COUNT | PRES CODE CLIENT PROVIDED | TDS | | | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW-8 | 4/8/2020 | 1055 | X | | GW | 1 | | X | | | | | | |
| DUPLICATE WELL | 4/8/2020 | | X | | GW | 1 | | X | | | | | | |
| FIELD BLANK | 4/7/2020 | | X | | GW | 1 | | X | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |

| CHEMICAL PRESERVATION CODES: | 1 – HCL | 2 – H2SO4 | 3 – HNO3 | 4 – NAOH | 5 – NA2S2O3 | 6 – UNPRESERVED | 7 – OTHER |
|---|---|---|---|---|---|---|---|

⑤ TURNAROUND TIME REQUESTED (PLEASE CHECK) (RUSH TAT IS SUBJECT TO PDC LABS APPROVAL AND SURCHARGE) ☒ NORMAL ☐ RUSH

DATE RESULTS NEEDED

RUSH RESULTS VIA (PLEASE CIRCLE) EMAIL ☐ PHONE ☐

EMAIL IF DIFFERENT FROM ABOVE:

PHONE # IF DIFFERENT FROM ABOVE:

⑥ *I understand that by initialing this box I give the lab permission to proceed with analysis, even though it may not meet all sample conformance requirements as defined in the receiving facility's Sample Acceptance Policy and the data will be qualified. Qualified data may NOT be acceptable to report to all regulatory authorities.*

PROCEED WITH ANALYSIS AND QUALIFY RESULTS: (INITIALS) ________

| ⑦ RELINQUISHED BY: (SIGNATURE) | DATE 4-9-2020<br>TIME 0800 | RECEIVED BY: (SIGNATURE) | DATE<br>TIME |
|---|---|---|---|
| RELINQUISHED BY: (SIGNATURE) | DATE<br>TIME | RECEIVED BY: (SIGNATURE) | DATE<br>TIME |
| RELINQUISHED BY: (SIGNATURE) | DATE<br>TIME | RECEIVED BY: (SIGNATURE) DCW | DATE 4/10/20<br>TIME 1000 |

⑧ COMMENTS: (FOR LAB USE ONLY)

SAMPLE TEMPERATURE UPON RECEIPT 2.2 °C

CHILL PROCESS STARTED PRIOR TO RECEIPT [✓ Y] OR N

SAMPLE(S) RECEIVED ON ICE [✓ Y] OR N

SAMPLE ACCEPTANCE NONCONFORMANT REPORT IS NEEDED Y OR [✓ N]

DATE AND TIME TAKEN FROM SAMPLE BOTTLE ________

Qualtrax ID #3219

Page 1 of 1

# Sikeston Board of Municipal Utilities
# Sikeston Power Station
# Fly Ash Pond Scott County, Missouri
## CCR Groundwater Data Base

|  |  |  |  | Field Parameters |  |  |  |  |  | Appendix III Monitoring Constituents (Detection) |  |  |  |  |  | Appendix IV Monitoring Constituents (Assessment) |  |  |  |  |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Duplicate Collected? | Date | Monitoring Purpose | Spec. Cond. | pH | Temp. | ORP | D.O. | Turbidity | Chloride | Fluoride | Sulfate | TDS | Boron | Calcium | Antimony | Arsenic | Barium | Beryllium | Cadmium | Chromium | Cobalt | Lead | Lithium | Mercury | Molybdenum | Selenium | Thallium | Radium 226/228 (Combined) |
| ID |  |  |  | µmhos/cm | S.U. | °C | mV | mg/L | NTU | mg/L | mg/L | mg/L | mg/L | ug/L | mg/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | pCi/L |
| Federal MCL |  |  |  |  |  |  |  |  |  | None | 4.0 | None | None | None | None | 6 | 10 | 2000 | 4 | 5 | 100 | 6 | 15 | 40 | 2 | 100 | 50 | 2 | 5 |
| MW-1 (DG) |  | 3/21/2018 | Background | 249.6 | 7.3 | 16.33 | -108.8 | 0.32 | 28.35 | 3.0 | <0.250 | 22 | 150 | 360 | 21 | <3.0 | <1.0 | 120 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.353 (ND) |
|  |  | 4/15/2018 | Background | 233.8 | 7.4 | 15.17 | -122.7 | 0.60 | 14.46 | 2.8 | 0.316 | 22 | 120 | 450 | 29 | <3.0 | <1.0 | 120 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.478 (ND) |
|  |  | 5/23/2018 | Background | 220.0 | 7.4 | 18.42 | -133.3 | 0.54 | 12.11 | 3.3 | <0.250 | 20 | 140 | 420 | 25 | <3.0 | <1.0 | 120 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.378 (ND) |
|  |  | 6/27/2018 | Background | 227.4 | 7.3 | 18.59 | -149.3 | 0.30 | 11.07 | 6.9 | <0.250 | 20 | 120 | 470 | 28 | <3.0 | <1.0 | 140 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 1.065 (ND) |
|  |  | 8/1/2018 | Background | 264.3 | 7.2 | 18.26 | -138.0 | 0.56 | 7.52 | 5.6 | <0.250 | 23 | 190 | 440 | 30 | <3.0 | <1.0 | 140 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.893(ND) |
|  |  | 9/5/2018 | Background | 281.3 | 7.1 | 18.70 | -132.1 | 0.41 | 3.20 | 7.0 | 0.252 | 24 | 140 | 490 | 34 | <3.0 | <1.0 | 150 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 1.100 |
|  |  | 11/6/2018 | Background | 311.8 | 7.1 | 17.86 | -128.8 | 1.00 | 1.30 | 9.0 | 0.262 | 26 | 200 | 480 | 38 | <3.0 | <1.0 | 170 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 1.282 |
|  |  | 12/12/2018 | Background | 317.5 | 7.1 | 16.30 | -96.3 | 0.45 | 2.27 | 9.1 | 0.256 | 30 | 140 | 440 | 38 | <3.0 | <1.0 | 180 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 1.423 (ND) |
|  |  | 3/27/2019 | Detection 1 | 361.2 | 7.1 | 16.60 | -101.9 | 0.36 | 53.91 | 7.9 | <0.250 | 27 | 210 | 440 | 41 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
|  |  | 9/24/2019 | Detection 2 | 372.9 | 7.0 | 18.22 | -127.5 | 0.56 | 0.53 | 4.3 | 0.260 | 35 | 230 | 500 | 47 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
|  |  | 10/22/2019 | Det/RESAMPLE |  |  |  |  |  |  | NA | NA | 41/42 | 180/170 | NA | 47/49 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | 4/6/2020 | Detection 3 | 416.5 | 7.1 | 17.32 | -117.7 | 0.31 | 4.38 | 5.4 | 0.255 | 39 | 230 | 520 | 48 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | 5/21/2020 | Det/RESAMPLE | 524.7 | 7.2 | 16.56 | -125.2 | 3.25 | 3.32 |  |  | 63 | 260 |  | 60 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| MW-2 (UG) | Yes | 3/21/2018 | Background | 157.8 | 6.4 | 15.86 | 65.3 | 2.72 | 3.41 | 3.4 | <0.250 | 16 | 110 | 28 | 16 | <3.0 | <1.0 | 130 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.896 (ND) |
|  |  | 4/15/2018 | Background | 159.8 | 6.4 | 14.04 | 64.7 | 0.87 | 4.05 | 2.3 | 0.335 | 18 | 63 | 23 | 14 | <3.0 | <1.0 | 120 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.483 (ND) |
|  | Yes | 5/23/2018 | Background | 175.3 | 6.2 | 17.40 | 121.7 | 0.58 | 1.72 | 4.2 | <0.250 | 20 | 100 | 36 | 18 | <3.0 | <1.0 | 170 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 1.199 (ND) |
|  | Yes | 6/27/2018 | Background | 172.1 | 6.2 | 18.38 | 243.8 | 0.27 | 5.30 | 4.7 | <0.250 | 18 | 87 | 42 | 19 | <3.0 | <1.0 | 180 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | 1.4 | <1.0 | 1.006 (ND) |
|  | Yes | 8/1/2018 | Background | 184.2 | 6.1 | 18.48 | 80.7 | 0.75 | 2.61 | 5.9 | <0.250 | 19 | 140 | 43 | 20 | <3.0 | <1.0 | 200 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | 2.0 | <1.0 | 0.751(ND) |
|  |  | 9/5/2018 | Background | 187.9 | 6.1 | 19.26 | 83.8 | 0.68 | 2.58 | 6.8 | <0.250 | 18 | 110 | 46 | 22 | <3.0 | <1.0 | 220 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | 2.2 | <1.0 | 1.734 |
|  | Yes | 11/6/2018 | Background | 174.3 | 6.2 | 17.77 | 79.7 | 0.60 | 1.19 | 4.2 | 0.272 | 19 | 100 | 43 | 20 | <3.0 | <1.0 | 170 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 1.583 |
|  |  | 12/12/2018 | Background | 186.3 | 6.1 | 16.78 | 82.3 | 0.67 | 5.78 | 5.5 | 0.254 | 21 | 140 | 48 | 21 | <3.0 | <1.0 | 210 | <1.0 | <1.0 | <4.0 | 2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 1.18 (ND) |
|  | Yes | 3/27/2019 | Detection 1 | 165.9 | 6.3 | 15.87 | 70.4 | 0.72 | 2.60 | 3.3 | <0.250 | 20 | 130 | 31 | 17 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
|  | Yes | 9/24/2019 | Detection 2 | 189.4 | 6.1 | 18.75 | 71.3 | 0.61 | 1.16 | 6.6 | <0.250 | 17 | 130 | 58 | 22 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
|  | Yes | 4/6/2020 | Detection 3 | 148.7 | 6.3 | 16.04 | 58.2 | 1.36 | 4.70 | 2.1/2.0 | 0.336/0.287 | 16/16 | 140/160 | 34/80 | 15/15 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | 5/21/2020 | Det/RESAMPLE | 168.1 | 6.2 | 16.47 | -0.8 | 6.90 | 2.76 |  | 0.374 | 16 | 100 | 36 | 18 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| MW-3 (UG) |  | 3/21/2018 | Background | 220.7 | 6.6 | 15.22 | 40.7 | 0.38 | 14.88 | 1.4 | 0.274 | 18 | 120 | 17 | 19 | <3.0 | <1.0 | 96 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 1.240 (ND) |
|  |  | 4/15/2018 | Background | 224.7 | 6.5 | 14.05 | 39.2 | 0.45 | 10.81 | 1.5 | 0.386 | 20 | 120 | 25 | 18 | <3.0 | <1.0 | 100 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 1.475 (ND) |
|  |  | 5/23/2018 | Background | 221.3 | 6.5 | 17.77 | 43.2 | 0.39 | 13.39 | 1.4 | <0.250 | 20 | 100 | 20 | 18 | <3.0 | <1.0 | 100 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.994 (ND) |
|  |  | 6/27/2018 | Background | 198.7 | 6.5 | 17.81 | 123.8 | 0.45 | 17.03 | 1.2 | <0.250 | 17 | 110 | 27 | 18 | <3.0 | <1.0 | 100 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.214 (ND) |
|  |  | 8/1/2018 | Background | 209.2 | 6.6 | 16.74 | 41.4 | 0.43 | 10.96 | 1.3 | <0.250 | 17 | 150 | 21 | 18 | <3.0 | <1.0 | 91 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.315(ND) |
|  |  | 9/5/2018 | Background | 196.8 | 6.5 | 17.62 | 56.8 | 0.46 | 6.21 | 1.2 | 0.308 | 15 | 100 | 22 | 17 | <3.0 | <1.0 | 98 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.860(ND) |
|  |  | 11/6/2018 | Background | 206.7 | 6.5 | 16.84 | 63.3 | 0.49 | 2.37 | 1.3 | 0.313 | 16 | 130 | 26 | 17 | <3.0 | <1.0 | 100 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 1.339 |
|  |  | 12/12/2018 | Background | 195.6 | 6.5 | 15.39 | 48.7 | 0.40 | 3.10 | 1.4 | 0.334 | 18 | 160 | 28 | 17 | <3.0 | <1.0 | 99 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | <10 | <0.20 | <1.0 | <1.0 | <1.0 | 0.8 (ND) |
|  |  | 3/27/2019 | Detection 1 | 196.0 | 6.4 | 15.07 | 52.2 | 0.84 | 12.50 | 1.5 | <0.250 | 19 | 140 | 22 | 16 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
|  |  | 9/24/2019 | Detection 2 | 191.4 | 6.5 | 17.07 | 58.1 | 0.53 | 2.28 | 1.2 | 0.332 | 16 | 130 | 26 | 17 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
|  |  | 4/6/2020 | Detection 3 | 198.4 | 6.4 | 14.94 | 61.3 | 1.17 | 7.37 | 1.8 | 0.371 | 20 | 380 | 29 | 16 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | 5/21/2020 | Det/RESAMPLE | 205.5 | 6.4 | 15.25 | 14.9 | 13.48 | 7.29 | 1.5 |  |  | 130 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

# Sikeston Board of Municipal Utilities
# Sikeston Power Station
# Fly Ash Pond Scott County, Missouri
## CCR Groundwater Data Base

| | | | | Field Parameters | | | | | | Appendix III Monitoring Constituents (Detection) | | | | | | Appendix IV Monitoring Constituents (Assessment) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | Duplicate Collected? | Date | Monitoring Purpose | Spec. Cond. | pH | Temp. | ORP | D.O. | Turbidity | Chloride | Fluoride | Sulfate | TDS | Boron | Calcium | Antimony | Arsenic | Barium | Beryllium | Cadmium | Chromium | Cobalt | Lead | Lithium | Mercury | Molybdenum | Selenium | Thallium | Radium 226/228 (Combined) |
| ID | | | | μmhos/cm | S.U. | °C | mV | mg/L | NTU | mg/L | mg/L | mg/L | mg/L | ug/L | mg/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | pCi/L |
| Federal MCL | | | | | | | | | | None | 4.0 | None | None | None | None | 6 | 10 | 2000 | 4 | 5 | 100 | 6 | 15 | 40 | 2 | 100 | 50 | 2 | 5 |
| MW-7 (DG) | | 3/21/2018 | Background | 901.8 | 7.3 | 14.85 | 41.8 | 0.58 | 1.61 | 12 | 0.752 | 190 | 440 | 1900 | 110 | <3.0 | <1.0 | 41 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | 25 | <0.20 | 160 | 5.4 | <1.0 | 0.883 (ND) |
| | Yes | 4/15/2018 | Background | 936.4 | 7.2 | 14.04 | 40.0 | 0.51 | 0.96 | 12 | 0.794 | 210 | 420 | 1900 | 110 | <3.0 | <1.0 | 43 | <1.0 | <1.0 | <4.0 | 2.0 | <1.0 | 19 | <0.20 | 170 | 2.3 | <1.0 | 0.0619 (ND) |
| | | 5/23/2018 | Background | 899.1 | 7.3 | 18.05 | 46.5 | 0.38 | 0.25 | 11 | 0.650 | 220 | 480 | 1800 | 120 | <3.0 | <1.0 | 44 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | 22 | <0.20 | 170 | 28 | <1.0 | 0.896 (ND) |
| | | 6/27/2018 | Background | 891.4 | 7.2 | 17.91 | 66.4 | 0.22 | 5.84 | 11 | 0.592 | 220 | 500 | 2000 | 140 | <3.0 | <1.0 | 48 | <1.0 | <1.0 | <4.0 | 2.1 | <1.0 | 26 | <0.20 | 160 | 53 | <1.0 | 1.153 (ND) |
| | | 8/1/2018 | Background | 958.3 | 7.2 | 18.03 | 53.0 | 0.28 | 1.77 | 9.1 | 0.608 | 230 | 590 | 2300 | 140 | <3.0 | <1.0 | 47 | <1.0 | <1.0 | <4.0 | 2.2 | <1.0 | 30 | <0.20 | 160 | 54 | <1.0 | 0.884(ND) |
| | Yes | 9/5/2018 | Background | 873.3 | 7.3 | 19.46 | 69.3 | 0.28 | 2.29 | 10 | 0.700 | 220 | 520 | 2100 | 130 | <3.0 | <1.0 | 47 | <1.0 | <1.0 | <4.0 | 2.0 | <1.0 | 27 | <0.20 | 150 | 42 | <1.0 | 0.652(ND) |
| | | 11/6/2018 | Background | 787.9 | 7.4 | 18.12 | 344.4 | 0.44 | 0.44 | 6.3 | 0.693 | 170 | 450 | 2000 | 120 | <3.0 | <1.0 | 43 | <1.0 | <1.0 | <4.0 | 2.0 | <1.0 | 26 | <0.20 | 150 | 15 | <1.0 | 1.478 |
| | Yes | 12/12/2018 | Background | 784.8 | 7.3 | 17.26 | 51.6 | 1.05 | 0.41 | 6.8 | 0.746 | 180 | 440 | 1800 | 120 | <3.0 | <1.0 | 44 | <1.0 | <1.0 | <4.0 | 2.1 | <1.0 | 26 | <0.20 | 150 | 11 | <1.0 | 0.975 (ND) |
| | | 3/27/2019 | Detection 1 | 797.4 | 7.3 | 16.39 | 52.6 | 0.32 | 2.37 | 6.6 | 0.670 | 170 | 480 | 1800 | 110 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| | | 9/24/2019 | Detection 2 | 751.7 | 7.3 | 18.88 | 119.0 | 0.31 | 0.59 | 3.9 | 0.684 | 150 | 470 | 1900 | 120 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| | | 4/6/2020 | Detection 3 | 865.6 | 7.2 | 16.34 | 68.3 | 0.24 | 1.62 | 4.0 | 0.737 | 200 | 540 | 2200 | 120 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MW-9 (DG) | | 3/21/2018 | Background | 979.8 | 7.4 | 14.98 | 25.1 | 0.52 | 1.60 | 17 | 0.929 | 230 | 480 | 4700 | 65 | <3.0 | <1.0 | 49 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | 19 | <0.20 | 630 | <1.0 | <1.0 | 0.491 (ND) |
| | | 4/15/2018 | Background | 972.7 | 7.4 | 14.63 | 24.9 | 1.73 | 2.32 | 21 | 1.09 | 240 | 460 | 5100 | 57 | <3.0 | 1.2 | 49 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | 11 | <0.20 | 680 | <1.0 | <1.0 | 0.982 (ND) |
| | | 5/23/2018 | Background | 1020.5 | 7.3 | 18.70 | 25.9 | 0.48 | 0.64 | 17 | 1.05 | 240 | 520 | 5800 | 55 | <3.0 | <1.0 | 45 | <1.0 | <1.0 | 8.1 | <2.0 | <1.0 | 15 | <0.20 | 840 | <1.0 | <1.0 | 0.359 (ND) |
| | | 6/27/2018 | Background | 902.9 | 7.3 | 19.33 | 25.2 | 0.42 | 4.97 | 15 | 0.910 | 220 | 520 | 4600 | 73 | <3.0 | <1.0 | 47 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | 15 | <0.20 | 560 | <1.0 | <1.0 | 0.327 (ND) |
| | | 8/1/2018 | Background | 942.6 | 7.3 | 19.10 | 20.7 | 0.47 | 2.03 | 16 | 0.916 | 220 | 560 | 4500 | 76 | <3.0 | <1.0 | 47 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | 18 | <0.20 | 500 | <1.0 | <1.0 | 0.418(ND) |
| | | 9/5/2018 | Background | 829.2 | 7.3 | 19.85 | 20.9 | 0.45 | 2.68 | 16 | 0.957 | 180 | 420 | 4400 | 80 | <3.0 | <1.0 | 48 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | 17 | <0.20 | 460 | <1.0 | <1.0 | 0.707(ND) |
| | | 11/6/2018 | Background | 732.8 | 7.3 | 18.19 | 428.8 | 0.60 | 0.45 | 11 | 0.885 | 130 | 410 | 3800 | 79 | <3.0 | <1.0 | 47 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | 13 | <0.20 | 420 | <1.0 | <1.0 | 1.473(ND) |
| | | 12/12/2018 | Background | 742.9 | 7.3 | 16.95 | 36.5 | 0.48 | 0.63 | 12 | 0.972 | 170 | 360 | 3700 | 78 | <3.0 | <1.0 | 53 | <1.0 | <1.0 | <4.0 | <2.0 | <1.0 | 17 | <0.20 | 420 | <1.0 | <1.0 | 1.232 (ND) |
| | | 3/27/2019 | Detection 1 | 673.2 | 7.4 | 16.74 | 22.1 | 0.51 | 0.96 | 11 | 0.827 | 120 | 440 | 3100 | 70 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| | | 9/24/2019 | Detection 2 | 891.5 | 7.4 | 19.25 | 38.3 | 0.41 | 0.62 | 16 | 0.847 | 220 | 540 | 5000 | 87 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| | | 4/6/2020 | Detection 3 | 967.5 | 7.3 | 17.60 | 61.6 | 0.34 | 0.92 | 18 | 0.816 | 250 | 840 | 4900 | 92 | | | | | | | | | | | | | | |
| | | 5/21/2020 | Det/RESAMPLE | 1024.4 | 7.4 | 17.09 | -51.1 | 4.95 | 0.59 | | | | 560 | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Notes:

1. All data transcribed from analytical lab data sheets or field notes.
2. Less than (<) symbol denotes concentration not detected at or above reportable limits. Bold values indicate analyte detected above reporting limit.
3. (ND) denotes Radium 226 and 228 (combined) concentration not detected above minimum detectable concentration.
4. (NA) denotes analysis not conducted, or not available at time of report.
5. Background monitoring per USEPA 40 CFR 257.93.
6. Detection monitoring per USEPA 40 CFR 257.94.
7. Assessment monitoring per USEPA 40 CFR 257.95.
8. Federal MCL = Maximum Contaminant Level per CFR 40 Subchapter D Part 141 subpart G Section 141.62 & 141.66, or Part 257 subpart D Section 257.95(h)(2).
9. Radium 226/228 combined assumes a concentration of 0 for negative values reported. Negative values indicated in red with parentheses.
10. Laboratory Qualifiers

Q4 = The matrix spike recovery result is unusable since the analyte concentration in the sample is greater than four times the spike level. The associated blank spike was acceptable.
X = Manual integration.
H = Hold time exceeded.

1505 East High Street
Jefferson City, Missouri 65101
Telephone (573) 659-9078
www.ger-inc.biz

**GREDELL Engineering Resources, Inc.**

# Sikeston Board of Municipal Utilities Sikeston Power Station Detection Monitoring Program for Fly Ash Pond – Calcium, Sulfate, and Total Dissolved Solids in MW-1 Alternate Source Demonstration

*Prepared for:*

BMU Sikeston
Board of Municipal Utilities

**Sikeston Power Station**
**1551 West Wakefield Avenue**
**Sikeston, MO 63801**

STATE OF MISSOURI
THOMAS R. GREDELL
9-11-2020
NUMBER
PE-021137
PROFESSIONAL ENGINEER

STATE OF MISSOURI
MIKEL C. CARLSON
9-11-20
RG 0126
REGISTERED GEOLOGIST

September 2020

# PROFESSIONAL ENGINEER'S CERTIFICATION

40 CFR 257.94(e)(2) Alternate Source Demonstration

I, Thomas R. Gredell, P.E., a professional engineer licensed in the State of Missouri, hereby certify in accordance with 40 CFR 257.94(e)(2) to the accuracy of the alternate source demonstration described in the following report for the Sikeston Board of Municipal Utilities, Sikeston Power Station, Fly Ash Pond CCR unit. The report demonstrates that the statistically significant increases of sulfate, total dissolved solids, and calcium in MW-1 resulted from a source other than the CCR unit. This demonstration successfully meets the requirements of 40 CFR 257.94(e) as found in federal regulation 40 CFR 257, Subpart D – Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments. In addition, the demonstration was made using generally accepted methods.

Name: Thomas R. Gredell, P.E.

Signature: Thomas R Gredell

Date: 9-11-2020

Registration Number: PE-021137
State of Registration: Missouri

THOMAS R.
GREDELL
NUMBER
PE-021137

# Sikeston Board of Municipal Utilities
# Sikeston Power Station
# Detection Monitoring Program for Fly Ash Pond – Calcium, Sulfate, and Total Dissolved Solids in MW-1
# Alternate Source Demonstration

**September 2020**

## Table of Contents

## List of Figures

## List of Tables

# 1.0 INTRODUCTION

This Alternate Source Demonstration Report has been prepared to address the results of the semi-annual sampling event initiated on April 6, 2020 at the Sikeston Board of Municipal Utilities (SBMU) Sikeston Power Station's (SPS) Fly Ash Pond, a coal combustion residual (CCR) surface impoundment. Following receipt of final analytical data, statistical analysis was performed by GREDELL Engineering Resources, Inc. (Gredell Engineering) for the parameters listed in Appendix III to Part 257 – Constituents for Detection Monitoring. Following this analysis, it was determined that several reported concentrations exceeded their respective prediction limits for the well constituent pairs. These well constituent pairs were; Calcium, Sulfate, and Total Dissolved Solids (TDS) in sample MW-1, Fluoride in sample MW-2, Chloride and Boron in sample MW-3, and TDS in sample MW-9. Resampling for these well constituent pairs, and Boron in MW-2, was conducted on May 21, 2020. Following receipt of final analytical data from the resampling event, it was confirmed that Calcium, Sulfate, and TDS concentrations in sample MW-1, and Fluoride in sample MW-2 represent statistically significant increases (SSIs). As a consequence, SBMU-SPS requested that Gredell Engineering conduct an evaluation of the analytical results and develop an Alternate Source Demonstration (ASD) if warranted for Calcium, Sulfate, and TDS in MW-1. Fluoride in MW-2 is the subject of a separate report. Chloride and Boron in sample MW-3, and TDS in sample MW-9 were not confirmed by resampling and therefore are not SSIs.

As stated in §257.94(e)(2), an owner or operator may demonstrate that a source other than the CCR unit caused the apparent SSI over background levels for a constituent. The owner or operator must complete the written demonstration within 90 days of detecting an apparent SSI over background levels to include obtaining a certification from a qualified professional engineer verifying the accuracy of the information in the report. If a successful demonstration is completed within the 90-day period, the owner of the CCR unit may continue with a detection monitoring program. The owner or operator must also include the certified demonstration in the annual groundwater monitoring and corrective action report required by §257.90(e).

Gredell Engineering has completed an evaluation of the groundwater sampling event, analytical data results, and other potential factors, for the SBMU SPS Fly Ash Pond groundwater monitoring well system to determine if an alternate source is the cause of the apparent SSIs in MW-1. This report presents the results of that evaluation and includes supporting documentation.

## 2.0 OBSERVATIONS AND DATA COLLECTION

The Fly Ash Pond groundwater monitoring well system consists of five wells, designated MW-1, MW-2, MW-3, MW-7, and MW-9 (Figure 1). Monitoring wells MW-1, MW-2, and MW-3 were installed in April 2016. Monitoring well MW-7 was installed in April 2017. Monitoring well MW-9 was installed in November 2017. All five monitoring wells were sampled on an approximate monthly basis beginning in March 2018 and ending in December 2018 to establish a background data base. Additional information regarding these wells is available in the Groundwater Monitoring, Sampling and Analysis Plan for the site (Gredell Engineering, 2018).

The results of the eight independent background sampling events were evaluated in accordance with §257.93, and intra-well analysis using prediction limits was selected as the statistical analysis approach for detection monitoring (Gredell Engineering, 2018). Following receipt of final analytical data reports from the contract laboratory, the reported concentration for each detection monitoring constituent from each well is compared to its respective prediction limit. If a concentration exceeds the respective prediction limit for a particular constituent well pair, or is outside the predicted range (in the case of pH), SSI over background is suspected.

Monitoring well MW-1 is located west of the Fly Ash Pond and within the containment area of the coal storage area (Figure 1). The well is situated between the north edge of the coal pile and the coal pile runoff diversion ditch. MW-1 was originally installed in April 2016 as a piezometer for the hydrogeologic characterization of the uppermost aquifer flowing beneath the Fly Ash and Bottom Ash Ponds at the site (Gredell Engineering, 2017). This piezometer was converted to a downgradient monitoring well and retained for routine groundwater elevation monitoring and NPDES compliance sampling. Additional sampling locations were proposed, and two additional downgradient wells (MW-7 and MW-9) were installed for Fly Ash Pond monitoring in April 2017 and November 2017, respectively. Groundwater elevation monitoring since 2016 has consistently demonstrated that flow direction is to the west-southwest, as indicated on Figure 1.

The April 6, 2020 detection monitoring event was preceded by abnormally heavy precipitation during the months of January (5.32 inches), February (6.92 inches), and March (8.24 inches). The effects of this heavy precipitation on the local water table are apparent on Figure 2, which is a hydrograph of groundwater elevations in MW-1 overlaid on a bar graph of total annual precipitation for January 1, 2016 through May 31, 2020 (obtained from National Oceanic & Atmospheric Administration Station: Sikeston Power Station, MO US GHCND: US00237772). Note that the estimated annual precipitation plotted for 2020 (71.35 inches) is an extrapolation based on the precipitation received from January through May, 2020 In 2019, the SPS experienced a 30 to 45 percent increase in precipitation relative to the previous three years (2018, 44.39 inches; 2017, 39.78 inches, and; 2016, 41.50 inches. However, the total precipitation in 2020 as of May 31st (29.73 inches) represents an additional 3 percent increase over 2019 (28.75 inches in the same period). This abnormally heavy precipitation is manifested on the hydrograph (Figure 2) by April and May groundwater elevations in MW-1 that exceed all previously recorded measurements.

During periods of abnormally heavy rainfall, infiltration to an aquifer is increased and groundwater mounding may result. Rainfall that exceeds the infiltration capacity becomes surface runoff. Within the coal storage area, this surface runoff moves toward the unlined perimeter diversion ditch (Figure 1). Runoff concentrates in this unlined diversion and flows counterclockwise around the coal storage area within close proximity to MW-1. Because the diversion is unlined, additional infiltration and aquifer recharge is expected to occur. The excessive runoff in 2020 is illustrated by the photographs presented as Figures 3 and 4. They show considerable coal sediment in the diversion ditch, which is not apparent in a photograph dating from November 2017 (Figure 5), nor was it apparent during other field activities conducted by Gredell Engineering in 2016 through 2018.

The analytical data for Calcium, Sulfate, and TDS in MW-1 for the April sampling event, and subsequent resampling data are summarized on Table 1.

**Table 1 - MW-1 Detection Monitoring Results and Prediction Limits**

| | Calcium (mg/L) | Sulfate (mg/L) | TDS (mg/L) |
|---|---|---|---|
| Detection Sampling 4-6-2020 | 48 | 39 | 230 |
| Resample 5-21-20 | 60 | 63 | 260 |
| Prediction Limit | 45.18 | 31.57 | 223.2 |

Calcium, Sulfate, and TDS concentrations in the MW-1 sample from the April sampling event exceeded their respective prediction limits, as documented in the 2020 Annual Groundwater Monitoring Report, dated **August** 2020, and posted in the SPS operating record in compliance with USEPA Part 257.90(e) (Gredell Engineering, 2020). In May, a resampling event was conducted and, following receipt of final analytical data on June 15th, the apparent SSIs for Calcium, Sulfate, and TDS in the MW-1 sample were confirmed.

During the preparation of a previous alternate source demonstration for MW-1, additional sampling was conducted in February 2020 (Figure 1). Two temporary borings (ASD-1 and ASD-2) were advanced along the margin of the existing coal pile to allow sampling of the shallow groundwater between the coal pile and the underlying aquifer. Groundwater was also sampled at MW-1, along with a surface water sample collected from the Fly Ash Pond (FAP-SW). Each sample was analyzed for major anions and cations to conduct geochemical analysis. A Piper Trilinear Plot (Piper, 1944) was developed with Sanitas$^{TM}$ Water (Version 9.6.24; 2019) to identify similarities/variations in hydrochemical facies (Freeze and Cherry, 1979). The reported concentrations are summarized on Table 2. These data were used to evaluate geochemical relationships between the samples with the objective of identifying the most plausible source for the apparent SSIs at MW-1.

**Table 2 - Alternate Source Demonstration Sampling Results Summary February 2020**

| | ASD-1 | ASD-2 | MW-1 | FAP-SW |
|---|---|---|---|---|
| Calcium (mg/L) | 79.1 | 120 | 43.0 | 18.4 |
| Sulfate (mg/L) | 151 | 152 | 25 | 21 |
| TDS (mg/L) | 860 | 700 | 170 | 175 |
| Magnesium (mg/L) | 28.7 | 27.4 | 9.06 | 4.96 |
| Potassium (mg/L) | 9.74 | 9.46 | 1.72 | 18.7 |
| Sodium (mg/L) | 151 | 135 | 7.40 | 36.7 |
| Bicarbonate (mg/L) | 350 | 508 | 128 | 172 |
| Carbonate (mg/L) | 0 | 0 | 0 | 0 |
| Chloride (mg/L) | 35 | 20 | 5 | 5 |

# 3.0 SUMMARY OF DATA ANALYSIS AND FINDINGS

The U.S. Environmental Protection Agency (USEPA) provides Unified Guidance for statistical analysis of groundwater monitoring data (USEPA, 2009). This Unified Guidance was reviewed to assess the validity of the apparent SSIs. Chapter 4 of the Unified Guidance discusses groundwater monitoring programs and statistical analysis of the associated data. A key component of statistical analysis is "*to determine whether or not the increase is actually due to a contaminant release*". The following discussion is intended to assess the validity of apparent SSIs of Calcium, Sulfate, and TDS associated with MW-1 and demonstrate if they are the result of a contaminant release from the Fly Ash Pond or caused by an alternate source.

A release from a plausible source will contribute water with elevated concentrations of indicator constituents to the aquifer, where it mixes with, and is diluted by, the natural (un-impacted) groundwater, which is characterized by relatively low (background) concentrations of these indicator constituents. The data summarized in Table 2 demonstrate that the concentrations of Calcium, Sulfate, and TDS in samples collected from ASD-1 and ASD-2 are at least four times greater than reported for the sample from the Fly Ash Pond, and considerably higher than the sample from MW-1. This suggests that water from the coal storage area is a more plausible source for these constituents in MW-1 than water derived from the Fly Ash Pond.

The area of change in groundwater geochemistry as it flows away from a source is referred to as a mixing zone. A Piper Trilinear Plot is a common and convenient tool for showing the effects of mixing waters. The mixing zone will plot on a straight line joining the source to the receiving water (Freeze and Cherry, 1979).

The cation/anion data in Table 2 was used to produce the Piper Trilinear Plot in Figure 6. The concentrations presented in Table 2 for each constituent are first converted from mg/L to milliequivalents per liter (mEq/L) through a calculation based on their valence charge and molecular weight. The concentrations of these major anions and cations in mEq/L are then expressed in relative percentages on the trilinear plot to assess the geochemistry of the sample. Hydrochemical facies can be assessed based on the location of each point, or cluster of points, on the Piper Trilinear Plot.

Major anion data are summarized by the triangular plot on the right side of Figure 6, which indicates that all samples plot in a similar area or facies, with separation owing to minor differences in Bicarbonate concentrations (Carbonate was absent in all samples). Most notable, however, is that the anion fingerprint in MW-1 is more similar to ASD-1 and ASD-2 than it is to the sample from the Fly Ash Pond. The triangular plot on the left side summarizes the major cation data and indicates that the samples cluster in three different areas or facies (MW-1 in "Calcium-type", FAP-SW in "Sodium- or Potassium-type", and ASD-1 and ASD-2 in "No dominant type" (Freeze and Cherry, 1979)). The anion and cation data can be considered collectively with the diamond portion of the Piper Trilinear Plot to assess if all samples plot collinearly.

The Piper Trilinear Plot suggests three separate geochemical populations defined by the samples from the coal storage area (ASD-1 and ASD-2), the Fly Ash Pond (FAP-SW), and MW-1. A sample from a chemical source should plot collinear with samples associated with the mixing zone. ASD-1 and ASD-2 plot closer to MW-1 and are therefore more geochemically similar to MW-1. Conversely FAP-SW plots farther from MW-1 and is less geochemically similar to MW-1. Additionally, FAP-SW plots along a different straight line with MW-1 than ASD-1 and ASD-2. The hydrograph for MW-1 and annual precipitation data summarized on Figure 2 demonstrate that 2019 was considerably wetter than the previous three years, and 2020 is on pace to be even wetter than 2019. Moreover, this abnormal precipitation led to excessive runoff and sedimentation from the stockpiled coal into the perimeter diversion that flows near MW-1, as presented in Figures 1, 3, and 4. A photograph of the same area taken in November 2017 (Figure 5) shows no excessive sedimentation, suggesting that the atypically heavy precipitation is a changed condition resulting in increased infiltration of coal-impacted surface water downward into the groundwater environment.

# 4.0 CONCLUSIONS AND RECOMMENDATIONS

On the basis of the data presented in this demonstration, Gredell Engineering concludes that the apparent SSIs of Calcium, Sulfate, and TDS in MW-1, detected following the April 6, 2020 sampling event, are attributable to an alternate source originating in the coal storage area and not evidence of a release from the Fly Ash Pond. The following supports this conclusion:

- Groundwater samples collected from ASD-1 and ASD-2 in the coal storage area have elevated concentrations of Calcium, Sulfate, and TDS relative to MW-1 and the Fly Ash Pond.
- Calcium, Sulfate, and TDS concentrations derived from the Fly Ash Pond are not high enough to be mixed with (and diluted by) natural (un-impacted) groundwater and exceed their respective prediction limits for MW-1.
- Piper Trilinear Plot analysis demonstrates that groundwater from MW-1 is geochemically more similar to groundwater under the coal storage area than water in the Fly Ash Pond, and the groundwater under the coal storage area represents a different mixing zone than would result from waters in the Fly Ash Pond.
- Higher than normal precipitation preceding the groundwater monitoring resulted in excessive runoff from the coal storage area that was conveyed as surface runoff into the unlined diversion ditch that lies in close proximity to MW-1. This excessive runoff and coal sedimentation increases the likelihood that infiltration of coal impacted surface water into the groundwater environment had a deleterious effect on the sample results from MW-1. The abnormal precipitation and excessive runoff is viewed as a temporary changed condition, as evidenced by a comparison of the photographs of the perimeter diversion ditch presented as Figures 3, 4, and 5.

Based on these conclusions, Gredell Engineering recommends that semi-annual detection monitoring continue in accordance with §257.94. As subsequent analytical results are received for Calcium, Sulfate, and TDS concentrations in MW-1, they should be reviewed and appropriate steps taken if prediction limit values continue to be exceeded. Periodic inspection and maintenance of the diversion ditch enclosing the coal storage area would ensure excess sediment from the coal stockpiles is removed.

# 5.0 LIMITATIONS

This report has been prepared for the exclusive use of the client and GREDELL Engineering Resources, Inc. for the specific project discussed in accordance with generally accepted environmental practices common to this locale at this time. The report is applicable only to this specific project and identified site conditions as they existed at the time of report preparation. The use of this report by others to develop independent interpretations of data or conclusions not explicitly stated in this report are the sole responsibility of those firms or individuals.

This report is not a guarantee of subsurface conditions. Variations in subsurface conditions may be present that were not identified during this or previous investigations. Interpretations of data and recommendations made in this report are based on observations of data that were available and referred to in this report unless otherwise noted. No other warranties, expressed or implied, are provided.

# 6.0 REFERENCES

Freeze, R.A. and Cherry J.A., 1979, *Groundwater*: Prentice-Hall, Inc. Englewood Cliffs, New Jersey, 604 p.

GREDELL Engineering Resources, Inc., 2017, Sikeston Power Station Site Characterization for Compliance with Missouri State Operating Permit #MO-0095575. Prepared for Sikeston Board of Municipal Utilities, May 31, 2017.

GREDELL Engineering Resources, Inc., 2020, Sikeston Power Station 2020 Annual Groundwater Monitoring Report for Fly Ash Pond for Compliance with USEPA 40 CFR 257.90(e). Prepared for Sikeston Board of Municipal Utilities, August 2020.

Piper, A. M., 1944. A Graphical Procedure in the Geochemical Interpretation of Water Analyses. Trans. Amer. Geophys. Union, 25, pp 914-923.

Sanitas Statistical Software, © 1992-2019 SANITAS TECHNOLOGIES, Alamosa Colorado 81101-0012.

USEPA, 2009, Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance: EPA 530/R-09-007, Office of Resource Conservation and Recovery, Program Implementation and Information Division, Washington, D.C.

# Figures

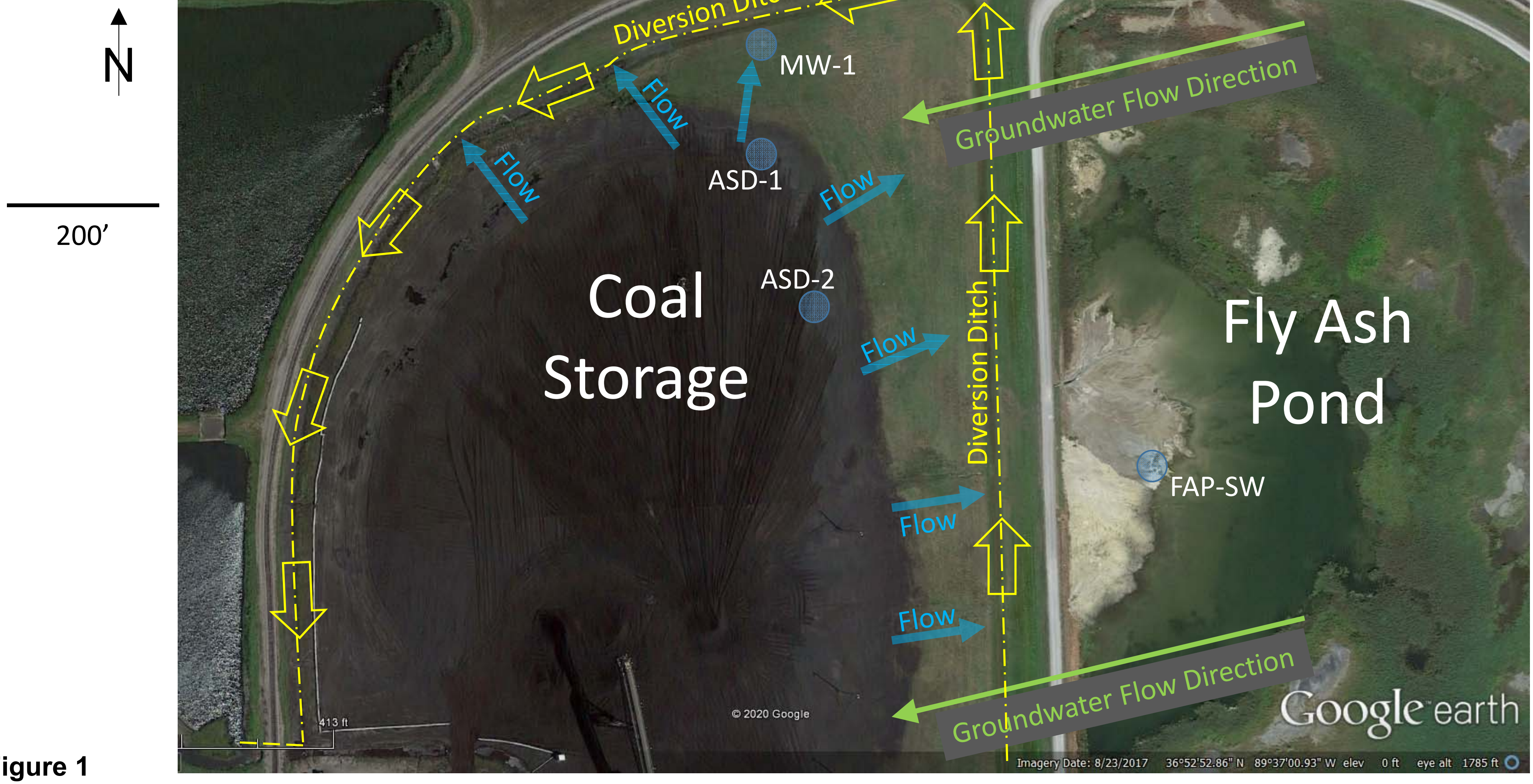


**Figure 1**
Site Map and Sampling Locations

Prepared by: GREDELL Engineering Resources, Inc.

**Notes:**

1. MW-1 groundwater elevations do not indicate sampling occurred.
2. 2020 annual precipitation extrapolated based on rainfall as of 5-31-2020.

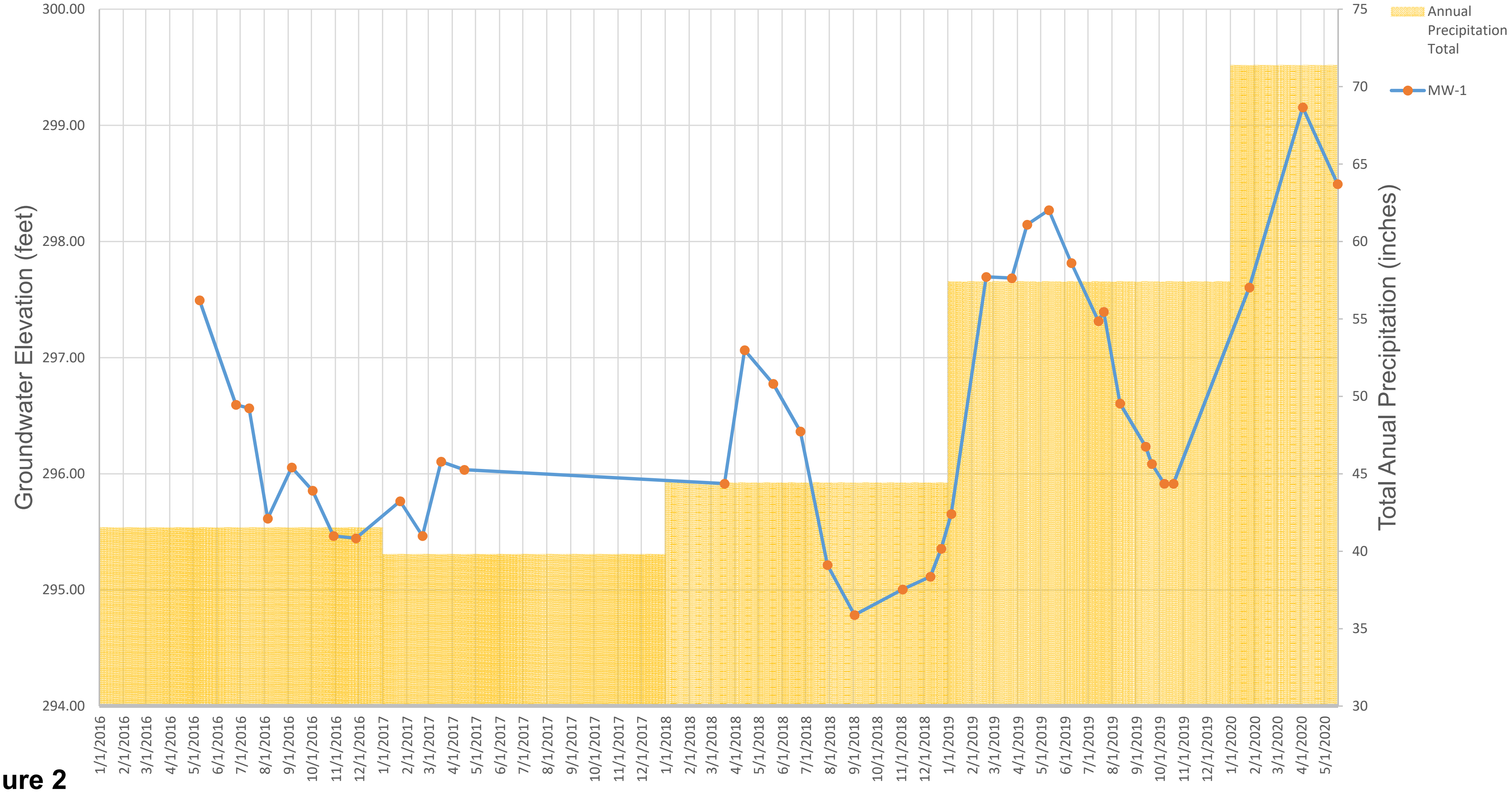


**Figure 2**

MW-1 Hydrograph and Annual Precipitation

Prepared by: GREDELL Engineering Resources, Inc.

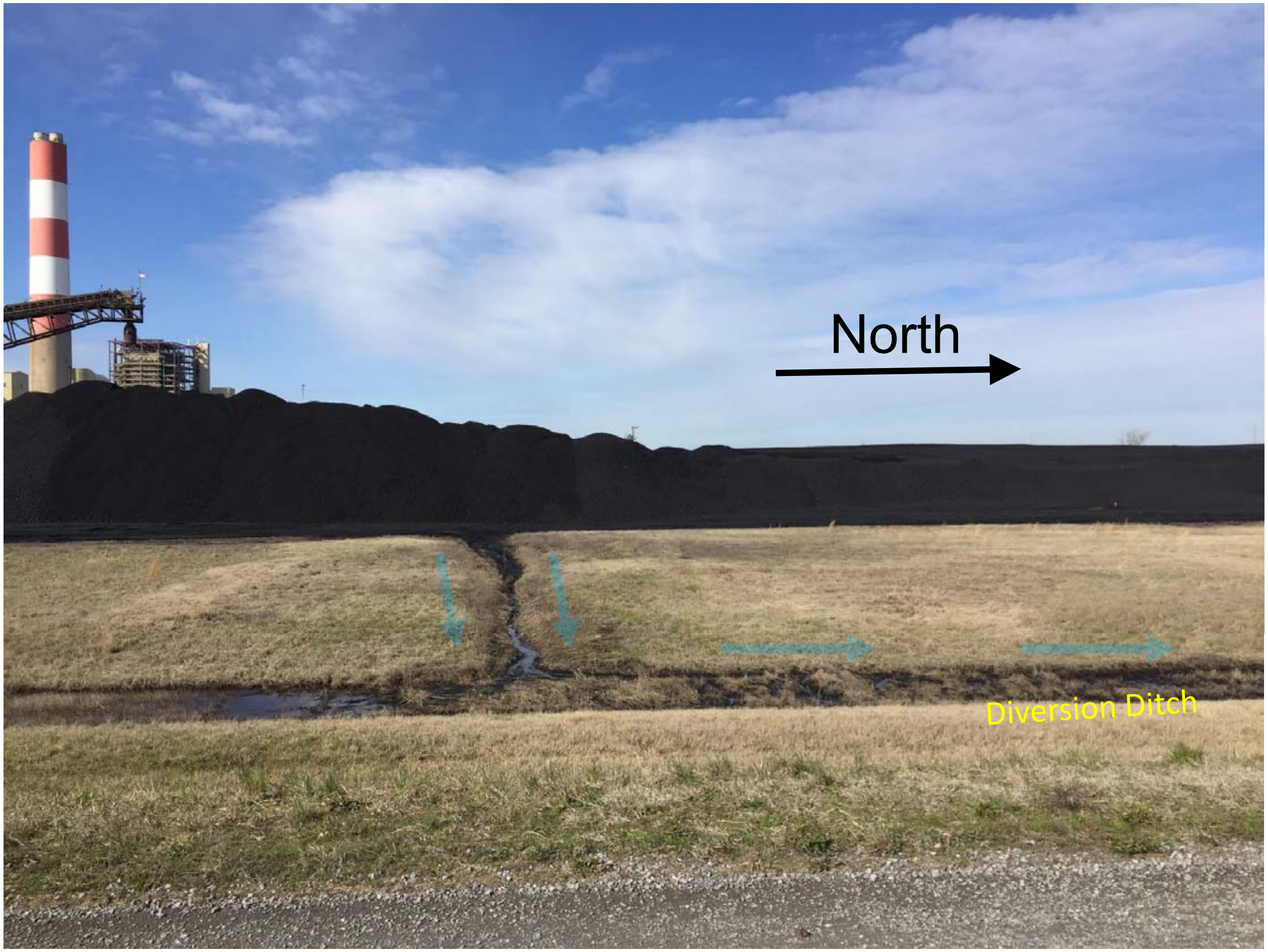


**Figure 3**
Diversion Ditch Photo February 2020 - Looking West

Prepared by: GREDELL Engineering Resources, Inc.

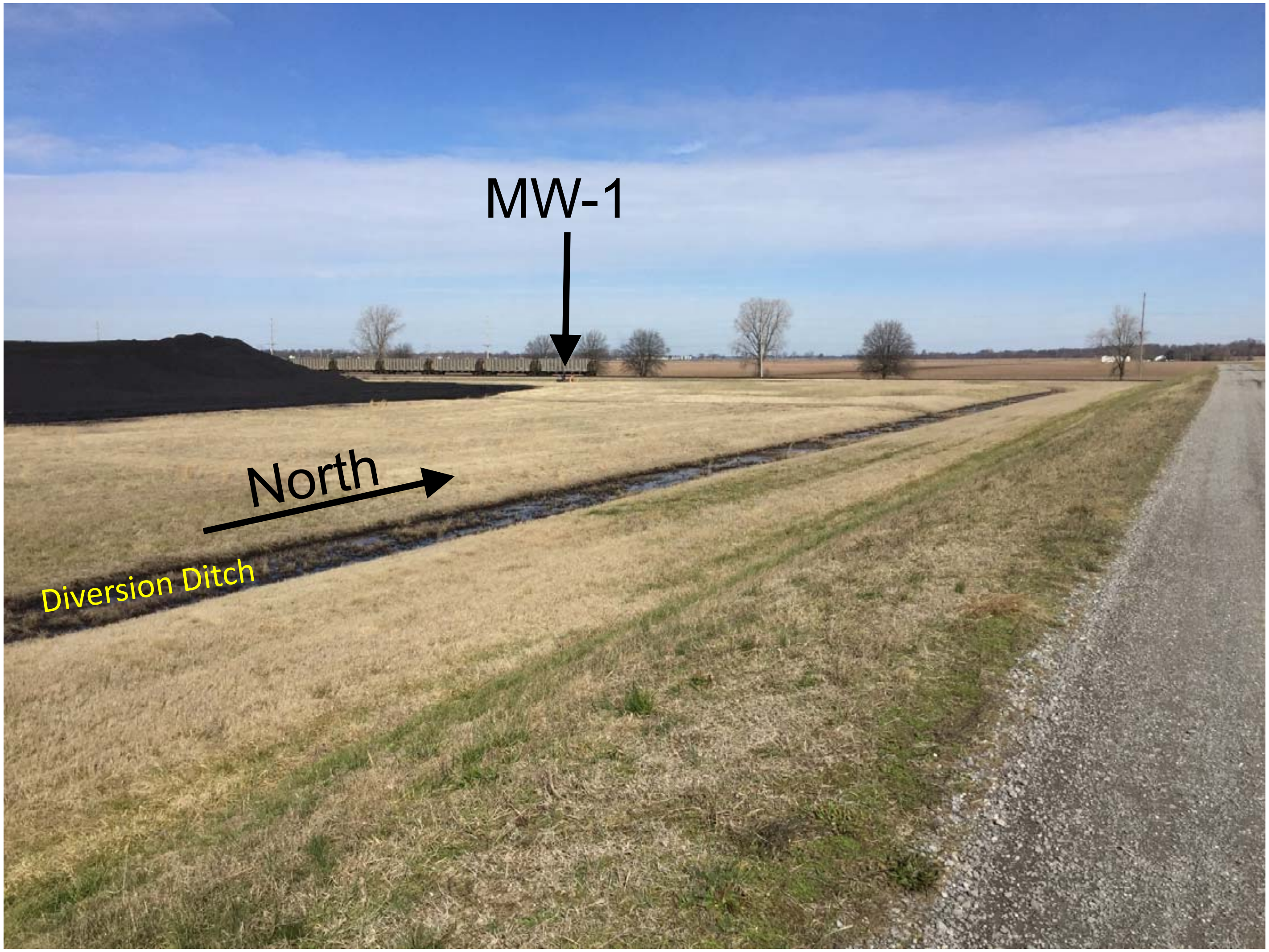
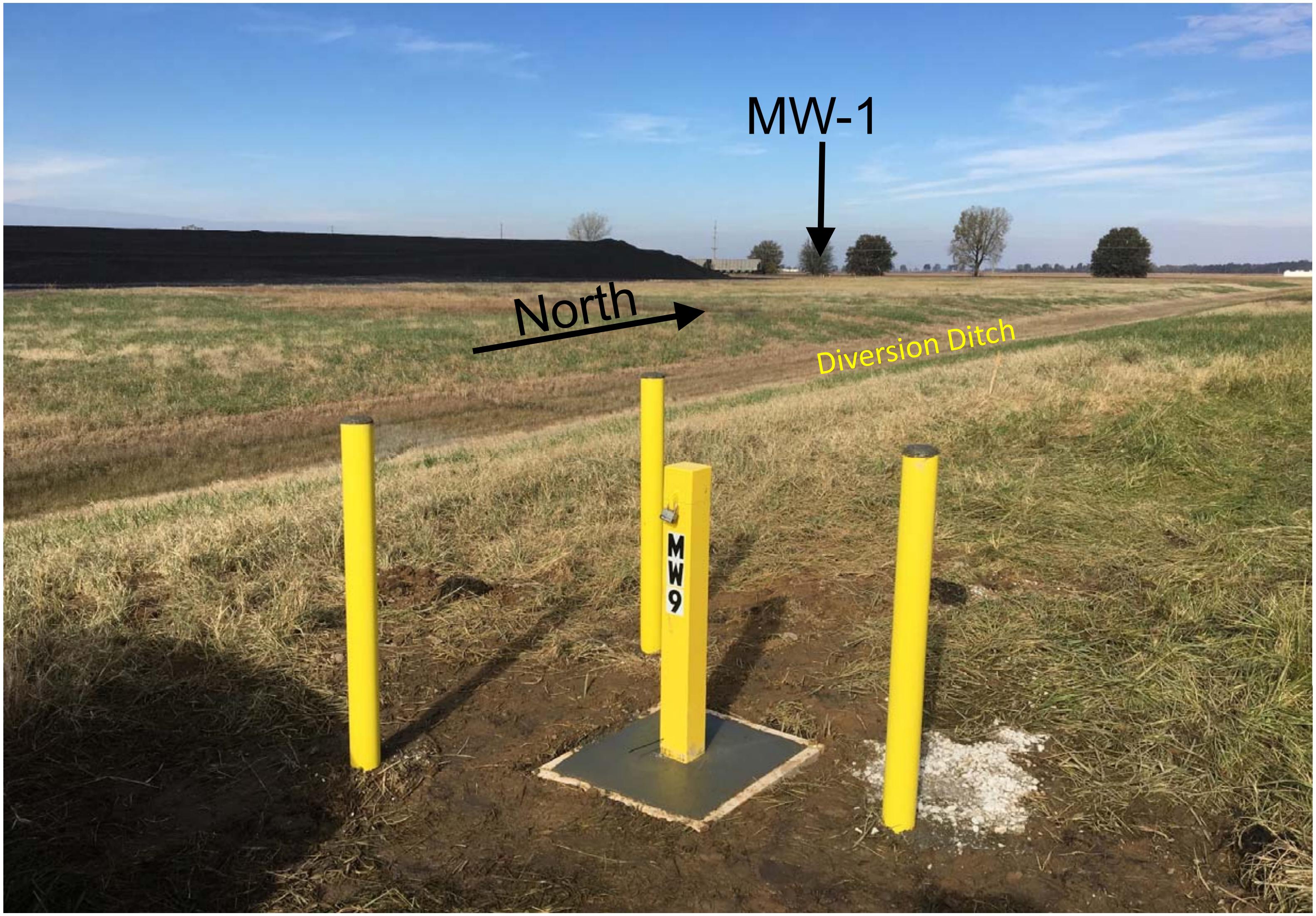


**Figure 4**
Diversion Ditch Photo February 2020 - Looking Northwest

Prepared by: GREDELL Engineering Resources, Inc.

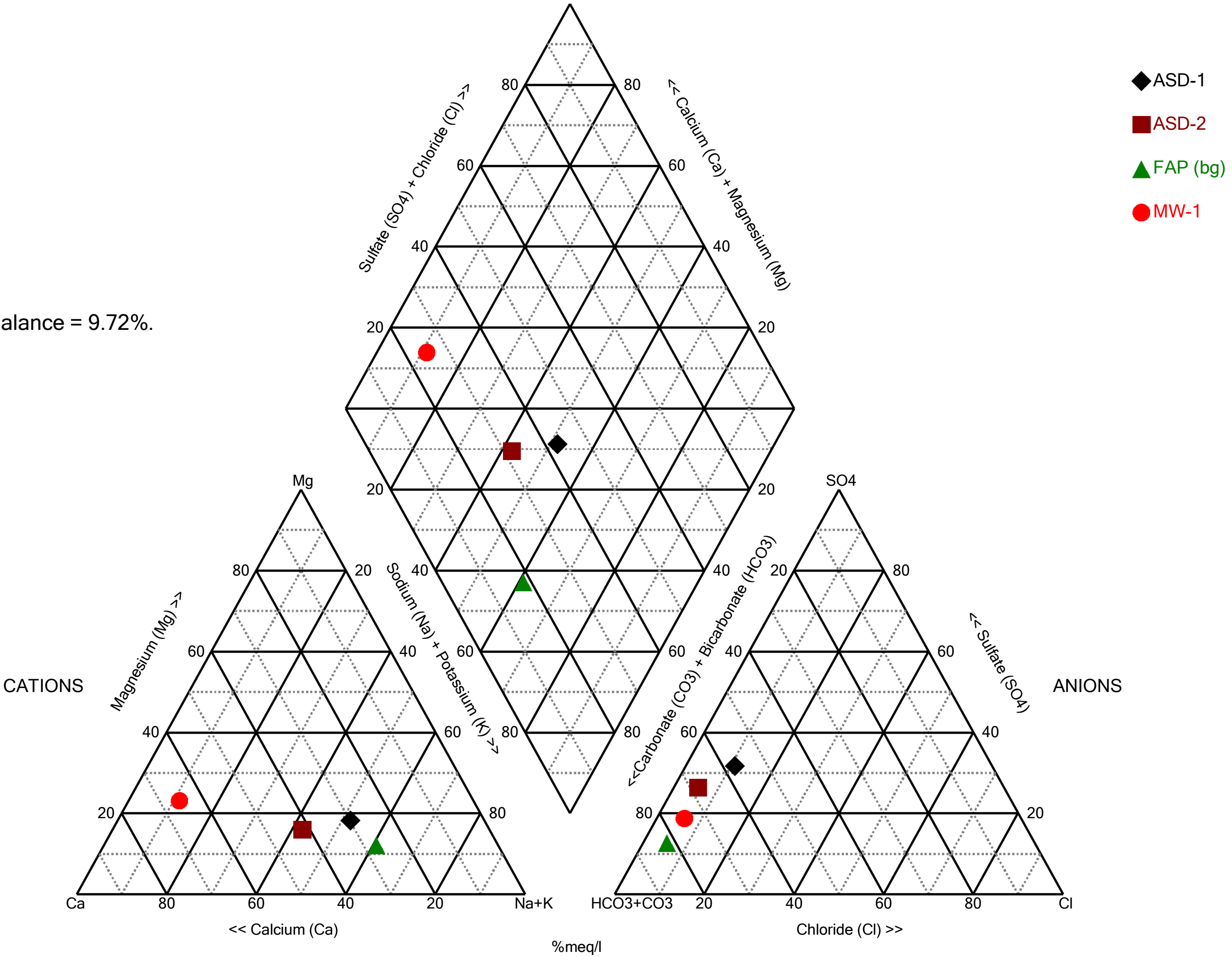


11-13-2017

**Figure 5**
Diversion Ditch Photo November 2017 - Looking Northwest

Prepared by: GREDELL Engineering Resources, Inc.

Sanitas™ v.9.6.25 Sanitas software licensed to GREDELL Engineering only. UG



Analysis Run 3/11/2020 9:57 AM

SBMU-Sikeston Power Station     Client: GREDELL Engineering     Data: ASDEDD

**Figure 6**
Piper Trilinear Plot

Prepared by: GREDELL Engineering Resources, Inc.

1505 East High Street
Jefferson City, Missouri 65101
Telephone (573) 659-9078
www.ger-inc.biz

**GREDELL Engineering Resources, Inc.**

# Sikeston Board of Municipal Utilities
# Sikeston Power Station
# Detection Monitoring Program for Fly Ash Pond – Fluoride in MW-2
# Alternate Source Demonstration

*Prepared for:*

**BMU**
Sikeston
Board of Municipal Utilities

**Sikeston Power Station**
**1551 West Wakefield Avenue**
**Sikeston, MO 63801**

THOMAS R. GREDELL
9-11-2020
NUMBER
PE-021137

MIKEL C. CARLSON
9-11-20
RG 0126

September 2020

# PROFESSIONAL ENGINEER'S CERTIFICATION

40 CFR 257.94(e)(2) Alternate Source Demonstration

I, Thomas R. Gredell, P.E., a professional engineer licensed in the State of Missouri, hereby certify in accordance with 40 CFR 257.94(e)(2) to the accuracy of the alternate source demonstration described in the following report for the Sikeston Board of Municipal Utilities, Sikeston Power Station, Fly Ash Pond CCR unit. The report demonstrates that the statistically significant increase of fluoride in MW-2 is not the result of a release from the Fly Ash Pond and is attributable to an alternate source. This demonstration successfully meets the requirements of 40 CFR 257.94(e) as found in federal regulation 40 CFR 257, Subpart D – Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments. In addition, the demonstration was made using EPA Unified Guidance (Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance: EPA 530/R-09-007) and generally accepted methods.

Name: Thomas R. Gredell, P.E.

Signature:

Date: 9-11-2020

Registration Number: PE-021137
State of Registration: Missouri

THOMAS R. GREDELL
NUMBER
PE-021137

# Sikeston Board of Municipal Utilities
# Sikeston Power Station
# Detection Monitoring Program for Fly Ash Pond - Fluoride in MW-2
# Alternate Source Demonstration

**September 2020**

## Table of Contents

## List of Figures

## List of Tables

## List of Appendices

# 1.0 INTRODUCTION

This Alternate Source Demonstration Report has been prepared to address the results of the semi-annual sampling event initiated on April 6, 2020 at the Sikeston Board of Municipal Utilities (SBMU) Sikeston Power Station's (SPS) Fly Ash Pond, a coal combustion residual (CCR) surface impoundment. Following receipt of final analytical data, statistical analysis was performed by GREDELL Engineering Resources, Inc. (Gredell Engineering) for the parameters listed in Appendix III to Part 257 – Constituents for Detection Monitoring. Following this analysis, it was apparent that several reported concentrations exceeded their respective prediction limits for the well constituent pairs. These well constituent pairs were; Fluoride in sample MW-2, Chloride and Boron in sample MW-3, Total Dissolved Solids (TDS) in sample MW-9, and Calcium, Sulfate, and TDS in sample MW-1. As a consequence, resampling for the aforementioned well constituent pairs, and Boron in MW-2, was conducted on May 21, 2020. Following receipt of final analytical data from the resampling event, it was confirmed that Calcium, Sulfate, and TDS concentrations in sample MW-1, and Fluoride in sample MW-2 represent statistically significant increases (SSIs). Because MW-2 is upgradient of the Fly Ash Pond, SBMU-SPS requested that Gredell Engineering conduct an evaluation of the analytical results and develop an Alternate Source Demonstration (ASD) if warranted. Calcium, Sulfate, and TDS in MW-1 is the subject of a separate report. Chloride and Boron in sample MW-3, and TDS in sample MW-9 were not confirmed by resampling and therefore are not SSIs.

As stated in §257.94(e)(2), an owner or operator may demonstrate that a source other than the CCR unit caused the apparent SSI over background levels for a constituent. The owner or operator must complete the written demonstration within 90 days of detecting an apparent SSI over background levels to include obtaining a certification from a qualified professional engineer verifying the accuracy of the information in the report. If a successful demonstration is completed within the 90-day period, the owner of the CCR unit may continue with a detection monitoring program. The owner or operator must also include the certified demonstration in the annual groundwater monitoring and corrective action report required by §257.90(e).

Gredell Engineering has completed an evaluation of the groundwater sampling events, analytical data results, and other potential factors, for the SBMU SPS Fly Ash Pond groundwater monitoring well system to determine if an alternate source is the cause of the apparent SSI in MW-2. This report presents the results of that evaluation and includes supporting documentation.

# 2.0 OBSERVATIONS AND DATA COLLECTION

The Fly Ash Pond groundwater monitoring well system consists of five wells, designated MW-1, MW-2, MW-3, MW-7, and MW-9 (Figure 1). Monitoring wells MW-1, MW-2, and MW-3 were installed in April 2016. Monitoring well MW-7 was installed in April 2017. Monitoring well MW-9 was installed in November 2017. All five monitoring wells were sampled on an approximate monthly basis beginning in March 2018 and ending in December 2018 to establish a background data base. Additional information regarding these wells is available in the Groundwater Monitoring, Sampling and Analysis Plan for the site (Gredell Engineering, 2018).

The results of the eight independent background sampling events were evaluated in accordance with §257.93, and intra-well analysis using prediction limits was selected as the statistical analysis approach for detection monitoring (Gredell Engineering, 2018). Following receipt of final analytical data reports from the contract laboratory, the reported concentration for each detection monitoring constituent from each well is compared to its respective prediction limit. If a concentration exceeds the respective prediction limit for a particular constituent well pair, or is outside the predicted range (in the case of pH), SSI over background is suspected.

The SPS initiated its semi-annual detection groundwater sampling event for the Fly Ash Pond on April 6, 2020. Final analytical results were received from the contract laboratory on April 16, 2020 (Appendix 1a). However, some results appeared elevated relative to their respective prediction limits (Fluoride in MW-2; Chloride and Boron in MW-3; TDS in MW-9; Calcium, Sulfate, and TDS in MW-1). Consequently, each constituent well pair with apparently elevated results was resampled on May 21, 2020. Final analytical results for these resamples were received from the contract laboratory on June 15, 2020 (Appendix 1b).

The following table summarizes the primary and duplicate sample Fluoride results for MW-2 during the April 6th sampling event and the May 21 resampling event. A duplicate sample was not collected from MW-2 during the May 21st resampling event.

**Table 1 – MW-2 Fluoride Results - 2020**

| | MW-2 Fluoride (mg/L) | MW-2 Duplicate Fluoride (mg/L) |
|---|---|---|
| **April 6, 2020** | 0.336 | 0.287 |
| **May 21, 2020** | 0.374 | N/A |

N/A = Not Prepared or Analyzed
MW-2 Fluoride Prediction Limit = 0.335 mg/L

Table 1 indicates that the original and resampling results for Fluoride in MW-2 exceed the 0.335 mg/L prediction limit, but the duplicate sample collected in April did not exceed the prediction limit. Although the statistical method used to assess groundwater data for the Fly Ash Pond recognizes Fluoride as an SSI in MW-2, groundwater elevation data measured since May 2016 (Table 2) clearly demonstrate that MW-2 is an upgradient well with respect to the Fly Ash Pond. Therefore, the source of the Fluoride can only be attributable to a source upgradient of MW-2 and the Fly Ash Pond.

# 3.0 SUMMARY OF DATA ANALYSIS AND FINDINGS

The U.S. Environmental Protection Agency (USEPA) provides Unified Guidance for statistical analysis of groundwater monitoring data (USEPA, 2009). This Unified Guidance document was reviewed to assess the validity of the apparent SSI. Chapter 4 of the Unified Guidance discusses groundwater monitoring programs and statistical analysis of the associated data. A key component of statistical analysis is "*to determine whether or not the increase is actually due to a contaminant release*". Two of these considerations are pertinent to the data associated with the Fly Ash Pond groundwater monitoring well system and for that reason are listed below.

1. Chapter 4, page 4-8: *Did the test correctly identify an actual release of an indicator or hazardous constituent?*
2. Chapter 4, page 4-9: *Are any of these contaminants observed upgradient of the regulated units?*

Each of these considerations were used to evaluate the background data and the validity of the apparent SSI for Fluoride in MW-2. The results of this evaluation are discussed below.

**Unified Guidance Consideration 1**

Monitoring well MW-2 was designed and located, and is monitored as an upgradient well in fulfillment of the requirement in §257.91(c)(1). Determination that MW-2 is a suitable location for monitoring upgradient groundwater in the "uppermost aquifer… passing the waste boundary of the CCR unit" was established following the completion of a year-long hydrogeologic characterization of the SPS site (Gredell Engineering, 2017). As documented in that report, 12 groundwater maps were developed showing the direction of flow and hydraulic gradient based on the monthly groundwater elevations. These groundwater maps demonstrate a consistent direction of flow showing minimal variation in hydraulic gradient over the 12 month time period extending from May 2016 to April 2017. Groundwater contours developed from the April 4, 2020 sampling event are presented for reference on Figure 1.

Since completion of the Gredell Engineering (2017) report, the piezometers installed for the hydrogeologic characterization were converted to monitoring wells MW-1 through MW-6 and have been consistently monitored since 2016. Moreover, additional monitoring wells (MW-7 through MW-9) were installed to ensure sufficient downgradient monitoring of the ash ponds at the SPS. In the five years of monitoring, the groundwater data demonstrate that MW-2 is consistently upgradient of the Fly Ash Pond (Table 2).

Based on the clear evidence that MW-2 was placed hydraulically upgradient from the Fly Ash Pond, the well is not positioned to detect a release from the pond. Therefore, it is concluded that the analytical results for MW-2 could not have correctly identified an actual release of Fluoride from the Fly Ash Pond. Therefore, the conclusion to the first consideration question from Unified Guidance listed above is negative.

## Unified Guidance Consideration 2

Relatively high concentrations of Fluoride have been observed from the public drinking water supply wells located east (upgradient) of the “regulated unit” (Fly Ash Pond). Data published by the Missouri Department of Natural Resources in their 2019 Annual Water Quality Report for the Sikeston Public Water System show Fluoride concentrations ranging from 0.61 to 0.86 mg/L (Appendix 2) and suggests that the source are “natural deposits”. Similar concentrations were reported in historical Annual Water Quality Reports.

The Fluoride data pertains to the eight supply wells currently operated by the City of Sikeston. Three of these wells (W7, W8/W13, and W9) are located within one-half mile of the Fly Ash Pond (Appendices 3a and 3b). Wells W7 and W8 were drilled in 1976, whereas Well W9 was drilled in 1959. Well W8 may have been replaced by Well W13, which was drilled in 2013 (Appendices 3a and 3b). The drill data indicate that wells W7, W8/W13, and W9 all have total depths of less than 160 feet and yield water from alluvium. The alluvium is the same hydrologic unit monitored by the groundwater monitoring well system at the SPS, including MW-2.

Calculated groundwater velocities reported by Gredell Engineering (2017) for the uppermost (alluvial) aquifer at SPS range in value from 4.00 feet per day (ft/day) to 0.06 ft/day. The velocity data from that report are reproduced for reference as Table 3. When converted to feet per year and multiplied by the difference between the years 2020 and 1976, it is readily apparent that all but the lowest calculated groundwater velocities are sufficient to allow for relatively high concentrations of Fluoride to move approximately one-half mile downgradient and potentially influence the concentration of Fluoride reported at MW-2.

# 4.0 CONCLUSIONS AND RECOMMENDATIONS

Gredell Engineering concludes that the apparent SSI of Fluoride in MW-2 is not the result of a release from the Fly Ash Pond and is attributable to an alternate source. The following supports this conclusion:

- Since inception of groundwater monitoring at the SPS, groundwater elevations measured in MW-2 have consistently demonstrated that it is an upgradient well with respect to the Fly Ash Pond and that it is higher in elevation than all other wells located at the site (Table 2).
- Groundwater flow direction is from the east-northeast to the west-southwest along a hydraulic gradient typically 0.001 to 0.0001 ft/ft, as documented during every monitoring event at the SPS.
- Fluoride is present in concentrations ranging from 0.61 to 0.86 mg/L in public water supply wells currently used by the City of Sikeston (Appendix 2). Three of these public wells are within one-half mile of the Fly Ash Pond and produce groundwater from the same alluvial aquifer that is monitored by MW-2 (Appendices 3a and 3b). Groundwater velocity data (Table 3) clearly indicate that travel times are sufficient to allow elevated concentrations of Fluoride to be detected in MW-2.

Based on these conclusions, Gredell Engineering recommends continuance of semi-annual detection monitoring in accordance with §257.94.

# 5.0 LIMITATIONS

This report has been prepared for the exclusive use of the client and GREDELL Engineering Resources, Inc. for the specific project discussed in accordance with generally accepted environmental practices common to this locale at this time. The report is applicable only to this specific project and identified site conditions as they existed at the time of report preparation. The use of this report by others to develop independent interpretations of data or conclusions not explicitly stated in this report are the sole responsibility of those firms or individuals.

This report is not a guarantee of subsurface conditions. Variations in subsurface conditions may be present that were not identified during this or previous investigations. Interpretations of data and recommendations made in this report are based on observations of data that were available and referred to in this report unless otherwise noted. No other warranties, expressed or implied, are provided.

# 6.0 REFERENCES

Freeze, R.A. and Cherry J.A., 1979, *Groundwater*: Prentice-Hall, Inc. Englewood Cliffs, New Jersey, 604 p.

GREDELL Engineering Resources, Inc., 2017, Sikeston Power Station Site Characterization for Compliance with Missouri State Operating Permit #MO-0095575. Prepared for Sikeston Board of Municipal Utilities, May 31, 2017.

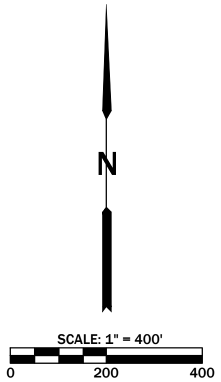
GREDELL Engineering Resources, Inc., 2018, Sikeston Power Station Groundwater Monitoring Sampling and Analysis Plan. Prepared for Sikeston Board of Municipal Utilities, September 10, 2018.

GREDELL Engineering Resources, Inc., 2019, Sikeston Power Station 2018 Annual Groundwater Monitoring and Corrective Action Report for Bottom Ash Pond for Compliance with USEPA 40 CFR 257.90(e). Prepared for Sikeston Board of Municipal Utilities, January 30, 2019.

Sanitas Statistical Software, © 1992-2019 SANITAS TECHNOLOGIES, Alamosa Colorado 81101-0012.

USEPA, 2009, Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance: EPA 530/R-09-007, Office of Resource Conservation and Recovery, Program Implementation and Information Division, Washington, D.C.

# FIGURES



**LEGEND**

| | |
|---|---|
| PROPERTY LINE | —PL— |
| GROUNDWATER CONTOUR (DASHED WHERE INFERRED) | —— |
| MONITORING WELL | MW |
| UP GRADIENT MONITORING LOCATION | UG |
| DOWN GRADIENT MONITORING LOCATION | DG |
| GENERAL FLOW DIRECTION | ← |

**NOTES:**

1. IMAGE PROVIDED BY BING MAPS.
2. MONITORING WELL LOCATIONS, CASING ELEVATIONS & UNDERGROUND CULVERT ELEVATIONS SURVEYED BY BOWEN ENGINEERING & SURVEYING.
3. GROUNDWATER ELEVATIONS MEASURED BY SIKESTON POWER STATION STAFF ON APRIL 6, 2020.
4. MAP DEVELOPMENT BASED ON CONTOURS GENERATED BY SURFER® SOFTWARE.
5. RANGE OF GROUNDWATER FLOW GRADIENT AS DETERMINED BY SURFER® SOFTWARE 0.0001 FT./FT. TO 0.001 FT./FT.

| MONITORING WELL ID | GROUNDWATER ELEVATION (FEET) | CASING ELEVATION (FEET) | NORTHING | EASTING |
|---|---|---|---|---|
| MW-1 | 299.16 | 312.77 | 383119.51 | 1078467.90 |
| MW-2 | 300.40 | 308.01 | 383207.42 | 1079751.30 |
| MW-3 | 300.00 | 308.55 | 381130.00 | 1079946.62 |
| MW-7 | 298.99 | 315.03 | 381584.50 | 1078847.00 |
| MW-9 | 299.41 | 314.68 | 382429.94 | 1078825.60 |

THE GEOLOGIST WHO REVIEWED AND APPROVED THIS REPORT ASSUMES RESPONSIBILITY ONLY FOR GEOLOGIC INTERPRETATIONS OF DATA APPEARING ON THE PAGE AND DISCLAIMS PURSUANT TO SECTION 256.456 RSMO ANY RESPONSIBILITY FOR ALL OTHER PLANS, SPECIFICATIONS, ESTIMATES, REPORTS OR OTHER DOCUMENTS OR INSTRUMENTS NOT PREPARED UNDER THE SUPERVISION OF THE GEOLOGIST RELATING TO OR INTENDED TO BE USED FOR ANY PART OR PARTS OF THE PROJECT TO WHICH THIS FIGURE REFERS.

# FIGURE 1
# SITE MAP AND SAMPLING LOCATIONS
APRIL 4, 2020

## SIKESTON POWER STATION
## FLY ASH POND
## ALTERNATE SOURCE DEMONSTRATION
## MW-2-FLUORIDE

| SURVEYED | DESIGNED | DRAWN | CHECKED | APPROVED | DATE | SCALE | PROJECT NAME | FILE NAME | SHEET # |
|---|---|---|---|---|---|---|---|---|---|
| NA | NA | CP | KE | MCC | 7/2020 | AS NOTED | SIKESTON/GWMAP/FAP | GWCONT FAP 2020 | 1 OF 1 |

**GREDELL Engineering Resources, Inc.**
ENVIRONMENTAL ENGINEERING LAND - AIR - WATER
1505 East High Street Telephone: (573) 659-9078
Jefferson City, Missouri Facsimile: (573) 659-9079
MO CORP. ENGINEERING LICENSE NO. E-2001001669-D

O:\CADD Files\SIKESTON\GROUNDWATER MAP\FAP\GW CONT MAP FAP APR 20.dwg, GW CONT MAP BAP, 8/10/2020 11:08:01 AM

# Tables

# Sikeston Board of Municipal Utilities
# Sikeston Power Station
# Detection Monitoring Program for Fly Ash Pond - Fluoride in MW-2
# Alternate Source Demonstration

## Table 1
## Groundwater Monitoring Well Summary

| Monitoring Well ID[1,2] | Northing Location[3,4] | Easting Location[3,4] | Ground Surface Elevation[3,4] (feet) | Top of Riser Elevation[3,4] (feet) | Well Depth[5] (feet) | Base of Well Elevation[6] (feet) | Screen Length[7] (feet) | Top of Screen Elevation (feet) |
|---|---|---|---|---|---|---|---|---|
| MW-1 | 383119.51 | 1078467.90 | 310.41 | 312.77 | 37.84 | 274.93 | 10 | 285.1 |
| MW-2 | 383207.42 | 1079751.30 | 305.53 | 308.01 | 37.42 | 270.59 | 10 | 280.8 |
| MW-3 | 381130.00 | 1079946.62 | 306.11 | 308.55 | 37.21 | 271.34 | 10 | 281.5 |
| MW-7 | 381584.50 | 1078847.00 | 312.70 | 315.03 | 37.37 | 277.66 | 10 | 287.9 |
| MW-9 | 382429.94 | 1078825.60 | 311.85 | 314.68 | 37.28 | 277.40 | 10 | 287.6 |

**NOTES:**

1. Refer to Figure 1 for monitoring well locations.
2. Refer to Sikeston Power Station On-Site Operating Record for well construction diagrams.
3. Monitoring well survey data provided by Bowen Engineering & Surveying, Inc.
4. Horizontal Datum: Missouri State Plane Coordinates - NAD 83 (Feet), Vertical Datum: NAVD 88 (Feet).
5. Depth measurements relative to surveyed point on top of well casing.
6. Sump installed at base of screen (0.2 feet length).
7. Actual screen length (9.7 feet) is the machine-slotted section of the 10-foot length of Schedule 40 PVC pipe.

# Sikeston Board of Municipal Utilities
# Sikeston Power Station
# Detection Monitoring Program for
# Fly Ash Pond - Fluoride in MW-2
# Alternate Source Demonstration

## Table 2
## Historical Groundwater Elevation Summary

| Well ID | MW-1 | MW-2 | MW-3 | MW-7 | MW-9 |
|---|---|---|---|---|---|
| Date | Groundwater Elevation (feet MSL) | | | | |
| 05/12/16 | 297.50 | 298.66 | 298.13 | NM | NM |
| 06/28/16 | 296.60 | 298.01 | 297.58 | NM | NM |
| 07/15/16 | 296.57 | 297.86 | 297.37 | NM | NM |
| 08/08/16 | 295.62 | 297.06 | 297.05 | NM | NM |
| 09/08/16 | 296.06 | 297.27 | 296.76 | NM | NM |
| 10/05/16 | 295.86 | 296.96 | 296.40 | NM | NM |
| 11/01/16 | 295.47 | 296.66 | 296.10 | NM | NM |
| 11/30/16 | 295.45 | 296.60 | 296.03 | NM | NM |
| 01/26/17 | 295.77 | 296.76 | 296.35 | NM | NM |
| 02/24/17 | 295.47 | 296.40 | 296.00 | NM | NM |
| 03/20/17 | 296.11 | 296.96 | 296.45 | NM | NM |
| 04/19/17 | 296.04 | 296.86 | 296.35 | NM | NM |
| 03/21/18 | 295.92 | 296.96 | 296.65 | 295.83 | 296.13 |
| 04/15/18 | 297.07 | 297.86 | 297.60 | 296.95 | 297.18 |
| 05/23/18 | 296.78 | 298.01 | 297.62 | 296.66 | 296.98 |
| 06/27/18 | 296.37 | 297.61 | 297.21 | 296.26 | 296.56 |
| 08/01/18 | 295.22 | 296.60 | 296.15 | 295.08 | 295.48 |
| 09/05/18 | 294.79 | 296.11 | 295.68 | 294.71 | 295.01 |
| 11/06/18 | 295.01 | 296.21 | 295.74 | 294.85 | 295.17 |
| 12/12/18 | 295.12 | 296.21 | 295.79 | 295.06 | 295.36 |
| 01/08/19 | 295.66 | 296.72 | 296.38 | 295.53 | 295.80 |
| 02/22/19 | 297.70 | 298.67 | 298.35 | 297.59 | 297.84 |
| 03/27/19 | 297.69 | 298.93 | 298.51 | 297.58 | 297.93 |
| 04/16/19 | 298.15 | 299.29 | 298.93 | 298.01 | 298.38 |
| 05/14/19 | 298.27 | 299.66 | 299.25 | 298.15 | 298.52 |
| 06/12/19 | 297.82 | 299.24 | 298.82 | 297.76 | 298.10 |
| 07/17/19 | 297.32 | 298.77 | 298.38 | 297.25 | 297.55 |
| 07/24/19 | 297.40 | 298.80 | 298.41 | 297.33 | 297.65 |
| 08/14/19 | 296.61 | 298.15 | 297.80 | 296.65 | 296.96 |
| 09/16/19 | 296.24 | 297.70 | 297.22 | 296.14 | 296.50 |
| 09/24/19 | 296.09 | 297.53 | 297.05 | 295.98 | 296.33 |
| 10/10/19 | 295.92 | 297.29 | 296.84 | 295.80 | 296.13 |
| 10/22/19 | 295.92 | 297.24 | 296.80 | 295.74 | 296.12 |
| 01/28/20 | 297.61 | 298.73 | 298.34 | 297.42 | 297.80 |
| 04/06/20 | 299.16 | 300.40 | 300.00 | 298.99 | 299.41 |
| 05/21/20 | 298.50 | 300.02 | 299.55 | NM | 298.71 |

**NOTES:**

🟨 Maximum groundwater elevation.
🟦 Minimum groundwater elevation.

1. Refer to Figure 1 for monitoring well locations.
2. Refer to Sikeston Power Station On-Site Operating Record for well construction diagrams.
3. NM - Not Measured.

Prepared by: KAE
Checked by: MCC

Prepared by: GREDELL Engineering Resources, Inc.

# Sikeston Board of Municipal Utilities
# Sikeston Power Station
# Detection Monitoring Program for
# Fly Ash Pond - Fluoride in MW-2
# Alternate Source Demonstration

## Table 3
## Calculated Groundwater Velocity for Alluvial Aquifer

| **Location** | **Sikeston Pond Area** | | | | | |
|---|---|---|---|---|---|---|
| **Hydraulic Conductivity (K)** | $K_{min}$ = 112 ft/day | | | | | |
| **Hydraulic Gradient (*i*)** | $i_{min}$ = 0.000172 ft/ft | | | $i_{max}$ = 0.00136 ft/ft | | |
| **Effective Porosity (n)** | 0.10 | 0.20 | 0.30 | 0.10 | 0.20 | 0.30 |
| **Velocity (=Ki/n) (ft/day)** | 0.19 | 0.10 | 0.06 | 1.52 | 0.76 | 0.51 |
| **Velocity (=Ki/n) (ft/year)** | 70 | 35 | 23 | 556 | 278 | 185 |
| **Travel Distance (1976-2020) (ft)** | 3,094 | 1,547 | 1,031 | 24,463 | 12,231 | 8,154 |

| **Location** | **Sikeston Pond Area** | | | | | |
|---|---|---|---|---|---|---|
| **Hydraulic Conductivity (K)** | $K_{max}$ = 294 ft/day | | | | | |
| **Hydraulic Gradient (*i*)** | $i_{min}$ = 0.000172 ft/ft | | | $i_{max}$ = 0.00136 ft/ft | | |
| **Effective Porosity (n)** | 0.10 | 0.20 | 0.30 | 0.10 | 0.20 | 0.30 |
| **Velocity (=Ki/n) (ft/day)** | 0.51 | 0.25 | 0.17 | 4.00 | 2.00 | 1.33 |
| **Velocity (=Ki/n) (ft/year)** | 185 | 92 | 62 | 1459 | 730 | 486 |
| **Travel Distance (1976-2020) (ft)** | 8,121 | 4,061 | 2,707 | 64,214 | 32,107 | 21,405 |

**NOTES:**

1. Hydraulic conductivity based on slug test results.
2. Hydraulic gradients based on calculated maximum and minimum values as determined by Surfer© Software.
3. Effective Porosity values represent estimated range. USEPA (2009) Unified Guidance indicates 0.20 is appropriate for sandy/gravelly granular material.

Prepared by: MCC
Checked by: KAE

Prepared by: GREDELL Engineering Resources, Inc.

# Appendices

# Appendix 1a

## Laboratory Analytical Results and
## Quality Control Reports
## April 6, 2020 Sample Event

**PDC Laboratories, Inc.**
PROFESSIONAL • DEPENDABLE • COMMITTED

April 16, 2020

Luke St Mary
Sikeston BMU, Sikeston Power Station
1551 W Wakefield
Sikeston, MO 63801

RE: Sikeston BMU-CCR Fly Ash Wells

Dear Luke St Mary:

Please find enclosed the analytical results for the **7** sample(s) the laboratory received on **4/8/20 10:00 am** and logged in under work order **0041811**. All testing is performed according to our current TNI accreditations unless otherwise noted. This report cannot be reproduced, except in full, without the written permission of PDC Laboratories, Inc.

If you have any questions regarding your report, please contact your project manager. Quality and timely data is of the utmost importance to us.

PDC Laboratories, Inc. appreciates the opportunity to provide you with analytical expertise. We are always trying to improve our customer service and we welcome you to contact the Director of Client Services, Lisa Grant, with any feedback you have about your experience with our laboratory at 309-683-1764 or lgrant@pdclab.com.

Sincerely,

Kurt Stepping
Senior Project Manager
(309) 692-9688 x1719
kstepping@pdclab.com

## ANALYTICAL RESULTS

# ANALYTICAL RESULTS

**Sample:** **0041811-01**
**Name:** MW-1
**Matrix:** Ground Water - Regular Sample

**Sampled:** 04/06/20 11:13
**Received:** 04/08/20 10:00
**PO #:** 23574

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **Anions - PIA** | | | | | | | | | |
| Chloride | 5.4 | mg/L | | 04/14/20 10:34 | 1 | 1.0 | 04/14/20 10:34 | LAM | EPA 300.0 REV 2.1 |
| Fluoride | 0.255 | mg/L | | 04/14/20 10:34 | 1 | 0.250 | 04/14/20 10:34 | LAM | EPA 300.0 REV 2.1 |
| Sulfate | 39 | mg/L | Q4 | 04/14/20 11:29 | 5 | 5.0 | 04/14/20 11:29 | LAM | EPA 300.0 REV 2.1 |
| **General Chemistry - PIA** | | | | | | | | | |
| Solids - total dissolved solids (TDS) | 230 | mg/L | | 04/09/20 13:28 | 1 | 26 | 04/09/20 14:08 | CPC | SM 2540C |
| **Total Metals - PIA** | | | | | | | | | |
| Boron | 520 | ug/L | | 04/14/20 08:45 | 5 | 10 | 04/16/20 08:49 | JMW | EPA 6020A |
| Calcium | 48000 | ug/L | | 04/14/20 08:45 | 5 | 100 | 04/15/20 08:03 | JMW | EPA 6020A |

**Sample:** **0041811-02**
**Name:** MW-2
**Matrix:** Ground Water - Regular Sample

**Sampled:** 04/06/20 09:04
**Received:** 04/08/20 10:00
**PO #:** 23574

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **Anions - PIA** | | | | | | | | | |
| Chloride | 2.1 | mg/L | | 04/14/20 11:47 | 1 | 1.0 | 04/14/20 11:47 | LAM | EPA 300.0 REV 2.1 |
| Fluoride | 0.336 | mg/L | | 04/14/20 11:47 | 1 | 0.250 | 04/14/20 11:47 | LAM | EPA 300.0 REV 2.1 |
| Sulfate | 16 | mg/L | Q4 | 04/14/20 12:41 | 5 | 5.0 | 04/14/20 12:41 | LAM | EPA 300.0 REV 2.1 |
| **General Chemistry - PIA** | | | | | | | | | |
| Solids - total dissolved solids (TDS) | 140 | mg/L | | 04/09/20 13:28 | 1 | 26 | 04/09/20 14:08 | CPC | SM 2540C |
| **Total Metals - PIA** | | | | | | | | | |
| Boron | 34 | ug/L | | 04/14/20 08:45 | 5 | 10 | 04/16/20 08:52 | JMW | EPA 6020A |
| Calcium | 15000 | ug/L | | 04/14/20 08:45 | 5 | 100 | 04/15/20 08:07 | JMW | EPA 6020A |

# ANALYTICAL RESULTS

**Sample:** **0041811-03**
**Name:** MW-3
**Matrix:** Ground Water - Regular Sample

**Sampled:** 04/06/20 08:22
**Received:** 04/08/20 10:00
**PO #:** 23574

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **Anions - PIA** | | | | | | | | | |
| Chloride | 1.8 | mg/L | | 04/13/20 19:38 | 1 | 1.0 | 04/13/20 19:38 | KCC | EPA 300.0 REV 2.1 |
| Fluoride | 0.371 | mg/L | | 04/13/20 19:38 | 1 | 0.250 | 04/13/20 19:38 | KCC | EPA 300.0 REV 2.1 |
| Sulfate | 20 | mg/L | | 04/13/20 20:33 | 10 | 10 | 04/13/20 20:33 | KCC | EPA 300.0 REV 2.1 |
| **General Chemistry - PIA** | | | | | | | | | |
| Solids - total dissolved solids (TDS) | 380 | mg/L | | 04/09/20 13:28 | 1 | 26 | 04/09/20 14:08 | CPC | SM 2540C |
| **Total Metals - PIA** | | | | | | | | | |
| Boron | 29 | ug/L | | 04/14/20 08:45 | 5 | 10 | 04/16/20 09:12 | JMW | EPA 6020A |
| Calcium | 16000 | ug/L | | 04/14/20 08:45 | 5 | 100 | 04/15/20 08:10 | JMW | EPA 6020A |

**Sample:** **0041811-04**
**Name:** MW-7
**Matrix:** Ground Water - Regular Sample

**Sampled:** 04/06/20 11:58
**Received:** 04/08/20 10:00
**PO #:** 23574

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **Anions - PIA** | | | | | | | | | |
| Chloride | 4.0 | mg/L | | 04/13/20 20:51 | 1 | 1.0 | 04/13/20 20:51 | KCC | EPA 300.0 REV 2.1 |
| Fluoride | 0.737 | mg/L | | 04/13/20 20:51 | 1 | 0.250 | 04/13/20 20:51 | KCC | EPA 300.0 REV 2.1 |
| Sulfate | 200 | mg/L | | 04/13/20 21:09 | 25 | 25 | 04/13/20 21:09 | KCC | EPA 300.0 REV 2.1 |
| **General Chemistry - PIA** | | | | | | | | | |
| Solids - total dissolved solids (TDS) | 540 | mg/L | | 04/09/20 13:28 | 1 | 26 | 04/09/20 14:08 | CPC | SM 2540C |
| **Total Metals - PIA** | | | | | | | | | |
| Boron | 2200 | ug/L | | 04/14/20 08:45 | 5 | 10 | 04/16/20 09:20 | JMW | EPA 6020A |
| Calcium | 120000 | ug/L | | 04/14/20 08:45 | 5 | 100 | 04/15/20 08:14 | JMW | EPA 6020A |

## ANALYTICAL RESULTS

**Sample:** **0041811-05**
**Name:** MW-9
**Matrix:** Ground Water - Regular Sample

**Sampled:** 04/06/20 13:19
**Received:** 04/08/20 10:00
**PO #:** 23574

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **Anions - PIA** | | | | | | | | | |
| Chloride | 18 | mg/L | Q4 | 04/14/20 14:30 | 5 | 5.0 | 04/14/20 14:30 | LAM | EPA 300.0 REV 2.1 |
| Fluoride | 0.816 | mg/L | Q3 | 04/14/20 12:59 | 1 | 0.250 | 04/14/20 12:59 | LAM | EPA 300.0 REV 2.1 |
| Sulfate | 250 | mg/L | Q4 | 04/14/20 14:48 | 25 | 25 | 04/14/20 14:48 | LAM | EPA 300.0 REV 2.1 |
| **General Chemistry - PIA** | | | | | | | | | |
| Solids - total dissolved solids (TDS) | 840 | mg/L | | 04/09/20 13:28 | 1 | 26 | 04/09/20 14:08 | CPC | SM 2540C |
| **Total Metals - PIA** | | | | | | | | | |
| Boron | 4900 | ug/L | | 04/14/20 08:45 | 5 | 10 | 04/16/20 09:23 | JMW | EPA 6020A |
| Calcium | 92000 | ug/L | | 04/14/20 08:45 | 5 | 100 | 04/15/20 08:18 | JMW | EPA 6020A |

**Sample:** **0041811-06**
**Name:** DUPLICATE WELL
**Matrix:** Ground Water - Regular Sample

**Sampled:** 04/06/20 00:00
**Received:** 04/08/20 10:00
**PO #:** 23574

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **Anions - PIA** | | | | | | | | | |
| Chloride | 2.0 | mg/L | | 04/14/20 15:06 | 1 | 1.0 | 04/14/20 15:06 | LAM | EPA 300.0 REV 2.1 |
| Fluoride | 0.287 | mg/L | | 04/14/20 15:06 | 1 | 0.250 | 04/14/20 15:06 | LAM | EPA 300.0 REV 2.1 |
| Sulfate | 16 | mg/L | | 04/14/20 15:24 | 5 | 5.0 | 04/14/20 15:24 | LAM | EPA 300.0 REV 2.1 |
| **General Chemistry - PIA** | | | | | | | | | |
| Solids - total dissolved solids (TDS) | 160 | mg/L | | 04/09/20 13:28 | 1 | 26 | 04/09/20 14:08 | CPC | SM 2540C |
| **Total Metals - PIA** | | | | | | | | | |
| Boron | 80 | ug/L | | 04/14/20 08:45 | 5 | 10 | 04/16/20 09:27 | JMW | EPA 6020A |
| Calcium | 15000 | ug/L | | 04/14/20 08:45 | 5 | 100 | 04/15/20 08:30 | JMW | EPA 6020A |

# ANALYTICAL RESULTS

**Sample:** **0041811-07**
**Name:** FIELD BLANK
**Matrix:** Ground Water - Regular Sample

**Sampled:** 04/06/20 00:00
**Received:** 04/08/20 10:00
**PO #:** 23574

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **Anions - PIA** | | | | | | | | | |
| Chloride | < 1.0 | mg/L | | 04/14/20 16:01 | 1 | 1.0 | 04/14/20 16:01 | LAM | EPA 300.0 REV 2.1 |
| Fluoride | < 0.250 | mg/L | | 04/14/20 16:01 | 1 | 0.250 | 04/14/20 16:01 | LAM | EPA 300.0 REV 2.1 |
| Sulfate | < 1.0 | mg/L | | 04/14/20 16:01 | 1 | 1.0 | 04/14/20 16:01 | LAM | EPA 300.0 REV 2.1 |
| **General Chemistry - PIA** | | | | | | | | | |
| Solids - total dissolved solids (TDS) | < 17 | mg/L | | 04/09/20 13:28 | 1 | 17 | 04/09/20 14:08 | CPC | SM 2540C |
| **Total Metals - PIA** | | | | | | | | | |
| Boron | 23 | ug/L | | 04/14/20 08:45 | 5 | 10 | 04/16/20 09:31 | JMW | EPA 6020A |
| Calcium | < 100 | ug/L | | 04/14/20 08:45 | 5 | 100 | 04/15/20 08:33 | JMW | EPA 6020A |

# QC SAMPLE RESULTS

| Parameter | Result | Unit | Qual | Spike Level | Source Result | %REC | %REC Limits | RPD | RPD Limit |
|---|---|---|---|---|---|---|---|---|---|
| ***Batch B008447 - No Prep - SM 2540C*** | | | | | | | | | |
| **Blank (B008447-BLK1)** | | | | Prepared & Analyzed: 04/09/20 | | | | | |
| Solids - total dissolved solids (TDS) | < 17 | mg/L | | | | | | | |
| **LCS (B008447-BS1)** | | | | Prepared & Analyzed: 04/09/20 | | | | | |
| Solids - total dissolved solids (TDS) | 1000 | mg/L | | 1000 | | 100 | 67.9-132 | | |
| **Duplicate (B008447-DUP1)** | **Sample: 0041195-01** | | | Prepared & Analyzed: 04/09/20 | | | | | |
| Solids - total dissolved solids (TDS) | 1310 | mg/L | M | | 727 | | | 58 | 5 |
| **Duplicate (B008447-DUP2)** | **Sample: 0041195-02** | | | Prepared & Analyzed: 04/09/20 | | | | | |
| Solids - total dissolved solids (TDS) | 427 | mg/L | M | | 360 | | | 17 | 5 |
| ***Batch B008764 - SW 3015 - EPA 6020A*** | | | | | | | | | |
| **Blank (B008764-BLK1)** | | | | Prepared: 04/14/20 Analyzed: 04/16/20 | | | | | |
| Boron | < 10 | ug/L | | | | | | | |
| Calcium | < 100 | ug/L | | | | | | | |
| **LCS (B008764-BS1)** | | | | Prepared: 04/14/20 Analyzed: 04/16/20 | | | | | |
| Boron | 574 | ug/L | | 555.6 | | 103 | 80-120 | | |
| Calcium | 5060 | ug/L | | 5556 | | 91 | 80-120 | | |
| **Matrix Spike (B008764-MS1)** | **Sample: 0041811-07** | | | Prepared: 04/14/20 Analyzed: 04/16/20 | | | | | |
| Boron | 591 | ug/L | | 555.6 | 23.4 | 102 | 75-125 | | |
| Calcium | 5170 | ug/L | | 5556 | 86.3 | 92 | 75-125 | | |
| **Matrix Spike Dup (B008764-MSD1)** | **Sample: 0041811-07** | | | Prepared: 04/14/20 Analyzed: 04/16/20 | | | | | |
| Boron | 594 | ug/L | | 555.6 | 23.4 | 103 | 75-125 | 0.5 | 20 |
| Calcium | 5420 | ug/L | | 5556 | 86.3 | 96 | 75-125 | 5 | 20 |
| ***Batch B008794 - No Prep - EPA 300.0 REV 2.1*** | | | | | | | | | |
| **Calibration Blank (B008794-CCB1)** | | | | Prepared & Analyzed: 04/13/20 | | | | | |
| Sulfate | 0.0870 | mg/L | | | | | | | |
| Fluoride | 0.00 | mg/L | | | | | | | |
| Chloride | 0.297 | mg/L | | | | | | | |
| **Calibration Check (B008794-CCV1)** | | | | Prepared & Analyzed: 04/13/20 | | | | | |
| Sulfate | 5.03 | mg/L | | 5.000 | | 101 | 90-110 | | |
| Fluoride | 5.13 | mg/L | | 5.000 | | 103 | 90-110 | | |
| Chloride | 4.73 | mg/L | | 5.000 | | 95 | 90-110 | | |
| ***Batch B008886 - No Prep - EPA 300.0 REV 2.1*** | | | | | | | | | |
| **Calibration Blank (B008886-CCB1)** | | | | Prepared & Analyzed: 04/14/20 | | | | | |
| Fluoride | 0.00 | mg/L | | | | | | | |
| Chloride | 0.457 | mg/L | | | | | | | |
| Sulfate | 0.00 | mg/L | | | | | | | |
| **Calibration Check (B008886-CCV1)** | | | | Prepared & Analyzed: 04/14/20 | | | | | |
| Sulfate | 5.20 | mg/L | | 5.000 | | 104 | 90-110 | | |
| Fluoride | 5.18 | mg/L | | 5.000 | | 104 | 90-110 | | |
| Chloride | 4.99 | mg/L | | 5.000 | | 100 | 90-110 | | |
| **Matrix Spike (B008886-MS1)** | **Sample: 0041811-01** | | | Prepared & Analyzed: 04/14/20 | | | | | |
| Chloride | 6.8 | mg/L | | 1.500 | 5.4 | 90 | 80-120 | | |

# QC SAMPLE RESULTS

| Parameter | Result | Unit | Qual | Spike Level | Source Result | %REC | %REC Limits | RPD | RPD Limit |
|---|---|---|---|---|---|---|---|---|---|
| ***Batch B008886 - No Prep - EPA 300.0 REV 2.1*** | | | | | | | | | |
| **Matrix Spike (B008886-MS1)** | **Sample: 0041811-01** | | | Prepared & Analyzed: 04/14/20 | | | | | |
| Sulfate | 1.00E9 | mg/L | Q4 | 1.500 | 38.8 | NR | 80-120 | | |
| Fluoride | 1.54 | mg/L | | 1.500 | 0.255 | 86 | 80-120 | | |
| **Matrix Spike (B008886-MS2)** | **Sample: 0041811-02** | | | Prepared & Analyzed: 04/14/20 | | | | | |
| Fluoride | 1.58 | mg/L | | 1.500 | 0.336 | 83 | 80-120 | | |
| Sulfate | 1.00E9 | mg/L | Q4 | 1.500 | 16.1 | NR | 80-120 | | |
| Chloride | 3.4 | mg/L | | 1.500 | 2.1 | 84 | 80-120 | | |
| **Matrix Spike (B008886-MS3)** | **Sample: 0041811-05** | | | Prepared & Analyzed: 04/14/20 | | | | | |
| Chloride | 1.0E9 | mg/L | Q4 | 1.500 | 18 | NR | 80-120 | | |
| Sulfate | 1.00E9 | mg/L | Q4 | 1.500 | 246 | NR | 80-120 | | |
| Fluoride | 1.68 | mg/L | Q1 | 1.500 | 0.816 | 58 | 80-120 | | |
| **Matrix Spike Dup (B008886-MSD1)** | **Sample: 0041811-01** | | | Prepared & Analyzed: 04/14/20 | | | | | |
| Fluoride | 1.51 | mg/L | | 1.500 | 0.255 | 84 | 80-120 | 2 | 20 |
| Chloride | 6.7 | mg/L | | 1.500 | 5.4 | 87 | 80-120 | 0.7 | 20 |
| Sulfate | 1.00E9 | mg/L | Q4 | 1.500 | 38.8 | NR | 80-120 | 0 | 20 |
| **Matrix Spike Dup (B008886-MSD2)** | **Sample: 0041811-02** | | | Prepared & Analyzed: 04/14/20 | | | | | |
| Sulfate | 1.00E9 | mg/L | Q4 | 1.500 | 16.1 | NR | 80-120 | 0 | 20 |
| Fluoride | 1.61 | mg/L | | 1.500 | 0.336 | 85 | 80-120 | 2 | 20 |
| Chloride | 3.4 | mg/L | | 1.500 | 2.1 | 84 | 80-120 | 0.1 | 20 |
| **Matrix Spike Dup (B008886-MSD3)** | **Sample: 0041811-05** | | | Prepared & Analyzed: 04/14/20 | | | | | |
| Chloride | 1.0E9 | mg/L | Q4 | 1.500 | 18 | NR | 80-120 | 0 | 20 |
| Sulfate | 1.00E9 | mg/L | Q4 | 1.500 | 246 | NR | 80-120 | 0 | 20 |
| Fluoride | 2.14 | mg/L | Q2 | 1.500 | 0.816 | 88 | 80-120 | 24 | 20 |

# NOTES

Specifications regarding method revisions and method modifications used for analysis are available upon request. Please contact your project manager.

* Not a TNI accredited analyte

## Certifications

CHI - McHenry, IL - 4314-A W. Crystal Lake Road, McHenry, IL 60050
TNI Accreditation for Drinking Water and Wastewater Fields of Testing through IL EPA Accreditation No. 100279
Illinois Department of Public Health Bacterial Analysis in Drinking Water Approved Laboratory Registry No. 17556

PIA - Peoria, IL - 2231 W. Altorfer Drive, Peoria, IL 61615
TNI Accreditation for Drinking Water, Wastewater, Solid and Hazardous Material Fields of Testing through IL EPA Accreditation No. 100230
Illinois Department of Public Health Bacterial Analysis in Drinking Water Approved Laboratory Registry No. 17553
Drinking Water Certifications/Accreditations: Iowa (240); Kansas (E-10338); Missouri (870)
Wastewater Certifications/Accreditations: Arkansas (88-0677); Iowa (240); Kansas (E-10338)
Solid and Hazardous Material Certifications/Accreditations: Arkansas (88-0677); Iowa (240); Kansas (E-10338)

SPIL - Springfield, IL - 1210 Capitol Airport Drive, Springfield, IL 62707
Illinois Department of Public Health Bacterial Analysis in Drinking Water Approved Laboratory Registry No. 17592

SPMO - Springfield, MO - 1805 W Sunset Street, Springfield, MO 65807
USEPA DMR-QA Program

STL - Hazelwood, MO - 944 Anglum Rd, Hazelwood, MO 63042
TNI Accreditation for Wastewater, Solid and Hazardous Material Fields of Testing through KS KDHE Certification No. E-10389
TNI Accreditation for Wastewater, Solid and Hazardous Material Fields of Testing through IL EPA Accreditation No. - 200080
Illinois Department of Public Health Bacterial Analysis in Drinking Water Approved Laboratory, Registry No. 171050
Missouri Department of Natural Resources - Certificate of Approval for Microbiological Laboratory Service - No. 1050

## Qualifiers

| | |
|---|---|
| M | Analyte failed to meet the required acceptance criteria for duplicate analysis. |
| Q1 | Matrix Spike failed % recovery acceptance limits. The associated blank spike recovery was acceptable. |
| Q2 | Matrix Spike Duplicate failed % recovery acceptance limits. The associated blank spike recovery was acceptable. |
| Q3 | Matrix Spike/Matrix Spike Duplicate both failed % recovery acceptance limits. The associated blank spike recovery was acceptable. |
| Q4 | The matrix spike recovery result is unusable since the analyte concentration in the sample is greater than four times the spike level. The associated blank spike was acceptable. |

Kurt

Certified by: Kurt Stepping, Senior Project Manager

PDC Laboratories, Inc.
P.O. Box 9071 • Peoria, IL 61612-9071
(309) 692-9688 • (800) 752-6651 • FAX (309) 692-9689

# DATA PACKAGE

`

**CLIENT; Sikeston BMU**

**PROJECT: Sikeston Power Station**

**PDC LAB WORKORDER: 0041811**

**DATE ISSUED: April 16, 2020**

# CASE NARRATIVE –

# PDC Work Order 0041811

PDC Laboratories, Inc. received 7 water samples on April 8, 2020 in good condition at our Peoria, IL facility. This sample set was designated as work order 0041811

| Sample ID's | | Date | |
|---|---|---|---|
| **Field** | **Lab ID** | **Collected** | **Received** |
| MW-1 | 0041811-01 | 4/6/20 | 4/8/20 |
| MW-2 | 0041811-02 | 4/6/20 | 4/8/20 |
| MW-3 | 0041811-03 | 4/6/20 | 4/8/20 |
| MW-7 | 0041811-04 | 4/6/20 | 4/8/20 |
| MW-9 | 0041811-05 | 4/6/20 | 4/8/20 |
| DUPLICATE WELL | 0041811-06 | 4/6/20 | 4/8/20 |
| FIELD BLANK | 0041811-07 | 4/6/20 | 4/8/20 |

**QC Summary:**

All items met acceptance criteria with the following noted exceptions:

TDS batch QC samples flagged with M, RPD outside acceptance criteria

SO4, CL, Batch QC samples flagged with Q4, sample exceeds 4x spiked values

F, batch QC sample flagged with Q3, Q2, Q1, matrix spike and spike dup outside acceptance criteria.

**Certification**

Signature: Kurt Step

Name: Kurt Stepping

Date: April 16, 2020

Title: Senior Project Manager

**PDC LABORATORIES, INC.**
WWW.PDCLAB.COM

| REGULATORY PROGRAM (Check one:) | | | |
|---|---|---|---|
| | | NPDES | ☐ |
| MORBCA | ☐ | RCRA | ☐ |
| CCDD | ☐ | TACO: RES OR IND/COMM | ☐ |

# CHAIN OF CUSTODY RECORD

STATE WHERE SAMPLE COLLECTED MO

*ALL HIGHLIGHTED AREAS MUST BE COMPLETED BY CLIENT (PLEASE PRINT)*

① CLIENT: SIKESTON BMU POWER STATION
PROJECT NUMBER:
PROJECT LOCATION: FLYASH APP III ONLY
PURCHASE ORDER #: 23574
ADDRESS: 1551 W WAKEFIELD
PHONE NUMBER: 573.475.3131
E-MAIL: LSTMARY@SBMU.NET
DATE SHIPPED: 4-7-2020
CITY STATE ZIP: SIKESTON, MO 63801
SAMPLER (PLEASE PRINT): Daniel Dillingham
CONTACT PERSON: LUKE ST MARY
SAMPLER'S SIGNATURE: Daniel a. Dillingham

MATRIX TYPES:
WW- WASTEWATER
DW- DRINKING WATER
GW- GROUND WATER
WWSL- SLUDGE
NAS- NON AQUEOUS SOLID
LCHT-LEACHATE
OIL-OIL
SO-SOIL
SOL-SOLID

③ ANALYSIS REQUESTED

④ (FOR LAB USE ONLY)
LOGIN # 0041811
LOGGED BY:
CLIENT: SIKESTON BMU
PROJECT: FLYASH APP III ONLY
PROJ. MGR.: KURT
CUSTODY SEAL #:

| ② SAMPLE DESCRIPTION (UNIQUE DESCRIPTION AS IT WILL APPEAR ON THE ANALYTICAL REPORT) | DATE COLLECTED | TIME COLLECTED | SAMPLE TYPE GRAB | SAMPLE TYPE COMP | MATRIX TYPE | BOTTLE COUNT | PRES CODE CLIENT PROVIDED | CL, F, SO4, TDS | B, CA | | | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW-1 | 4-6-2020 | 1113 | X | | GW | 2 | | X | X | | | | | | |
| MW-2 | 4-6-2020 | 0904 | X | | GW | 2 | | X | X | | | | | | |
| MW-3 | 4-6-2020 | 0822 | X | | GW | 2 | | X | X | | | | | | |
| MW-7 | 4-6-2020 | 1158 | X | | GW | 2 | | X | X | | | | | | |
| MW-9 | 4-6-2020 | 1319 | X | | GW | 2 | | X | X | | | | | | |
| DUPLICATE WELL | 4-6-2020 | | X | | GW | 2 | | X | X | | | | | | |
| FIELD BLANK | 4-6-2020 | | X | | GW | 2 | | X | X | | | | | | |

CHEMICAL PRESERVATION CODES: I – HCL 2 – H2SO4 3 – HNO3 4 – NAOH 5 – NA2S2O3 6 – UNPRESERVED 7 – OTHER

⑤ TURNAROUND TIME REQUESTED (PLEASE CHECK) ☒ NORMAL ☐ RUSH
(RUSH TAT IS SUBJECT TO PDC LABS APPROVAL AND SURCHARGE)
RUSH RESULTS VIA (PLEASE CIRCLE) EMAIL ☐ PHONE ☐
DATE RESULTS NEEDED
EMAIL IF DIFFERENT FROM ABOVE:
PHONE # IF DIFFERENT FROM ABOVE:

⑥ *I understand that by initialing this box I give the lab permission to proceed with analysis, even though it may not meet all sample conformance requirements as defined in the receiving facility's Sample Acceptance Policy and the data will be qualified. Qualified data may NOT be acceptable to report to all regulatory authorities.*
PROCEED WITH ANALYSIS AND QUALIFY RESULTS: (INITIALS) ______

| ⑦ RELINQUISHED BY: (SIGNATURE) | DATE / TIME | RECEIVED BY: (SIGNATURE) | DATE / TIME |
|---|---|---|---|
| | DATE 4-7-2020<br>TIME 0730 | | DATE<br>TIME |
| RELINQUISHED BY: (SIGNATURE) | DATE<br>TIME | RECEIVED BY: (SIGNATURE) | DATE<br>TIME |
| RELINQUISHED BY: (SIGNATURE) | DATE<br>TIME | RECEIVED BY: (SIGNATURE) | DATE 4/8/20<br>TIME 1100 |

⑧ COMMENTS: (FOR LAB USE ONLY)

SAMPLE TEMPERATURE UPON RECEIPT 1.5 °C
CHILL PROCESS STARTED PRIOR TO RECEIPT [✓ Y] OR N
SAMPLE(S) RECEIVED ON ICE [✓ Y] OR N
SAMPLE ACCEPTANCE NONCONFORMANT REPORT IS NEEDED Y OR [✓ N]
DATE AND TIME TAKEN FROM SAMPLE BOTTLE ______

# Appendix 1b

## Laboratory Analytical Results and Quality Control Reports May 21, 2020 Resample Event

PDC Laboratories, Inc.
PROFESSIONAL • DEPENDABLE • COMMITTED

June 15, 2020

Luke St Mary
Sikeston BMU, Sikeston Power Station
1551 W Wakefield
Sikeston, MO 63801

RE: Sikeston Bottom Ash App III and App IV 2019

Dear Luke St Mary:

Please find enclosed the analytical results for the **6** sample(s) the laboratory received on **5/26/20 8:00 am** and logged in under work order **0054242**. All testing is performed according to our current TNI accreditations unless otherwise noted. This report cannot be reproduced, except in full, without the written permission of PDC Laboratories, Inc.

If you have any questions regarding your report, please contact your project manager. Quality and timely data is of the utmost importance to us.

PDC Laboratories, Inc. appreciates the opportunity to provide you with analytical expertise. We are always trying to improve our customer service and we welcome you to contact the Director of Client Services, Lisa Grant, with any feedback you have about your experience with our laboratory at 309-683-1764 or lgrant@pdclab.com.

Sincerely,

Kurt Stepping
Senior Project Manager
(309) 692-9688 x1719
kstepping@pdclab.com

# ANALYTICAL RESULTS

**Sample:** **0054242-01**
**Name:** MW-1
**Alias:** RESAMPLE

**Sampled:** 05/21/20 12:16
**Received:** 05/26/20 08:00
**Matrix:** Ground Water - Regular Sample

**PO #:** 23573

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **Anions - PIA** | | | | | | | | | |
| Sulfate | 63 | mg/L | | 06/02/20 00:17 | 10 | 10 | 06/02/20 00:17 | KCC | EPA 300.0 REV 2.1 |
| **General Chemistry - PIA** | | | | | | | | | |
| Solids - total dissolved solids (TDS) | 260 | mg/L | | 05/28/20 07:45 | 1 | 26 | 05/28/20 08:44 | BMS | SM 2540C |
| **Total Metals - PIA** | | | | | | | | | |
| Calcium | 60000 | ug/L | | 06/09/20 13:19 | 5 | 200 | 06/11/20 08:51 | JMW | EPA 6020A |

**Sample:** **0054242-02**
**Name:** DUPLICATE
**Alias:** RESAMPLE

**Sampled:** 05/21/20 00:00
**Received:** 05/26/20 08:00
**Matrix:** Ground Water - Regular Sample

**PO #:** 23573

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **Anions - PIA** | | | | | | | | | |
| Sulfate | 16 | mg/L | | 06/04/20 14:35 | 5 | 5.0 | 06/04/20 14:35 | MGU | EPA 300.0 REV 2.1 |
| **General Chemistry - PIA** | | | | | | | | | |
| Solids - total dissolved solids (TDS) | 100 | mg/L | H | 05/29/20 12:45 | 1 | 17 | 05/29/20 13:05 | BMS | SM 2540C |
| Solids - total dissolved solids (TDS) | 90 | mg/L | M, X | 05/28/20 07:45 | 1 | 17 | 05/28/20 08:44 | BMS | SM 2540C |
| **Total Metals - PIA** | | | | | | | | | |
| Calcium | 18000 | ug/L | | 06/09/20 13:19 | 5 | 200 | 06/11/20 08:54 | JMW | EPA 6020A |

# ANALYTICAL RESULTS

**Sample:** **0054242-03**
**Name:** MW-2
**Alias:** RESAMPLE

**Sampled:** 05/21/20 08:33
**Received:** 05/26/20 08:00
**Matrix:** Ground Water - Regular Sample

**PO #:** 23573

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **Anions - PIA** | | | | | | | | | |
| Fluoride | 0.374 | mg/L | | 06/02/20 00:35 | 1 | 0.250 | 06/02/20 00:35 | KCC | EPA 300.0 REV 2.1 |
| **Total Metals - PIA** | | | | | | | | | |
| Boron | 36 | ug/L | | 06/09/20 13:19 | 5 | 10 | 06/11/20 08:58 | JMW | EPA 6020A |

**Sample:** **0054242-04**
**Name:** MW-3
**Alias:** RESAMPLE

**Sampled:** 05/21/20 07:30
**Received:** 05/26/20 08:00
**Matrix:** Ground Water - Regular Sample

**PO #:** 23573

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **Anions - PIA** | | | | | | | | | |
| Chloride | 1.5 | mg/L | Q1 | 06/02/20 02:06 | 1 | 1.0 | 06/02/20 02:06 | KCC | EPA 300.0 REV 2.1 |
| **General Chemistry - PIA** | | | | | | | | | |
| Solids - total dissolved solids (TDS) | 130 | mg/L | | 05/28/20 07:45 | 1 | 26 | 05/28/20 08:44 | BMS | SM 2540C |

**Sample:** **0054242-05**
**Name:** MW-9
**Alias:** RESAMPLE

**Sampled:** 05/21/20 14:24
**Received:** 05/26/20 08:00
**Matrix:** Ground Water - Regular Sample

**PO #:** 23573

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **General Chemistry - PIA** | | | | | | | | | |
| Solids - total dissolved solids (TDS) | 560 | mg/L | | 05/28/20 07:45 | 1 | 26 | 05/28/20 08:44 | BMS | SM 2540C |

# ANALYTICAL RESULTS

**Sample:** **0054242-06**
**Name:** FIELD BLANK
**Matrix:** Ground Water - Regular Sample

**Sampled:** 05/21/20 00:00
**Received:** 05/26/20 08:00
**PO #:** 23573

| Parameter | Result | Unit | Qualifier | Prepared | Dilution | MRL | Analyzed | Analyst | Method |
|---|---|---|---|---|---|---|---|---|---|
| **Anions - PIA** | | | | | | | | | |
| Chloride | < 1.0 | mg/L | | 06/02/20 03:01 | 1 | 1.0 | 06/02/20 03:01 | KCC | EPA 300.0 REV 2.1 |
| Fluoride | < 0.250 | mg/L | | 06/02/20 03:01 | 1 | 0.250 | 06/02/20 03:01 | KCC | EPA 300.0 REV 2.1 |
| Sulfate | < 1.0 | mg/L | | 06/02/20 03:01 | 1 | 1.0 | 06/02/20 03:01 | KCC | EPA 300.0 REV 2.1 |
| **General Chemistry - PIA** | | | | | | | | | |
| Solids - total dissolved solids (TDS) | < 17 | mg/L | | 05/28/20 07:45 | 1 | 17 | 05/28/20 08:44 | BMS | SM 2540C |
| **Total Metals - PIA** | | | | | | | | | |
| Boron | < 10 | ug/L | | 06/09/20 13:19 | 5 | 10 | 06/11/20 09:02 | JMW | EPA 6020A |
| Calcium | 220 | ug/L | | 06/09/20 13:19 | 5 | 200 | 06/11/20 09:02 | JMW | EPA 6020A |

# QC SAMPLE RESULTS

| Parameter | Result | Unit | Qual | Spike Level | Source Result | %REC | %REC Limits | RPD | RPD Limit |
|---|---|---|---|---|---|---|---|---|---|
| ***Batch B012525 - No Prep - SM 2540C*** | | | | | | | | | |
| **Blank (B012525-BLK1)** | | | | Prepared & Analyzed: 05/28/20 | | | | | |
| Solids - total dissolved solids (TDS) | < 17 | mg/L | | | | | | | |
| **LCS (B012525-BS1)** | | | | Prepared & Analyzed: 05/28/20 | | | | | |
| Solids - total dissolved solids (TDS) | 947 | mg/L | | 1000 | | 95 | 67.9-132 | | |
| **Duplicate (B012525-DUP2)** | **Sample: 0054242-02RE1** | | | Prepared & Analyzed: 05/28/20 | | | | | |
| Solids - total dissolved solids (TDS) | 110 | mg/L | M, X | | 90.0 | | | 20 | |
| ***Batch B012718 - No Prep - SM 2540C*** | | | | | | | | | |
| **Blank (B012718-BLK1)** | | | | Prepared & Analyzed: 05/29/20 | | | | | |
| Solids - total dissolved solids (TDS) | < 17 | mg/L | | | | | | | |
| **LCS (B012718-BS1)** | | | | Prepared & Analyzed: 05/29/20 | | | | | |
| Solids - total dissolved solids (TDS) | 947 | mg/L | | 1000 | | 95 | 67.9-132 | | |
| **Duplicate (B012718-DUP1)** | **Sample: 0054242-02** | | | Prepared & Analyzed: 05/29/20 | | | | | |
| Solids - total dissolved solids (TDS) | 100 | mg/L | H | | 100 | | | 0 | 5 |
| ***Batch B013015 - No Prep - EPA 300.0 REV 2.1*** | | | | | | | | | |
| **Calibration Blank (B013015-CCB1)** | | | | Prepared & Analyzed: 06/01/20 | | | | | |
| Fluoride | 0.00 | mg/L | | | | | | | |
| Chloride | 0.552 | mg/L | | | | | | | |
| Sulfate | 0.00 | mg/L | | | | | | | |
| **Calibration Check (B013015-CCV1)** | | | | Prepared & Analyzed: 06/01/20 | | | | | |
| Chloride | 4.88 | mg/L | | 5.000 | | 98 | 90-110 | | |
| Fluoride | 4.95 | mg/L | | 5.000 | | 99 | 90-110 | | |
| Sulfate | 5.17 | mg/L | | 5.000 | | 103 | 90-110 | | |
| **Matrix Spike (B013015-MS3)** | **Sample: 0054242-03** | | | Prepared & Analyzed: 06/02/20 | | | | | |
| Fluoride | 1.76 | mg/L | | 1.500 | 0.374 | 92 | 80-120 | | |
| **Matrix Spike (B013015-MS4)** | **Sample: 0054242-04** | | | Prepared & Analyzed: 06/02/20 | | | | | |
| Chloride | 2.6 | mg/L | Q1 | 1.500 | 1.5 | 75 | 80-120 | | |
| **Matrix Spike Dup (B013015-MSD3)** | **Sample: 0054242-03** | | | Prepared & Analyzed: 06/02/20 | | | | | |
| Fluoride | 1.78 | mg/L | | 1.500 | 0.374 | 94 | 80-120 | 2 | 20 |
| **Matrix Spike Dup (B013015-MSD4)** | **Sample: 0054242-04** | | | Prepared & Analyzed: 06/02/20 | | | | | |
| Chloride | 3.1 | mg/L | | 1.500 | 1.5 | 107 | 80-120 | 17 | 20 |
| ***Batch B013404 - No Prep - EPA 300.0 REV 2.1*** | | | | | | | | | |
| **Calibration Blank (B013404-CCB1)** | | | | Prepared & Analyzed: 06/04/20 | | | | | |
| Sulfate | 0.00 | mg/L | | | | | | | |
| **Calibration Check (B013404-CCV1)** | | | | Prepared & Analyzed: 06/04/20 | | | | | |
| Sulfate | 5.07 | mg/L | | 5.000 | | 101 | 90-110 | | |
| ***Batch B013688 - SW 3015 - EPA 6020A*** | | | | | | | | | |
| **Blank (B013688-BLK1)** | | | | Prepared: 06/09/20 Analyzed: 06/11/20 | | | | | |
| Boron | < 10 | ug/L | | | | | | | |
| Calcium | < 200 | ug/L | | | | | | | |
| **LCS (B013688-BS1)** | | | | Prepared: 06/09/20 Analyzed: 06/11/20 | | | | | |

# QC SAMPLE RESULTS

| Parameter | Result | Unit | Qual | Spike Level | Source Result | %REC | %REC Limits | RPD | RPD Limit |
|---|---|---|---|---|---|---|---|---|---|
| ***Batch B013688 - SW 3015 - EPA 6020A*** | | | | | | | | | |
| **LCS (B013688-BS1)** | | | | Prepared: 06/09/20 Analyzed: 06/11/20 | | | | | |
| Boron | 524 | ug/L | | 555.6 | | 94 | 80-120 | | |
| Calcium | 5630 | ug/L | | 5556 | | 101 | 80-120 | | |
| **Matrix Spike (B013688-MS1)** | **Sample: 0054994-01** | | | Prepared: 06/09/20 Analyzed: 06/11/20 | | | | | |
| Boron | 1900 | ug/L | | 555.6 | 1340 | 101 | 75-125 | | |
| Calcium | 186000 | ug/L | Q4 | 5556 | 183000 | 63 | 75-125 | | |
| **Matrix Spike Dup (B013688-MSD1)** | **Sample: 0054994-01** | | | Prepared: 06/09/20 Analyzed: 06/11/20 | | | | | |
| Boron | 1920 | ug/L | | 555.6 | 1340 | 104 | 75-125 | 1 | 20 |
| Calcium | 185000 | ug/L | Q4 | 5556 | 183000 | 42 | 75-125 | 0.6 | 20 |

# NOTES

Specifications regarding method revisions and method modifications used for analysis are available upon request. Please contact your project manager.

* Not a TNI accredited analyte

## Certifications

CHI - McHenry, IL - 4314-A W. Crystal Lake Road, McHenry, IL 60050
TNI Accreditation for Drinking Water and Wastewater Fields of Testing through IL EPA Accreditation No. 100279
Illinois Department of Public Health Bacterial Analysis in Drinking Water Approved Laboratory Registry No. 17556

PIA - Peoria, IL - 2231 W. Altorfer Drive, Peoria, IL 61615
TNI Accreditation for Drinking Water, Wastewater, Solid and Hazardous Material Fields of Testing through IL EPA Accreditation No. 100230
Illinois Department of Public Health Bacterial Analysis in Drinking Water Approved Laboratory Registry No. 17553
Drinking Water Certifications/Accreditations: Iowa (240); Kansas (E-10338); Missouri (870)
Wastewater Certifications/Accreditations: Arkansas (88-0677); Iowa (240); Kansas (E-10338)
Solid and Hazardous Material Certifications/Accreditations: Arkansas (88-0677); Iowa (240); Kansas (E-10338)

SPMO - Springfield, MO - 1805 W Sunset Street, Springfield, MO 65807
USEPA DMR-QA Program

STL - Hazelwood, MO - 944 Anglum Rd, Hazelwood, MO 63042
TNI Accreditation for Wastewater, Solid and Hazardous Material Fields of Testing through KS KDHE Certification No. E-10389
TNI Accreditation for Wastewater, Solid and Hazardous Material Fields of Testing through IL EPA Accreditation No. - 200080
Illinois Department of Public Health Bacterial Analysis in Drinking Water Approved Laboratory, Registry No. 171050
Missouri Department of Natural Resources - Certificate of Approval for Microbiological Laboratory Service - No. 1050

## Qualifiers

| | |
|---|---|
| H | Test performed after the expiration of the appropriate regulatory/advisory maximum allowable hold time. |
| M | Analyte failed to meet the required acceptance criteria for duplicate analysis. |
| Q1 | Matrix Spike failed % recovery acceptance limits. The associated blank spike recovery was acceptable. |
| Q4 | The matrix spike recovery result is unusable since the analyte concentration in the sample is greater than four times the spike level. The associated blank spike was acceptable. |
| X | Sample did not meet weighback criteria established in the method. Reset out of hold for confirmation of result. Both sets of data to be reported. H flagged data is to confirm the validity of the initial data in spite of the weigh back criteria. |

Kurt

Certified by: Kurt Stepping, Senior Project Manager

PDC Laboratories, Inc.
P.O. Box 9071 • Peoria, IL 61612-9071
(309) 692-9688 • (800) 752-6651 • FAX (309) 692-9689

# DATA PACKAGE

`

**CLIENT: Sikeston BMU**

**PROJECT: Sikeston Power Station**

**PDC LAB WORKORDER: 0054242**

**DATE ISSUED: June 15, 2020**

# CASE NARRATIVE –

## PDC Work Order 0054242

PDC Laboratories, Inc. received 6 water samples on May 26, 2020 in good condition at our Peoria, IL facility. This sample set was designated as work order 0054242

| Sample ID's | | Date | |
|---|---|---|---|
| **Field** | **Lab ID** | **Collected** | **Received** |
| MW-1 | 0054242-01 | 5/21/20 | 5/26/20 |
| DUPLICATE | 0054242-02 | 5/21/20 | 5/26/20 |
| MW-2 | 0054242-03 | 5/21/20 | 5/26/20 |
| MW-3 | 0054242-04 | 5/21/20 | 5/26/20 |
| MW-9 | 0054242-05 | 5/21/20 | 5/26/20 |
| FIELD BLANK | 0054242-06 | 5/21/20 | 5/26/20 |
| | | | |

**QC Summary:**

All items met acceptance criteria with the following noted exceptions:

Ca, batch QC sample flagged with Q4, sample exceeds 4x spiked values

Cl, batch QC sample flagged with Q1, matrix spike outside acceptance criteria.

Initial analysis for TDS on sample 0054242-02 was below method criteria for weigh back and also was done in duplicate with an RPD greater than 5%. Flagged with X and M. See LIMS report for full X qualifier description.

TDS on sample 0054242-02 was repeated in duplicate out of hold time to confirm initial analysis. Re-analysis RPD was 0%, weigh back was acceptable. Re-analysis flagged with H for hold time.

**Certification**

Signature: Kurt Step

Name: Kurt Stepping

Date: June 15, 2020

Title: Senior Project Manager

**PDC LABORATORIES, INC.**
WWW.PDCLAB.COM

| REGULATORY PROGRAM (Check one:) | |
|---|---|
| | NPDES ☐ |
| MORBCA ☐ | RCRA ☐ |
| CCDD ☐ | TACO: RES or IND/COMM ☐ |

# CHAIN OF CUSTODY RECORD

STATE WHERE SAMPLE COLLECTED MO

*ALL HIGHLIGHTED AREAS MUST BE COMPLETED BY CLIENT (PLEASE PRINT)*

① CLIENT SIKESTON BMU POWER STATION
PROJECT NUMBER
PROJECT LOCATION RESAMPLES
PURCHASE ORDER #
ADDRESS 1551 W WAKEFIELD
PHONE NUMBER 573.475.3131
E-MAIL LSTMARY@SBMU.NET
DATE SHIPPED
CITY STATE ZIP SIKESTON, MO 63801
SAMPLER (PLEASE PRINT) Daniel Dillingham
CONTACT PERSON LUKE ST MARY
SAMPLER'S SIGNATURE

MATRIX TYPES:
WW- WASTEWATER
DW- DRINKING WATER
GW- GROUND WATER
WWSL- SLUDGE
NAS- NON AQUEOUS SOLID
LCHT-LEACHATE
OIL-OIL
SO-SOIL
SOL-SOLID

③ ANALYSIS REQUESTED

④ (FOR LAB USE ONLY)
LOGIN # 0054242
LOGGED BY:
CLIENT: SIKESTON BMU
PROJECT: RESAMPLES MAY 2020
PROJ. MGR.: KURT
CUSTODY SEAL #:

| ② SAMPLE DESCRIPTION (UNIQUE DESCRIPTION AS IT WILL APPEAR ON THE ANALYTICAL REPORT) | DATE COLLECTED | TIME COLLECTED | SAMPLE TYPE GRAB | SAMPLE TYPE COMP | MATRIX TYPE | BOTTLE COUNT | PRES CODE CLIENT PROVIDED | TDS | SULFATE | CALCIUM | FLUORIDE | BORON | CHLORIDE | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW-1 | 05-21-20 | 1216 | X | | GW | 2 | | X | X | X | | | | | |
| DUPLICATE | 05-21-20 | | X | | GW | 2 | | X | X | X | | | | | |
| MW-2 | 05-21-20 | 0833 | X | | GW | 2 | | | | | X | X | | | |
| MW-3 | 05-21-20 | 0730 | X | | GW | 1 | | X | | | | | X | | |
| MW-9 | 05-21-20 | 1424 | X | | GW | 1 | | X | | | | | | | |
| FIELD BLANK | 05-21-20 | | X | | GW | 2 | | X | X | X | X | X | X | | |

CHEMICAL PRESERVATION CODES: 1 – HCL | 2 – H2SO4 | 3 – HNO3 | 4 – NAOH | 5 – NA2S2O3 | 6 – UNPRESERVED | 7 – OTHER

⑤ TURNAROUND TIME REQUESTED (PLEASE CHECK) ☒ NORMAL ☐ RUSH
(RUSH TAT IS SUBJECT TO PDC LABS APPROVAL AND SURCHARGE)
DATE RESULTS NEEDED
RUSH RESULTS VIA (PLEASE CIRCLE) EMAIL ☐ PHONE ☐
EMAIL IF DIFFERENT FROM ABOVE:
PHONE # IF DIFFERENT FROM ABOVE:

⑥ *I understand that by initialing this box I give the lab permission to proceed with analysis, even though it may not meet all sample conformance requirements as defined in the receiving facility's Sample Acceptance Policy and the data will be qualified. Qualified data may NOT be acceptable to report to all regulatory authorities.*

PROCEED WITH ANALYSIS AND QUALIFY RESULTS: (INITIALS) ____________

| ⑦ RELINQUISHED BY: (SIGNATURE) | DATE / TIME | RECEIVED BY: (SIGNATURE) | DATE / TIME |
|---|---|---|---|
| Ashish Patel | DATE 5-22-2020<br>TIME 0700 | | DATE<br>TIME |
| RELINQUISHED BY: (SIGNATURE) | DATE<br>TIME | RECEIVED BY: (SIGNATURE) | DATE<br>TIME |
| RELINQUISHED BY: (SIGNATURE) | DATE<br>TIME | RECEIVED BY: (SIGNATURE) | DATE 5/26/20<br>TIME 8 00 |

⑧ COMMENTS: (FOR LAB USE ONLY)

SAMPLE TEMPERATURE UPON RECEIPT 19.0 °C
CHILL PROCESS STARTED PRIOR TO RECEIPT [✓ Y] OR N
SAMPLE(S) RECEIVED ON ICE [✓ Y] OR N
SAMPLE ACCEPTANCE NONCONFORMANT REPORT IS NEEDED Y OR [✓ N]
DATE AND TIME TAKEN FROM SAMPLE BOTTLE ____________

# Appendix 2

## 2019 Annual Water Quality Report
## For Sikeston Public Water System

# SIKESTON PWS

## Public Water System ID Number: MO4010743

# 2019 Annual Water Quality Report

## *(Consumer Confidence Report)*

***This report is intended to provide you with important information about your drinking water and the efforts made to provide safe drinking water.***

**Attencion!**

Este informe contiene información muy importante. Tradúscalo o prequntele a alguien que lo entienda bien.
[Translated: This report contains very important information. Translate or ask someone who understands this very well.]

## What is the source of my water?

The sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs, and groundwater wells. As water travels over the surface of the land or through the ground, it dissolves naturally-occurring minerals and, in some cases, radioactive material, and can pick up substances resulting from the presence of animals or from human activity.

**Our water comes from the following source(s):**

| Source Name | Type |
|---|---|
| PLANT 1 – WELL 11 | GROUND WATER |
| PLANT 2 – WELLS 1, 6, 7, 12 | GROUND WATER |
| PLANT 3 – WELLS 8, 9, 13 | GROUND WATER |

## Source Water Assessment

The Department of Natural Resources conducted a source water assessment to determine the susceptibility of our water source to potential contaminants. This process involved the establishment of source water area delineations for each well or surface water intake and then a contaminant inventory was performed within those delineated areas to assess potential threats to each source. Assessment maps and summary information sheets are available on the internet at https://drinkingwater.missouri.edu/. To access the maps for your water system you will need the State-assigned identification code, which is printed at the top of this report. The Source Water Inventory Project maps and information sheets provide a foundation upon which a more comprehensive source water protection plan can be developed.

## Why are there contaminants in my water?

Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the Environmental Protection Agency's Safe Drinking Water Hotline (800-426-4791).

Contaminants that may be present in source water include:
A. Microbial contaminants, such as viruses and bacteria, which may come from sewage treatment plants, septic systems, agricultural livestock operations, and wildlife.
B. Inorganic contaminants, such as salts and metals, which can be naturally-occurring or result from urban stormwater runoff, industrial, or domestic wastewater discharges, oil and gas production, mining, or farming.
C. Pesticides and herbicides, which may come from a variety of sources such as agriculture, urban stormwater runoff, and residential uses.
D. Organic chemical contaminants, including synthetic and volatile organic chemicals, which are byproducts of industrial processes and petroleum production, and can also come from gas stations, urban stormwater runoff, and septic systems.
E. Radioactive contaminants, which can be naturally-occurring or be the result of oil and gas production and mining activities.

In order to ensure that tap water is safe to drink, the Department of Natural Resources prescribes regulations which limit the amount of certain contaminants in water provided by public water systems. Department of Health regulations establish limits for contaminants in bottled water which must provide the same protection for public health.

## Is our water system meeting other rules that govern our operations?

The Missouri Department of Natural Resources regulates our water system and requires us to test our water on a regular basis to ensure its safety. Our system has been assigned the identification number MO4010743 for the purposes of tracking our test results. Last year, we tested for a variety of contaminants. The detectable results of these tests are on the following pages of this report. Any violations of state requirements or standards will be further explained later in this report.

## How might I become actively involved?

If you would like to observe the decision-making process that affect drinking water quality or if you have any further questions about your drinking water report, please call us at **573-380-3996** to inquire about scheduled meetings or contact persons.

## Do I need to take any special precautions?

Some people may be more vulnerable to contaminants in drinking water than the general population. Immunocompromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. EPA/CDC guidelines on appropriate means to lessen the risk of infection by Cryptosporidium and other microbial contaminants are available from the Safe Drinking Water Hotline (800-426-4791).

## Terms and Abbreviations

**Population**: 16393. This is the equivalent residential population served including non-bill paying customers.
**90th percentile**: For Lead and Copper testing. 10% of test results are above this level and 90% are below this level.
**AL**: Action Level, or the concentration of a contaminant which, when exceeded, triggers treatment or other requirements which a water system must follow.
**HAA5**: Haloacetic Acids (mono-, di- and tri-chloracetic acid, and mono- and di-bromoacetic acid) as a group.
**LRAA**: Locational Running Annual Average, or the locational average of sample analytical results for samples taken during the previous four calendar quarters.
**MCLG**: Maximum Contaminant Level Goal, or the level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety.
**MCL**: Maximum Contaminant Level, or the highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology.
**n/a**: not applicable.
**nd**: not detectable at testing limits.
**NTU**: Nephelometric Turbidity Unit, used to measure cloudiness in drinking water.
**ppb**: parts per billion or micrograms per liter.
**ppm**: parts per million or milligrams per liter.
**RAA**: Running Annual Average, or the average of sample analytical results for samples taken during the previous four calendar quarters.
**Range of Results**: Shows the lowest and highest levels found during a testing period, if only one sample was taken, then this number equals the Highest Test Result or Highest Value.
**SMCL**: Secondary Maximum Contaminant Level, or the secondary standards that are non-enforceable guidelines for contaminants and may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor or color) in drinking water. EPA recommends these standards but does not require water systems to comply
**TT**: Treatment Technique, or a required process intended to reduce the level of a contaminant in drinking water.
**TTHM**: Total Trihalomethanes (chloroform, bromodichloromethane, dibromochloromethane, and bromoform) as a group.

MISSOURI
DEPARTMENT OF
NATURAL RESOURCES

April 15, 2020

# SIKESTON PWS

Public Water System ID Number: MO4010743

# 2019 Annual Water Quality Report

*(Consumer Confidence Report)*

# Contaminants Report

SIKESTON PWS will provide a printed hard copy of the CCR upon request. To request a copy of this report to be mailed, please call us at **573-380-3996**. The CCR can also be found on the internet at www.dnr.mo.gov/ccr/MO4010743.pdf.

*The state has reduced monitoring requirements for certain contaminants to less often than once per year because the concentrations of these contaminants are not expected to vary significantly from year to year. Records with a sample year more than one year old are still considered representative. No data older than 5 years need be included. If more than one sample is collected during the monitoring period, the Range of Sampled Results will show the lowest and highest tested results. The Highest Test Result, Highest LRAA, or Highest Value must be below the maximum contaminant level (MCL) or the contaminant has exceeded the level of health based standards and a violation is issued to the water system.*

## Regulated Contaminants

| Regulated Contaminants | Collection Date | Highest Test Result | Range of Sampled Result(s) (low – high) | Unit | MCL | MCLG | Typical Source |
|---|---|---|---|---|---|---|---|
| BARIUM | 5/29/2018 | 0.42 | 0.149 - 0.42 | ppm | 2 | 2 | Discharge of drilling wastes; Discharge from metal refineries; Erosion of natural deposits |
| FLUORIDE | 5/29/2018 | 0.86 | 0.61 - 0.86 | ppm | 4 | 4 | Natural deposits; Water additive which promotes strong teeth |
| NITRATE-NITRITE | 8/27/2019 | 0.012 | 0 - 0.012 | ppm | 10 | 10 | Runoff from fertilizer use; Leaching from septic tanks, sewage; Erosion of natural deposits |

| Disinfection Byproducts | Sample Point | Monitoring Period | Highest LRAA | Range of Sampled Result(s) (low – high) | Unit | MCL | MCLG | Typical Source |
|---|---|---|---|---|---|---|---|---|
| (HAA5) | DBPDUAL-01 | 2019 | 16 | 15.6 - 15.6 | ppb | 60 | 0 | Byproduct of drinking water disinfection |
| (HAA5) | DBPDUAL-03 | 2019 | 16 | 16.2 - 16.2 | ppb | 60 | 0 | Byproduct of drinking water disinfection |
| TTHM | DBPDUAL-01 | 2019 | 16 | 16.2 - 16.2 | ppb | 80 | 0 | Byproduct of drinking water disinfection |
| TTHM | DBPDUAL-03 | 2019 | 24 | 23.7 - 23.7 | ppb | 80 | 0 | Byproduct of drinking water disinfection |

| Lead and Copper | Date | 90th Percentile: 90% of your water utility levels were less than | Range of Sampled Results (low – high) | Unit | AL | Sites Over AL | Typical Source |
|---|---|---|---|---|---|---|---|
| COPPER | 2017 - 2019 | 0.113 | 0.0197 - 0.138 | ppm | 1.3 | 0 | Corrosion of household plumbing systems |

| Microbiological | Result | MCL | MCLG | Typical Source |
|---|---|---|---|---|
| COLIFORM (TCR) | In the month of July, 1 sample(s) returned as positive | Treatment Technique Trigger | 0 | Naturally present in the environment |

## Violations and Health Effects Information

During the 2019 calendar year, we had the below noted violation(s) of drinking water regulations.

| Compliance Period | Analyte | Type |
|---|---|---|
| No Violations Occurred in the Calendar Year of 2019 | | |

### Special Lead and Copper Notice:

If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. Lead in drinking water is primarily from materials and components associated with service lines and home plumbing. SIKESTON PWS is responsible for providing high quality drinking water, but cannot control the variety of materials used in plumbing components. When your water has been sitting for several hours, you can minimize the potential for lead exposure by flushing your tap for 30 seconds to 2 minutes before using water for drinking or cooking. If you are concerned about lead in your water, you may wish to have your water tested. Information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the Safe Drinking Water Hotline (800-426-4791) or at http://water.epa.gov/drink/info/lead/index.cfm.

You can also find sample results for all contaminants from both past and present compliance monitoring online at the Missouri DNR Drinking Water Watch website http://dnr.mo.gov/DWW/indexSearchDNR.jsp. To find Lead and Copper results for your system, type your water system name in the box titled Water System Name and select *Find Water Systems* at the bottom of the page. The new screen will show you the water system name and number, select and click the Water System Number. At the top of the next page, under the *Help* column find, *Other Chemical Results by Analyte*, select and click on it. Scroll down alphabetically to Lead and click the blue Analyte Code (1030). The Lead and Copper locations will be displayed under the heading *Sample Comments*. Scroll to find your location and click on the *Sample No.* for the results. If your house was selected by the water system and you assisted in taking a Lead and Copper sample from your home but cannot find your location in the list, please contact SIKESTON PWS for your results.

April 15, 2020

# SIKESTON PWS

Public Water System ID Number: MO4010743

# 2019 Annual Water Quality Report

*(Consumer Confidence Report)*

## Optional Monitoring (not required by EPA)

### Optional Contaminants

*Monitoring is not required for optional contaminants.*

| Secondary Contaminants | Collection Date | Your Water System Highest Sampled Result | Range of Sampled Result(s) (low - high) | Unit | SMCL |
|---|---|---|---|---|---|
| ALKALINITY, CACO3 STABILITY | 5/29/2018 | 224 | 196 - 224 | MG/L | |
| CALCIUM | 5/29/2018 | 63 | 39.8 - 63 | MG/L | |
| CHLORIDE | 5/29/2018 | 21 | 10.1 - 21 | MG/L | 250 |
| HARDNESS, CARBONATE | 5/29/2018 | 207 | 133 - 207 | MG/L | |
| IRON | 5/29/2018 | 0.0116 | 0 - 0.0116 | MG/L | 0.3 |
| MAGNESIUM | 5/29/2018 | 12 | 8.14 - 12 | MG/L | |
| MANGANESE | 5/29/2018 | 0.002 | 0.0019 - 0.002 | MG/L | 0.05 |
| PH | 5/29/2018 | 7.55 | 7.5 - 7.55 | PH | 8.5 |
| POTASSIUM | 5/29/2018 | 2.08 | 1.54 - 2.08 | MG/L | |
| SODIUM | 5/29/2018 | 8.77 | 8.17 - 8.77 | MG/L | |
| SULFATE | 5/29/2018 | 32 | 14.5 - 32 | MG/L | 250 |
| TDS | 5/29/2018 | 290 | 174 - 290 | MG/L | 500 |
| ZINC | 5/29/2018 | 0.0252 | 0.0124 - 0.0252 | MG/L | 5 |

Secondary standards are non-enforceable guidelines for contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor or color) in drinking water. EPA recommends these standards but does not require water systems to comply.

April 15, 2020

# Appendix 3a

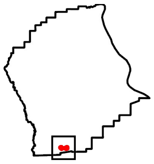
## 2020 Sikeston Public Well Assessment Reports (CARES)

# Sikeston

## General System Information

PWSS No. 4010743

Prepared by CARES, University of Missouri Extension

| | |
|---|---|
| **Name** | Sikeston |
| **PWSSID** | MO4010743 |
| **Population Served** | 16,393 |
| **Primary County Served** | Scott |
| **Service Connections** | 7,908 |
| **Source(s) of Water** | Southeast Missouri Lowlands Groundwater Province |
| **System Classification** | Community (C) |
| **Primary Source Type** | Groundwater (GW) |
| **System Type** | Municipality |
| **System Treatment** | 4-log Treatment of Viruses, Fluoridation, Greensand Filtration, Sedimentation, Gaseous Pre-Chlorination, Permanganate, Slat Tray Aeration, Gaseous Post-Chlorination, Diffused Aeration, (Pre) pH Adjustment, pH Adjustment, Rapid Sand Filtration |
| **DNR Region of Operations** | Southeast Regional Office |
| **Source Water/Wellhead Protection Plan** | No |
| **Drinking Water Watch** | Drinking Water Watch |
| **Reference Maps** |   |

# Sikeston

**Overview Map (Aerial)**
PWSS No. 4010743 - 8 Wells, Scott County

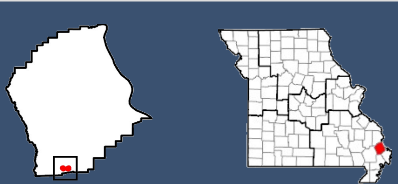
Map Prepared: Jun 11, 2020
Data Release: May 4, 2020

MISSOURI DEPARTMENT OF NATURAL RESOURCES
Prepared by CARES, University of Missouri Extension

**Groundwater System**
● System Well

**Source Water Protection Boundary**
○ 20-Year Time of Travel
○ Half-Mile Buffer

0 0.5 1
Miles



SWAP - Source Water Assessment Plan - http://drinkingwater.missouri.edu/swap
Aerial Photos: Bing Maps, Microsoft. Jun 11, 2020.

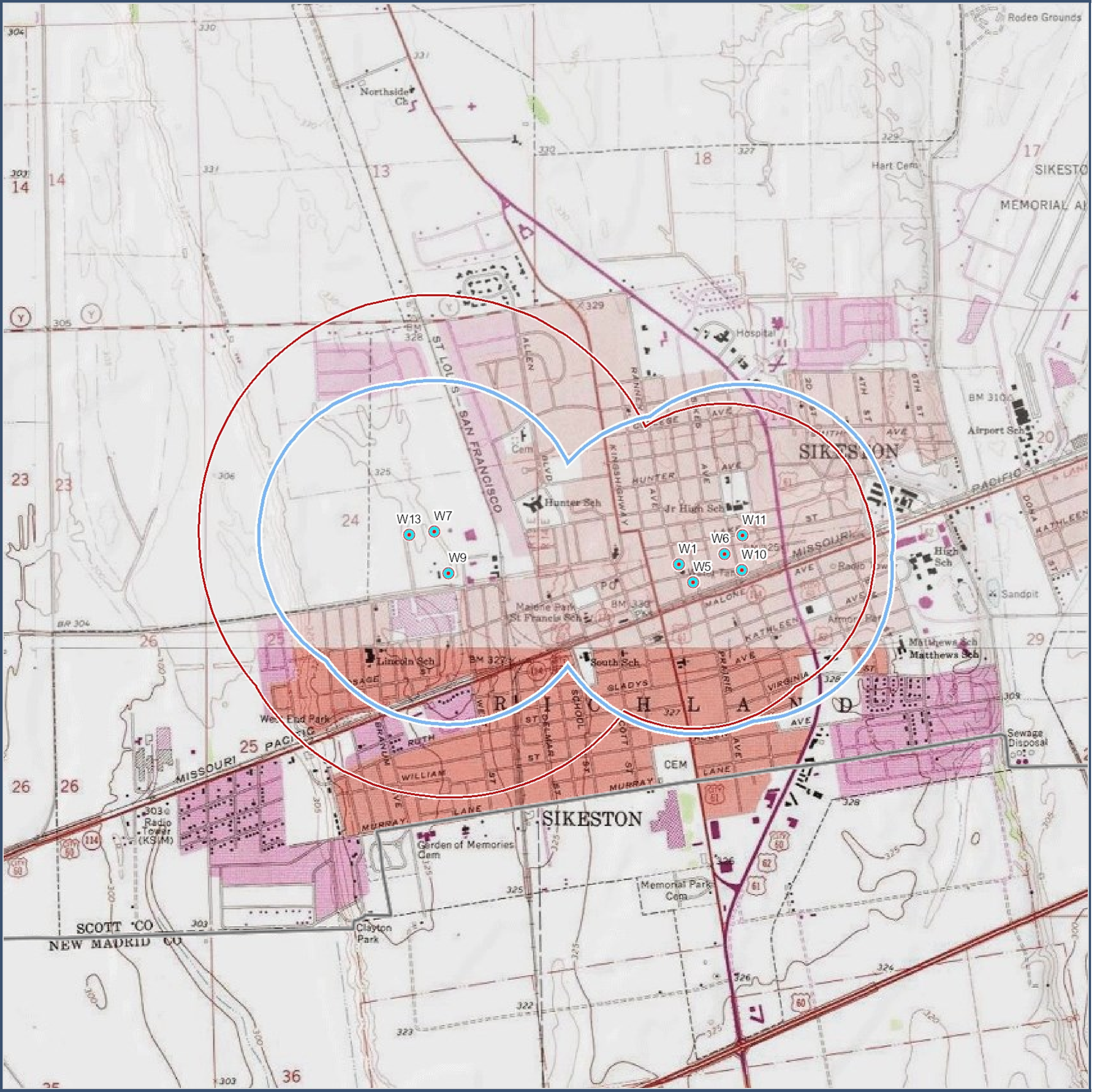
# Sikeston

**Overview Map (Topo)**
PWSS No. 4010743 - 8 Wells, Scott County

Map Prepared: Jun 11, 2020
Data Release: May 4, 2020

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Prepared by CARES, University of Missouri Extension



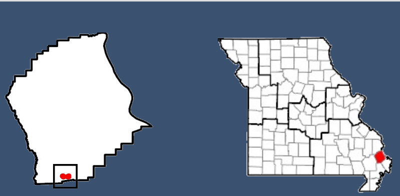
**Groundwater System**

● System Well

**Source Water Protection Boundary**

◯ 20-Year Time of Travel

◯ Half-Mile Buffer



0 0.5 1

Miles

SWAP - Source Water Assessment Plan - http://drinkingwater.missouri.edu/swap
For basemap symbols, see the U.S. Geological Survey (USGS) publication: Topographic Map Symbols.

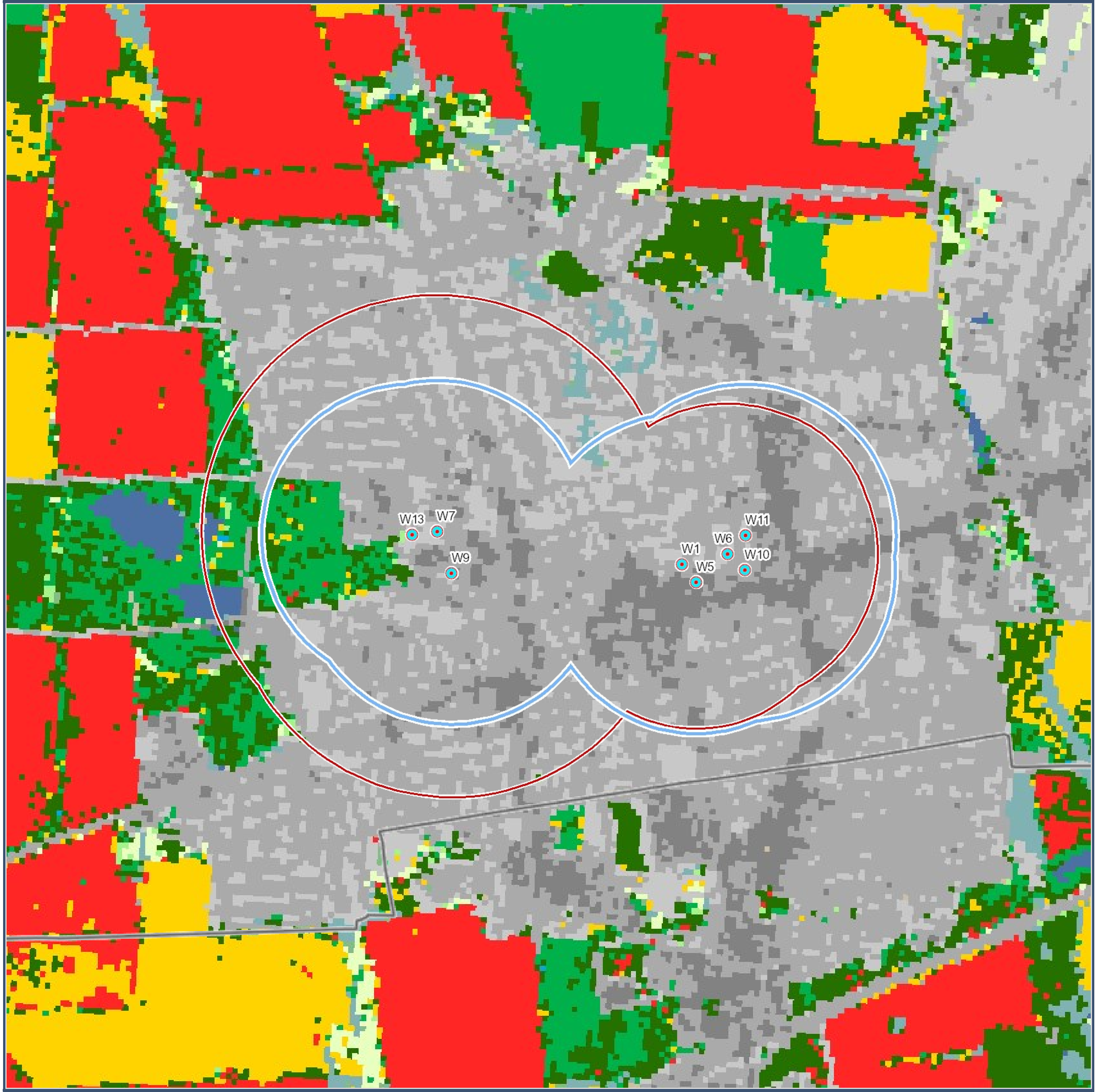
# Sikeston

**Overview Map (Land Use)**
PWSS No. 4010743 - 8 Wells, Scott County

Map Prepared: Jun 11, 2020
Data Release: May 4, 2020

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Prepared by CARES, University of Missouri Extension



## Land Use

- 🟨 Corn
- 🟥 Cotton
- 🟦 Rice
- 🟩 Soybeans
- 🟩 Other Crop
- 🟩 Other Hay/Non Alfalfa
- ⬜ Grassland/Pasture
- 🟩 Forest/Shrubland
- ⬛ Developed/High Intensity
- ⬜ Developed/Low-Med Intensity
- ⬜ Developed/Open Space
- 🟦 Open Water
- 🟦 Wetlands
- 🟫 Barren

**Groundwater System**

- ◉ System Well

**Source Water Protection Boundary**

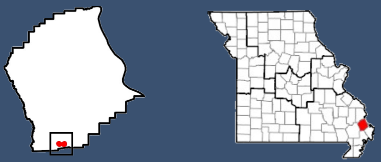
- ⬭ 20-Year Time of Travel
- ⬭ Half-Mile Buffer

SWAP - Source Water Assessment Plan -
http://drinkingwater.missouri.edu/swap
Aerial Photos: Bing Maps, Microsoft. Jun 11, 2020.

N

0 0.5 1

Miles



# Sikeston

**Land Use Statistics**
PWSS No. 4010743

Map Prepared: Jun 11, 2020
Data Release: May 4, 2020

Prepared by CARES, University of Missouri Extension

| Land Use | % Land Area, 2017 | % Land Area, 2018 | % Land Area, 2019 | Avg. % Land Area |
|---|---|---|---|---|
| Corn | 0 | 0 | 0 | 0 |
| Cotton | 0 | 0 | 0 | 0 |
| Rice | 0 | 0 | 0 | 0 |
| Soybeans | 0 | 0.04 | 0 | 0.01 |
| Other Crop | 0 | 0 | 0 | 0 |
| Other Hay/Non-Alfalfa | 0 | 0 | 0 | 0 |
| Grassland/Pasture | 0 | 0 | 0 | 0 |
| Forest/Shrubland | 0 | 0 | 0 | 0 |
| Developed/High Intensity | 23.04 | 22.78 | 23.04 | 22.95 |
| Developed/Low-Med Intensity | 62.14 | 61.83 | 61.3 | 61.76 |
| Developed/Open Space | 14.82 | 15.35 | 15.66 | 15.27 |
| Open Water | 0 | 0 | 0 | 0 |
| Wetlands | 0 | 0 | 0 | 0 |
| Barren | 0 | 0 | 0 | 0 |

# Sikeston

**Well/Intake Data** - PWSS No. 4010743
Scott County, Sheet 1 of 2

Sheet Prepared: Jun 11, 2020

MISSOURI DEPARTMENT OF NATURAL RESOURCES
Prepared by CARES, University of Missouri Extension

| Well Number | W1 | W5 | W6 | W7 | W9 |
|---|---|---|---|---|---|
| Local Well Name | Well #1, Plant #2 | Well #6, Plant #2 | Well #7, Plant #2 | Well #8, Plant #3 | Well #10, Plant #3 |
| Well ID # | 13051 | 13049 | 13048 | 13047 | 13045 |
| DGLS ID # | 0011630 | 0019120 | 0026235 | | |
| Status | Active | Active | Active | Active | Emergency |
| Latitude | 36.879040 | 36.878180 | 36.879540 | 36.880623 | 36.878620 |
| Longitude | -89.586450 | -89.585580 | -89.583700 | -89.601124 | -89.600250 |
| 12-Digit Hydrologic Unit | 080202010305 | 080202010305 | 080202010305 | 080202040604 | 080202040604 |
| County | Scott | Scott | Scott | Scott | Scott |
| MoDNR Region | Southeast | Southeast | Southeast | Southeast | Southeast |
| Groundwater Province[1] | Southeast Missouri Lowlands Gr | Southeast Missouri Lowlands Gr | Southeast Missouri Lowlands Gr | Southeast Missouri Lowlands Gr | Southeast Missouri Lowlands Gr |
| Source Aquifer(s)[2] | Wilcox aquifer | Wilcox aquifer | Wilcox aquifer | Alluvial aquifer | Alluvial aquifer |
| Confined/Unconfined[3] | Unconfined | Unconfined | Unconfined | Unconfined | Unconfined |
| Regional Drilling Area[4] | Area 5 | Area 5 | Area 5 | Area 5 | Area 5 |
| Total Dissolved Solids[5] | undetermined | undetermined | undetermined | undetermined | undetermined |
| Date Drilled (year) | 1951 | 1960 | 1969 | 1976 | 1959 |
| Material (C/U) | Unconsolidated | Unconsolidated | Unconsolidated | Unconsolidated | Unconsolidated |
| Casing Base Formation | Wilcox | Wilcox | Wilcox | Alluvium | Alluvium |
| Total Depth Formation | Midway | Wilcox | Midway | Alluvium | Alluvium |
| Total Depth | 421 | 401 | 404 | 145 | 142 |
| Ground Elevation (ft) | 327 | 326 | 326 | 325 | 325 |
| Casing Depth (ft) | 331 | 307 | 309 | 108 | 119 |
| Casing Size (in) | 12 | 18 | 18 | 18 | 12 |
| Casing Type | | | | Steel | Steel |
| Screen Length (ft) | 81 | 80 | 80 | 30 | 21 |
| Screen Size (in) | 8 | 12 | 12 | 12 | 12 |
| Static Water Level (ft) | 60 | 66 | 65 | 27 | 30 |
| Well Yield (gpm) | 600 | 1100 | 1450 | 1300 | 1000 |
| Head (ft) | 90 | 69 | 105 | 57 | 34 |
| Draw Down (ft) | 60 | 54 | 59 | 33 | |
| Pump Test Date (year) | 1975 | 1960 | 1992 | 1976 | 1987 |
| Pump Type | Vertical Turbine | Vertical Turbine | Vertical Turbine | Vertical Turbine | Vertical Turbine |
| Pump Manufacturer | | | | | |
| Pump Depth (ft) | 150 | 135 | 170 | 84 | 64 |
| Pump Capacity (gpm) | 863 | 1500 | 1600 | 1350 | 1150 |
| Pump Meter (Y/N) | | | | | |
| GWUDISW (Y/N) | | | | | |
| Surface Drainage | | | | | |
| State Approved (Y/N) | | | | | |
| Liquefaction Risk | High | High | High | High | High |
| Landslide Risk | Low | Low | Low | Low | Low |
| Collapse Risk | Low | Low | Low | Low | Low |
| Flood Risk | Low | Low | Low | Low | Low |
| Surface Contamination Risk | Low | Low | Low | Moderate | Moderate |
| Conduit Flow Risk[6] | K6 | K6 | K6 | K6 | K6 |

# Sikeston

**Well/Intake Data** - PWSS No. 4010743

Sheet Prepared: Aug 12, 2020

Scott County, Sheet 2 of 2

Prepared by CARES, University of Missouri Extension

| | | | |
|---|---|---|---|
| Well Number | W10 | W11 | W13 |
| Local Well Name | Well #11, Plant #1 | Well #12 | Well #13 Plant #3 |
| Well ID # | 13044 | 13043 | 18782 |
| DGLS ID # | | | |
| Status | Active | Active | Active |
| Latitude | 36.878770 | 36.880440 | 36.880459 |
| Longitude | -89.582680 | -89.582630 | -89.602615 |
| 12-Digit Hydrologic Unit | 080202010305 | 080202010305 | 080202040604 |
| County | Scott | Scott | Scott |
| MoDNR Region | Southeast | Southeast | Southeast |
| Groundwater Province[1] | Southeast Missouri Lowlands | Southeast Missouri Lowlands | Southeast Missouri Lowlands |
| Source Aquifer(s)[2] | Wilcox | Wilcox | Alluvial |
| Confined/Unconfined[3] | Unconfined | Unconfined | Unconfined |
| Regional Drilling Area[4] | Area 5 | Area 5 | Area 5 |
| Total Dissolved Solids[5] | undetermined | undetermined | undetermined |
| Date Drilled (year) | 1987 | 1991 | 2013 |
| Material (C/U) | Unconsolidated | Unconsolidated | Unconsolidated |
| Casing Base Formation | Wilcox | Wilcox | Alluvium |
| Total Depth Formation | Wilcox | Wilcox | Alluvium |
| Total Depth | 390 | 391 | 160 |
| Ground Elevation (ft) | 325 | 325 | 325 |
| Casing Depth (ft) | 300 | 292 | 111 |
| Casing Size (in) | 16 | 18 | 16 |
| Casing Type | Steel | Steel | Steel |
| Screen Length (ft) | 80 | 80 | 110 |
| Screen Size (in) | 10 | 12 | |
| Static Water Level (ft) | 65 | 80 | 31 |
| Well Yield (gpm) | 1062 | 835 | 2400 |
| Head (ft) | 109 | 94 | 69 |
| Draw Down (ft) | 43 | | |
| Pump Test Date (year) | 1987 | 1991 | |
| Pump Type | Vertical Turbine | Vertical Turbine | Vertical Turbine |
| Pump Manufacturer | | | |
| Pump Depth (ft) | 174 | 174 | 100 |
| Pump Capacity (gpm) | 1000 | 1000 | 1000 |
| Pump Meter (Y/N) | | | |
| GWUDISW (Y/N) | | | |
| Surface Drainage | | | |
| State Approved (Y/N) | | | |
| Liquefaction Risk | High | High | High |
| Landslide Risk | Low | Low | Low |
| Collapse Risk | Low | Low | Low |
| Flood Risk | Low | Low | Low |
| Surface Contamination Risk | Low | Low | Moderate |
| Conduit Flow Risk[6] | K6 | K6 | K6 |

# Sikeston

**Contaminant Summary**

PWSS No. 4010743

Sheet Prepared: Jun 11, 2020

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Prepared by CARES, University of Missouri Extension

## 57 potential contaminant sources in the listed databases (multiple databases may list the same contaminant source):

| | Database |
|---|---|
| ✔ | ACRES (Assessment, Cleanup And Redevelopment Exchange System) |
| ✔ | AIR (Integrated Compliance Information System-Air) |
| ✔ | AIRS/AFS (Air Facility System) |
| ✔ | AIRS/AQS (Air Quality System) |
| | BR (Biennial Reporters) |
| | BRAC (Base Realignment And Closure) |
| ✔ | CAMDBS (Clean Air Markets Division Business Systems) |
| | CEDRI (Compliance And Emissions Data Reporting Interface) |
| | ECRM (Enforcement Criminal Records Management) |
| | E-GGRT (Electronic Greenhouse Gas Reporting Tool) |
| | EGRID (Emissions & Generation Resource Integrated Database) |
| ✔ | EIA-860 (Energy Information Administration-860 Database) |
| ✔ | EIS (Emission Inventory System) |
| | FFDOCKET (Federal Facility Hazardous Waste Compliance Docket) |
| ✔ | ICIS (Integrated Compliance Information System) |
| | LMOP (Landfill Methane Outreach Program) |
| | LUST-ARRA (Leaking Underground Storage Tank - American Recovery And Reinvestment Act) |

| | Database |
|---|---|
| | MN-TEMPO (Minnesota - Permitting, Compliance, & Enforcement) |
| ✔ | MO-DNR (Missouri Department Of Natural Resources) |
| ✔ | NCDB (National Compliance Database) |
| ✔ | NPDES (National Pollutant Discharge Elimination System) |
| | OTAQREG (Office Of Transportation And Air Quality Fuels Registration) |
| | RADINFO (Radiation Information System) |
| | RBLC (Ract/Bact/Laer Clearinghouse) |
| ✔ | RCRAINFO (Resource Conservation And Recovery Act Information System) |
| | RFS (Renewable Fuel Standard) |
| | RMP (Risk Management Plan) |
| ✔ | SEMS (Superfund Enterprise Management System) |
| ✔ | SFDW (Safe Drinking Water Information System) |
| | SSTS (Section Seven Tracking System) |
| | STATE (State Systems) |
| | TRIS (Toxics Release Inventory System) |
| | TSCA (Toxic Substances Control Act) |
| ✔ | SWIP (Source Water Inventory Project Field Inventory - see below) |

## 60 potential contaminant sources in the SWIP Field Inventory:

| Count | Site Type |
|---|---|
| 0 | Airport or abandoned airfield |
| 0 | Animal feedlot |
| 0 | Apartments and condominiums |
| 0 | Asphalt plant |
| 6 | Auto repair shop |
| 8 | Automotive dealership |
| 0 | Barber and beauty shop |
| 0 | Boat yard and marina |
| 0 | CAFO |
| 0 | Campground |
| 2 | Car wash |
| 0 | Cement Plant |
| 0 | Cemetery |
| 0 | Communication equipment mfg |
| 0 | Country club |
| 3 | Dry cleaner |
| 1 | Dumping and/or burning site |
| 0 | Electric equipment mfg or storage |
| 0 | Electric substation |
| 0 | Farm machinery storage |
| 3 | Feed/Fertilizer/Co-op |
| 2 | Fire station |
| 2 | Funeral service and crematory |
| 1 | Furniture manufacturer |
| 0 | Furniture repair or finishing shop |
| 0 | Garden and/or nursery |
| 0 | Garden, nursery, and/or florist |
| 0 | Gasoline service station |
| 0 | Golf courses |
| 0 | Government office |
| 0 | Grain bin |
| 3 | Hardware and lumber store |
| 0 | Hazardous waste (Federal facility) |
| 1 | Highway maintenance facility |
| 0 | Jewelry or metal plating shop |
| 0 | Junk yard or salvage yard |
| 0 | Lagoon (commercial) |
| 0 | Lagoon (industrial) |
| 0 | Lagoon (municipal) |
| 0 | Lagoon (residential) |
| 0 | Landfill (municipal) |

| Count | Site Type |
|---|---|
| 0 | Laundromat |
| 0 | Livestock auction |
| 0 | Machine or metalworking shop |
| 2 | Manufacturing (general) |
| 0 | Material stockpile (industrial) |
| 0 | Medical institution |
| 0 | Metal production facility |
| 0 | Mining operation |
| 7 | Other |
| 1 | Paint store |
| 0 | Park land |
| 0 | Parking lot |
| 1 | Petroleum production or storage |
| 0 | Pharmacies |
| 0 | Photography shop or processing lab |
| 0 | Pit toilet |
| 0 | Plastic material and synthetic mfg |
| 1 | Print shop |
| 0 | Railroad yard |
| 0 | Recycling/reduction facility |
| 0 | Research lab |
| 0 | Restaurant |
| 1 | Sawdust pile |
| 0 | School |
| 0 | Sports and hobby shop |
| 0 | Swimming pool |
| 0 | Tailing pond |
| 5 | Tank (above-ground fuel) |
| 0 | Tank (other) |
| 0 | Tank (pesticide) |
| 6 | Tank (underground fuel) |
| 0 | Trucking terminal |
| 1 | Veterinary service |
| 0 | Wastewater treatment facility |
| 2 | Well (abandoned) |
| 1 | Well (domestic) |
| 0 | Well (irrigation) |
| 0 | Well (livestock) |
| 0 | Well (monitoring) |
| 0 | Well (public water supply) |
| 0 | Well (unknown) |

# Sikeston

**Susceptibility Determination**
PWSS No. 4010743

Sheet Prepared: Jun 11, 2020

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Prepared by CARES, University of Missouri Extension

The Missouri Department of Natural Resources (MoDNR) has assembled this information to assess the susceptibility of drinking water sources to contamination. There are many unforseen and unpredictable factors that may cause a source to be contaminated. MoDNR routinely monitors all public supplies to ensure public health is protected. Public water systems and local communities are encouraged to take all measures possible to reduce the susceptibility of their drinking water source to chemical contamination. For more information, call 1-800-361-4827.

***Dots containing numeric values correspond to the number of individual wells or surface water intakes.***

## GROUND WATER

| | Minimally Susceptible | Moderately Susceptible | Highly Susceptible | Undetermined |
|---|---|---|---|---|
| **Geological and Hydrogeological Assessment Criteria** | | | | |
| Are any system wells deemed by the Public Drinking Water Branch to be under the direct influence of surface water? | ○ | ○ | ○ | ● |
| Are any system wells potentially prone to karst conditions or solution flow? | ● | ○ | ○ | ○ |
| Do any system wells draw water from a source with high total dissolved solids (TDS)? | ○ | ○ | ○ | ● |
| Are any system wells located proximal to known subsurface or groundwater contamination? | ○ | ○ | ○ | ● |
| Do any system wells draw water from an unconfined aquifer? | ● | ○ | ○ | ○ |
| Based on known stratigraphic relationships for each well, the risk of contamination from surface sources is: | 5 | 3 | ○ | ○ |
| **Well Construction and Maintenance Assessment Criteria** | | | | |
| Are all system wells state-approved? | ○ | ○ | ○ | ● |
| Do any system wells exhibit structural defects, construction deficiencies, or other conditions that might allow contamination to enter the well at the wellhead? | ○ | ○ | ○ | ● |
| Are security measures in place to prevent unauthorized tampering with all system wells? | ○ | ○ | ○ | ● |
| Does the system have back-up, emergency power available? | ○ | ○ | ○ | ● |
| **Monitoring Assessment Criteria** | | | | |
| Have any system wells exhibited consistent detections for any of the following parameters in raw water? | | | | |
| Volatile Organic Chemicals (VOC): | ○ | ○ | ● | ○ |
| Synthetic Organic Chemicals (SOC): | ● | ○ | ○ | ○ |
| Inorganic Compounds (IOC): | ● | ○ | ○ | ○ |
| Nitrates/Nitrites: | ● | ○ | ○ | ○ |
| Radionuclides: | ● | ○ | ○ | ○ |
| Bacteria/Viruses/Microbial Pathogens: | ○ | ○ | ○ | ● |
| **Natural Hazard Assessment Criteria** | | | | |
| The number of system wells located in a region prone to flooding. | 8 | ○ | ○ | ○ |
| The number of system wells located in a region that may experience the following conditions in the event of a large-scale earthquake. | | | | |
| Potential liquefaction risk: | ○ | ○ | 8 | ○ |
| Potential landslide risk: | 8 | ○ | ○ | ○ |
| Potential subsurface collapse/instability risk: | 8 | ○ | ○ | ○ |
| Are any system wells prone to declining water levels during a prolonged drought? | ○ | ○ | ○ | ● |
| Do all system wells have lightning surge protection? | ○ | ○ | ○ | ● |
| **Potential Contaminant Inventory Assessment Criteria** | | | | |
| Potential sources of contamination exist within the wellhead protection area: | ○ | ● | ○ | ○ |
| A system well is located in an area with a high density of transportation corridors: | ○ | 1 | 7 | ○ |
| A system well is located in an area that may have improperly maintained or faulty on-site septic systems: | ○ | ○ | ○ | ● |
| **Additional Assessment Criteria** | | | | |
| Does the system have a wellhead/source water protection plan endorsed by the Department of Natural Resources? | ○ | ● | ○ | ○ |
| Does the system have an emergency interconnection with a neighboring public water system? | ○ | ● | ○ | ○ |

# Sikeston

**Notes**
PWSS No. 4010743

Map Prepared: Jun 11, 2020
Data Release: May 4, 2020

Prepared by CARES, University of Missouri Extension

1 For additional information about Missouri's regional groundwater provinces, please visit the Missouri Department of Natural Resources' Water Resources Center Web page or contact the Missouri Geological Survey.

2 Source aquifers are determined from well log information, where available, and on general water quality characteristics for the regional groundwater province within which each well is located. Source aquifers for wells with little or no well log information are inferred based on best available information.

Additional Source Aquifer Notes:

- Water sources labeled "Cincinnatian, Pennsylvanian, or Devonian/Silurian" are not regionally extensive aquifer systems in Missouri. These represent isolated, localized water-bearing formations. Broad water quality descriptions are Not currently available for these sources. "Precambrian" water sources exhibit water quality characteristics similar to the St. Francois aquifer.
- The Springfield Plateau aquifer is regionally extensive only in southwest and west-central Missouri. Aquifers labeled "Mississippian" or "Springfield Plateau (equivalent)" refer to wells that draw water from the same geological formations that comprise the Springfield Plateau aquifer, but are located in areas of the state not hydraulically connected to the regional aquifer system. Broad water quality generalizations are not available for these isolated, localized water-bearing units.

3 Unconfined aquifers are generally more vulnerable to surface or shallow subsurface contamination and warrant additional protections around the wellhead. Confined aquifers are not as vulnerable to surface or shallow subsurface contamination, but may exhibit naturally elevated levels of dissolved minerals, radionuclides, or variations in other water quality parameters such as dissolved oxygen and pH.

4 Please refer to 10 CSR 23-3.090 and 10 CSR 23-3.100 for additional information about well construction standards for Missouri's regional well drilling areas.

5 TDS1 Total dissolved solids information is currently only available for the Ozark and Springfield Plateau aquifers. Information is based on broad, regional groundwater quality trends, rather than on well-specific monitoring.

6 K6 This well is not constructed in materials prone to conduit or solution flow.

# Appendix 3b

## 2014 Sikeston Public Well Assessment Reports (CARES)

# Sikeston

## PWSS No. 4010743

8 Wells, Scott County

Prepared by:

CENTER FOR APPLIED RESEARCH AND ENVIRONMENTAL SYSTEMS
UNIVERSITY OF MISSOURI

Map Update: Jun 06, 2014

Missouri Department of
Natural Resources

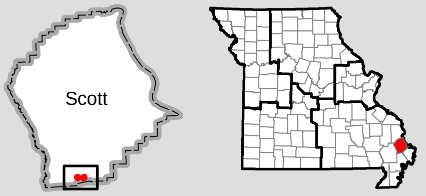
**Well System**

◉ System Well

**SWAP Delineation Boundary**

○ 20-year time of travel

○ Half-mile buffer



Miles

0 0.45 0.9

SWAP - Source Water Assessment Plan --
http://drinkingwater.missouri.edu/swap/
Aerial photos: USDA National Agriculture Inventory Program (NAIP), 2012.

# Sikeston

## PWSS No. 4010743

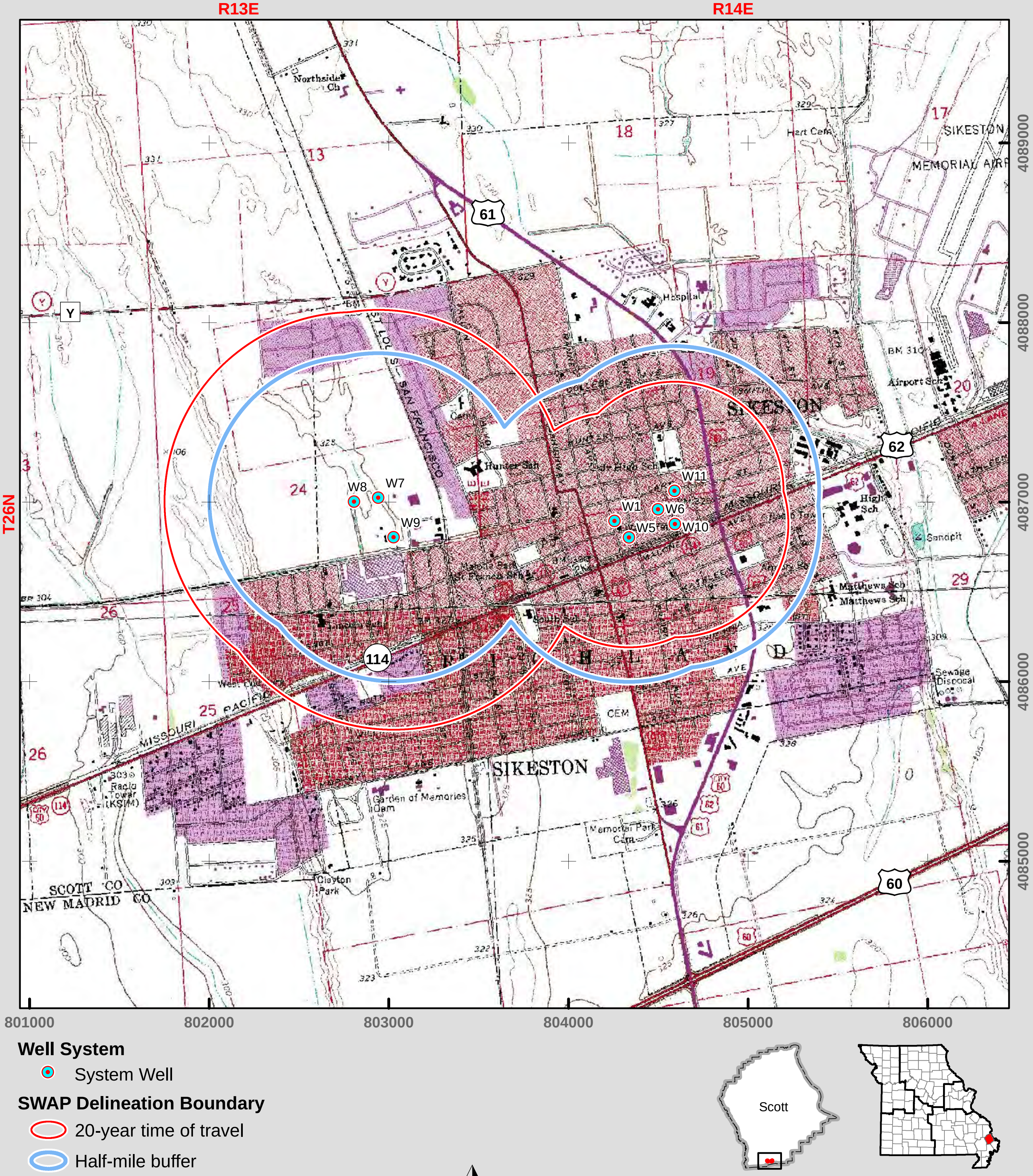
8 Wells, Scott County

Prepared by:

CENTER FOR APPLIED RESEARCH AND ENVIRONMENTAL SYSTEMS UNIVERSITY OF MISSOURI

Map Update: Jun 06, 2014

Missouri Department of Natural Resources



**Well System**

● System Well

**SWAP Delineation Boundary**

○ 20-year time of travel

○ Half-mile buffer

Miles

0 0.45 0.9

SWAP - Source Water Assessment Plan --
http://drinkingwater.missouri.edu/swap/
For basemap symbols, see the U.S. Geological Survey (USGS) publication: Topographic Map Symbols.

# Sikeston

PWSS No. 4010743

Scott County, sheet 1 of 2

8 wells

Sheet Update: Jun 09, 2014

Prepared by:

CENTER FOR APPLIED RESEARCH AND ENVIRONMENTAL SYSTEMS
UNIVERSITY OF MISSOURI

Missouri Department of
Natural Resources

| Well Number | W1 | W5 | W6 | W7 | W8 |
|---|---|---|---|---|---|
| Extended PWS # | 4010743101 | 4010743105 | 4010743106 | 4010743107 | 4010743108 |
| Local Well Name | Well #1, Plant #2 | Well #6, Plant #2 | Well #7, Plant #2 | Well #8, Plant #3 | Well #9, Plant #3 |
| Well ID # | 13051 | 13049 | 13048 | 13047 | 13046 |
| DGLS ID # | 0011630 | 0019120 | 0026235 | | |
| Facility Type | City | City | City | City | City |
| Status | Active | Active | Active | Active | Active |
| Latitude | 36.87904 | 36.87818 | 36.87954 | 36.8806231803 | 36.880473182 |
| Longitude | -89.58645 | -89.58558 | -89.5837 | -89.6011240613 | -89.6026440566 |
| Location Method | GPS | GPS | GPS | GPS | GPS |
| Method Accuracy (ft) | 38 | 43 | 43 | 43 | 39 |
| USGS 7.5 Quadrangle | Sikeston North | Sikeston North | Sikeston North | Sikeston North | Sikeston North |
| County | Scott | Scott | Scott | Scott | Scott |
| MoDNR Region | Southeast | Southeast | Southeast | Southeast | Southeast |
| Date Drilled (year) | 1951 | 1960 | 1969 | 1976 | 1976 |
| Material (C/U) | Unconsolidated | Unconsolidated | Unconsolidated | Unconsolidated | Unconsolidated |
| Base of Casing Formation | Wilcox | Wilcox | Wilcox | Alluvium | Alluvium |
| Total Depth Formation | Midway | Wilcox | Midway | Alluvium | Alluvium |
| Total Depth | 421 | 401 | 404 | 145 | 143 |
| Ground Elevation (ft) | | | | | |
| Top Seal | | | | | |
| Bottom Seal | | | | | |
| Casing Depth (ft) | 331 | 307 | 309 | 108 | 108 |
| Casing Size (in) | 12 | 18 | 18 | 18 | 18 |
| Casing Type | | | | Steel | Steel |
| Elev. of Casing Top (ft) | | | | | |
| Outer Casing Depth (ft) | | | | | |
| Outer Casing Size (in) | | | | | |
| Screen Length (ft) | 81 | 80 | 80 | 30 | 30 |
| Screen Size (in) | 8 | 12 | 12 | 12 | 12 |
| Static Water Level (ft) | 60 | 66 | 65 | 27 | 27 |
| Well Yield (gpm) | 600 | 1100 | 1450 | 1300 | 1300 |
| Head (ft) | | | | | |
| Draw Down (ft) | 60 | 54 | 59 | 33 | 34 |
| Pump Test Date (year) | 1975 | 1960 | 1992 | 1976 | |
| Pump Type | Vertical Turbine | Vertical Turbine | Vertical Turbine | Vertical Turbine | Vertical Turbine |
| Pump Manufacturer | | | | | |
| Pump Depth (ft) | 150 | 135 | 170 | 84 | 84 |
| Pump Capacity (gpm) | 863 | 1500 | 1600 | 1350 | 1350 |
| Pump Meter (Y/N) | | | | | |
| VOC Detection (Y/N) | N | N | N | N | N |
| Nitrate Detection (Y/N) | N | N | N | N | N |
| Chlorination (Y/N) | Y | Y | Y | Y | Y |
| Filtration (Y/N) | Y | Y | Y | Y | Y |
| GWUDISW (Y/N) | | | | | |
| Surface Drainage | | | | | |
| State Approved(Y/N) | | | | | |
| Date Abandoned (year) | | | | | |
| Date Plugged (year) | | | | | |

# Sikeston

PWSS No. 4010743
Scott County, sheet 2 of 2
8 wells

Prepared by:
CENTER FOR APPLIED RESEARCH AND ENVIRONMENTAL SYSTEMS UNIVERSITY OF MISSOURI

Sheet Update: Jun 09, 2014

Missouri Department of
Natural Resources

| | | | |
|---|---|---|---|
| Well Number | W9 | W10 | W11 |
| Extended PWS # | 4010743109 | 4010743110 | 4010743111 |
| Local Well Name | Well #10, Plant #3 | Well #11, Plant #1 | Well #12 |
| Well ID # | 13045 | 13044 | 13043 |
| DGLS ID # | | | |
| Facility Type | City | City | City |
| Status | Active | Active | Active |
| Latitude | 36.87862 | 36.87877 | 36.88044 |
| Longitude | -89.60025 | -89.58268 | -89.58263 |
| Location Method | GPS | GPS | GPS |
| Method Accuracy (ft) | 65 | 44 | 45 |
| USGS 7.5 Quadrangle | Sikeston North | Sikeston North | Sikeston North |
| County | Scott | Scott | Scott |
| MoDNR Region | Southeast | Southeast | Southeast |
| Date Drilled (year) | 1959 | 1987 | 1991 |
| Material (C/U) | Unconsolidated | Unconsolidated | Unconsolidated |
| Base of Casing Formation | Alluvium | Wilcox | Wilcox |
| Total Depth Formation | Alluvium | Wilcox | Wilcox |
| Total Depth | 142 | 390 | 382 |
| Ground Elevation (ft) | | | |
| Top Seal | | | |
| Bottom Seal | | | |
| Casing Depth (ft) | 119 | 300 | 292 |
| Casing Size (in) | 12 | 16 | 18 |
| Casing Type | Steel | Steel | Steel |
| Elev. of Casing Top (ft) | | | |
| Outer Casing Depth (ft) | | | |
| Outer Casing Size (in) | | | |
| Screen Length (ft) | 21 | 80 | 80 |
| Screen Size (in) | 12 | 10 | 12 |
| Static Water Level (ft) | 30 | 65 | |
| Well Yield (gpm) | 1000 | 1062 | |
| Head (ft) | | | |
| Draw Down (ft) | | 43 | |
| Pump Test Date (year) | 1987 | 1987 | |
| Pump Type | Vertical Turbine | Vertical Turbine | Vertical Turbine |
| Pump Manufacturer | | | |
| Pump Depth (ft) | 64 | 174 | 174 |
| Pump Capacity (gpm) | 1150 | 1000 | 1000 |
| Pump Meter (Y/N) | | | |
| VOC Detection (Y/N) | N | N | N |
| Nitrate Detection (Y/N) | N | N | N |
| Chlorination (Y/N) | Y | Y | Y |
| Filtration (Y/N) | Y | Y | Y |
| GWUDISW (Y/N) | | | |
| Surface Drainage | | | |
| State Approved(Y/N) | | | |
| Date Abandoned (year) | | | |
| Date Plugged (year) | | | |

# Sikeston

PWSS No. 4010743

Scott County, sheet 1 of 4

162 potential contaminant sources

Sheet Update: Jun 09, 2014

Prepared by:
CENTER FOR APPLIED RESEARCH AND ENVIRONMENTAL SYSTEMS
UNIVERSITY OF MISSOURI

Missouri Department of
Natural Resources

| Map C.No. | CARES ID | Site Name | Type | Location Code | Accuracy Code | Method Code | Database Code |
|---|---|---|---|---|---|---|---|
| C1 | 140966 | Elanco Products | | UN | NV | UN | Dealcov |
| C2 | 108627 | Scott-New Madrid Electric Coop | | UN | NV | UN | Chemcov |
| C3 | 108628 | Coleman Plant | | UN | NV | UN | Chemcov |
| C4 | 108630 | Sikeston Bd of Municipal Utilities | | UN | NV | UN | Chemcov |
| C5 | 110225 | Board Of Municipal Utilities | | UN | NV | UN | Tanks |
| C6 | 110226 | Board Of Municipal Utilities | | UN | NV | UN | Tanks |
| C7 | 110379 | Boyer Construction Company | | UN | NV | UN | Tanks |
| C8 | 110498 | Bridger Equipment Company | | UN | NV | UN | Tanks |
| C9 | 110543 | Brown Sand & Gravel Co, Inc | | UN | NV | UN | Tanks |
| C10 | 111299 | Charles Terrell | | UN | NV | UN | Tanks |
| C11 | 111413 | City Garage | | UN | NV | UN | Tanks |
| C12 | 111527 | City Of Miner | | UN | NV | UN | Tanks |
| C13 | 111831 | Community Shelter Workshop | | UN | NV | UN | Tanks |
| C14 | 111964 | Cooney Equipment Company | | UN | NV | UN | Tanks |
| C15 | 112305 | Dekalb Ag Research | | UN | NV | UN | Tanks |
| C16 | 112309 | Dekalb-pfizer Genetics | | UN | NV | UN | Tanks |
| C17 | 112488 | Don King Equipment | | UN | NV | UN | Tanks |
| C18 | 113154 | Ferrell Excavating | | UN | NV | UN | Tanks |
| C19 | 113947 | Hale Auction Company | | UN | NV | UN | Tanks |
| C20 | 114303 | Holiday 66 Service | | UN | NV | UN | Tanks |
| C21 | 114332 | Home Oil Co | | UN | NV | UN | Tanks |
| C22 | 114397 | Hucks #139 | | UN | NV | UN | Tanks |
| C23 | 114828 | Joe Williams | | UN | NV | UN | Tanks |
| C24 | 115060 | Kellett Oil Co. | | UN | NV | UN | Tanks |
| C25 | 115145 | Kimo's Office Building | | UN | NV | UN | Tanks |
| C26 | 115609 | Lewis Bros Bakeries, Inc | | UN | NV | UN | Tanks |
| C27 | 115921 | Malone & Hyde Drug Dist-never Owned | | UN | NV | UN | Tanks |
| C28 | 116354 | Mhtd Dist Garage | | UN | NV | UN | Tanks |
| C29 | 116376 | Mid South Tractor Parts | | UN | NV | UN | Tanks |
| C30 | 117395 | Par Gas (sinclair) | | UN | NV | UN | Tanks |
| C31 | 117520 | Pepsi Cola | | UN | NV | UN | Tanks |
| C32 | 118701 | Santie Wholesale Oil Co | | UN | NV | UN | Tanks |
| C33 | 118714 | Saunders System Inc | | UN | NV | UN | Tanks |
| C34 | 118760 | Scott Co R-v School Dist | | UN | NV | UN | Tanks |
| C35 | 118765 | Scott-new Madrid-mississippi El Cor | | UN | NV | UN | Tanks |
| C36 | 118815 | Semo Motor Company | | UN | NV | UN | Tanks |
| C37 | 118816 | Semo Nursing Center Inc | | UN | NV | UN | Tanks |
| C38 | 119100 | Sikeston | | UN | NV | UN | Tanks |
| C39 | 119102 | Sikeston Coca-cola Bottling Co | | UN | NV | UN | Tanks |
| C40 | 119103 | Sikeston Concrete Prods Co, Inc | | UN | NV | UN | Tanks |
| C41 | 119104 | Sikeston General Oil Co | | UN | NV | UN | Tanks |
| C42 | 119106 | Sikeston Maint Shed | | UN | NV | UN | Tanks |
| C43 | 119107 | Sikeston Pepsi Cola | | UN | NV | UN | Tanks |
| C44 | 119381 | Southwestern Bell | | UN | NV | UN | Tanks |
| C45 | 120481 | Todd Corporation | | UN | NV | UN | Tanks |
| C46 | 120611 | Trigg Shell | | UN | NV | UN | Tanks |
| C47 | 120622 | Troop E Satellite | | UN | NV | UN | Tanks |
| C48 | 120761 | Union Pacific | | UN | NV | UN | Tanks |
| C49 | 120798 | United Parcel Service, Inc | | UN | NV | UN | Tanks |
| C50 | 120840 | Uptown Shell | | UN | NV | UN | Tanks |

## Method Codes

| Code | Address Matching (Geocoding) |
|---|---|
| A2 | Block/Group |
| A3 | Street Centerline |
| A4 | Nearest Street Intersection |
| A5 | Primary Street Name |
| A6 | Digitization |
| AO | Other Address Matching |
| Z1 | ZIP Code Centroid |
| | Census - 1990 |
| C1 | Block Centroid |
| C2 | Block/Group Centroid |
| C3 | Tract Centroid |

| Code | Global Positioning System |
|---|---|
| G1 | Static Mode |
| G2 | Kinematic Mode |
| G3 | Differential Post Processing |
| G4 | Precise Positioning Service |
| G5 | Signal Averaging |
| G6 | Real Time Differential Processing |
| | Interpolation |
| I1 | Topo Map |
| I2 | Aerial Photography (DOQQ) |
| I3 | Satellite Imagery |

| Code | Other |
|---|---|
| P1 | Land Survey |
| S2 | Quarter Description |
| UN | Unknown |

## Location Codes

| | |
|---|---|
| BL | Building |
| CF | Center of Facility |
| IN | Intersection |
| LS | Lagoon or Pond |
| MG | Main Access Point (Gate) |
| MA | Main Office |
| OT | Other |
| PL | Pile |
| RD | Road |
| TK | Tank, Standpipe, or Tower |
| WL | Well |
| UN | Unknown |

## Accuracy Codes

| Code | Metric |
|---|---|
| m | Meters |
| km | Kilometers |
| | English |
| ft | Feet |
| yd | Yards |
| mi | Miles |
| UN | Unknown |
| NF | Site not found at database position |
| NV | Site position not verified |

Although all data in this dataset have been used by the Missouri Department of Natural Resources (MoDNR), no warranty, expressed or implied,is made by MoDNR as to the accuracy of the data and related materials. The act of distribution shall not constitute any such warranty, and no responsibility is assumed by MoDNR in the use of these data or related materials. This sheet is subject to change as additional information is acquired. Additional information at: http://drinkingwater.missouri.edu

# Sikeston

PWSS No. 4010743

Scott County, sheet 2 of 4

162 potential contaminant sources

Sheet Update: Jun 09, 2014

Prepared by:

CENTER FOR APPLIED RESEARCH AND ENVIRONMENTAL SYSTEMS
UNIVERSITY OF MISSOURI

Missouri Department of
Natural Resources

| Map C.No. | CARES ID | Site Name | Type | Location Code | Accuracy Code | Method Code | Database Code |
|---|---|---|---|---|---|---|---|
| C51 | 120845 | U-pump-it | | UN | NV | UN | Tanks |
| C52 | 121651 | Woodtruss | | UN | NV | UN | Tanks |
| C53 | 121750 | Quality Plating | | UN | NV | UN | SMARS |
| C54 | 122606 | Jerry James Trailers Inc. | | UN | NV | UN | HW Gen |
| C55 | 123286 | Scott-new Madrid-mississippi Electric | | UN | NV | UN | HW Gen |
| C56 | 123833 | Cooney Equipment Co. | | UN | NV | UN | HW Gen |
| C57 | 123835 | Semo Motor Co. | | UN | NV | UN | HW Gen |
| C58 | 123836 | Sikeston Dry Cleaners | | UN | NV | UN | HW Gen |
| C59 | 123890 | Todd, Inc. | | UN | NV | UN | HW Gen |
| C60 | 124108 | Satterfield Body Shop | Hazar Entry | CF | 33 ft | I2 | HW Gen |
| C61 | 124665 | Missouri Delta Community Hospital | | UN | NV | UN | HW Gen |
| C62 | 124814 | Auto Tire & Parts | | UN | NV | UN | HW Gen |
| C63 | 125054 | Stricker Body Shop | | UN | NV | UN | HW Gen |
| C64 | 125343 | At&t | | UN | NV | UN | HW Gen |
| C65 | 125753 | King Cleaners | | UN | NV | UN | HW Gen |
| C66 | 125930 | Mid-south Tractor Parts | | UN | NV | UN | HW Gen |
| C67 | 126133 | Carnell's Body Shop | | UN | NV | UN | HW Gen |
| C68 | 126233 | Mo Dept Of Transportation | | UN | NV | UN | HW Gen |
| C69 | 126406 | Heritage American Homes | | UN | NV | UN | HW Gen |
| C70 | 127163 | One Day Cleaners | | UN | NV | UN | HW Gen |
| C71 | 127545 | Kelpro, Inc. | | UN | NV | UN | HW Gen |
| C72 | 127758 | Chamberlain's Amoco | | UN | NV | UN | HW Gen |
| C73 | 127798 | Canedy Sign Co., Inc. | | UN | NV | UN | HW Gen |
| C74 | 127851 | Faultless Cleaners | | UN | NV | UN | HW Gen |
| C75 | 128391 | Don King Salvage | | UN | NV | UN | HW Gen |
| C76 | 128417 | Bootheel Diesel Fuel Injection | | UN | NV | UN | HW Gen |
| C77 | 128903 | Sikeston Light And Water | | UN | NV | UN | HW Gen |
| C78 | 128972 | Missouri Highway & Transportation Dept. | | UN | NV | UN | HW Gen |
| C79 | 129213 | Media Press | | UN | NV | UN | HW Gen |
| C80 | 129679 | Dekalb Plant Genetics | | UN | NV | UN | HW Gen |
| C81 | 129840 | Quality Plating % Usepa Region Vii | | UN | NV | UN | HW Gen |
| C82 | 130016 | Central States Coca-cola | | UN | NV | UN | HW Gen |
| C83 | 130088 | Curtis H. Cline | | UN | NV | UN | HW Gen |
| C84 | 130731 | Dekalb Corp | | UN | NV | UN | HW Gen |
| C85 | 132505 | HANDY STREET CALCIUM ARSENATE SITE | | UN | NV | UN | CERCLIS |
| C86 | 132606 | MRM INDUSTRIES | | UN | NV | UN | CERCLIS |
| C87 | 135413 | Dekalb Agresearch Inc | | UN | NV | UN | APCP |
| C88 | 136492 | Mcmullin Gin Co Inc | | UN | NV | UN | APCP |
| C89 | 136493 | Sikeston Cotton Oil Mill Inc | | UN | NV | UN | APCP |
| C90 | 136501 | Missouri Delta Community Hospital | | UN | NV | UN | APCP |
| C91 | 136502 | Old Coal-fired Generator | | UN | NV | UN | APCP |
| C92 | 136503 | Sikeston Power Station | | UN | NV | UN | APCP |
| C93 | 136505 | Hendrick Concrete Products Corp | | UN | NV | UN | APCP |
| C94 | 136506 | Sikeston Woodworking | | UN | NV | UN | APCP |
| C95 | 136510 | Daily Standard | | UN | NV | UN | APCP |
| C96 | 136514 | Crowder Gin Company, Inc | | UN | NV | UN | APCP |
| C97 | 136517 | Marnor Aluminum Processing Inc | | UN | NV | UN | APCP |
| C98 | 136521 | Mrm Industries Inc | | UN | NV | UN | APCP |
| C99 | 136528 | Faultless Cleaners Inc | | UN | NV | UN | APCP |
| C100 | 136537 | Sikeston | | UN | NV | UN | APCP |

## Method Codes

| Code | Address Matching (Geocoding) |
|---|---|
| A2 | Block/Group |
| A3 | Street Centerline |
| A4 | Nearest Street Intersection |
| A5 | Primary Street Name |
| A6 | Digitization |
| AO | Other Address Matching |
| Z1 | ZIP Code Centroid |
| | Census - 1990 |
| C1 | Block Centroid |
| C2 | Block/Group Centroid |
| C3 | Tract Centroid |

| Code | Global Positioning System |
|---|---|
| G1 | Static Mode |
| G2 | Kinematic Mode |
| G3 | Differential Post Processing |
| G4 | Precise Positioning Service |
| G5 | Signal Averaging |
| G6 | Real Time Differential Processing |
| | Interpolation |
| I1 | Topo Map |
| I2 | Aerial Photography (DOQQ) |
| I3 | Satellite Imagery |

| Code | Other |
|---|---|
| P1 | Land Survey |
| S2 | Quarter Description |
| UN | Unknown |

## Location Codes

| | |
|---|---|
| BL | Building |
| CF | Center of Facility |
| IN | Intersection |
| LS | Lagoon or Pond |
| MG | Main Access Point (Gate) |
| MA | Main Office |
| OT | Other |
| PL | Pile |
| RD | Road |
| TK | Tank, Standpipe, or Tower |
| WL | Well |
| UN | Unknown |

## Accuracy Codes

| Code | Metric |
|---|---|
| m | Meters |
| km | Kilometers |
| | English |
| ft | Feet |
| yd | Yards |
| mi | Miles |
| UN | Unknown |
| NF | Site not found at database position |
| NV | Site position not verified |

# Sikeston

PWSS No. 4010743

Scott County, sheet 3 of 4

162 potential contaminant sources

Sheet Update: Jun 09, 2014

Prepared by:

CENTER FOR APPLIED RESEARCH AND ENVIRONMENTAL SYSTEMS
UNIVERSITY OF MISSOURI

Missouri Department of
Natural Resources

| Map C.No. | CARES ID | Site Name | Type | Location Code | Accuracy Code | Method Code | Database Code |
|---|---|---|---|---|---|---|---|
| C101 | 136539 | King Laundry And Dry Cleaners | | UN | NV | UN | APCP |
| C102 | 136540 | Sikeston Dry Cleaners | | UN | NV | UN | APCP |
| C103 | 385324 | Magic Car Wash | Car wash | BL | 33 ft | I2 | CARES |
| C104 | 385325 | Williams Auto Sales | Auto repair shop | BL | 33 ft | I2 | CARES |
| C105 | 385326 | Rogers Auto Sales | Automotive dealership | BL | 33 ft | I2 | CARES |
| C106 | 385327 | The House of Color | Paint store | BL | 33 ft | I2 | CARES |
| C107 | 385328 | Drakes Auto Sales | Automotive dealership | BL | 33 ft | I2 | CARES |
| C108 | 385329 | Hucks | Tank (underground fuel) | BL | 33 ft | I2 | CARES |
| C109 | 385330 | Jim's Auto Sales | Automotive dealership | BL | 33 ft | I2 | CARES |
| C110 | 385331 | Cox's Car Wash | Car wash | BL | 33 ft | I2 | CARES |
| C111 | 385332 | Sinclair Gas | Tank (above-ground fuel) | BL | 33 ft | I2 | CARES |
| C112 | 385333 | Midtown Motors | Automotive dealership | CF | 33 ft | I2 | CARES |
| C113 | 385334 | C&C Motors | Automotive dealership | BL | 33 ft | I2 | CARES |
| C114 | 385335 | Moll Priniting Company | Print shop | BL | 33 ft | I2 | CARES |
| C115 | 385336 | Feeders Supply | Feed/Fertilizer/Co-op | BL | 33 ft | I2 | CARES |
| C116 | 385338 | Meeks Print Shop | Other | BL | 33 ft | I2 | CARES |
| C117 | 385339 | Cornell's Collision Repair | Auto repair shop | BL | 33 ft | I2 | CARES |
| C118 | 385340 | FG Convienience Store | Tank (underground fuel) | BL | 33 ft | I2 | CARES |
| C119 | 385341 | Rhodes Convienience Store | Tank (underground fuel) | BL | 33 ft | I2 | CARES |
| C120 | 385342 | Animal Health Center | Veterinary service | BL | 33 ft | I2 | CARES |
| C121 | 385343 | Elite Car Wash | Other | BL | 33 ft | I2 | CARES |
| C122 | 385344 | Sikeston Fire Department | Fire station | BL | 33 ft | I2 | CARES |
| C123 | 385345 | Allsops Woodworking | Furniture manufacturer | BL | 33 ft | I2 | CARES |
| C124 | 385346 | Sonny's Solid Waste | Tank (above-ground fuel) | CF | 33 ft | I2 | CARES |
| C125 | 385349 | Auto Repair | Auto repair shop | BL | 33 ft | I2 | CARES |
| C126 | 385350 | | Well (domestic) | WL | 33 ft | I2 | CARES |
| C127 | 385351 | Riggs Building Supplies and Home Center | Hardware and lumber store | BL | 33 ft | I2 | CARES |
| C128 | 385352 | Sabona Mfg. | Manufacturing (general) | BL | 33 ft | I2 | CARES |
| C129 | 385353 | Janitrol/Janitor Supply | Other | BL | 33 ft | I2 | CARES |
| C130 | 385354 | Patriot/Heritage Homes | Manufacturing (general) | BL | 33 ft | I2 | CARES |
| C131 | 385355 | Sheltered Workshop | Sawdust pile | CF | 33 ft | I2 | CARES |
| C132 | 385356 | Aramark | Dry cleaner | BL | 33 ft | I2 | CARES |
| C133 | 385357 | | Other | TK | 33 ft | I2 | CARES |
| C134 | 385358 | Riggs Wholesale Co. | Hardware and lumber store | BL | 33 ft | I2 | CARES |
| C135 | 385359 | Electric Substation | Other | CF | 33 ft | I2 | CARES |
| C136 | 385440 | Sikeston Auto Service | Auto repair shop | BL | 33 ft | I2 | CARES |
| C137 | 385441 | Sinclair Service Station | Tank (above-ground fuel) | BL | 33 ft | I2 | CARES |
| C138 | 385442 | Phillips 66 | Tank (underground fuel) | BL | 33 ft | I2 | CARES |
| C139 | 385443 | Sikeston Laundry and Drycleaners | Dry cleaner | BL | 33 ft | I2 | CARES |
| C140 | 385444 | C & K Building Materials | Hardware and lumber store | BL | 33 ft | I2 | CARES |
| C141 | 385445 | King Laudry and Cleaners | Dry cleaner | BL | 33 ft | I2 | CARES |
| C142 | 385446 | Moll Printing Co. | Other | BL | 33 ft | I2 | CARES |
| C143 | 385447 | Premier Motor | Automotive dealership | BL | 33 ft | I2 | CARES |
| C144 | 385448 | Amoco | Tank (underground fuel) | BL | 33 ft | I2 | CARES |
| C145 | 385449 | Griffs Auto Sales | Automotive dealership | BL | 33 ft | I2 | CARES |
| C146 | 385450 | Beaver Janitor Supply | Other | TK | 33 ft | I2 | CARES |
| C147 | 385451 | Blanchard Funeral Parlor | Funeral service and crematory | BL | 33 ft | I2 | CARES |
| C148 | 385452 | Service Station | Tank (underground fuel) | BL | 33 ft | I2 | CARES |
| C149 | 385453 | Cargill | Feed/Fertilizer/Co-op | CF | 33 ft | I2 | CARES |
| C150 | 385454 | | Tank (above-ground fuel) | TK | 33 ft | I2 | CARES |

## Method Codes

| Code | Address Matching (Geocoding) |
|---|---|
| A2 | Block/Group |
| A3 | Street Centerline |
| A4 | Nearest Street Intersection |
| A5 | Primary Street Name |
| A6 | Digitization |
| AO | Other Address Matching |
| Z1 | ZIP Code Centroid |
| | Census - 1990 |
| C1 | Block Centroid |
| C2 | Block/Group Centroid |
| C3 | Tract Centroid |

| Code | Global Positioning System |
|---|---|
| G1 | Static Mode |
| G2 | Kinematic Mode |
| G3 | Differential Post Processing |
| G4 | Precise Positioning Service |
| G5 | Signal Averaging |
| G6 | Real Time Differential Processing |
| | Interpolation |
| I1 | Topo Map |
| I2 | Aerial Photography (DOQQ) |
| I3 | Satellite Imagery |

| Code | Other |
|---|---|
| P1 | Land Survey |
| S2 | Quarter Description |
| UN | Unknown |

## Location Codes

| | |
|---|---|
| BL | Building |
| CF | Center of Facility |
| IN | Intersection |
| LS | Lagoon or Pond |
| MG | Main Access Point (Gate) |
| MA | Main Office |
| OT | Other |
| PL | Pile |
| RD | Road |
| TK | Tank, Standpipe, or Tower |
| WL | Well |
| UN | Unknown |

## Accuracy Codes

| Code | Metric |
|---|---|
| m | Meters |
| km | Kilometers |
| | English |
| ft | Feet |
| yd | Yards |
| mi | Miles |
| UN | Unknown |
| NF | Site not found at database position |
| NV | Site position not verified |

Although all data in this dataset have been used by the Missouri Department of Natural Resources (MoDNR), no warranty, expressed or implied,is made by MoDNR as to the accuracy of the data and related materials. The act of distribution shall not constitute any such warranty, and no responsibility is assumed by MoDNR in the use of these data or related materials. This sheet is subject to change as additional information is acquired. Additional information at: http://drinkingwater.missouri.edu

# Sikeston

PWSS No. 4010743

Scott County, sheet 4 of 4

162 potential contaminant sources

Prepared by:

CENTER FOR APPLIED RESEARCH AND ENVIRONMENTAL SYSTEMS UNIVERSITY OF MISSOURI

Sheet Update: Jun 09, 2014

Missouri Department of
Natural Resources

| Map C.No. | CARES ID | Site Name | Type | Location Code | Accuracy Code | Method Code | Database Code |
|---|---|---|---|---|---|---|---|
| C151 | 385455 | Sikeston Seed Co., Inc. | Feed/Fertilizer/Co-op | BL | 33 ft | I2 | CARES |
| C152 | 385456 | H & H Small Engine Repair | Auto repair shop | BL | 33 ft | I2 | CARES |
| C153 | 385457 | Auto Repair | Auto repair shop | BL | 33 ft | I2 | CARES |
| C154 | 385458 | J J Auto Sales | Automotive dealership | BL | 33 ft | I2 | CARES |
| C155 | 385459 | Sikeston City Dump | Dumping and/or burning site | CF | 33 ft | I2 | CARES |
| C156 | 385460 | William Farr and Purnell Funeral Home | Funeral service and crematory | BL | 33 ft | I2 | CARES |
| C157 | 385461 |  | Well (abandoned) | BL | 33 ft | I2 | CARES |
| C158 | 385462 |  | Well (abandoned) | BL | 33 ft | I2 | CARES |
| C159 | 385463 | Sikeston Fire Station | Fire station | BL | 33 ft | I2 | CARES |
| C160 | 385464 |  | Tank (above-ground fuel) | TK | 33 ft | I2 | CARES |
| C161 | 385465 | Sikeston Highway Maintenence Facility | Highway maintenance facility | CF | 33 ft | I2 | CARES |
| C162 | 385466 | Shell | Petroleum production or storage | BL | 33 ft | I2 | CARES |

## Method Codes

| Code | Address Matching (Geocoding) | Code | Global Positioning System | Code | Other |
|---|---|---|---|---|---|
| A2 | Block/Group | G1 | Static Mode | P1 | Land Survey |
| A3 | Street Centerline | G2 | Kinematic Mode | S2 | Quarter Description |
| A4 | Nearest Street Intersection | G3 | Differential Post Processing | UN | Unknown |
| A5 | Primary Street Name | G4 | Precise Positioning Service |  |  |
| A6 | Digitization | G5 | Signal Averaging |  |  |
| AO | Other Address Matching | G6 | Real Time Differential Processing |  |  |
| Z1 | ZIP Code Centroid |  | Interpolation |  |  |
|  | Census - 1990 | I1 | Topo Map |  |  |
| C1 | Block Centroid | I2 | Aerial Photography (DOQQ) |  |  |
| C2 | Block/Group Centroid | I3 | Satellite Imagery |  |  |
| C3 | Tract Centroid |  |  |  |  |

## Location Codes

| | |
|---|---|
| BL | Building |
| CF | Center of Facility |
| IN | Intersection |
| LS | Lagoon or Pond |
| MG | Main Access Point (Gate) |
| MA | Main Office |
| OT | Other |
| PL | Pile |
| RD | Road |
| TK | Tank, Standpipe, or Tower |
| WL | Well |
| UN | Unknown |

## Accuracy Codes

| Code | Metric |
|---|---|
| m | Meters |
| km | Kilometers |
|  | English |
| ft | Feet |
| yd | Yards |
| mi | Miles |
| UN | Unknown |
| NF | Site not found at database position |
| NV | Site position not verified |

# Sikeston

PWSS No. 4010743

Contaminant Summary Sheet

162 potential contaminant sources

Sheet Update: Jun 09, 2014

Prepared by:

CENTER FOR APPLIED RESEARCH AND ENVIRONMENTAL SYSTEMS
UNIVERSITY OF MISSOURI

Missouri Department of
Natural Resources

## 162 Potential Contaminant Sources in the Listed Databases:

| | |
|---|---|
| | AFS (EPA AIRS Facility Sites) |
| 16 | APCP (MoDNR Air Pollution Control Program Sites) |
| | APF (MoDNR Active Permitted Landfills & Transfer Stations) |
| 2 | CERCLIS (EPA CERCLIS) |
| 3 | Chemcov (VA Selected Chemical Sites) |
| 1 | Dealcov (MDA Pesticide Dealer Locations) |
| | Dioxin (MoDNR Confirmed Dioxin List) |
| | Grain B (USDA Former Grain Bin Sites) |
| 31 | HW Gen (MoDNR Hazardous Waste Generators) |
| | HW Tran (MoDNR Hazardous Waste Transporters) |
| | LUST (MoDNR Leaking Underground Storage Tanks) |
| | MoDOT (MoDOT Highway Maintenance Facilities) |
| | PADS (EPA PCB Activity Data Base System) |

| | |
|---|---|
| | Perchlo (MoDNR Perchlorate Sites in Missouri) |
| | Pest Ap (MDA Licensed Pesticide Applicators) |
| | RCRIS (EPA Resource Conservation and Recovery Information System) |
| | Silos (USGS Minuteman II Missile Silos) |
| 1 | SMARS (MoDNR Superfund Management and Registry System) |
| 48 | Tanks (MoDNR Petroleum Tank Database) |
| | Tier 2 (MERC Tier II Reports) |
| | Tire D (MoDNR Resolved and Unresolved Waste Tire Dumps) |
| | TRI (EPA Toxic Release Inventory) |
| | VCP (MoDNR Voluntary Cleanup Program Sites) |
| | WQIS (MoDNR Water Quality Information System) |
| 60 | SWIP Field Inventory (see below) |

## 60 Potential Contaminant Sources in the SWIP Field Inventory:

| | |
|---|---|
| 0 | Airport or abandoned airfield |
| 0 | Animal feedlot |
| 0 | Apartments and condominiums |
| 0 | Asphalt plant |
| 6 | Auto repair shop |
| 8 | Automotive dealership |
| 0 | Barber and beauty shop |
| 0 | Boat yard and marina |
| 0 | CAFO |
| 0 | Campground |
| 2 | Car wash |
| 0 | Cement Plant |
| 0 | Cemetery |
| 0 | Communication equipment mfg |
| 0 | Country club |
| 3 | Dry cleaner |
| 1 | Dumping and/or burning site |
| 0 | Electric equipment mfg or storage |
| 0 | Electric substation |
| 0 | Farm machinery storage |
| 3 | Feed/Fertilizer/Co-op |
| 2 | Fire station |
| 2 | Funeral service and crematory |
| 1 | Furniture manufacturer |
| 0 | Furniture repair or finishing shop |
| 0 | Garden and/or nursery |
| 0 | Garden, nursery, and/or florist |
| 0 | Gasoline service station |
| 0 | Golf courses |
| 0 | Government office |
| 0 | Grain bin |
| 3 | Hardware and lumber store |
| 0 | Hazardous waste (Federal facility) |
| 1 | Highway maintenance facility |
| 0 | Jewelry or metal plating shop |
| 0 | Junk yard or salvage yard |
| 0 | Lagoon (commercial) |
| 0 | Lagoon (industrial) |
| 0 | Lagoon (municipal) |
| 0 | Lagoon (residential) |
| 0 | Landfill (municipal) |
| 0 | Laundromat |
| 0 | Livestock auction |

| | |
|---|---|
| 0 | Machine or metalworking shop |
| 2 | Manufacturing (general) |
| 0 | Material stockpile (industrial) |
| 0 | Medical institution |
| 0 | Metal production facility |
| 0 | Mining operation |
| 7 | Other |
| 1 | Paint store |
| 0 | Park land |
| 0 | Parking lot |
| 1 | Petroleum production or storage |
| 0 | Pharmacies |
| 0 | Photography shop or processing lab |
| 0 | Pit toilet |
| 0 | Plastic material and synthetic mfg |
| 1 | Print shop |
| 0 | Railroad yard |
| 0 | Recycling/reduction facility |
| 0 | Research lab |
| 0 | Restaurant |
| 1 | Sawdust pile |
| 0 | School |
| 0 | Sports and hobby shop |
| 0 | Swimming pool |
| 0 | Tailing pond |
| 5 | Tank (above-ground fuel) |
| 0 | Tank (other) |
| 0 | Tank (pesticide) |
| 6 | Tank (underground fuel) |
| 0 | Trucking terminal |
| 1 | Veterinary service |
| 0 | Wastewater treatment facility |
| 2 | Well (abandoned) |
| 1 | Well (domestic) |
| 0 | Well (irrigation) |
| 0 | Well (livestock) |
| 0 | Well (monitoring) |
| 0 | Well (public water supply) |
| 0 | Well (unknown) |

# Sikeston

PWSS No. 4010743

Susceptibility Determination Sheet

8 wells

Sheet Update: Mar 14, 2014

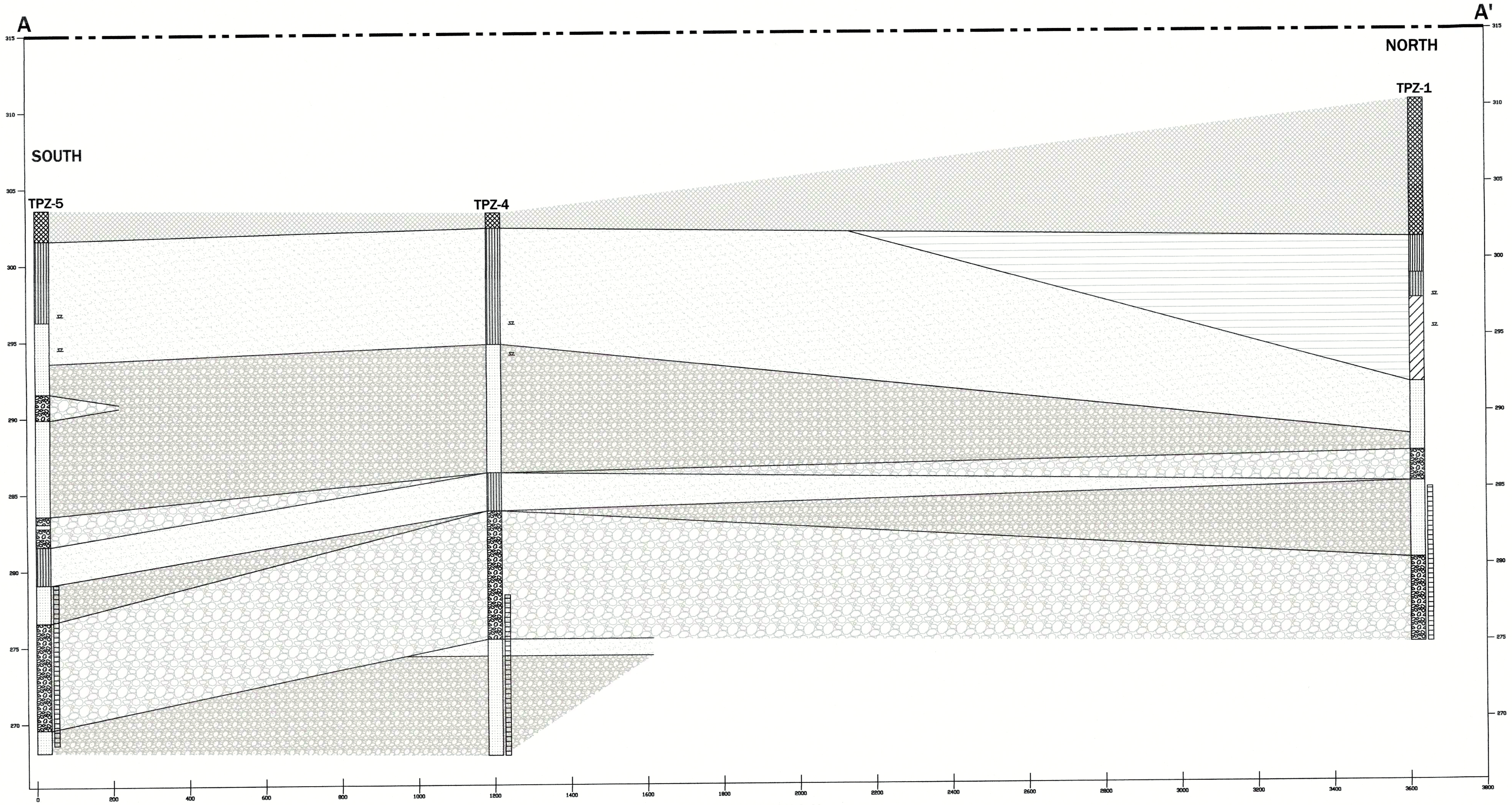
Prepared by:
CENTER FOR APPLIED RESEARCH AND ENVIRONMENTAL SYSTEMS
UNIVERSITY OF MISSOURI

Missouri Department of
Natural Resources

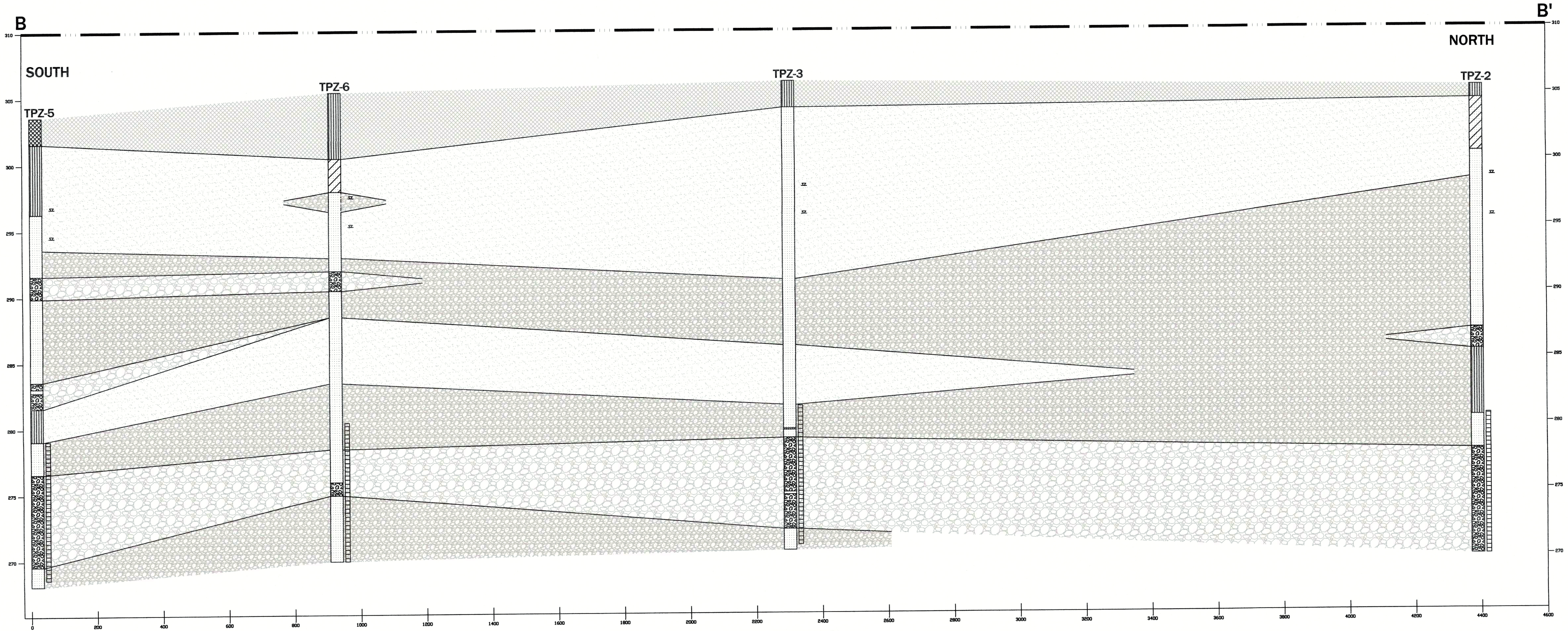
| The Missouri Department of Natural Resources (MoDNR) has assembled this information to assess the susceptibility of drinking water sources to contamination. There are many unforseen and unpredictable factors that may cause a source to be contaminated. MoDNR routinely monitors all public supplies to ensure public health is protected. Public water systems and local communities are encouraged to take all measures possible to reduce the susceptibility of their drinking water source to chemical contamination. For more information, call 1-800-361-4827. | Not Susceptible | Moderately Susceptible | Highly Susceptible | Incomplete Data |
|---|---|---|---|---|
| **A system is highly susceptible because of construction deficiencies if:** | | | | |
| A well was not constructed according to plans approved by MoDNR-PDWB, | | | | X |
| A well was not cased to a depth approved by MoDNR, | | | | X |
| A well casing is not of sufficient weight, | | | | X |
| A well is not sufficiently sealed (grouted) around the casing, or<br>A well has developed holes in the casing or other flaws that compromise its integrity. | | | | X |
| **A system is highly susceptible due to direct influence of surface water if:** | | | | |
| A well has tested positive for surface water indicators such as algae or high turbidity. | | | | X |
| **A system is highly susceptible to surface contaminants if:** | | | | |
| A well casing does not extend 12 inches above the well house floor, or 18 inches above the ground surface, | | | | X |
| A well casing does not extend four feet above the 100-year flood level, or four feet above the highest known flood elevation, | | | | X |
| A well is not provided with a properly screened vent, or | | | | X |
| All openings in a well casing are not properly sealed. | | | | X |
| **A system is highly susceptible based on detection histories if:** | | | | |
| Volatile Organic Chemicals (VOCs) have been detected in a well, | X | | | |
| Synthetic Organic Chemicals (SOCs) have been detected in a well, | | | | X |
| Inorganic Chemicals (IOCs) have been detected in a well above naturally occurring levels, | | | | X |
| Nitrates have been detected at or above one-half the MCL, | X | | | |
| Bacteria has been consistently detected in a well, or | | | | X |
| Viruses or microbiological contaminants are detected in a well. | | | | X |
| **A system is highly susceptible to weather, vandalism, and sabotage if:** | | | | |
| A well is not in a locked well house of adequate construction. | | | | X (1) |
| **A system is moderately susceptible due to local geology if:** | | | | |
| A producing aquifer is less than 100 feet below the surface, | X | | | |
| A producing aquifer has conduit flow conditions due to surficial karst topography, | | | | X |
| A producing aquifer is not overlain by an impermeable confining layer, | | | | X |
| A producing aquifer is overlain by a conductive (>5X10e-4) formation (including soil), or | | | | X |
| A producing aquifer is confined, but there are open wells nearby penetrating that layer. | | | | X |
| **A system is moderately susceptible to contaminants if:** | | | | |
| Any contaminants listed in Appendix F-a are found in the source water area, | | X (2) | | |
| Septic systems are present in the source water area, | | | | X |
| A well is indirectly connected to a surface water body, | | | | X |
| A submersible well pump cannot be ruled out from containing PCBs or PHAs, or | | | | X |
| There is a high density of transportation corridors in the source water area. | | | | X |
| **A system is highly susceptible to contamination if:** | | | | |
| Any contaminant sites identified in the source water area are known to have contaminated groundwater that may migrate toward a well. | | | | X |

(1) This system was not assessed to determine if adequate security devices such as padlocks, gates, and lighting are in place to deter vandals and saboteurs. All water systems should have this type of protection in place.
(2) A well (or wells) serving this system has been determined to be susceptible due to the presence of potential contaminant sources. The water system and the wellhead protection team should take extra care to ensure that all potential contaminants in the source water area are handled properly to avoid contamination of the drinking water supply.

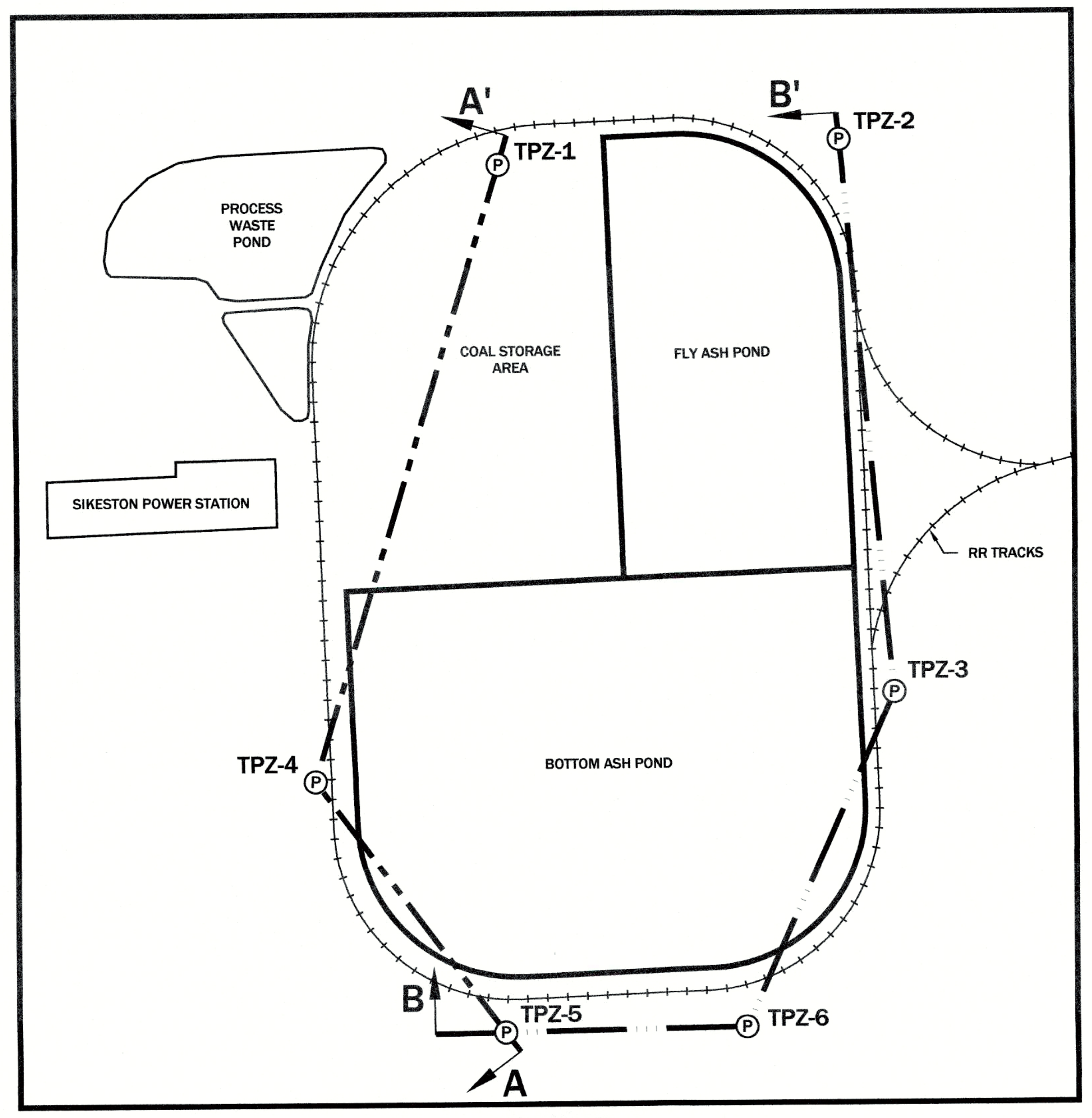
# ATTACHMENT D5 – SITE HYDROGEOLOGY



**CROSS SECTION A-A'**
SCALE:
HORIZONTAL - 1"=200'
VERTICAL - 1"=5'



**CROSS SECTION B-B'**
SCALE:
HORIZONTAL - 1"=200'
VERTICAL - 1"=5'



**INSET MAP**
SCALE: 1"=500'

**LEGEND**

| | |
|---|---|
| ▩ FILL | ▨ FILL/SOIL |
| ▨ CLAY | ☰ BACKSWAMP DEPOSITS |
| ▨ SANDY CLAY | ☐ FLOODPLAIN DEPOSITS |
| ▥ SILT | ▩ TRANSITIONAL DEPOSITS |
| ▥ SILTY SAND | ▩ CHANNEL/CHANNEL BAR DEPOSITS |
| ░ SAND | |
| ▩ SAND AND GRAVEL | |
| ▯ PIEZOMETER SCREEN | |

▽ MINIMUM AND MAXIMUM WATER TABLE ELEVATION
— INFERRED FACIES BOUNDARY

NOTES:
1. FACIES SEQUENCES ONE FOOT THICK AND GREATER USED FOR INTERPRETATION PURPOSES. ADDITIONAL BOREHOLE INFORMATION PRESENTED IN APPENDIX 4.
2. ADDITIONAL PIEZOMETER INFORMATION PRESENTED IN APPENDIX 6.
3. WATER TABLE ELEVATIONS REPRESENT MAXIMUM AND MINIMUM READINGS DURING 12 MONTH MONITORING PERIOD.

**GREDELL Engineering Resources, Inc.**
ENVIRONMENTAL ENGINEERING LAND - AIR - WATER
1505 East High Street
Jefferson City, Missouri
Telephone: (573) 659-9078
Facsimile: (573) 659-9079
MO CORP. ENGINEERING LICENSE NO. E-2001001669-D

SIKESTON POWER STATION
SITE CHARACTERIZATION

| SURVEYED | DESIGNED | DRAWN | CHECKED | APPROVED | DATE | SCALE |
|---|---|---|---|---|---|---|
| NA | KE | AJK | KE | MCC | 5/2017 | AS NOTED |

FIGURE 5
GEOLOGIC CROSS SECTIONS

| PROJECT NAME | FILE NAME | SHEET # |
|---|---|---|
| SIKESTON/NPDES | GEOLOGIC X SECS | 1 OF 1 |

MIKE C. CARLSON
RG0130
5-31-17

THE GEOLOGIST WHO REVIEWED AND APPROVED THIS REPORT ASSUMES RESPONSIBILITY ONLY FOR GEOLOGIC INTERPRETATIONS OF DATA APPEARING ON THE PAGE AND DISCLAIMS PURSUANT TO SECTION 256.456 RSMO ANY RESPONSIBILITY FOR ALL OTHER PLANS, SPECIFICATIONS, ESTIMATES, REPORTS OR OTHER DOCUMENTS OR INSTRUMENTS NOT PREPARED UNDER THE SUPERVISION OF THE GEOLOGIST RELATING TO OR INTENDED TO BE USED FOR ANY PART OR PARTS OF THE PROJECT TO WHICH THIS FIGURE REFERS.

# ATTACHMENT D6 – STRUCTURAL STABILITY ASSESSMENT

1505 East High Street
Jefferson City, Missouri  65101
Telephone (573) 659-9078
Facsimile (573) 659-9079

**GREDELL Engineering Resources, Inc.**

# Sikeston Board of Municipal Utilities
# Sikeston Power Station
# Bottom Ash Pond
# Structural Stability Assessment

*Prepared for:*

**Sikeston Power Station**
**1551 West Wakefield Avenue**
**Sikeston, MO 63801**

October 17, 2016

# Sikeston Board of Municipal Utilities
# Sikeston Power Station
# Bottom Ash Pond
# Structural Stability Assessment

**October 17, 2016**

## Table of Contents

## List of Appendices

# PROFESSIONAL ENGINEER'S CERTIFICATION

40 CFR 257.73(d) Periodic Structural Stability Assessments.

I, Thomas R. Gredell, P.E., a professional engineer licensed in the State of Missouri, hereby certify in accordance with 40 CFR 257.73(d)(3) that this structural stability assessment for the Sikeston Board of Municipal Utilities, Sikeston Power Station, Bottom Ash Pond meets the requirements of 40 CFR 257.73(d) as found in federal regulation 40 CFR 257, Subpart D – Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments and has been prepared using methods and procedures consistent with the professional standard of care and customary practice for engineering investigations of projects of this nature.

Name: Thomas R. Gredell, P.E.

Signature: Thomas R Gredell

Date: 10-17-2016

Registration Number: PE-021137
State of Registration: Missouri

THOMAS R. GREDELL
NUMBER PE-021137

# 1.0 INTRODUCTION

In accordance with the scope of services outlined in the Sikeston Board of Municipal Utilities (SBMU) Work Order No. 4 dated August 02, 2016, GREDELL Engineering Resources, Inc. (Gredell Engineering) conducted an initial structural stability assessment for the SBMU Sikeston Power Station (SPS) Bottom Ash Pond, a coal combustion residual (CCR) surface impoundment. The purpose of this assessment was to determine if the Bottom Ash Pond was designed, constructed, operated, and maintained in a manner consistent with recognized and generally accepted good engineering practices under the Federal CCR rule, section (§) 40 CFR 257.73(d). This report describes Gredell Engineering's assessment for the Bottom Ash Pond and includes the required certification by a qualified professional engineer stating this structural stability assessment was conducted in accordance with §257.73(d).

## 1.1 40 CFR §257.73(d) Periodic Structural Stability Assessment

§257.73(d), which requires the initial structural stability assessment completed by Gredell Engineering, is provided for reference below.

*(d)(1) The owner or operate of the CCR unit must conduct initial and periodic structural stability assessments and document whether the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater which can be impounded therein. The assessment must, at a minimum, document whether the CCR unit has been designed, constructed, operated, and maintained with:*

*(d)(1)(i) Stable foundations and abutments;*

*(d)(1)(ii) Adequate slope protection to protect against surface erosion, wave action, and adverse effects of sudden drawdown;*

*(d)(1)(iii) Dikes mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR unit;*

*(d)(1)(iv) Vegetated slopes of dikes and surrounding areas not to exceed a height of six inches above the slope of the dike, except for slopes which have an alternate form or forms of slope protection;*

*(d)(1)(v) A single spillway or combination of spillways configured as specified in paragraph (d)1(v)(A) of this section. The combined capacity of all spillways must be designed, constructed, operated, and maintained to adequately manage flow during and following the peak discharge from the event specified in paragraph (d)(1)(v)(B) of this section;*

*(d)(1)(v)(A) All spillways must be either: (1) of non-erodible construction and designed to carry sustained flows; or (2) Earth- or grass-lined and designed to carry short-term, infrequent flows at non-erosive velocities where sustained flows are not expected.;*

*(d)(1)(v)(B) The combined capacity of all spillways must adequately manage flow during and following the peak discharge from a: (1) Probable maximum flood (PMF) for a high hazard potential CCR surface impoundment; or (2) 1000-year flood for a significant hazard potential CCR surface impoundment; or (3) 100-year flood for a low hazard potential CCR surface impoundment;*

*(d)(1)(vi) Hydraulic structures underlying the base of the CCR unit or passing through the dike of the CCR unit that maintain structural integrity and are free of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, and debris which may negatively affect the operation of the hydraulic structure;*

*(d)(1)(vii) For CCR units with downstream slopes which can be inundated by the pool of an adjacent water body, such as a river, stream or lake, downstream slopes that maintain structural stability during low pool of the adjacent water body or sudden drawdown of the adjacent water body;*

*(d)(2) The periodic assessment described in paragraph (d)(1) of this section must identify any structural stability deficiencies associated with the CCR unit in addition to recommending corrective measures. If a deficiency or a release is identified during the periodic assessment, the owner or operator unit must remedy the deficiency or release as soon as feasible and prepare documentation detailing the corrective measures taken;*

*(d)(3) The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer stating that the initial assessment and each subsequent periodic assessment was conducted in accordance with the requirements of this section.*

# 2.0 BOTTOM ASH POND DESCRIPTION

SPS is located west of the City of Sikeston, south of West Wakefield Avenue, and east of Route BB in Scott County, Missouri. The Bottom Ash Pond at SPS resides to the southeast of SPS, and directly south of SPS's coal pile and inactive Fly Ash Pond. The Bottom Ash Pond occupies approximately 61 acres with a minimum and consistent berm elevation of 322.3 feet. Based on an aerial survey conducted by Surdex Corporation on May 06, 2012, the Bottom Ash Pond has an approximate remaining capacity of 333 acre-feet (ac-ft) (14,500,000 cubic feet [$ft^3$]).

SPS and the Bottom Ash Pond are located at a transition between agricultural and urban areas. The Bottom Ash Pond is surrounded by agricultural, commercial, and residential areas. Residential areas are located approximately 150 feet east/southeast of the Bottom Ash Pond. Commercial areas are located approximately 700 feet south of the Bottom Ash Pond. The remaining area around the Bottom Ash Pond is agricultural land. There is City-owned property to the east, south, and west of the Bottom Ash Pond. See Appendix A, Figure 1 – Aerial View, for a depiction of the Bottom Ash Pond.

# 3.0 STRUCTURAL STABILITY ASSESSMENT

The Federal CCR Rule requires an initial and periodic structural stability assessment for existing CCR surface impoundments. Periodic structural stability assessments shall be conducted every five years. Structural stability assessments must document whether the design, construction, operation, and maintenance of the CCR surface impoundment is consistent with recognized and generally accepted good engineering practices.

## 3.1 Foundations and Abutments

The foundation soils for the Bottom Ash Pond consist of existing soils or fills compacted to support the finished construction of the Bottom Ash Pond. Topsoil and soil with unsuitable material was stripped to a minimum depth of 6 inches. The stripped surface was further excavated or filled to the desired grades. The foundation soils beneath the berms of the Bottom Ash Pond consist of silty sand (SM) and fine to medium course sand (SP) (Geotechnology 2011).

The foundation soils where designed to be compacted in accordance with the construction specifications to a 95% maximum density at optimum moisture for silty sands and 70% relative density for sands prior to the construction of any features of the Bottom Ash Pond. The construction specifications may be found in the Sikeston Board of Municipal Utilities, Sikeston Power Station, Bottom Ash Pond, History of Construction, Appendix C – Historical Construction Specifications.

No deficiencies were found during the assessment of the foundations and abutments of the Bottom Ash Pond, therefore, no corrective measures are recommended.

## 3.2 Slope Protection

The Bottom Ash Pond has sufficient slope protection on the interior and exterior slopes to protect against various methods of erosion which may cause detrimental effects to the berms of the Bottom Ash Pond. The interior slopes of the bottom ash are protected from surface erosion and wave action by vegetative growth and rip-rap. Rip-rap was visible from the top of the berms to an observed water line elevation of 318.5 feet (as observed on October 5, 2016). Additionally, aerial photography obtained by Surdex Corporation on May 06, 2012 depicts rip-rap along the interior slopes to an observed water line elevation of 315 feet). The exterior slopes of the Bottom Ash Pond berms are protected from erosion by a thick, consistent grass vegetative cover.

No deficiencies were found during the assessment of the slope protection measures for the Bottom Ash Pond, therefore, no corrective measures are recommended.

## 3.3 Berm Stability

The berms of the Bottom Ash Pond were constructed on top of the prepared foundation soils. The berm fill material consists of fine sands and silty sands (SP and SM) (Geotechnology 2011). The berm fill materials were designed to be placed and compacted in accordance with the construction specifications to 70 percent relative density. The berms were constructed with 2 horizontal to 1 vertical slopes (2H:1V). The design finished top elevation of the berms was 322 feet. A recent aerial topographic survey shows that the berm has a consistent elevation that ranges between 322.3 and 322.6.

A global stability evaluation was conducted by Geotechnology in 2011 on the Bottom Ash Pond berms provide information on the stability of the berms for decision making purposes. The evaluation included four borings in the berms of the Bottom Ash Pond. The standard penetration tests for the borings equates to an average N value of 22 which correlates to a medium-dense compaction for the berm material. An N value of 22 indicates the berms were mechanically compacted during construction.

The global stability evaluation, assessed a range of loading conditions in the Bottom Ash Pond. The evaluation was conducted for steady state seepage at normal pool (elevation 317 feet), steady state seepage at maximum pool (elevation 321.5 feet), and pseudo-static conductions for seismic loading (elevation 317 feet). The calculated factors of safety for each condition were determined to be 2.1 (steady state, normal pool) and 1.5 (steady state, maximum pool), and 1.3 (pseudo-static, normal pool) (Geotechnology 2011). A factor of safety less than 1 would indicate an unstable condition in the berms.

Based on the available geotechnical data and analyses of the Bottom Ash Pond, it is determined the dikes of the Bottom Ash Pond were mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR unit. Additionally, no evidence has been found or observed that leads Gredell Engineering to believe the specifications were not followed.

A visual inspection of the berms of the Bottom Ash Pond identified an area of saturated soil along the northern berm of the Bottom Ash Pond and west of the Fly Ash Pond. The area was previously identified by SPS personnel as an area of persistent wet conditions from rainfall due to the lack of drainage along the toe of the slope of the Bottom Ash Pond. The wet ground conditions were observed to begin approximately midway on the exterior slope of the berm (approximate elevation of 314 feet) and continued to the toe of the exterior slope of the berm. The type of grass vegetation was visually observed to change along a horizontal line along the exterior slope of the berm that generally matched the beginning of the wet conditions. Simple manual field techniques were also used to confirm the observations of wet conditions.

Due to the lack of recent precipitation, the saturated condition of the soil may be the result of seepage through the northern berm from the Bottom Ash Pond. However, no visible flow was observed and stability analysis of critical sections of Bottom Ash Pond berms by others reportedly exceed the minimum Factors of Safety required by the CCR rule.

Based on the observations and rationale described above, the wet, saturated soil condition is identified as a deficiency under the rule. Consistent with recognized and generally accepted good engineering practices, it is recommended corrective measures be undertaken by SBMU to further evaluate the potential seepage through the northern berm of the Bottom Ash Pond. The evaluation should recommend appropriate corrective measures to stabilize and/or repair the northern berm of the Bottom Ash Pond. At a minimum, corrective measures should be taken to improve the conditions for future routine maintenance (i.e., mowing) and observation.

## 3.4 Maximum Vegetation Height Requirement

As stated above, §257.73(d)(1)(iv) requires the vegetated slopes of berms and surrounding areas to not exceed six inches above the vegetated slope of the berm. §257.73(d)(1)(iv) was remanded with vacatur by the United States Court of Appeals for the District of Columbia Circuit on June 14, 2016. Therefore, the Bottom Ash Pond is no longer subject the maximum vegetation height requirement stipulated in §257.73(d)(1)(iv).

## 3.5 Spillway Design and Capacity

Discharge from the Bottom Ash Pond is through a concrete stop-log structure with dimensions of 6 feet wide, 11 feet long, and 8.5 feet deep with a top elevation of 322.53 feet (the active spillway). The active spillway is not currently operated with stop-logs. The discharge structure outlet is a single, 10-inch carbon fiber pipe which discharges Bottom Ash Pond effluent into the Process Waste Pond. The discharge pipe inlet and outlet invert elevations are 314.53 feet and 304.97 feet, respectively. The discharge pipe is routed from the discharge structure to a control valve with an invert elevation of approximately 306.3 feet. The distance from the discharge structure to the control valve is approximately 80 feet and the slope of the discharge pipe is approximately 10.3%. From the control valve, the discharge pipe is routed to the Process Waste Pond over a distance of approximately 1,820 feet with a slope of approximately 0.07%. Average daily and monthly maximum flow rates from the Bottom Ash Pond to the Process Waste Pond are 1.22 and 2.13 million gallons per day (MGD), respectively, as identified in SBMU's NPDES permit process flow diagram.

The Bottom Ash Pond also has a second overflow structure constructed of a concrete inlet with a 30-inch corrugated metal discharge pipe through the berm separating the Bottom Ash Pond from the inactive Fly Ash Pond. The discharge of the overflow structure is into the inactive Fly Ash Pond. The overflow structure is inoperable due to excess CCR deposits in the inactive Fly Ash Pond obstructing the discharge end of the 30-inch pipe.

The hazard potential classification for the Bottom Ash Pond was determined by modeling a worst-case probable scenario breach of the Bottom Ash Pond Berms and its resulting flood waters impact on the surrounding land using HydroCAD. Based on the HydroCAD model, the Bottom Ash Pond at SPS was classified as Significant. As stated above, §257.73(d)(1)(v)(B)(2) requires the inflow design flood for CCR surface impoundments with significant hazard potential classifications to be the 1,000 year flood (Gredell Engineering Resources, 2016a). The 1,000-year flood is the volume of runoff generated by the 1,000 year rainfall event for a given location. The 1,000 year, 24 hour rainfall event was modeled to determine if the existing Bottom Ash Pond and its associated discharge structures are negatively impacted by the discharge from the Bottom Ash Pond. From the National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Volume 8, Version 2, the 1,000-year, 24-hour precipitation event for Sikeston, Missouri is 12 inches of rainfall.

The peak discharge from the combined process wastewaters and the 1,000-year flood was determined to be 967 cubic feet per second (CFS) with a total influent volume of 2,622,500 $ft^3$ (19.6 MG). The maximum water elevation in the Bottom Ash Pond from the combined influents was determined to be 320.3 feet, 1.7 feet below the top of the Bottom Ash Pond berms (elevation 322 feet). The current capacity of the Bottom Ash pond with 61 acres area and 1.7 feet of storage is approximately 4,517,000 $ft^3$. The peak discharge from the Bottom Ash Pond during the 1,000-year inflow design flood was determined to be 1.78 CFS (1.15 MGD). Therefore, the Bottom Ash Pond active spillway has adequate hydrologic and hydraulic capacity to manage flow during and following the peak discharge from the inflow design flood, as required by §257.73(d)(1)(v) (Gredell Engineering Resources, 2016b).

No deficiencies were found during the assessment of active spillway of the Bottom Ash Pond. The emergency spillway between the Bottom Ash Pond and the Fly Ash Pond was found to be deficient due to excess fly ash at the discharge of the 30-inch corrugated metal pipe impeding the flow path of water from the Bottom Ash Pond. Consistent with recognized and generally accepted good engineering practices, it is recommended corrective measures be taken to either remove the accumulated CCR from the discharge end of the overflow structure, or construct an alternate overflow structure capable of adequately managing flow during and following the peak discharge from the design flood event.

## 3.6 Structural Integrity of Hydraulic Structures

As stated above, §257.73(d)(1)(vi) requires the structural integrity of hydraulic structures passing through or beneath a CCR surface impoundment to be maintained in a manner to prevent conditions which negatively affect the operation of the hydraulic structure.

### 3.6.1 Identified Hydraulic Structures

The Bottom Ash Pond has multiple hydraulic structures pass through the berms and one hydraulic structure passing beneath the CCR surface impoundment. Hydraulic structures passing through the berms of the Bottom Ash Pond Include:

- Overflow Structure: 30-inch corrugated metal pipe passing through the northern berm between the Bottom Ash Pond and the Fly Ash Pond (approximate 318.25 feet invert elevation).
- Active Discharge Structure: 10-inch carbon fiber pipe passing through the northern berm of the Bottom Ash Pond, discharging into the Process Waste Pond (approximate 314.5 feet invert elevation).
- Makeup Water Inlet: 8-inch iron pipe passing through the northern berm of the Bottom Ash Pond from the Fly Ash Pond (approximate 321.5 feet invert elevation).

Multiple hydraulic structures are buried on top of, or along the interior of, the Bottom Ash Pond, but do not pass completely through the berms. The following pipes are laid in concrete lined pipe trenches up the exterior slopes, then along and across the top of the berms to the interior of the Bottom Ash Pond. Once within the interior of the Bottom Ash Pond, the pipes are either re-buried or lay above grade. All pipes through the berms, with the exception of the Bottom Ash Pond's active spillway and inoperable overflow structure, are located above the normal water level of the Bottom Ash Pond (approximate elevation 318.5 feet).

- Bottom Ash Transport Water Inlet: estimated 8 to 10-inch iron pipe (the end of the pipe was physically inaccessible for direct measurement);
- Plant Operations Wastewater Inlet: 12-inch iron pipe;
- Pipe Trench Sump Discharge Pipe: 4-inch PVC pipe;
- Former Transport Water Inlets: Dual, 3-inch iron pipes;

The Bottom Ash Pond was constructed with dual, 2,140-foot long culverts passing beneath the compacted clay liner to convey stormwater from the eastern side to the western side of the Bottom Ash Pond. The stormwater culverts were located in the same location and along the same trajectory as the original Compress Road, which was removed during the construction of the Bottom Ash Pond. The purpose of the dual stormwater culverts is to maintain the gravity flow of off-site stormwater (originating on the east side of the Bottom Ash Pond) to the west side of the Bottom Ash Pond, eventually discharging into Ditch #4. The stormwater culverts were constructed as continuously reinforced concrete box culverts with inside dimensions of 5 feet tall by 8 feet wide for approximately 2,090 feet measured from inlet on the east to discharge on the west. The remaining 50 feet of the stormwater culverts are constructed of oval corrugated metal arch-pipe with approximate inside dimensions of 4 feet tall by 6.5 feet wide. The inlet and discharge elevations are 301.9 feet and 297.7 feet, respectively.

### 3.6.2 Structural Integrity of Identified Hydraulic Structures

A visual inspection was conducted of each hydraulic structure passing through or beneath the berms of the Bottom Ash Pond, where visible, for structural integrity, significant deterioration and deformation, distortion, bedding deficiencies, sedimentation, and debris which may negatively impact the operation of the hydraulic structure. The results of the visual inspection are described below.

- Overflow Structure: The concrete headwall of the overflow structure was in good condition with no visual signs of deterioration. The iron shear gate and inlet of the 30-inch corrugated metal pipe appeared to be in good condition with no visual signs of deterioration. The discharge of the 30-inch corrugated metal pipe was not identified due to excessive CCR accumulation that buried the discharge end in the inactive the Fly Ash Pond. The excessive CCR accumulation that negates the functionality of the overflow structure. The inoperable overflow structure is not determined to be a deficiency because the active discharge structure adequately manages flow during and following the peak discharge from the design flood event (the 1,000-year flood).
- Active Discharge Structure: The concrete discharge structure serving the 10-inch carbon fiber discharge pipe appeared in good condition with no visual signs of deterioration. The inlet of the 10-inch discharge pipe was beneath the water surface and therefore, not directly observed. The control valve serving the discharge was observed to be in good condition and was reported to have been recently operated per plant personnel. The discharge of the 10-inch carbon fiber pipe is moderately deteriorated. The deterioration does not compromise the operation of the discharge pipe.
- Makeup Water Inlet: The 8-inch iron pipe passing through the northern berm of the Bottom Ash Pond from the Fly Ash Pond appeared in good condition with no visual signs of deterioration. The inlet and discharge ends of the pipe showed no signs of deterioration and the inlet valves were observed and reported to be in operating condition.
- Bottom Ash Transport Water Inlet: The bottom ash transport pipe was estimated at 8 to 10-inches in diameter. An exact determination was not possible because the inlet discharge end of the pipe is inaccessible. The bottom ash transport water pipe is located below grade after rising from within the concrete lined pipe trench. The transport pipe appeared to be in good condition within the concrete lined pipe trench and at its discharge location in the Bottom Ash Pond. The concrete lined pipe trench did not appear to show any signs of significant deterioration.
- Plant Operations Wastewater Inlet: The plant operations wastewater 12-inch iron inlet pipe was observed to be in good condition within the concrete lined pipe trench. The plant

operations wastewater inlet pipe is located below grade after rising from within the concrete lined pipe trench. The discharge end of the pipe was showed signs of slight deterioration due to corrosion. The deterioration of the discharge end of the pipe does not compromise the operation of the inlet pipe.

- Pipe Trench Sump Discharge Pipe: The pipe trench sump discharge pipe (a 4-inch PVC pipe that runs along the top of the Bottom Ash Pond berm) was observed to be in good condition with no signs of deterioration. The PVC pipe is not located below grade at any point along its path within the boundary of the CCR Surface Impoundment.
- Dual Former Transport Water Inlets: The two former transport water inlet (3-inch) iron pipes are not located below grade at any point along their path, and therefore, were not evaluated as part of this initial structural stability assessment.

A visual inspection of the dual stormwater culverts located beneath the compacted clay liner of the Bottom Ash Pond was conducted via remote video operations. Each stormwater culvert was inspected independently. A complete inspection of the southern stormwater culvert was accomplished. However, approximately 300 feet of the northern stormwater culvert was not able to be directly inspected. Sediments within the northern stormwater culvert prevented the direct inspection of the stormwater culvert between approximately 1,600 and 1,900 feet (as measured from the inlet using the remote video equipment). The remote video capabilities of the inspection equipment allowed for an indirect visual inspection of the 300 feet by zooming the video camera. The observed condition of this section of the northern stormwater culvert were observed to be consistent with the remainder of the stormwater culvert, which is discussed below.

The continuously reinforced concrete box culvert sections of the stormwater culverts were observed to be in good condition. All surfaces of the concrete sections of the stormwater culverts were visible from the inlet of each culvert to approximately 1,200 feet into the culverts. From 1,200 feet to 2,090 feet, the bottom of the continuously reinforced concrete box culverts was obscured by sediment deposits with a maximum estimated thickness of 6-inches in depth. Recurring normal concrete shrinkage cracking in the top of both stormwater culverts was observed at regular intervals. No apparent separation or displacement of the concrete was observed. Minor seepage and calcification were observed at each crack. Cracking along the exterior vertical walls of the concrete box culvert was observed, but infrequent. Where cracking was present in the vertical walls, seepage and calcification were present. No deterioration was observed along the bottom of the concrete sections of the stormwater culverts where it was visible and not obscured by sediments. Debris was identified in the concrete sections of the stormwater culvert in the form of random individual rip-rap stones and tires. The observed minor shrinkage cracking of the concrete sections of the stormwater culvert do not negatively affect the structural integrity nor the operation of the hydraulic structures. The sediment within the concrete section of the stormwater culverts has a slight negative impact on the operation of the hydraulic structure by reducing the hydraulic capacity and flow velocity within the stormwater culverts. However, the percentage of the total cross sectional area of the stormwater culverts is less than 10% for the reinforced concrete box culvert sections. The flat topography surrounding the Bottom Ash Pond will not result in inundation of the Bottom Ash Pond due to the slightly reduced capacity of the structure. However, the sediment in the stormwater culverts is identified as a deficiency to be addressed in the future.

The final 50 feet (2,090 to 2,140 feet) of each stormwater culvert is constructed of corrugated metal pipe. The northern stormwater culvert appears to be in good condition with minimal deterioration. The southern stormwater culvert appears to be in good condition except for two locations where seams near the top of the corrugated metal pipe have separated. The bituminous lining of both the corrugated metal culverts is deteriorating and is in danger of no longer functioning properly. The bottom of both corrugated metal pipe culverts is obscured by sediments approximately 6- to 10-inches thick. The sediment within the metal pipe section of the stormwater culverts has a slight negative impact on the operation of the hydraulic structure by reducing the hydraulic capacity and flow velocity within the stormwater culverts. However, the percentage of the total cross sectional area of the stormwater culverts is less than 25% for the corrugated metal arch-pipe sections. The flat topography surrounding the Bottom Ash Pond will not result in inundation of the Bottom Ash Pond due to the slightly reduced capacity of the structure. However, the sediment in the stormwater culverts is identified as a deficiency to be addressed in the future. The separated seams of the southern stormwater culvert are also identified as a deficiency.

A factor in the sedimentation of the stormwater culverts is believed to be that the bottom elevation of the grassed lined channel downstream of the discharge of the stormwater culverts was observed to be higher than the invert discharge elevation of the stormwater culverts. The elevation of the grass lined channel reduces the velocity of water discharging from the stormwater culverts, resulting in sedimentation within the culverts. The elevation of the bottom of the grass lined channel negatively impacts the operation of the stormwater culverts by reducing the discharge velocity of stormwater from the stormwater culverts. Therefore, the elevation of the bottom of the grass lined channel is identified as a deficiency.

Consistent with recognized and generally accepted good engineering practices, it is recommended corrective measures be taken to address the deficiencies identified in the hydraulic structures passing through or beneath the berms of the Bottom Ash Pond. The identified deficiencies and recommended corrective measures are as follows:

- It is recommended corrective measures be taken to lower the grade of the grass lined channel by a minimum of 100 feet to a depth of at least 1 foot below the discharge elevation of the stormwater culverts to allow complete discharge of the stormwater culverts following a rainfall event. The excavation of the channel will also provide a sediment trap for the deposition of sediments in the stormwater flow.
- Remove the sediment and debris (rip-rap stones and tires) from within both stormwater culverts located beneath the Bottom Ash Pond.

- Repair the separated seams of the corrugated metal pipe section in the southern stormwater culvert.

Generally accepted good engineering practices for surface impoundments typically include secondary discharge structures or spillways in the event a surface impoundment's active spillway is deemed inoperable. Accordingly, it is recommended corrective measures be taken to remove the obstructions to the discharge end of the pipe in the inactive Fly Ash Pond to render it operative. Alternatively, design and install a broad crested weir emergency spillway in the Bottom Ash Pond berm at least 100 feet west of the inoperable structure.

### 3.7 Downstream Inundation and Sudden Drawdown

As stated above, §257.73(d)(1)(vii) requires the structural integrity of the CCR unit must be maintained during low pool of the adjacent water body or sudden drawdown of the adjacent water body. The Bottom Ash Pond berms are not subject to inundation by an adjacent water body. Therefore, the structural integrity of the Bottom Ash Pond was not assessed for low pool or sudden drawdown of an adjacent water body.

### 3.8 Miscellaneous Assessed Site Features

Various site features which are present in or near the Bottom Ash Pond were assessed for their impact on the structural stability of the Bottom Ash Pond. Various identified site features are as follows:

- Three electrical manholes were identified along the northern berm of the Bottom Ash Pond. The manholes are reported by SBMU personnel to support the original power supply that powered the original scrubber sludge pump station located in the northeast corner of the Bottom Ash Pond. The electrical manholes and the associated electrical conduit run parallel to the centerline of the berm, do not pass through the berm and therefore are not found to be detrimental to the structural integrity of the Bottom Ash Pond Berms.
- Three 10-inch iron pipes were identified along the interior of the eastern berm of the Bottom Ash Pond. The iron pipes do not penetrate the berms of Bottom Ash Pond. SPS personnel identified the pipes as former aeration lines. The pipes observed were laid on the bottom of the Bottom Ash Pond, as reported by SPS personnel. The aeration lines were connected with a header pipe that ran along the inside of the northern half of the east berm. The aeration system was operated during the early years of operation to treat odors, but have not been used in recent years and are not anticipated to be used in the future.
- A pit was observed in the deposited CCR materials in the southwest portion of the Bottom Ash Pond. The pit was 50 to 80 feet in horizontal dimension, approximately 10+/- feet deep and at least 20 feet inward of the Bottom Ash Pond berms. The pit was identified

by SPS personnel as an excavation used to obtain a quantity of CCR materials for off-site testing for potential beneficial use. The pit was not backfilled and had vegetation growing around the perimeter.

# 4.0 RECOMMENDED CORRECTIVE MEASURES SUMMARY

As stated above, §257.73(d)(2) pertaining to CCR surface impoundments states each periodic assessment must identify any structural stability deficiencies associated with the CCR surface impoundment and recommend corrective measures. A summary of the identified deficiencies and recommended corrective measures are provided below:

- An area of wet/saturated soil was identified along the exterior of the northern berm of the Bottom Ash Pond and west of the Fly Ash Pond. The wet area was observed from the toe of the exterior slope up the berm to an approximate elevation of 314 feet. Due to a lack of recent precipitation and other observations made in the field, the wet/saturated condition of the soil may be an indication of seepage from the Bottom Ash Pond through this portion of north berm. Therefore, Gredell Engineering has identified this condition as a CCR rule deficiency.

  Gredell Engineering recommends further investigation of the wet area along the northern berm of the Bottom Ash Pond. If the wet area is confirmed to be caused by seepage from the Bottom Ash Pond, corrective measures will be necessary to remediate this condition. An evaluation should be made that recommends appropriate corrective measures to stabilize and/or repair the northern berm of the Bottom Ash Pond. At a minimum, corrective measures should be taken to improve the conditions of the berm for future routine maintenance (i.e., mowing) and observation.

- The bottom elevation of the grass lined channel downstream of the discharge of the stormwater culverts underneath the Bottom Ash Pond was observed to be higher than the invert discharge elevation of the stormwater culverts. The elevation of the grass lined channel reduces the velocity of water discharging from the stormwater culverts, resulting in sedimentation within the culverts. The elevation of the bottom of the grass lined channel negatively impacts the operation of the stormwater culverts by reducing the discharge total flow and velocity of stormwater from the culverts. Therefore, the elevation of the bottom of the grass lined channel is identified as a CCR rule deficiency.

  The recommended corrective measure is to lower the elevation of the bottom of the grass lined channel by at least 1-foot below the elevation of the stormwater culverts for a minimum of 100 feet downstream of the discharge end of the culverts. This will allow complete discharge of the stormwater culverts following a rainfall event. The excavation of the channel will also provide a sediment trap for the deposition of future sediments in the stormwater flow.

- The build-up of sediment and debris observed within the concrete and corrugated metal pipe sections of the stormwater culverts underneath the Bottom Ash Pond creates a negative impact on the operation of the hydraulic structures by reducing the hydraulic capacity and velocity within the stormwater culverts. The sediment within the metal pipe section of the stormwater culverts reduces the hydraulic capacity and flow velocity within the stormwater culverts. However, the percentage reduction of the total cross sectional area of the stormwater culverts is 25% or less. It is noted that the flat topography surrounding the Bottom Ash Pond will likely result in all surrounding onsite and offsite stormwater conveyances being full during a significant flood event. As such, the reduced capacity of the stormwater culverts is not expected to result in the upstream inundation of the Bottom Ash Pond due to the reduced capacity of the structure. Nevertheless, Gredell Engineering has identified the build-up of sediment and debris in the stormwater culverts as a CCR rule deficiency.

Gredell Engineering recommends corrective measures be taken to remove the sediment and debris (individual rip-rap stones and tires) from within both stormwater culverts located beneath the Bottom Ash Pond.

- The southern stormwater culvert appears to be in good condition except for two locations where seams near the top of the corrugated metal pipe have been damaged and separated. The bituminous lining of both the corrugated metal culverts is cracking and deteriorating and could no longer function properly. Therefore, the separated seams of the southern stormwater culvert are identified as a CCR rule deficiency.

  Gredell Engineering recommends repair of the separated seams of the corrugated metal pipe section in the southern stormwater culvert.

Although not identified as a CCR rule deficiency, generally accepted engineering practices for surface impoundments typically include secondary discharge structures or spillways to be used in cases of excessive flow or in the event a surface impoundment’s active spillway is rendered inoperable. Currently, the Bottom Ash Pond has one, operable discharge structure. The overflow structure between the Bottom Ash Pond and the Fly Ash Pond is currently inoperable due to excess CCR accumulation at the discharge of the 30-inch corrugated metal pipe, impeding the flow of water from the Bottom Ash Pond. The inoperable overflow structure was not determined to be a deficiency because Gredell Engineering’s hydrologic and hydraulic evaluation determined that the one discharge structure adequately manages the anticipated flow during, and following, the peak discharge from the design flood event (the 1,000-year flood). However, consistent with generally accepted engineering practices, it is recommended that measures be taken to either: 1) render the existing secondary overflow structure operable (this would involve removing the obstructions to the discharge end of the pipe in the inactive Fly Ash Pond); or 2) to construct an alternative, secondary overflow structure (an alternate, secondary overflow structure could be the installation of a broad crested weir spillway in the Bottom Ash Pond berm at least 100 feet west of the inoperable structure).

# 5.0 MISCELLANEOUS REQUIREMENTS

Section 257.73(g) states that SBMU must comply with:

- The recordkeeping requirements specified in 257.105(f);
- The notification requirements specified in 257.106(f); and,
- The Internet requirements specified in 257.107(f).

# 6.0 REFERENCES

Geotechnology Inc., 2011. “Global Stability Evaluation Fly Ash and Bottom Ash Ponds Sikeston Power Station Sikeston, Missouri.”

Gredell Engineering Resources, Inc., 2016a. “Sikeston Board of Municipal Utilities Sikeston Power Station Bottom Ash Pond Hazard Potential Classification Assessment.”

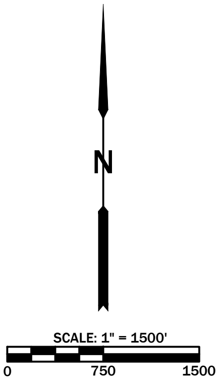
Gredell Engineering Resources, Inc., 2016b. “Sikeston Board of Municipal Utilities Sikeston Power Station Bottom Ash Pond Inflow Design Flood Control System Plan.”

Gredell Engineering Resources, Inc., 2016c. “Sikeston Board of Municipal Utilities Sikeston Power Station Bottom Ash Pond History of Construction.”

Sikeston Board of Municipal Utilities, 2015. “Sikeston Power Station Missouri State Operating Permit, MO-0095575.”

# APPENDIX A

## Figures



## STRUCTURAL STABILITY ASSESSMENT
## BOTTOM ASH POND
## SIKESTON POWER STATION

**GREDELL Engineering Resources, Inc.**

ENVIRONMENTAL ENGINEERING LAND - AIR - WATER

1505 East High Street
Jefferson City, Missouri

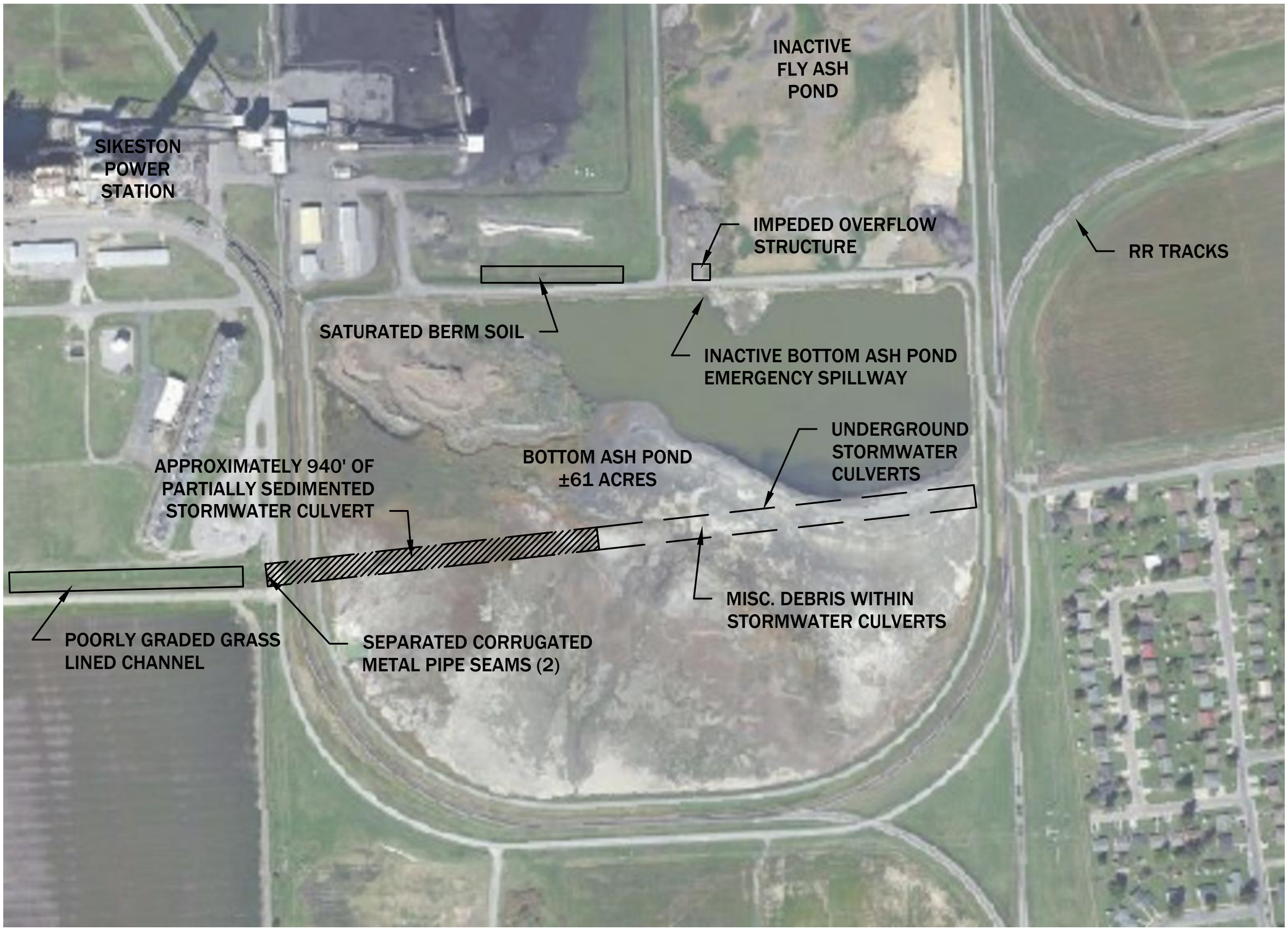
Telephone: (573) 659-9078
Facsimile: (573) 659-9079

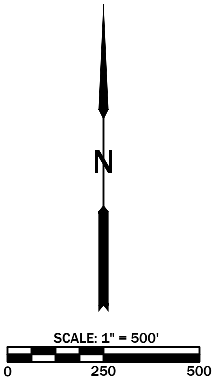
MO CORP. ENGINEERING LICENSE NO. E-2001001669-D

## FIGURE 1 - AERIAL VIEW

| DATE | SCALE | PROJECT NAME | REVISION |
|---|---|---|---|
| 10/2016 | AS NOTED | SIKESTON | |
| DRAWN | APPROVED | FILE NAME | SHEET # |
| AJK | TG | STRUC STAB ASSMNT | 1 OF 1 |

M:\Share\CADDFiles\SIKESTON\POND CLOSURE\STRUC STAB ASSMNT.dwg, FIGURE 1 - AERIAL VIEW, 10/14/2016 2:02:05 PM





## STRUCTURAL STABILITY ASSESSMENT
## BOTTOM ASH POND
## SIKESTON POWER STATION

**GREDELL Engineering Resources, Inc.**

**ENVIRONMENTAL ENGINEERING** LAND - AIR - WATER

1505 East High Street
Jefferson City, Missouri

Telephone: (573) 659-9078
Facsimile: (573) 659-9079

MO CORP. ENGINEERING LICENSE NO. E-2001001669-D

## FIGURE 2 - BOTTOM ASH POND IDENTIFIED DEFICIENCIES

| DATE | SCALE | PROJECT NAME | REVISION |
|---|---|---|---|
| 10/2016 | AS NOTED | SIKESTON | |
| DRAWN | APPROVED | FILE NAME | SHEET # |
| AJK | TG | STRUC STAB ASSMNT | 1 OF 1 |

M:\Share\CADDFiles\SIKESTON\POND CLOSURE\STRUC STAB ASSMNT.dwg, FIGURE 2 - BOTTOM ASH POND IDENTIFIED DEFICIENCIES, 10/14/2016 2:02:06 PM

# ATTACHMENT D7 – SAFETY FACTOR ASSESSMENT

# REPORT ON
# DETAILED INITIAL SAFETY FACTOR ASSESSMENT
# SIKESTON POWER STATION
# BOTTOM ASH POND
# SIKESTON, MISSOURI

by Haley & Aldrich, Inc.
Cleveland, Ohio

for Sikeston Board of Municipal Utilities
Sikeston, Missouri

File No. 128065-001
October 2016

HALEY & ALDRICH, INC.
6500 Rockside Road
Suite 200
Cleveland, OH 44131
216.739.0555

14 October 2016
File No. 128065-001

Sikeston Power Station Board of Municipal Utilities
P.O. Box 468
Aberdeen, Ohio 45101

Attention: Mr. Mark, McGill
Results Engineer/Plant Chemist

Subject: Report on Detailed Initial Safety Factor Assessment
Sikeston Power Station
Bottom Ash Pond
Sikeston, Missouri

Mr. McGill:

We are pleased to submit herewith our report entitled, "Report on Detailed Initial Safety Factor Assessment, Sikeston Power Station, Bottom Ash Pond, Sikeston, Missouri." This report includes background information regarding the project from inception through completion including references to our Preliminary Seismic Screening completed 20 June 2016, the results of our field investigation program, and the results of the Detailed Initial Safety Factor Assessment.

This work was performed by Haley & Aldrich, Inc. (Haley & Aldrich) on behalf of the Sikeston Board of Municipal Utilities (Sikeston BMU) in accordance with the United States Environmental Protection Agency's Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities, 40 CFR Part 257, specifically §257.73(e). The safety factor assessment discussed herein has been referred to as an "initial" assessment to coincide with the terminology used in §257.73(e) and §257.73(f) to distinguish it from the "periodic" assessments that are required every five years following the "initial" assessment has been completed.

The scope of our work in this Detailed Initial Safety Factor Assessment consisted of the following: 1) using the results of the Preliminary Seismic Screening to identify data and information gaps needed to complete this safety factor assessment work; 2) Planning and executing a field investigation program to obtain supplemental subsurface information for seismic response evaluation and slope stability analyses; 3) Conducting a geotechnical laboratory testing program on soil samples recovered from the supplemental subsurface explorations; 4) performing advanced/detailed level engineering evaluations related to seismic response analysis, liquefaction and slope stability; and 5) preparing and submitting this report presenting the results of our assessment.

Thank you for inviting us to complete this assessment and please feel free to contact us if you wish to discuss the contents of the report.

Sincerely yours,
HALEY & ALDRICH, INC.

Derr A Shelton
Derrick A. Shelton
Geotechnical Program Manager | Senior Associate

Steven F. Putrich, P.E.
Project Principal

Enclosures

\\Was\common\Projects\128065-Sikeston\Deliverables\Report\2016-1014-HAI-Sikeston Safety Factor Formal Report-F.docx

## Table of Contents

## Table of Contents

# List of Tables

# List of Figures

# 1. Introduction

## 1.1 GENERAL

Haley & Aldrich, Inc. (Haley & Aldrich) has been contracted by the Sikeston Board of Municipal Utilities (Sikeston BMU) to perform a Detailed Initial Safety Factor Assessment for the Bottom Ash Pond located at Sikeston Power Station in Sikeston, Missouri. This work was completed in accordance with the United States Environmental Protection Agency's (EPA's) Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities, 40 CFR Part 257, specifically §257.73(e) (EPA, 2015) and in accordance with our scope of services dated 29 June 2016.

## 1.2 PURPOSE OF SAFETY FACTOR ASSESSMENT

The purpose of this study was to investigate the subsurface soil and water conditions at the site and to perform a detailed initial safety factor assessment in accordance with Section §257.73(e)(1) of the Final CCR Rule. To achieve the objective discussed above, the scope of work undertaken for this investigation included the tasks listed below.

- Planning and executing a field investigation program to obtain supplemental subsurface information for the detailed liquefaction and slope stability analyses. The program consisted of:

  - performing a seismic survey;
  - installing four (4) drive-point piezometers to depths ranging from 3 ft to 15 ft below ground surface; and
  - collecting four (4) bulk samples of ponded material from the Bottom Ash Pond.

- Conducting a geotechnical laboratory testing program on bulk samples collected during the field investigation program.

- Performing an advanced site-specific seismic response analysis and Newmark displacement analysis of the impoundment embankment.

- Evaluating liquefaction susceptibility of material used to construct the impoundment embankments.

- Performing static and seismic stability analyses for rotational failure surfaces using limit equilibrium methods.

## 1.3 ELEVATION DATUM AND HORIZONTAL CONTROL

The elevations referenced in this report are in feet and are based on the North American Vertical Datum of 1988 (NAVD88). The horizontal control is the Missouri State Plane East coordinate system, which is based on North American Datum 83 (NAD83).

# 2. Description of Ponds

A summary of relevant information associated with the Bottom Ash Pond is provided below. Additional details can be found in the Dam Safety Assessment report prepared by O'Brien and Gere (O'Brien & Gere, 2010) and the Global Stability Evaluations report prepared by Geotechnology, Inc. (Geotechnology, 2011). Refer to Figure 1, "Project Locus" for the general site location.

## 2.1 DESCRIPTION OF BOTTOM ASH POND

The Bottom Ash Pond is a Coal Combustion Residuals (CCR) surface impoundment located east of the Sikeston Power Station in Sikeston, Missouri. The Bottom Ash Pond makes up the southern portion of the oval shaped Sikeston Power Station CCR impoundment system. The Bottom Ash Pond is bordered on the north by the Fly Ash Pond and the plant's coal stockpiling area, on the south agricultural land, on the east by agricultural land and residential properties, and on the west by the plant facilities and agricultural land.

The Bottom Ash Pond was originally designed by Burns & McDonnell, with construction completed in 1981. The Bottom Ash Pond previously received sluiced scrubber sludge until 1998 when the plant facilities underwent system upgrades and no longer generated scrubber sludge. The current primary function of the Bottom Ash Pond is to settle and store bottom ash sluiced from the Sikeston Power Station generating unit. A 30-in. diameter pipe connects the Bottom Ash Pond to the Fly Ash Pond through a splitter dike, which is generally closed to flow unless heavy rainfall temporarily raises the water level in the Bottom Ash Pond. Effluent from the Bottom Ash Pond flows into a 12-in. diameter steel pipe that extends below grade and discharges into the Process Waste Pond.

The impoundment is a combined incised/diked earthen embankment structure with an average 20-ft crest width. The embankment height as measured from the crest to the exterior toe of slope is approximately 12 ft. The interior and exterior slopes are designed at 2 horizontal to 1 vertical (2H:1V). The Bottom Ash Pond was designed with a 2-ft thick clay liner on the interior slope and bottom of the pond. The impoundment has a total surface area of approximately 54 acres. The top of the impoundment embankment is at approximately El. 322. The maximum storage and surcharge pool levels of are El. 315 and El. 322, respectively. The corresponding available freeboard is 7 ft.

# 3. Field Investigation Program

## 3.1 PREVIOUS EXPLORATIONS AND LABORATORY TESTING PERFORMED BY OTHERS

Several subsurface exploration and laboratory testing programs were previously completed at the site by others. The approximate locations of the relevant historic explorations performed by others are shown on the attached Figure 2. A brief summary of the explorations is provided below, and relevant logs and laboratory test results are included in Appendix A. Note that "relevant" explorations refers to explorations from previous investigations by others that were directly used in our safety factor assessment of the Bottom Ash Pond.

- Twenty (20) rotary wash test borings and seven (7) Dutch cone soundings were performed by Burns & McDonnell in 1977 as part of the subsurface exploration program for the power plant site. Out of these, seven (7) test borings are relevant to Bottom Ash Pond and were used in our evaluation of the subsurface conditions.

- Fourteen (14) test borings were drilled by Geotechnology, Inc. in 2011 as part of the ash ponds investigation program. In six (6) of these test borings, a piezometer was installed. Of the fourteen (14) test borings, six (6) were relevant to Bottom Ash Pond and were used in our evaluation of the subsurface conditions.

- One (1) groundwater monitoring well was installed by Layne-Western Company, Inc. in 1979 adjacent to the west side of the Bottom Ash pond.

## 3.2 CURRENT SUBSURFACE EXPLORATION PROGRAM

A subsurface exploration program was conducted at the project site by Haley & Aldrich on 21 July 2016 to obtain subsurface information for engineering evaluations. The program consisted of installing drive-in piezometers and performing a seismic survey.

### 3.2.1 Piezometers

Four (4) piezometers were installed to depths ranging from 5.0 to 14.5 ft below ground surface as summarized in Table I[1]. The location of the piezometers is shown on Figure 2.

The piezometers consisted of drive-point piezometers manufactured by Solinst Canada, Ltd. Each piezometer consisted of a stainless steel 50 mesh cylindrical filter-screen within a 6-in. long, 0.75-in. diameter stainless steel body. The individual piezometers were attached to various lengths of 0.75-in. diameter NPT black iron pipe. The piezometers were installed by Haley & Aldrich representatives using a slide hammer and each piezometer included a shield to reduce the potential for smearing and plugging of the mesh screen during installation.

At each piezometer location, bulk samples of CCR material within the upper 1.0 to 2.0 ft below ground surface were collected. The samples were transmitted to Shannon & Wilson, Inc. of St. Louis, MO for laboratory testing.

---

[1] Note: A table that does not appear near its citation can be found in a separate table at the end of the report.

### 3.2.2 Seismic Survey

Haley & Aldrich engaged the University of Memphis Center for Earthquake Research and Information (CERI) to perform a seismic survey at the site on 21 July 2016. The purpose of the seismic survey was to characterize the shear wave velocity of the subsurface soils at the site and develop a subsurface shear wave velocity profile to be used in seismic response analysis and liquefaction evaluation. The survey was performed along County Road 478 located south of the power plant. The survey was performed using multi-channel analysis of surface wavers (MASW), Refraction Microtremor (ReMi), and refraction/reflection techniques. Details of the techniques used and results of the survey are included in Appendix C along with a plan showing the location of the survey.

## 3.3 LABORATORY TESTING PROGRAM

A laboratory testing program was conducted on selected samples of bottom ash and scrubber sludge (CCR material) recovered at the location of each drive-in piezometer to aid in classification and for determination of engineering properties required for design. The primary purpose of the testing program was to evaluate the index properties of the CCR material. Testing included natural moisture contents and grain size distributions with hydrometer analysis. The tests were performed in general conformance with applicable ASTM test procedures. Results of the laboratory testing program are presented in Appendix B and are summarized in Table III.

# 4. Subsurface Conditions

## 4.1 GEOLOGY

The site is located within the New Madrid seismic zone. The new Madrid Seismic Zone lies at the north end of the Mississippi embayment, which is a deep, low-lying basin filled with Cretaceous to recent sediments. Sikeston Power Station is located in the Southeastern Lowlands physiographic region in southeastern Missouri (MDNR, 2002). The site lies on Sikeston Ridge and in the adjacent lowland flood plain area immediately west of it. Soils underlying the site consist of alluvial soils, deposited and reworked through stream actions of Ohio and Mississippi Rivers (Burns & McDonnell, 1977).

Bedrock is present at a depth of approximately 770 ft below ground surface. The bedrock consists of limestone, sandstone, and dolomite (Luckey, 1985). The seismic survey conducted at the site indicates that the geologic strata consist of, from top to bottom, a Holocene silt and clay stratum at the ground surface; a Quaternary sand stratum at a depth of approximately 13 ft, and a Quaternary gravel stratum at a depth of approximately 73 ft. Below the Quaternary gravel, Eocene strata exist at a depth of 191 ft below ground surface; the Paleocene Midway Group is located at a depth of 252 ft and the top of the Cretaceous formation is located at depth of 328 ft. Refer to the seismic survey included in Appendix C for additional geology information. The geologic stratigraphy at our site is graphically presented in Appendix D.

## 4.2 SUBSURFACE CONDITIONS

Descriptions of the near-surface soil conditions encountered during the historic subsurface exploration programs conducted at the site are provided below in order of increasing depth below ground surface. Actual soil conditions between boring locations may differ from these typical descriptions. Refer to the test boring logs for specific descriptions of soil samples obtained from the borings.

- *EMBANKMENT FILL* - Below the surface of the impoundment embankment crest, there is a stratum of fill material primarily described in historic logs as poorly-graded SAND (SP), silty SAND (SM) and clayey SAND (SC). This stratum was encountered in historic borings B-6, B-7, P-8, and P-10. This stratum was fully penetrated where encountered. The thickness of this stratum ranged from approximately 12 to 17 ft. The density of coarse-grained soils encountered in this stratum ranged from loose to dense but was generally medium dense.

- *ALLUVIAL SAND* – Below the EMBANKMENT FILL there is a stratum of natural soil (Quaternary alluvial deposits) primarily described in the historic logs as poorly-graded SAND (SP), well-graded SAND (SW) and silty SAND (SM). This stratum was encountered in all relevant historic test borings. Where encountered, this stratum was not fully penetrated in any of the borings. The density of coarse-grained soils encountered in this stratum ranged from loose to very dense but was generally medium dense.

## 4.3 GROUNDWATER CONDITIONS

Water levels were measured in the drive-in piezometers upon completion of installation. Measured water levels are summarized in Table I. Where encountered, measured water levels in the piezometers generally ranged from a depth of 0.5 to 8.0 ft below ground surface, which corresponds to a water level ranging between approximately El. 311.8 and El. 318.3. Water was not measured in piezometer HAP-2.

In historic borings performed by Burns & McDonnell and Geotechnology, Inc., water levels were typically measured in the boreholes when water was encountered during drilling of the test borings. Measured water levels in historic test borings are summarized in Table II. Where encountered, measured water levels in the test borings generally ranged from a depth of 3.5 to 17.0 ft below ground surface.

In addition to water levels measured in the test borings, long-term water levels were measured in observation wells near the Bottom Ash Pond as summarized in Table IV. Measured water levels in the observation wells generally ranged from a depth of 10.4 to 24.5 ft below ground surface, which corresponds to a water level ranging between approximately El. 296.8 and El. 299.0.

Water level readings have been made in the piezometers and subsurface explorations at times and under conditions discussed herein. However, it must be noted that fluctuations in the level of the water may occur due to variations in power plant sluicing activities, season, rainfall, temperature, dewatering activities, and other factors not evident at the time measurements were made and reported herein.

# 5. Safety Factor Assessment

As mentioned previously, the purpose of this study was to perform a detailed initial safety factor assessment in accordance with Section §257.73(e)(1) of the Final CCR Rule. As required by the Rule, the certified initial safety factor assessment is performed for a CCR unit to determine calculated factors of safety for each CCR unit relative to the minimum prescribed safety factors for the critical cross section of the embankment. The minimum required safety factors are defined as follows:

- For dikes constructed of soils that have susceptibility to liquefaction, the calculated liquefaction factor of safety must equal or exceed 1.20.
- The calculated static factor of safety under the long-term, maximum storage pool loading conditions must equal or exceed 1.50.
- The calculated static factor of safety under the maximum surcharge pool loading condition must equal or exceed 1.40.
- The calculated seismic factor of safety must equal or exceed 1.00.

Stability analyses have been performed in general conformance with the principles and methodologies described in the USACE Slope Stability Manual (U.S. Army Corps of Engineers, 2003). Conventional static and seismic stability analyses of the impoundment embankments were performed for rotational failures using limit equilibrium methods. Limit equilibrium methods compare forces, moments, and stresses which cause instability of the mass of the embankment to those which resist that instability. The principle of the limit equilibrium method is to assume that if the slope under consideration were about to fail, or at the structural limit of failure, then one must determine the resulting shear stresses along the expected failure surface. These determined shear stresses are then compared with the shear strength of the soils along the expected failure surface to determine the safety factor. The details of the analyses performed for the Bottom Ash Pond are presented in the following sections of this report.

## 5.1 DESIGN WATER LEVELS

In accordance with the Federal CCR Rule, the water retained in an impoundment must be modeled at the maximum storage pool level for the static drained and seismic undrained analyses. The maximum surcharge pool level must be used to model the ponded water for the static undrained analyses. A summary of the maximum storage pool and surcharge pool water levels at the Bottom Ash Pond are provided below.

| Location | Maximum Storage Pool Level | Maximum Surcharge Pool Level | Available Freeboard |
|---|---|---|---|
| Bottom Ash Pond | El. 315 | El. 322 | 7 ft |

The elevation of the groundwater table within the embankment and at the toe of slope were estimated based on groundwater conditions encountered in nearby subsurface explorations and observation wells. Additionally, there is no current evidence of seepage emanating from the exterior slopes of the ponds, suggesting that the phreatic surface is contained within and/or below the embankments.

Given the prescribed impoundment pool levels and the observed static groundwater levels discussed above, a seepage analysis was performed to determine the piezometric head between the interior slope of the impoundment embankment and the exterior toe of the embankment. The computer software program, Slide 6.029, developed by RocScience, Inc., was used to perform the seepage analyses. Permeability values for each material layer were estimated from typical published values based on material description and correlations to grain size. During the course of the seepage analyses, minor adjustments were made to the permeability values and isotropic permeability ratios to best model the conditions observed in the field. Results from the seepage analysis provided pore pressure values within the model that were used in the stability analysis.

The models suggest that much of the seepage emanating from the Bottom Ash Pond is moving downward into the more permeable foundation soils and establishing a groundwater table at or near approximately El. 298 rather than moving laterally through the clay liner and embankments. The phreatic surfaces used in the slope stability models are shown on the slope stability graphical output included in Appendix D.

## 5.2 MATERIAL PROPERTIES

The material properties used in our analyses have been developed using the results of the referenced historic test borings and laboratory testing. In cases where subsurface explorations and/or laboratory test data did not exist for certain materials, properties were estimated based on properties used in historic analyses previously performed by others at or near the site as indicated below:

- Clay Liner – typical published values
- Bottom Ash/Scrubber Sludge – typical published values

A summary of the material properties is provided below in Table V. It should be noted that a small amount of cohesion was used for the Embankment Fill material to avoid surficial sloughing failures.

**TABLE V**
MATERIAL PROPERTIES

| Material | Material Strength | Unit Weight (pcf) | Cohesion (psf) | Friction Angle (degrees) |
|---|---|---|---|---|
| Bottom Ash/ Scrubber Sludge | Drained | 90 | 0 | 30 |
| | Undrained | 90 | 750 | 0 |
| Clay Liner | Drained | 125 | 0 | 28 |
| | Undrained | 125 | 1000 | 0 |
| Embankment Fill | Drained | 120 | 50 | 35 |
| | Undrained | 120 | 100 | 35 |
| Foundation Soils | Drained | 120 | 0 | 35 |
| | Undrained | 120 | 0 | 35 |

A seismic survey was used to obtain in-situ measurements of shear wave velocity. The insitu measurements were performed to a depth of 770 ft below existing ground surface. The site specific shear wave velocity profile is included in Appendix D.

## 5.3 SITE SPECIFIC SEISMIC RESPONSE ANALYSIS

### 5.3.1 Seismic Response Analysis

As mentioned previously, the Sikeston Power Station is located within the New Madrid Seismic Zone and the Mississippi embayment. The natural embayment soils underlying the Bottom Ash Pond are estimated to be approximately 770-ft thick. It has been demonstrated that strong ground motions migrating up through the thick soil in the Mississippi embayment alter the spectral response at the ground surface so that it is much different than the response in the bedrock below the site.

Accordingly, a site-specific target response spectrum was created for the Sikeston Power Station to develop the 2,500-year earthquake motions for use in this study. This target spectrum was developed based on the maximum critical risk-targeted ($MCE_R$) spectral response acceleration. Two different design methods (probabilistic and deterministic) were used to approximate the $MCE_R$ spectrum and the lesser of the spectral response accelerations from each method at each period was used to create the site-specific target spectrum. The seismic hazard analysis results were then used to compute a 2,500-yr return period deterministic target spectrum. A special type of target spectrum, called the conditional mean spectrum (CMS), was created for the study because it focuses the mean spectral response of all the ground motions to a particular period along the target spectrum.

A CMS target spectrum was generated for both the short period (T*=0.1s) related to the sliding mass and long period (T*=1.0 s) related to the soil column thickness. The CMS spectrum corresponding to the long period (T*=1.0 s) was determined to be the most conservative and was used to complete the seismic response analysis

Seven time-history records were used to match the CMS target spectrum for the site. The time histories represent the site-specific ground motions associated with the controlling earthquake event and consider the magnitude, distance and focal mechanism. The results of the one-dimensional ground response analysis indicate that the calculated site-specific peak ground acceleration (PGA) for a 2,500-year event ranges from 0.30g to 0.73g for top of bedrock and from 0.37g to 0.50g at the ground surface. Details of the seismic response analysis are included in Appendix D.

### 5.3.2 Newmark Displacement Analysis

The Newmark displacement analysis is based on the shear stress time history acting along the failure plane within the slope. The yield acceleration determined by the analysis is the minimum amount of ground acceleration necessary to initiate motion along the failure surface and is used to determine the appropriate pseudo-static coefficient for seismic stability analyses.

Shake 2000 was used to perform the Newmark displacement analysis by incorporating the results of the one-dimensional ground response analysis and estimating slope displacement for each of the seven time-histories discussed above. The critical impoundment cross-section was evaluated and the most conservative location of the failure plane was determined to be 10 to 12 ft below the top of slope. Correction factors were applied to scale the displacements to the target magnitude 8 event. Details of the analysis are included in Appendix D along with graphical presentation of the results.

## 5.4 LIQUEFACTION POTENTIAL EVALUATION

During strong earthquake shaking, loose, saturated cohesionless soil deposits may experience a sudden loss of strength and stiffness, sometimes resulting in loss of bearing capacity, large permanent lateral displacements, and/or seismic settlement of the ground. This phenomenon is called soil liquefaction. In accordance with the requirements of §257.73(e)(1), evaluations have been performed to assess the potential for liquefaction of the soils used to construct the impoundment embankment.

The results of the subsurface explorations performed at the site indicate that the majority of soils used to construct impoundment embankments consist of poorly-graded SAND, silty SAND, and clayey SAND. These materials are generally susceptible to liquefaction when saturated. However, groundwater is located approximately 5 to 10 ft below the embankments. Consequently, the existing embankment soils are not saturated and as a result, are not susceptible to liquefaction. In accordance with the requirements of §257.73(e)(1), a post-liquefaction stability analysis is not required since the soils used to construct the embankment are not susceptible to liquefaction in their current state.

## 5.5 STABILITY ANALYSIS

### 5.5.1 Methodology for Analyses

The computer software program Slide 6.029 was used to evaluate the static and seismic stability of the impoundment embankment. Analyses were performed to evaluate static drained (long-term) and undrained (short-term) strength conditions for circular failures using Spencer's method of slices. Spencer's method of slices was selected because it fully satisfies the requirements of force and moment equilibrium (limit equilibrium method).

Seismic stability was evaluated using pseudo-static analyses. Pseudo-static analyses model the seismic shaking as a "permanent" body force that is added to the force-body diagram of a conventional static limit-equilibrium analysis; typically, only the horizontal component of earthquake shaking is modeled because the effects of vertical forces tend to average out to near zero (Jibson, 2011). This is a traditional approach for evaluating the stability of a slope during earthquake shaking and provides a simplified safety factor analysis for one earthquake pulse. A 20 percent reduction in material strength was incorporated in the pseudo-static analyses to represent the approximate threshold between large and small strains induced by cyclic loading (Duncan, 2014). A safety factor greater than or equal to one (FS ≥ 1.0) indicates a slope is stable and a safety factor below one (FS < 1.0) indicates that the slope is unstable.

### 5.5.2 Pseudo-static Coefficient

The pseudo-static coefficient, $k_S$, used in our seismic analyses was selected using the results of the Newmark displacement analysis discussed previously. According to the MSHA Impoundment Design Manual, the acceptable displacement of coal refuse impoundments is 25% of the upstream freeboard (MSHA, 2009)[2]. At the Bottom Ash Pond, that equates to 21 in. based on 7 ft of freeboard.

---

[2] This document is mentioned in the preamble of the Rule and is one of the reference documents that was used by the EPA to evaluate how to perform static and seismic stability analyses.

For a 21-in. acceptable displacement, the Newmark displacement curves in Appendix D show that the minimum allowable yield acceleration corresponding to the average displacement is 0.21g. A pseudostatic coefficient lower than 0.21g will result in more than 21 in. deformation and one higher than 0.25g will result in less than 21 in. deformation. For the seismic stability analyses performed for the impoundments, a pseudostatic coefficient of 0.25g was selected. This value was selected because it is slightly above the minimum value, which is conservative, and will result in displacements that are below MSHA acceptable values.

### 5.5.3 Results of Stability Evaluation

The critical cross section is defined as that which is anticipated to be most susceptible to failure amongst all cross sections. To identify the critical cross section at our project site, we examined the following conditions at several cross section locations at the impoundment:

a. the geometry of the upstream and downstream slopes;
b. phreatic surface levels within and below the cross sections;
c. subsurface soil conditions;
d. presence or lack of surcharge loads behind the crest of the embankments; and
e. presence or lack of reinforcing measures in front of the embankments.

Examination of the conditions noted above resulted in the identification of one critical cross section at the Bottom Ash Pond. The location of the critical cross section is shown on Figure 2. The results of our analyses are presented below in Table VI and are shown on the Slide output files included in Appendix D.

As shown below, the static safety factors are above the minimum required values for the critical cross sections. Similarly, the pseudo-static analyses for the analyzed section indicates an acceptable seismic safety factor.

**TABLE VI**
SUMMARY OF STATIC AND SEISMIC STABILITY EVALUATIONS

| Pond | Cross Section | Condition | Earthquake Event | Soil Strength[1] | Required Safety Factor | Calculated Safety Factor |
|---|---|---|---|---|---|---|
| Bottom Ash Pond | A-A’ | Static | - | Drained | 1.5 | 2.1 |
| | | | | Undrained | 1.4 | 2.5 |
| | | Seismic | 2,500-year | Undrained[2] | 1.0 | 1.2 |

1. Refer to Table V for material properties.
2. Soil strengths have been reduced by 20 percent for seismic analyses.

## 5.6 CONCLUSIONS

The analyses associated with the safety factor assessment have been performed in accordance with the requirement of Section §257.73 of the Final CCR Rule. A summary of our conclusions as they relate to the rule requirements are provided below.

- §257.73(e)(1)(i) - *The calculated static factor of safety under the long-term, maximum storage pool loading conditions must equal or exceed 1.50.*

As shown in Table VI, the static safety factors for the long-term (drained) maximum storage pool condition are above the minimum required value for the critical section analyzed. Accordingly, this requirement has been met.

- §257.73(e)(1)(ii) - *The calculated static factor of safety under the maximum surcharge pool loading condition must equal or exceed 1.40.*

  As shown in Table VI, the static safety factors for the maximum surcharge pool loading condition (undrained) are above the minimum required value for the critical section analyzed. Accordingly, this requirement has been met.

- §257.73(e)(1)(iii) - *The calculated seismic factor of safety must equal or exceed 1.00.*

  As shown in Table VI, the calculated seismic safety factor is above the minimum required value for the critical section analyzed. Accordingly, this requirement has been met.

- §257.73(e)(1)(iv) - *For dikes constructed of soils that have susceptibility to liquefaction, the calculated liquefaction factor of safety must equal or exceed 1.20.*

  The results of historic subsurface investigations indicate that the material used to construct the impoundment embankment are not susceptible to liquefaction because they are not saturated. Accordingly, this requirement has been met.

# 6. Certification

Based on our review of the information provided to us by Sikeston BMU and the results of our field investigations and analyses, it is our opinion that the calculated factors of safety for the critical cross section of the impoundment embankment meet the minimum factors of safety specified in §257.73(e)(1)(i) through (iv) of the EPA's Final CCR Rule.

*Certification Statement*

I certify that the Initial Safety Factor Assessment for the Bottom Ash Pond at the Sikeston Power Station meets the requirements of §257.73(e) of the EPA's Final CCR Rule.

Signed: ______________________________
Consulting Engineer

| | |
|---|---|
| Print Name: | Steven F. Putrich |
| Missouri License No.: | 2014035813 |
| Title: | Project Principal |
| Company: | Haley & Aldrich, Inc. |

Professional Engineer's Seal:

STEVEN F.
PUTRICH
NUMBER
PE-2014035813
10-14-16

## References

1. Burns & McDonnell, (1977). “Report of Preliminary Subsurface Investigation for Board of Municipal Utilities, Sikeston, Missouri”, 76-076-1, 1977.

2. Duncan, J.M., Wright, S.G, and Brandon, T.L. (2014). Soil Strength and Slope Stability. John Wiley & Sons, Upper Saddle River, 2nd Edition, pp. 182-184.

3. Environmental Protection Agency, (2015). Code of Federal Regulations, “Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule, “Title 40, Chapter I, Parts 257 and 261, April 17.

4. Jibson, R.W., (2011). “Methods for assessing the stability of slopes during earthquakes—A Retrospective,” Engineering Geology, v. 122, p. 43-50.

5. Hynes-Griffin, M.E. and Franklin, A.G. (1984). “Rationalizing the seismic coefficient method,” [Miscellaneous Paper GL-84-13]. U.S. Army Corp of Engineers Waterways Experiment Station. Vicksburg, Mississippi, 21pp.

6. Luckey, R.R., (1985). “Water Resources of the Southeast Lowlands, Missouri: U.S. Geological Survey, Water Resources Investigations Report”, 84-4277, 78 p.

7. Mine Safety and Health Administration – U.S. Department of Labor (MSHA), (May 2009. Rev. August 2010). Engineering and Design Manual Coal Refuse Disposal Facilities - Second Edition.

8. Missouri Department of Natural Resources (MDNR), (2002), “Physiographic Regions of Missouri”.

9. U.S. Army Corps of Engineers (2003). “Engineering and Design: Slope Stability,” Engineer Manual EM-1110-2-1902, Department of the Army, U.S. Army Corps of Engineers, Washington, DC, October.

10. O’Brien & Gere Engineering, Inc. (2010). “Dam Safety Assessment of CCW Impoundments Sikeston Power Station”.

11. Geotechnology, Inc. (2011). “Global Stability Evaluations Fly Ash and Bottom Ash Ponds Sikeston Power Station, Sikeston, Missouri”.

\\Was\common\Projects\128065-Sikeston\Deliverables\Report\2016-1014-HAI-Sikeston Safety Factor Formal Report-F.docx

# TABLES

# TABLE I
SUMMARY OF PIEZOMETER INSTALLATION
SIKESTON POWER PLANT BOTTOM ASH POND
SIKESTON, MISSOURI

| Piezometer Designation[1] | Ground Surface El.[2] (ft) | Northing[2] | Easting[2] | Total Depth (ft) | Depth to Water (ft) | |
|---|---|---|---|---|---|---|
| | | | | | Depth 7/21/2016[3] (ft) | Elevation 7/21/2016[3] (ft) |
| HAP-1 | 320.6 | 380854.393 | 1078051.494 | 14.5 | 5.0 | 315.6 |
| HAP-2 | 320.6 | 380296.771 | 1078427.273 | 11.0 | Not measured | Not measured |
| HAP-3 | 319.7 | 380261.526 | 1079064.430 | 11.0 | 8.0 | 311.8 |
| HAP-4 | 318.8 | 380411.896 | 1079534.587 | 5.0 | 0.5 | 318.3 |

Notes:

1. Installation of piezometers on 21 July 2016 was performed by Haley & Aldrich, Inc.
2. The elevation data are provided in feet above sea level and refer to NAVD88 Datum. Ground surface elevation data at piezometer locations was provided by Gredell Engineering Resources, Inc. and were determined using the results of the Surdex Aerial Mapping performed during Summer 2016. The coordinates are provided in units of feet, relative to the Missouri State Plane East Coordinate System (NAD83).
3. Water level readings at the piezometers have been made at times and under conditions discussed herein. However, it must be noted that fluctuations in the level of the water may occur due to variation in season, rainfall, temperature, plant operations, and other factors not evident at the time measurements were made and reported.

**TABLE II**

SUMMARY OF RELEVANT HISTORIC SUBSURFACE EXPLORATIONS
SIKESTON POWER PLANT BOTTOM ASH POND
SIKESTON, MISSOURI

| Exploration Designation[1,2] | Performed By | Year Drilled | Ground Surface Elevation[3] (ft) | Boring Depth (ft) | Depth to Groundwater[3] (ft) |
|---|---|---|---|---|---|
| B-6 | Geotechnology, Inc. | 2011 | 322.2 | 45.0 | Not Measured |
| B-7 | Geotechnology, Inc. | 2011 | 322.1 | 45.0 | Not Measured |
| B-13 | Geotechnology, Inc. | 2011 | 306.2 | 35.0 | 11.5 |
| B-14 | Geotechnology, Inc. | 2011 | 305.0 | 35.0 | 11.5 |
| P-8 | Geotechnology, Inc. | 2011 | 322.0 | 25.0 | See Table IV |
| P-10 | Geotechnology, Inc. | 2011 | 322.2 | 20.0 | 17.0 |
| P-12 | Burns & McDonnell | 1977 | 306.0 | 60.0 | 9.0 |
| P-13 | Burns & McDonnell | 1977 | 306.3 | 100.0 | 9.5 |
| P-16 | Burns & McDonnell | 1977 | 307.1 | 60.0 | 11.0 |
| P-17 | Burns & McDonnell | 1977 | 307.1 | 85.0 | 9.0 |
| P-18 | Burns & McDonnell | 1977 | 303.8 | 75.0 | 7.0 |
| P-19 | Burns & McDonnell | 1977 | 300.0 | 50.0 | 6.0 |
| P-20 | Burns & McDonnell | 1977 | 299.4 | 95.0 | 3.5 |
| TPZ-3 | Gredell Engineering Resources, Inc. | 2016 | 306.1 | 37.2 | See Table IV |
| Well C | Layne-Western Company, Inc. | 1979 | 310.0 | 15.3 | Unknown |

Notes:
1. Technical monitoring of explorations shown above was not performed by Haley & Aldrich, Inc.
2. "Relevant" explorations are defined as explorations used in our evaluation of the stability of the Bottom Ash Pond.
3. Ground surface elevations and groundwater depths shown above reflect the elevation and depth reported on the corresponding boring log. The ground surface elevation of Well C has been approximated using Google Earth. The ground surface elevation for TPZ-3 was provided by Sikeston BMU.

**TABLE III**

SUMMARY OF CURRENT AND HISTORIC LABORATORY TEST RESULTS
SIKESTON POWER PLANT BOTTOM ASH POND
SIKESTON, MISSOURI

| Boring Designation | Sample Number | Sample Depth (ft) | USCS Symbol | Material Type | Moisture Content (%) | LL | PL | PI | % Gravel | % Sand | % Fines | Direct Shear | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | Moisture Content (%) | Total Density | c' (tsf) | ϕ' (degrees) |
| ↓ CURRENT TESTING BY HALEY & ALDRICH PERFORMED IN 2016 ↓ | | | | | | | | | | | | | | | |
| HAP-1 | P-1 | 1.0-2.0 | ML | CCR | 34.4 | | | | 0.0 | 35.4 | 64.6 | | | | |
| HAP-2 | P-2 | 0.0-1.0 | SM | CCR | 22.1 | | | | 0.0 | 83.6 | 16.4 | | | | |
| HAP-3 | P-3 | 1.0-2.0 | SP-SM | CCR | 27.5 | | | | 0.0 | 86.0 | 14.0 | | | | |
| HAP-4 | P-4 | 1.0-2.0 | ML | CCR | 54.1 | | | | 0.0 | 47.1 | 52.9 | | | | |
| ↓ HISTORIC TESTING BY GEOTECHNOLOGY, INC. IN 2011 ↓ | | | | | | | | | | | | | | | |
| B-1, B-2 | Composite | 0.0-20.0 | SM | Soil (Borrow) | | | | | 1.3 | 81.0 | 17.7 | | | 0 | 39 |
| B-11, B-12 | Composite | 0.0-15.0 | SM | Soil (Borrow) | | | | | 3.3 | 81.7 | 15.0 | | | 0 | 41 |
| B-13, B-14 | Composite | 0.0-15.0 | SM | Soil (Borrow) | | | | | 2.0 | 82.0 | 16.0 | | | 0 | 42 |
| B-6, B-7 | Composite | 0.0-20.0 | SM | Soil (Borrow) | | | | | 0.0 | 81.4 | 18.6 | | | 0 | 36 |
| B-6 | | 33.5 | SP | Soil (Natural) | | | | | 0.0 | 96.7 | 3.3 | | | | |
| B-7 | | 13.5 | SP | Soil (Natural) | | | | | 0.0 | 96.1 | 3.9 | | | | |
| B-13 | | 18.5 | SP | Soil (Natural) | | | | | 0.2 | 97.2 | 2.6 | | | | |
| B-14 | | 13.5 | SP | Soil (Natural) | | | | | 1.8 | 95.7 | 2.5 | | | | |
| P-8 | | 18.5 | SM | Soil (Natural) | | | | | 0.3 | 77.2 | 22.5 | | | | |
| ↓ HISTORIC TESTING BY BURNS & MCDONNELL IN 1977 ↓ | | | | | | | | | | | | | | | |
| P-13 | Bag 2 | 5.0-8.5 | SP | Soil (Natural) | | | | | 0.0 | 96.8 | 3.2 | | | | |
| P-13 | D-13 | 63.5-65 | SP | Soil (Natural) | | | | | 0.0 | 94.2 | 5.8 | | | | |
| P-13 | D-17 | 83.5-85.0 | SP | Soil (Natural) | | | | | 26.0 | 71.1 | 2.9 | | | | |
| P-13 | D-20 | 98.5-100.0 | SP | Soil (Natural) | | | | | 21.0 | 72.8 | 6.2 | | | | |
| P-16 | D-5 | 23.5-25.0 | SP | Soil (Natural) | | | | | 0.0 | 97.0 | 3.0 | | | | |
| P-16 | D-12 | 58.5-60.0 | SP | Soil (Natural) | | | | | 0.0 | 94.5 | 5.5 | | | | |
| P-17 | Bag 2 | 5.0-8.5 | SP | Soil (Natural) | | | | | 0.0 | 95.5 | 4.5 | | | | |
| P-17 | D-12 | 58.5-60.0 | SP-SM | Soil (Natural) | | | | | 0.0 | 91.7 | 8.3 | | | | |
| P-17 | D-15 | 73.5-75.0 | SP-SM | Soil (Natural) | | | | | 0.0 | 93.6 | 6.4 | | | | |
| P-18 | D-5 | 23.5-25.0 | SP | Soil (Natural) | | | | | 5.0 | 91.9 | 3.1 | | | | |
| P-19 | Bag 1 | 1.5-3.5 | CL | Soil (Natural) | | 45 | 21 | 24 | | | | | | | |
| P-20 | Bag 1 | 1.0-3.5 | ML | Soil (Natural) | | 21 | 19 | 2 | | | | | | | |
| P-20 | D-3 | 13.5-15.0 | SP-SM | Soil (Natural) | | | | | 0.8 | 90.6 | 8.6 | | | | |
| P-20 | D-12 | 58.5-60.0 | SP-SM | Soil (Natural) | | | | | 17.0 | 77.2 | 5.8 | | | | |
| P-20 | D-18 | 88.5-90.0 | CL | Soil (Natural) | | 45 | 22 | 23 | | | | | | | |

**TABLE IV**

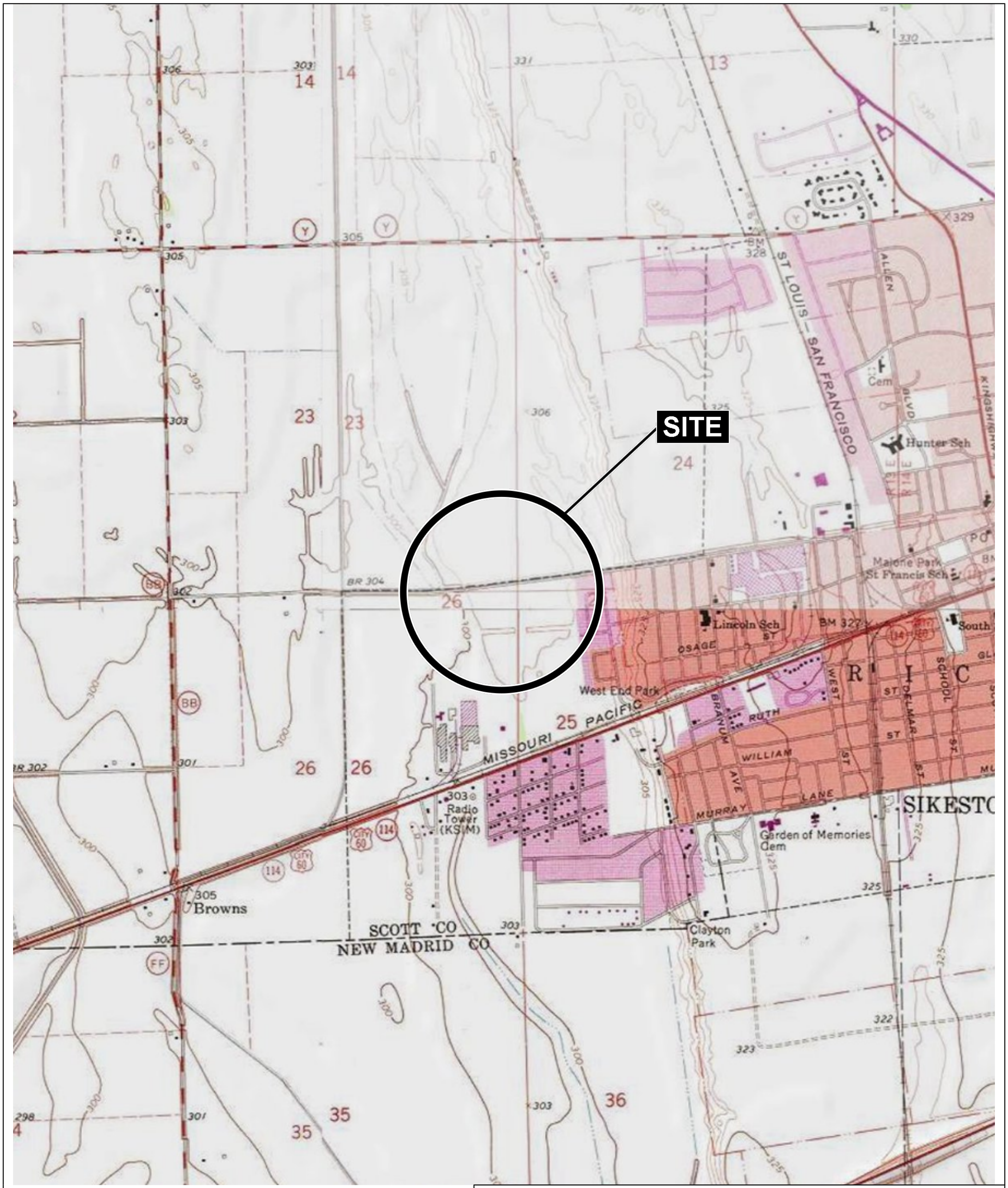
SUMMARY OF GROUNDWATER LEVEL MEASUREMENTS
SIKESTON POWER PLANT BOTTOM ASH POND
SIKESTON, MISSOURI

| Observation Well | Top of Casing Elevation[1] (ft) | Well Depth (ft) | Measurement Date | Depth to Water[2,3] (ft) | Groundwater Elevation (ft) | Well Installation Notes |
|---|---|---|---|---|---|---|
| P-8 | 322.0 | 25.0 | 6/1/2016 | 23.0 | 299.0 | Well was installed on 8/30/2011 by Geotechnology, Inc. |
| | | | 6/16/2016 | 24.5 | 297.5 | |
| | | | 6/24/2016 | 24.1 | 297.9 | |
| | | | 7/15/2016 | 24.2 | 297.8 | |
| | | | 9/8/2016 | 24.4 | 297.6 | |
| | | | | | | |
| TPZ-3 | 308.6 | 37.2 | 5/4/2016 | 10.4 | 298.1 | Well was installed on 5/13/2016 by Gredell Engineering Resources, Inc. |
| | | | 6/24/2016 | 11.0 | 297.6 | |
| | | | 7/15/2016 | 11.2 | 297.4 | |
| | | | 8/8/2016 | 11.5 | 297.1 | |
| | | | 9/8/2016 | 11.8 | 296.8 | |
| | | | | | | |

Notes:

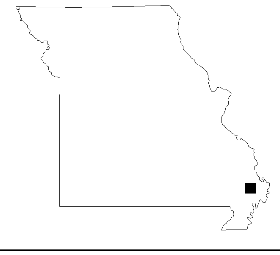
1. Top of casing elevation of P-8 was reported by Geotechnology, Inc. and top of casing elevation of TPZ-3 was provided by Sikeston BMU.
2. Depth to water level readings were provided by Sikeston BMU.
3. Water level readings have been made in the wells at times and under conditions discussed herein. However it must be noted that fluctuations in the level of the water may occur due to variations in season, rainfall, temperature, and other factors not evident at the time measurements were made and reported.

# FIGURES



MAP SOURCE: ESRI

SITE COORDINATES: 36°52'32"N, 89°36'56"W



HALEY ALDRICH

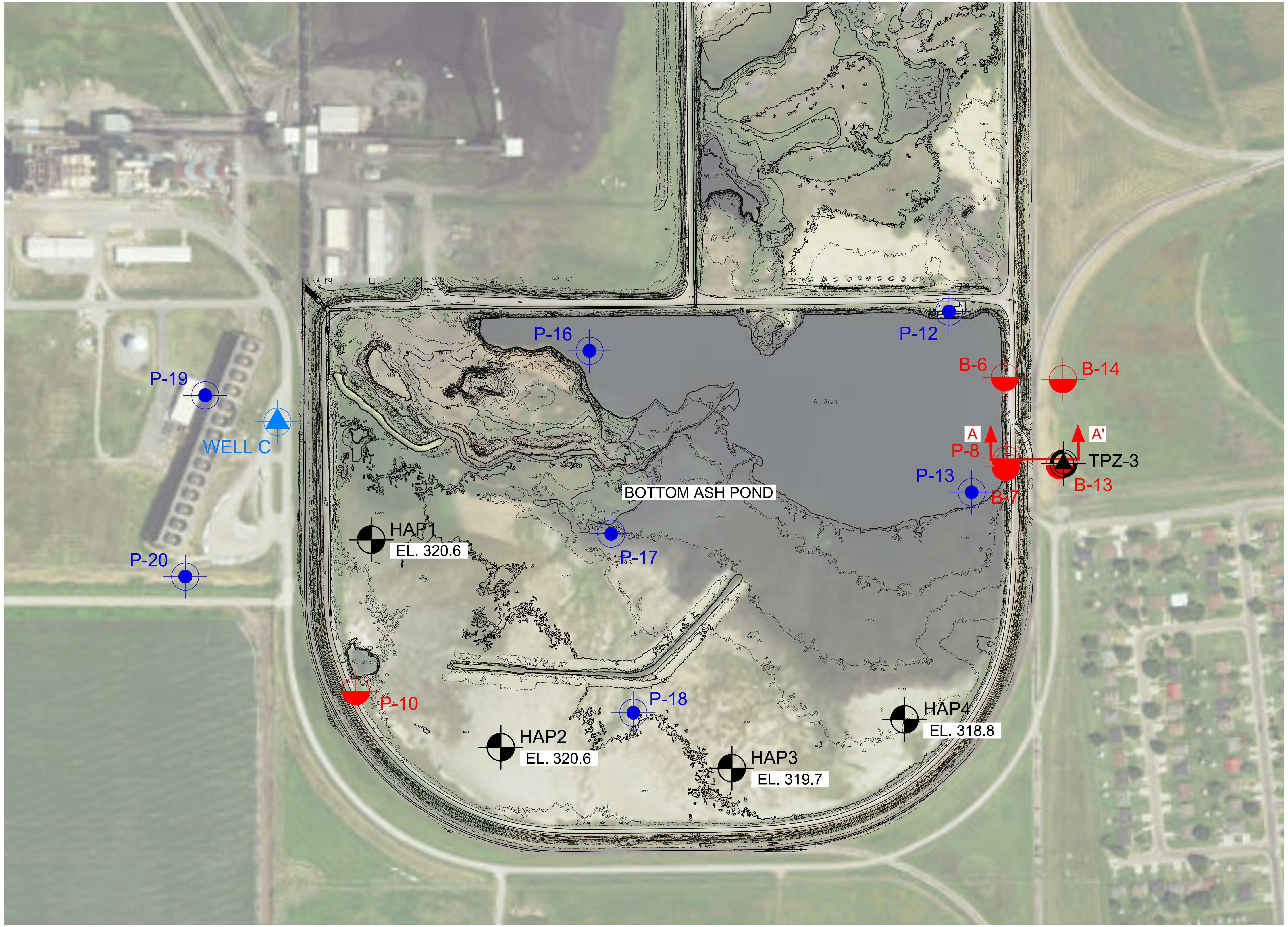
SIKESTON POWER STATION
BOTTOM ASH IMPOUNDMENT
SIKESTON, MISSOURI

PROJECT LOCUS

APPROXIMATE SCALE: 1 IN = 2000 FT
OCTOBER 2016

FIGURE 1

128065_001 LOCUS FIG 1.PDF



LEGEND

| | |
|---|---|
| HAP4 EL. 318.8 | DESIGNATION, LOCATION AND GROUND SURFACE ELEVATION OF PIEZOMETERS INSTALLED ON 21 JULY 2016 BY HALEY & ALDRICH, INC. |
| TPZ-3 | DESIGNATION AND LOCATION OF MONITORING WELL INSTALLED IN 2016 BY GREDELL ENGINEERING RESOURCES, INC. |
| B-14 | DESIGNATION AND APPROXIMATE LOCATION OF HISTORIC BORINGS PERFORMED IN 2011 BY GEOTECHNOLOGY, INC. "P" DESIGNATION INDICATES A PIEZOMETER WAS INSTALLED IN THE COMPLETED BOREHOLE. |
| WELL C | DESIGNATION AND APPROXIMATE LOCATION OF MONITORING WELL INSTALLED IN 1979 BY LAYNE-WESTERN COMPANY, INC. |
| P-17 | DESIGNATION AND APPROXIMATE LOCATION OF BORINGS PERFORMED IN 1977 BY BURNS & MCDONNELL. |
| A A' | CRITICAL CROSS SECTION |

NOTES:

1. BACKGROUND IMAGE FOR KEY MAP IS DATED 2 AUGUST 2014 FROM ESRI GIS.
2. ELEVATIONS INDICATED ON THIS DRAWING ARE IN FEET AND REFER TO NAVD88 DATUM.
3. THE LOCATION OF THE GEOTECHNOLOGY, INC. BORINGS WERE APPROXIMATED FROM A PLAN ENTITLED "AERIAL PHOTOGRAPH OF SITE AND BORING LOCATIONS" DATED 8 OCTOBER 2011 (LATEST REVISION) BY GEOTECHNOLOGY, INC. OF ST. LOUIS, MISSOURI.
4. THE LOCATION OF THE LAYNE-WESTERN COMPANY, INC. MONITORING WELL WAS APPROXIMATED FROM AN ELECTRONIC CAD IMAGE ENTITLED " SITE CHARACTERIZATION WORK PLAN FIGURE 1 - SITE LOCATION MAP" DATED JULY 2015 FROM GREDELL ENGINEERING RESOURCES, INC. OF JEFFERSON CITY, MISSOURI.
5. BURNS & MCDONNELL BORING LOCATIONS WERE APPROXIMATED FROM A PLAN ENTITLED "FIGURE 2" PREPARED BY BURNS & MCDONNELL OF KANSAS CITY, MISSOURI.
6. TECHNICAL MONITORING OF PIEZOMETERS INSTALLED ON 21 JULY 2016 WAS PERFORMED BY HALEY & ALDRICH, INC.
7. AS-DRILLED LOCATIONS AND ELEVATIONS OF HALEY & ALDRICH PIEZOMETERS WERE DETERMINED BY GREDELL ENGINEERING RESOURCES, INC. USING SURDEX AERIAL MAPPING INFORMATION COMPLETED IN SUMMER 2016.

N

0 300 600
SCALE IN FEET

HALEY ALDRICH

SIKESTON POWER STATION
BOTTOM ASH IMPOUNDMENT
SIKESTON, MISSOURI

## SUBSURFACE EXPLORATION LOCATION PLAN

SCALE: AS SHOWN
OCTOBER 2016

FIGURE 2

POSTOLOWSKI, KEVIN Printed: 10/7/2016 10:16 AM Layout: FIG 2
G:\128065 SIKESTON\CAD\128065_001_0003 SIKESTON ELP.DWG

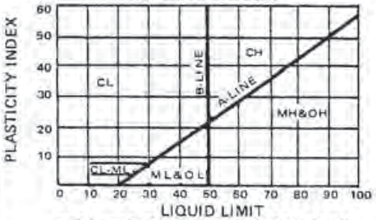
# APPENDIX A

# Historic Test Boring Logs and Laboratory Test Results

## UNIFIED SOIL CLASSIFICATION SYSTEM

| MAJOR DIVISIONS | | | LETTER SYMBOL | DESCRIPTION |
|---|---|---|---|---|
| COARSE-GRAINED SOILS MORE THAN 50% LARGER THAN NO. 200 SIEVE SIZE | GRAVEL AND GRAVELLY SOILS | CLEAN GRAVELS LITTLE OR NO FINES | GW | WELL-GRADED GRAVEL, GRAVEL-SAND MIXTURE |
| | | | GP | POORLY-GRADED GRAVEL, GRAVEL—SAND MIXTURE |
| | | GRAVELS WITH FINES APPRECIABLE FINES | GM | SILTY GRAVEL, GRAVEL-SAND-SILT MIXTURE |
| | | | GC | CLAYEY-GRAVEL, GRAVEL-SAND-CLAY MIXTURE |
| | SAND AND SANDY SOILS | CLEAN SANDS LITTLE OR NO FINES | SW | WELL-GRADED SAND, GRAVELLY SAND |
| | | | SP | POORLY-GRADED SAND, GRAVELLY SAND |
| | | SANDS WITH FINES APPRECIABLE FINES | SM | SILTY SAND, SAND-SILT MIXTURE |
| | | | SC | CLAYEY SAND, SAND-CLAY MIXTURE |
| FINE-GRAINED SOILS MORE THAN 50% SMALLER THAN NO. 200 SIEVE SIZE | SILTS AND CLAYS | LIQUID LIMIT LESS THAN 50 | ML | SILT, CLAYEY SILT, SILTY OR CLAYEY VERY FINE SAND, SLIGHT PLASTICITY |
| | | | CL | CLAY, SANDY CLAY, SILTY CLAY, LOW TO MEDIUM PLASTICITY |
| | | | OL | ORGANIC SILTS OR SILTY CLAYS OF LOW PLASTICITY |
| | SILTS AND CLAYS | LIQUID LIMIT MORE THAN 50 | CH | SILT, FINE SANDY OR SILTY SOIL WITH HIGH PLASTICITY |
| | | | CH | CLAY, HIGH PLASTICITY |
| | | | OH | ORGANIC CLAY OF MEDIUM TO HIGH PLASTICITY |
| HIGHLY ORGANIC SOILS | | | PT | PEAT, HUMUS, SWAMP SOIL |

### PLASTICITY CHART



FOR LABORATORY CLASSIFICATION OF FINE GRAINED SOILS

### RELATIVE PARTICLE SIZE

| | |
|---|---|
| BOULDER | LARGER THAN 12" |
| COBBLE | 3" TO 12" |
| GRAVEL COARSE | 3/4" TO 3" |
| FINE | 4.76MM TO 3/4" |
| SAND COARSE | 2MM TO 4,76MM |
| MEDIUM | 0.42MM to 2MM |
| FINE | 0.074MM TO 0.42MM |
| SILTS AND CLAY | SMALLER THAN 0.074MM |

### RELATIVE PLASTICITY

| | |
|---|---|
| NONPLASTIC | CANNOT ROLL INTO BALL |
| TRACE PLASTICITY | BARELY ROLL INTO BALL |
| MEDIUM PLASTIC | CAN BE ROLLED INTO BALL |
| HIGHLY PLASTIC | NO RUPTURE BY KNEADING |

### RELATIVE COMPOSITION

| | |
|---|---|
| TRACE | 0-10% |
| SOME | 11-35% |
| AND/WITH | 36-50% |

| RELATIVE MOISTURE | |
|---|---|
| DRY | POWDERY |
| DAMP | BELOW PLASTIC LIMIT |
| MOIST | PL TO LL RANGE |
| WET | ABOVE LIQUID LIMIT |

| DENSITY | N-VALUE |
|---|---|
| VERY LOOSE | 0-4 |
| LOOSE | 5-10 |
| MEDIUM | 11-30 |
| DENSE | 31-50 |
| VERY DENSE | >50 |

| RELATIVE CONSISTENCY | | N-VALUE |
|---|---|---|
| VERY SOFT | < 1/4 TSF | 0 - 2 |
| SOFT | 1/4-1/2 TSF | 2 - 4 |
| MEDIUM | 1/2-1 TSF | 4 - 8 |
| STIFF | 1-2 TSF | 8 - 15 |
| VERY STIFF | 2-4 TSF | 15 - 30 |
| HARD | > 4 TSF | 30 - |

N-VALUE (BLOW COUNT) IS THE STANDARD PENETRATION RESISTANCE BASED ON THE TOTAL NUMBER OF BLOWS, USING A 140-LB HAMMER WITH 30-INCH FREE FALL, REQUIRED TO DRIVE A SPLIT-SPOON THE LAST TWO OF THREE 6-INCH DRIVE INCREMENTS. (EXAMPLE: 4/7/9, N = 7+9=16)

020377

Burns & McDonnell
Engineers-Architects-Consultants

TS-GT-H

---

## DRILLING LOG

JOB NO. 76-076-1
PROJECT PHSIKEMO
HOLE NO. P - 12
GROUND ELEV. 306.00
LOCATION 500' offset S. of Sta. 40+00
SHEET 1 OF 4

| DRILLING TYPE | HOLE DEPTH | OVERBURDEN FOOTAGE | BEDROCK FOOTAGE | OVERBURDEN SAMPLES | NO. CORE BOXES | % CORE RECOVERY | WATER TABLE |
|---|---|---|---|---|---|---|---|
| Rotary wash | 60.2 | | | | | | 9.0 |

DRILLING CO. RAYMOND INT. Co.
DRILLER(S) DON FERRARY
DRILLING RIG CME 750
PENETRATION TEST SPT
DRILLING DATE March 8, 77 TO March 8, 77
INSPECTOR(S) C. A. BUHR

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|---|
| 1 | | | | | | | (tan, silty sand) |
| 2 | | | | | | | |
| 3 | Lt. Brown, pred. fine sand, some med. sand, trace silt, tan + rust colouring, subrounded, trace lignite, med. density, damp to moist. | SP ~~SM~~ | 4/5/7 | 15" Recov. | | D-1 | dry<br>damp |
| 4 | | | | | | | |
| 5 | | | | | | | |
| 6 | | | | | | | moist<br>wet |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | Brown, fine to med. sand, trace coarse sand, trace silt, lignite part., subrounded, med. density, sat. | SP | 5/5/7 | 10" Recov. | | D-2 | water @ 9' |
| 10 | | | | | | | |
| 11 | | | | | | | |
| 12 | | | | | | | |
| 13 | | | | | | | |

122673

Burns & McDonnell
Engineers-Architects-Consultants

Form J-2-1-1A

BURNS & McDONNELL ENGINEERING COMPANY

## DRILLING LOG

PROJECT PHSIKEMO HOLE NO. P-12 SHEET 2 OF 4

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|---|
| 14 | Gray-brown, pred. fine sand, w/ med. sand, trace coarse sand + fine gravel, trace silt, subrounded to occass. subangular, loose, sat., lignite part. | SP | 3/3/5 | 11" Recov. | | D-3 | 3/4" lignite part. in sluff mat'l. |
| 18 | Brown-gray, fine sand, some med. sand, trace coarse sand + fine gravel, trace silt, lignite part., subrounded to occass. subangular, med. density, sat. | SP | 10/9/14 | Full Recov. | | D-4 | |
| 23 | Gray, fine sand, w/ med. sand, trace silt, lignite, subrounded to subangular, dense, sat. | SP | 11/17/23 | 10½" Recov. | | D-5 | |
| 28 | Gray, somewhat well graded sand, some gravel, lignite part. + seam, subrounded to subangular, dense, sat.; coarser above lignite seam, (trace chert ?). | SP/SW | 8/14/17 | 10" Recov. | | D-6 | |

---

BURNS & McDONNELL ENGINEERING COMPANY

## DRILLING LOG

PROJECT PHSIKEMO HOLE NO. P-12 SHEET 3 OF 4

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|---|
| 33 | Similar to previous; becoming pred. finner sand toward bottom with several successive lignite seams, (trace chert) | SP/(SW) | 11/12/14 | 10½" Recov. | | D-7 | |
| 38 | Top 4" brown, fine to med. sand, trace coarse sand; lignite seam; gray pred. fine sand, some med. sand, lignite part., subrounded to subangular, med. density — to loose, sat. | SP | 3/6/8 | 7½" Recov. | | D-8 | |
| 42 | | | | | | | — gravel seam in drilling noted |
| 43 | Brown-gray, well graded sand, some fine gravel, lignite part., subrounded to subangular, med. density, sat.; slightly finner towards tip. | SW/SP | 8/10/12 | 7" Recov. | | D-9 | |
| 48 | Same as previous, consistent throughout sample. | SW/SP | 8/14/15 | 8" Recov. | | D-10 | |

BURNS & McDONNELL ENGINEERING COMPANY

# DRILLING LOG

PROJECT PHSIKEMO HOLE NO. P-12 SHEET 4 OF 4

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|---|
| 53<br>54<br>55 | Similar to previous; becomming slightly finner & milky toward tip, dense, red-tint. | SP/SW | 13/15/21 | 9" Recov. | | D-11 | |
| 56<br>57 | | | | | | | |
| 58<br>59<br>60 | Brown-gray well graded sand, w/ fine & coarse gravel, red-milky mat'l, trace lignite, subrounded to subangular, dense, sat. | SP/SW | 11/16/22 | 7" Recov. | | D-12 | |
| | T.D. 60± | | | | | | |

---

# DRILLING LOG

JOB NO. 76-076-1 PROJECT PHSIKEMO HOLE NO. P-13

GROUND ELEV. 306.30 LOCATION 1000' offset S. of Sta. 40+00 SHEET 1 OF 6

| DRILLING TYPE | HOLE DEPTH | OVERBURDEN FOOTAGE | BEDROCK FOOTAGE | OVERBURDEN SAMPLES | NO. CORE BOXES | % CORE RECOVERY | WATER TABLE |
|---|---|---|---|---|---|---|---|
| Rotary Wash | 100± | | | | | | 9.5 |

DRILLING CO. RAYMOND INT. Co. DRILLER(S) DON FERRARY

DRILLING RIG CME 750 PENETRATION TEST SPT

DRILLING DATE MARCH 1, 77 TO March 2, 77 INSPECTOR(S) C.A. BUHR

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|---|
| 1<br>2 | | | | | | | Yellow-Lt. Brown, silty fine sand, dry, organics. (SM-SP) Bag #1 |
| 3<br>4<br>5 | Lt.-Yellow Brown, fine sand, trace med. sand, subrounded, ~~trace~~ w/ silt, trace lignite, loose, damp. | SP (SM) | 3/3/3 | 12" Recov. | | D-1 | |
| 6<br>7 | | | | | | | Yellow-Lt. Brown, fine sand, w/ silt, damp. (SP-SM) Bag #2 |
| 8<br>9<br>10 | Lt.-Brown, fine sand, trace to some med. sand, subrounded, ~~trace~~ w/ silt, lignite part., med. density, wet to sat. | SP (SM) | 5/6/6 | 11" Recov. | | D-2 | water @ 9.5 |
| 11<br>12<br>13 | | | | | | | |

## BURNS & McDONNELL ENGINEERING COMPANY
## DRILLING LOG

PROJECT PHSIKEMO HOLE NO. P-13 SHEET 2 OF 6

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|---|
| 14 | Lt.- Brown, fine sand, some med. sand, slight trace coarse sand + fine gravel, subrounded, trace silt, lignite part., loose, sat. | SP | 3/4/4 | 13" Recov | | D-3 | — End Tues. |
| 17 | | | | | | | Use of Fiber Tex + Mica Tex for drilling water with mud d |
| 18 | Lt.- Brown, pred. fine sand, trace to some med. sand, trace coarse sand + fine gravel in sluff mat'l, trace silt, lignite part., subrounded, dense, sat. | SP | 16/16/18 | 12" Recov | | D-4 | |
| 23 | Dark- Brown, same as previous, except becoming occas., subangular, med. dense. | SP | 5/6/7 | 7" Recov. | | D-5 | |
| 28 | Dark-brown to gray-brown, fine to med. sand, trace coarse sand, trace silt, lignite part., + seams, subrounded to subangular, med. density, sat. | SP | 5/12/12 | 9½" Recov. | | D-6 | coarse sand + fine gravel in sluff mat'l. |

---

## BURNS & McDONNELL ENGINEERING COMPANY
## DRILLING LOG

PROJECT PHSIKEMO HOLE NO. P-13 SHEET 3 OF 6

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|---|
| 33 | Gray, fine to med. sand, some coarse sand, trace fine gravel, trace silt – milky, lignite, subrounded to subangular, med. density, sat. | SP | 6/10/12 | 5" Recov. | | D-7 | fine + coarse gravel in sluff mat'l |
| 36 | | | | | | | Driller noted coal seam @±$36^{2}$' |
| 38 | Gray, fine to med. sand, similar to previous, less milky, w/ fine + coarse gravel encountered @ tip. | SP | 7/10/8 | 8" Recov. | | D-8 | |
| 42 | Gray, well graded sand, trace gravel, trace silt, lignite, subrounded to subangular, med. density, sat. | SP/SW | 6/11/13 | 7" Recov. | | D-9 | |
| 48 | Gray, similar to previous, becoming slightly finer toward bottom, lignite seam – ¾" part. @ tip. | SP/(SW) | 8/11/13 | 8" Recov. | | D-10 | Driller noted gravel like mat'l during drilling |

BURNS & McDONNELL ENGINEERING COMPANY
DRILLING LOG

PROJECT PHSIKEMO HOLE NO. P-13 SHEET 4 OF 6

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|---|
| 52 | | | | | | | |
| 53 | Top 2½" coal seam; Gray, fine to med. sand, trace coarse sand & fine gravel, milky, subrounded to subangular, dense, sat. | SP | 11/15/16 | 7" Recov. | | D-11 | Coal Seam |
| 54 | | | | | | | |
| 55 | | | | | | | |
| 56 | | | | | | | |
| 57 | | | | | | | |
| 58 | Gray, well graded sand, pred. med to fine sand, some coarse sand, trace fine gravel, trace silt, subrounded to subangular, med. density, sat., lignite. | SW/(SP) | 6/6/7 | 8" Recov. | | D-12 | |
| 59 | | | | | | | |
| 60 | | | | | | | |
| 61 | | | | | | | |
| 62 | | | | | | | |
| 63 | Gray, fine sand, trace med sand, trace silt, subrounded to subangular, lignite part., very dense, sat. | SP | 15/25/26 | 9½" Recov. | | D-13 | |
| 64 | | | | | | | |
| 65 | | | | | | | |
| 66 | | | | | | | |
| 67 | | | | | | | |
| 68 | | | | | | | |

---

BURNS & McDONNELL ENGINEERING COMPANY
DRILLING LOG

PROJECT PHSIKEMO HOLE NO. P-13 SHEET 5 OF 6

** → Interesting Sample

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|---|
| 69 | Brown- Gray, well graded sand, trace gravel, trace silt, lignite, milky - large 1" conclomerate ? silt-clay ~~stone~~ cemented mat'l, subrounded to subangular, med. density, sat., red tint to milkyness. | SW/SP | 10/10/10 | 6" Recov. | | D-14 | |
| 70 | | | | | | | |
| 71 | | | | | | | |
| 72 | | | | | | | |
| 73 | ↕ | | | | | | |
| 74 | Same as previous w/ red milky tint. | SW/SP | 11/13/14 | 6½" Recov. | | D-15 | |
| 75 | | | | | | | |
| 76 | | | | | | | |
| 77 | | | | | | | |
| 78 | Gray- ~~Red~~- brown, fine to med. sand, trace coarse sand, red-milky tint, subrounded to subangular, lignite, dense, sat. | SP | 25/21/23 | 8" Recov. | | D-16 | |
| 79 | | | | | | | |
| 80 | | | | | | | |
| 81 | | | | | | | |
| 82 | | | | | | | |
| 83 | Gray - brown, fine to med. sand, some coarse sand, trace gravel, red-milky tint, subrounded to subangular, lignite, med. density, sat. | SP | 11/13/13 | 7½" Recov. | | D-17 | Gravel layer noted by driller |
| 84 | | | | | | | |
| 85 | | | | | | | |

BURNS & McDONNELL ENGINEERING COMPANY

# DRILLING LOG

PROJECT PHSIKEMO HOLE NO. P - 13 SHEET 6 OF 6

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|---|
| 87 | | | | | | | |
| 88 | Same as previous; becoming slightly coarser ~~+ more toward well graded~~ | SP/ ~~(SW)~~ | 11/14/15 | 7" Recov. | | D-18 | |
| 89 | | | | | | | |
| 90 | | | | | | | |
| 91 | | | | | | | |
| 92 | | | | | | | |
| 93 | Similar to previous; only well graded, (trace chert) | SW/(SP) | 13/14/16 | 7" Recov. | | D-19 | |
| 94 | | | | | | | |
| 95 | | | | | | | |
| 96 | | | | | | | |
| 97 | | | | | | | |
| 98 | Red-brown, fine to med. sand, trace coarse sand & gravel, 'milky, subrounded to subangular, lignite, very dense, sat. | SP | 50/1½" pen. | 6" Recov. | | D-20 | |
| 99 | | | | | | | |
| 100 | T.D. 100' | | | | | | |

* T- [illegible] Coarse Gravel

---

# DRILLING LOG

JOB NO. 76-076-1 PROJECT PHSIKEMO HOLE NO. P-16

GROUND ELEV. 307.11 LOCATION 500' offset S. of Sta. 50+00 SHEET 1 OF 4

| DRILLING TYPE | HOLE DEPTH | OVERBURDEN FOOTAGE | BEDROCK FOOTAGE | OVERBURDEN SAMPLES | NO. CORE BOXES | % CORE RECOVERY | WATER TABLE |
|---|---|---|---|---|---|---|---|
| Rotary Wash | 60' | | | | | | 11.0 |

DRILLING CO. RAYMOND INT. CO. DRILLER(S) DON FERRARY

DRILLING RIG CME 750 PENETRATION TEST SPT

DRILLING DATE MARCH 7,77 TO MARCH 7,77 INSPECTOR(S) C. A. BUHR

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|---|
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | ~~Yellow~~ - Lt. Brown, silty fine sand, subrounded, trace lignite, loose, damp to dry. | SM/SP | 2/3/4 | 15" Recov. | | D-1 | |
| 4 | | | | | | | |
| 5 | | | | | | | change |
| 6 | | | | | | | |
| 7 | | | | | | | |
| 8 | ~~X~~ Brown, fine sand, trace med. sand, some silt, lignite, subrounded, med. density, wet. | SP/(SM) | 3/6/7 | 10" Recov. | | D-2 | |
| 9 | | | | | | | |
| 10 | | | | | | | |
| 11 | | | | | | | Water @ 11' |
| 12 | | | | | | | |
| 13 | | | | | | | |

BURNS & McDONNELL ENGINEERING COMPANY

# DRILLING LOG

PROJECT PHSIKEMO HOLE NO. P-16 SHEET 2 OF 4

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|
| 14 | Brown, pred. med. to fine sand, trace coarse sand, trace silt, lignite, subrounded to occass. subangular, loose, sat. | SP | 2/3/4 | 13" Recov | D-3 | |
| 16–17 | ↕ | | | | | |
| 19 | Brown, same as previous. | SP | 4/3/5 | 3" Recov | D-4 | fine gravel in sluff mat'l } |
| 23 | Dark brown, pred. fine sand, some med. sand, trace silt, lignite part. & seam, subrounded to occass. subangular, med. density, sat.; becoming coarser toward bottom, trace coarse sand & fine gravel. | SP | 5/10/13 | 9" Recov | D-5 | |
| 28 | Brown, fine to med. sand, trace coarse sand & fine gravel, trace silt, lignite, subrounded to occass. subangular, dense, sat. | SP | 12/19/23 | 9" Recov | D-6 | |

11/27/83 BURNS & McDONNELL ENGINEERING COMPANY FORM J-2-1-1B

---

BURNS & McDONNELL ENGINEERING COMPANY

# DRILLING LOG

PROJECT PHSIKEMO HOLE NO. P-16 SHEET 3 OF 4

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|
| | | | | | | lignite seam noted @ 31' |
| * 33 | Gray-brown, very fine sand; becoming yellow-brown fine to med. gravelly sand, lignite, trace chert; becoming similar to previous sample w/ lignite seams, med. density, sat. | SP | 6/9/16 | 9½" Recov | D-7 | fine & coarse gravel noted in sluff mat'l } |
| 37 | | | | | | more lignite seams noted in wash } |
| 38 | Gray, very ~~pred.~~ fine sand, trace silt, lignite part., subrounded to subangular, med. density, sat. | SP | 10/14/14 | 7" Recov | D-3 | |
| 43 | Gray, pred. fine to med. sand, trace coarse sand & fine gravel, trace silt, lignite part., subrounded to subangular, med. density, sat. | SP | 9/13/16 | 8" Recov. | D-9 | |
| 48 | Similar to previous, milky slightly coarser & more well graded, dense, lignite seam @ tip. | SP/(SW) | 15/16/17 | 5½" Recov. | D-10 | |

11/27/83 BURNS & McDONNELL ENGINEERING COMPANY FORM J-2-1-1B

BURNS & McDONNELL ENGINEERING COMPANY

# DRILLING LOG

PROJECT PHSIKEMO HOLE NO. P - 16 SHEET 4 OF 4

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|---|
| 53<br>54<br>55 | Gray, fine to med. sand, some coarse sand, trace fine gravel, very milky, lignite part., subrounded to subangular, dense, sat. | SP/(SW) | 17/18/18 | $2\frac{1}{2}$" Recov | | D-11 | Between $50^{2}$ + $55^{2}$, some caving of gravelly mat'l occurred |
| 56<br>57 | | | | | | | |
| 58<br>59 | Gray, fine sand, trace med. sand, trace silt, lignite, subrounded to subangular, med. density, sat. | SP | 11/9/10 | 6" Recov | | D-12 | |
| 60 | | | | | | | |
| | T.D. $60^{2}$ | | | | | | |

11/27/63 BURNS & McDONNELL ENGINEERING COMPANY FORM J-2-1-1a

---

# DRILLING LOG

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| JOB NO. 76-076-1 | PROJECT PHSIKEMO | | | | | HOLE NO. P-17 | |
| GROUND ELEV. 307.08 | LOCATION 1000' offset S. of Sta. 50+00 | | | | | SHEET 1 OF 5 | |
| DRILLING TYPE | HOLE DEPTH | OVERBURDEN FOOTAGE | BEDROCK FOOTAGE | OVERBURDEN SAMPLES | NO. CORE BOXES | % CORE RECOVERY | WATER TABLE |
| Rotary Wash | $85^{2}$ | | | | | | 9.0 |

DRILLING CO. Raymond Int. Co. DRILLER(S) DON FERRARY

DRILLING RIG CME 750 PENETRATION TEST SPT

DRILLING DATE March 2, 77 TO March 7, 77 INSPECTOR(S) C. A. BUHR

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | | BOX OR SAMPLE NO. | REMARKS | |
|---|---|---|---|---|---|---|---|---|
| 1<br>2<br>3 | | | | | | | Lt. Yellow-brown silty fine sand, damp, organics (SM-SP) | Bag #1 |
| 4<br>5 | Lt. Rust-brown, fine sand, trace med. sand, w/silt, subrounded, trace lignite, loose, damp to dry. | SP/SM | 2/4/4 | $13\frac{1}{2}$" Recov | | D-1 | - - | |
| 6<br>7<br>8 | | | | | | | Lt. Yellow-brown, fine sand, trace med. sand, w/ silt, damp to moist. (SP - SM) | Bag #2 |
| 9<br>10 | Brown, fine sand, trace med. sand, w/ silt, trace lignite, very loose, wet to sat. | SP/(SM) | 2/1/1 | $10\frac{1}{2}$" Recov | | D-2 | - - <br>water @ $9^{2}$ | |
| 11<br>12<br>13 | | | | | | | | |

122673 Burns & McDonnell Engineers-Architects-Consultants Form J-2-1-1A

# DRILLING LOG

PROJECT PHSIKEMO HOLE NO. P-17 SHEET 2 OF 5

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|---|
| 14 | Brown, fine sand, trace med. sand, trace silt, lignite part., subrounded, med. density, sat. | SP | 7/9/11 | Full Recov. | | D-3 | |
| 15 | | | | | | | |
| 16 | | | | | | | |
| 17 | | | | | | | |
| 18 | Brown, prd. fine to med. sand, some coarse sand, trace fine gravel, trace silt, lignite. part., subrounded to occass. subangular, med. density, sat. | SP | 10/10/12 | 9½" Recov. | | D-4 | |
| 19 | | | | | | | |
| 20 | | | | | | | |
| 21 | | | | | | | |
| 22 | | | | | | | |
| 23 | Brown, prd. fine to med. sand, trace coarse sand, trace silt, lignite part., subrounded to subangular, dense, sat.; (fine gravel toward top of sample.) | SP | 11/18/22 | 9½" Recov. | | D-5 | |
| 24 | | | | | | | |
| 25 | | | | | | | |
| 26 | | | | | | | |
| 27 | | | | | | | Drilled to 28± wed. - end drill |
| 28 | Brown, prd. fine to med. sand, some coarse sand, trace fine & coarse gravel, trace silt - milky, subrounded to subangular, lignite, dense, sat. | SP/SW | 9/15/23 | 10½" Recov. | | D-6 | |
| 29 | | | | | | | |
| 30 | | | | | | | |

---

# DRILLING LOG

PROJECT PHSIKEMO HOLE NO. P-17 SHEET 3 OF 5

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|---|
| 33 | Upper 6" pea gravel, subrounded; remaining 3" gray, prd. fine sand, trace med. sand, trace silt, lignite part., sat; becoming coarser and trace fi. gravel @ tip. | GP/SP | 6/3/10 | 3" Recov. | | D-7 | Coal fragments in drilling water. Drilling action gravel from 33' to 34' |
| 34 | | | | | | | |
| 35 | | | | | | | |
| 36 | | | | | | | |
| 37 | | | | | | | |
| 38 | Gray, fine sand, some med. sand, trace ~~med.~~ coarse sand, trace silt, lignite part. & seams, subrounded to subangular, med. density, sat. | SP | 9/11/13 | 6" Recov. | | D-8 | |
| 39 | | | | | | | |
| 40 | | | | | | | |
| 41 | | | | | | | |
| 42 | | | | | | | |
| 43 | | | | | | | |
| 44 | Same; becoming dense, trace fine gravel. | SP | 12/19/21 | 7½" Recov. | | D-9 | |
| 45 | | | | | | | |
| 46 | | | | | | | |
| 47 | Gray, prd. fine to med. sand, some coarse sand and fine gravel, subrounded to subangular, trace silt, lignite part. & seams, med. density, sat.; slightly coarser toward top. | SP/(SW) | 3/6/13 | 6½" Recov. | | D-10 | |
| 48 | | | | | | | |
| 49 | | | | | | | |
| 50 | | | | | | | |

BURNS & McDONNELL ENGINEERING COMPANY

# DRILLING LOG

PROJECT PHSIKEMO HOLE NO. P-17 SHEET 4 OF 5

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|---|
| 51 | | | | | | | |
| 52 | | | | | | | |
| * 53 | Similar to previous; more uniformly fine to med. sand, dense, milky. | SP | 13/17/16 | 7" Recov. | | D-11 | milky - silty clay & not firmly bonded as some previously found mat'l from other holes; (in sluff mat'l) |
| 54 | | | | | | | |
| 55 | | | | | | | |
| 56 | | | | | | | |
| 57 | | | | | | | |
| 58 | Gray, pred. fine sand, trace med. sand, trace silt, lignite part., subrounded to subangular, very dense, sat.; becoming very silty toward tip. | SP/SM | 18/50/3" pen. | 8" Recov. | | D-12 | fine + coarse gravel noted in sluff mat'l. |
| 59 | | | | | | | |
| 60 | | | | | | | |
| 61 | | | | | | | |
| 62 | | | | | | | |
| 63 | Gray, pred. fine to med. sand, trace coarse sand and fine gravel, lignite subrounded to subangular, dense, sat.; lignite + ~~seam~~ ~~with~~ gravel seam present. | SP | 10/18/16 | 9" Recov. | | D-13 | |
| 64 | | | | | | | |
| 65 | | | | | | | |
| 66 | | | | | | | |
| 67 | | | | | | | |
| 68 | | | | | | | |

---

BURNS & McDONNELL ENGINEERING COMPANY

# DRILLING LOG

PROJECT PHSIKEMO HOLE NO. P-17 SHEET 5 OF 5

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|---|
| 69 | Brown-gray, well graded sand, some fine gravel, trace coarse gravel, milky, trace lignite, subrounded to subangular, dense, sat. | SW/(SP) | 13/18/26 | 7" Recov. | | D-14 | |
| 70 | | | | | | | |
| 71 | | | | | | | |
| 72 | ↓ similar - finer | | | | | | |
| 73 | | | | | | | |
| 74 | Similar to previous; more uniform sand, finer, very dense. | SP/(SW) | 15/50/8½" pen. | 8" Recov. | | D-15 | |
| 75 | | | | | | | |
| 76 | ↓ similar - finer | | | | | | |
| 77 | | | | | | | |
| 78 | | | | | | | |
| 77 | Brown-gray, pred. fine to med. sand, some coarse sand, trace fine gravel, trace lignite part., subrounded to subangular, dense, sat. | SP | 11/14/19 | 6½" Recov. | | D-16 | |
| 80 | | | | | | | — end Fri. |
| 81 | | | | | | | |
| 82 | | | | | | | |
| 83 | Brown-gray, same as previous; med. density, milky. | SP | 8/12/16 | 11" Recov. | | D-17 | |
| 84 | | | | | | | |
| 85 | TD $85^{2}$ | | | | | | Hole caved ē 30' casing - rate plugged. end hole |

# DRILLING LOG

JOB NO. 76-076-1 PROJECT PHSIKEMO HOLE NO. P-18

GROUND ELEV. 303.83 LOCATION 1500' S. of Sta. 50+00 SHEET 1 OF 5

| DRILLING TYPE | HOLE DEPTH | OVERBURDEN FOOTAGE | BEDROCK FOOTAGE | OVERBURDEN SAMPLES | NO. CORE BOXES | % CORE RECOVERY | WATER TABLE |
|---|---|---|---|---|---|---|---|
| Rotary Wash | 75± | | | | | | 7.0 |

DRILLING CO. RAYMOND INT. CO. DRILLER(S) DON FERRAY

DRILLING RIG CME 750 PENETRATION TEST SPT

DRILLING DATE MARCH 21 77 TO MARCH 21, 77 INSPECTOR(S) C. A. BUHR

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|---|
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | Yellow-Brown, pred. fine sand, trace to some med. sand, some silt, trace lignite part. & seam, subrounded, med. density, moist to wet. | SP | 5/7/7 | 15" Recov | | D-1 | |
| 4 | | | | | | | |
| 5 | | | | | | | |
| 6 | | | | | | | |
| 7 | | | | | | | Water @ 7± |
| 8 | Dk. brown, pred. fine to med. sand, trace coarse sand, trace to some silt, trace lignite, subrounded, loose, sat., trace of slightly silty seams. | SP/(SM) | 2/3/5 | $11\frac{1}{2}$" Recov. | | D-2 | |
| 9 | | | | | | | |
| 10 | | | | | | | |
| 11 | | | | | | | |
| 12 | | | | | | | |
| 13 | | | | | | | |

---

# DRILLING LOG

PROJECT PHSIKEMO HOLE NO. P-18 SHEET 2 OF 5

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|---|
| 14 | ~~DK.~~ Brown, pred. med. to fine sand, trace coarse sand, trace silt, trace lignite, subrounded, med. density, sat. | SP | 4/7/8 | 13" Recov | | D-3 | |
| 15 | | | | | | | |
| 16 | | | | | | | |
| 17 | | | | | | | |
| 18 | Brown, fine to med, sand, some coarse sand, trace fine gravel, trace silt, trace lignite, loose, sat., subrounded. | SP/(SW) | 5/2/5 | 4" Recov. | | D-4 | } fine gravel in wash mat'l |
| 19 | | | | | | | |
| 20 | | | | | | | |
| 21 | | | | | | | |
| 22 | | | | | | | |
| 23 | Brown, well graded sand, some fine gravel, trace silt, lignite part. ($\frac{1}{4}$"), subrounded to occass. subangular, med. density, sat. | SW/(SP) | 6/8/9 | 9" Recov. | | D-5 | |
| 24 | | | | | | | |
| 25 | | | | | | | |
| 26 | | | | | | | |
| 27 | | | | | | | |
| 28 | Gray, pred. fine to med, sand, trace coarse sand & fine gravel, lignite part. & seams, subrounded to subangular, med. density, sat. | SP/(SW) | 8/7/10 | $9\frac{1}{2}$" Recov. | | D-6 | |
| 29 | | | | | | | |
| 30 | | | | | | | |

BURNS & McDONNELL ENGINEERING COMPANY

# DRILLING LOG

PROJECT PHSIKEMO HOLE NO. P-18 SHEET 3 OF 5

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|
| 33 | Gray, pred. fine to med. sand, trace coarse sand, lignite part. + seam, subrounded to subangular, med. density, sat. | SP | 7/10/10 | 9½" Recov | D-7 | thin lignite seam |
| 38 | Gray, fine sand, trace med. sand + occass. coarse sand, lignite part. + pockets, subrounded to subangular, dense, sat, | SP | 12/29/16 | 10½" Recov. | D-8 | |
| 43 | Gray, pred. fine to med. sand, trace coarse sand, milky, lignite part., subrounded to subangular, med. density, sat, | SP | 6/11/13 | 9½" Recov. | D-9 | thin gravel seam |
| 48 | Gray, fine to med. sand, trace coarse sand, milky, lignite part. + seams, subrounded to subangular, med. density, sat. | SP | 8/12/11 | 7" Recov. | D-10 | |

11/27/63 BURNS & McDONNELL ENGINEERING COMPANY FORM J-2-1-1a

---

BURNS & McDONNELL ENGINEERING COMPANY

# DRILLING LOG

PROJECT PHSIKEMO HOLE NO. P-18 SHEET 4 OF 5

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|
| 53 | Gray, pred. fine to med. sand, trace coarse sand, lignite part., subrounded to subangular, very dense, sat; alternating finer coarser layers, becoming silty-very fine sand @ tip. | SP<br>SM | 13/50/10" pen. | 10" Recov. | D-11 | |
| 58 | Brown-gray, fine to med. sand, trace coarse sand + fine gravel, lignite part., subrounded to subangular, dense, sat. (trace milkyness) | SP/(SW) | 13/22/22 | 9" Recov. | D-12 | |
| 63 | | | | | | 2" gravel seam @ 63$^{2}$ |
| 64 | Brown-gray, fine to med. sand, trace to some coarse sand, milky, lignite part. + seam, subrounded to subangular, dense, sat. | SP/(SW) | 11/15/15 | 10" Recov. | D-13 | |

11/27/53 BURNS & McDONNELL ENGINEERING COMPANY FORM J-2-1-1a

BURNS & McDONNELL ENGINEERING COMPANY

# DRILLING LOG

PROJECT PHSIKEMO HOLE NO. P-18 SHEET 5 OF 5

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|---|
| 69–71 | Brown-gray, med. to fine sand, trace to some coarse sand + fine gravel, slight milkyness, lignite part., subrounded to subangular, med. density, sat. | SP/SW | 14/12/15 | 10½" Recov. | | D-14 | fine + coarse gravel noted in sluff until & |
| 71–73 | ↕ | | | | | | |
| 73–74 | Same; dense, slight red-tint. | SP/SW | 8/21/19 | Recov. | | D-15 | |
| 76 | | | | | | | Hole caved @ $37^{0}$, plugged, end drilling |
| 77 | T.D. $75^{0}$ | | | | | | |
| 79–80 | | | | Recov. | | ~~D-16~~ | |
| 81 | ~~T.D. $80^{0}$~~ | | | | | | |
| 84–85 | | | | ~~Recov.~~ | | ~~D-17~~ | |

---

# DRILLING LOG

JOB NO. 76-076-1 PROJECT PHSIKEMO HOLE NO. P-19

GROUND ELEV. 299.96 LOCATION 487' offset S. ⊥ Sta. 64+77 SHEET 1 OF 3

| DRILLING TYPE | HOLE DEPTH | OVERBURDEN FOOTAGE | BEDROCK FOOTAGE | OVERBURDEN SAMPLES | NO. CORE BOXES | % CORE RECOVERY | WATER TABLE |
|---|---|---|---|---|---|---|---|
| Rotary Wash | $50^{0}$ | | | | | | 6.0 |

DRILLING CO. RAYMOND INT. CO. DRILLER(S) DON FERRARY

DRILLING RIG CME 750 PENETRATION TEST SPT

DRILLING DATE MARCH 9, 77 TO MARCH 9, 77 INSPECTOR(S) C. A. BUHR

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|---|
| 2–3 | | | | | | | Bag Sample: Rust-brown-dk. clayey silt to silty clay, low to med. plast., moist to wet. |
| 3–5 | Dk. brown, clayey silt, trace fine sand, low to no plast., occass. rust streaks, organic smell, moist to wet. | ML/CL | 2/for 2 ft. | ½" Recov. | | D-1 | |
| 6 | | | | | | | water @ $6^{0}$ |
| 8–10 | Gray, well graded sand, some coarse sand + fine gravel, lignite part., subrounded to occass. subangular, med. density, sat. | SW/SP | 3/6/13 | 9" Recov. | | D-2 | |

BURNS & McDONNELL ENGINEERING COMPANY

# DRILLING LOG

PROJECT PHSIKEMO HOLE NO. P-19 SHEET 2 OF 3

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|---|
| 14<br>15<br>16<br>17 | Top 4" – brown-gray, well graded sand, trace fine gravel, subrounded to occass. subangular; becoming finer, going through color changes – brown, rust-brown, lt.-brown, lignite seam, dk. brown; tip pred. fine sand, w/ med. sand, trace coarse sand, subrounded to subangular; lignite throughout, sat. | SW/SP | 5/7/13 | 10½" Recov. | | D-3 | |
| 18<br>19<br>20 | Lt. Yellow-brown, fine to med. sand, trace coarse sand, lignite part., subrounded to subangular, med. density, sat. | SP | 6/6/8 | 6" Recov. | | D-4 | trace chert in wash ? |
| 21<br>22 | | | | | | | |
| 23<br>24<br>25 | Gray, pred. fine to med. sand, trace coarse sand & fine gravel, trace lignite, subrounded to subangular, med. density, sat. | SP/(SW) | 6/8/10 | 4" Recov. | | D-5 | |
| 26<br>27 | | | | | | | |
| 28<br>29<br>30 | Top 1" similar to previous, finer; becoming gray silt, trace very fine sand, no plast., lignite part. & seams, moist. med. density to dense. | ML | 6/8/10 | 12" Recov. | | D-6 | — change |

---

BURNS & McDONNELL ENGINEERING COMPANY

# DRILLING LOG

PROJECT PHSIKEMO HOLE NO. P-19 SHEET 3 OF 3

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|---|
| 33<br>34<br>35 | Gray, very fine sand, trace silt, trace med. sand., lignite part., subrounded to subangular, sat., med. density. | SP/~~[illegible]~~ | 6/8/10 | 1" Recov. | | D-7 | |
| 36<br>37 | | | | | | | |
| 38<br>39<br>40 | Gray, similar to previous; becoming coarser w/ lignite part. & seams, subrounded to subangular, med. density, sat. | SP | 6/10/12 | 6" Recov. | | D-8 | |
| 41<br>42 | | | | | | | |
| 43<br>44<br>45<br>46 | Gray, fine to med. sand, trace coarse sand, ~~toward top~~, milky, lignite, subrounded to subangular, dense, sat.; slightly coarser toward top. | SP | 10/16/23 | 10" Recov. | | D-9 | |
| 47<br>48<br>49<br>50 | Gray, fine to med. sand, slightly milky, lignite part., subrounded to subangular, dense, sat. | SP | 15/18/18 | 9" Recov. | | D-10 | excessive plugging & caving — @ [illegible] pt unable to pull rods, end drilling |

T.D. 50'

# DRILLING LOG

JOB NO. 76-076-1
PROJECT PHSIKEMO
HOLE NO. P-20
GROUND ELEV. 299.41
LOCATION 1000' offset S. of Sta. 60+00
SHEET 1 OF 6

| DRILLING TYPE | HOLE DEPTH | OVERBURDEN FOOTAGE | BEDROCK FOOTAGE | OVERBURDEN SAMPLES | NO. CORE BOXES | % CORE RECOVERY | WATER TABLE |
|---|---|---|---|---|---|---|---|
| Rotary Wash | 95.0 | | | | | | 3.5 |

DRILLING CO. RAYMOND INT. CO.
DRILLER(S) DON FERRARY
DRILLING RIG CME 750
PENETRATION TEST SPT
DRILLING DATE MARCH 8, 77 TO MARCH 9, 77
INSPECTOR(S) C.A. BUHR

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|---|
| 1 | | | | | | | |
| 2 | | | | | | | Bag Sample: Dk. brown to black, sandy silt, trace plast., wet to sat., organic. Water @ 3± |
| 3 | Top 7" gray, silt, trace fine sand, trace clay, no plast., low dry strength; bottom 6" gray, fine to med. sand, trace coarse sand, lignite, subrounded to occass. subangular, med. density, sat. | ML<br>SP | 2/4/10 | 13" Recov. | | D-1 | |
| 4 | | | | | | | |
| 5 | | | | | | | |
| 6 | | | | | | | |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | Gray, fine to med. sand, trace coarse sand, trace silt, trace lignite, subrounded to subangular, dense, sat., 1 lignite seam. | SP | 7/14/21 | 16" Recov. | | D-2 | |
| 10 | | | | | | | |
| 11 | | | | | | | |
| 12 | | | | | | | |
| 13 | | | | | | | |

---

BURNS & McDONNELL ENGINEERING COMPANY

# DRILLING LOG

PROJECT PHSIKEMO
HOLE NO. P-20
SHEET 2 OF 6

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|---|
| 14 | Gray, fine to med. sand, trace lignite, subrounded to subangular, very dense, sat., becoming finer towards tip. | SP | 12/23/31 | Full Recov | | D-3 | fine gravel noted in sluff |
| 15 | | | | | | | |
| 16 | | | | | | | |
| 17 | | | | | | | gravel seam noted by driller @ 17± |
| 18 | Gray, somewhat well graded sand, trace gravel, trace lignite, chert, subrounded to subangular, med. density, sat. | SP/SW | 10/11/12 | 6½" Recov. | | D-4 | |
| 19 | | | | | | | |
| 20 | | | | | | | |
| 21 | | | | | | | |
| 22 | | | | | | | |
| 23 | Gray, fine to med. sand, trace coarse sand, milky, lignite part., subrounded to subangular, med. density, sat. | SP | 10/12/16 | 6" Recov. | | D-5 | |
| 24 | | | | | | | |
| 25 | | | | | | | |
| 26 | | | | | | | |
| 27 | | | | | | | |
| 28 | Dk. gray, fine to med. sand, much lignite part. + seams, subrounded to subangular, med. density, sat. | SP | 6/3/14 | 10" Recov. | | D-6 | |
| 29 | | | | | | | |
| 30 | | | | | | | |

BURNS & McDONNELL ENGINEERING COMPANY
# DRILLING LOG

PROJECT PHSIKEMO HOLE NO. P-20 SHEET 3 OF 6

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|---|
| 33 | Gray, fine to med. sand, lignite part., subrounded to subangular, med. density, sat. | SP | 8/10/15 | 10" Recov. | | D-7 | Chert in sluff |
| 34 | | | | | | | |
| 35 | | | | | | | |
| 36 | | | | | | | |
| 37 | | | | | | | |
| 38 | Gray, pred. fine sand, w/ med. sand, lignite part. & seams, subrounded to subangular, med. density, sat.; coarse sand & fine gravel noted above top lignite seam. | SP | 7/9/9 | 12½" Recov. | | D-8 | |
| 39 | | | | | | | |
| 40 | | | | | | | |
| 41 | | | | | | | |
| 42 | | | | | | | |
| 43 | Gray, fine to med. sand, some coarse sand, trace fine gravel, lignite part. & seam, chert, subrounded to subangular, med. density, sat. | SP/(SW) | 9/10/10 | 8½" Recov. | | D-9 | |
| 44 | | | | | | | |
| 45 | | | | | | | |
| 46 | | | | | | | |
| 47 | Gray, fine to med. sand, very milky, subrounded to subangular, med. density, sat. | SP | 8/12/11 | 8" Recov. | | D-10 | * silty clay - firm, in sluff mat'l & wash noted |
| 48 | | | | | | | |
| 49 | | | | | | | |
| 50 | | | | | | | |

---

BURNS & McDONNELL ENGINEERING COMPANY
# DRILLING LOG

PROJECT PHSIKEMO HOLE NO. P-20 SHEET 4 OF 6

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|---|
| 51 | | | | | | | |
| 52 | | | | | | | |
| 53 | Gray, fine sand, trace to some med. sand, lignite, subrounded to subangular, med. density to dense, sat. | SP | 9/13/16 | 10½" Recov. | | D-11 | |
| 54 | | | | | | | |
| 55 | | | | | | | |
| 56 | | | | | | | |
| 57 | | | | | | | |
| ** * → 58 | Brown-gray, well graded sand, some gravel, red- very milky-tint, chert, trace lignite, subrounded to subangular, med. density, sat. | SW/SP | 10/10/12 | 7½" Recov. | | D-12 | |
| 59 | | | | | | | |
| 60 | | | | | | | end Tues. caving problems. |
| 61 | | | | | | | |
| 62 | | | | | | | Lignite seam located above sample D-13 |
| 63 | Top 2½" — gray, fine to med. sand, w/ great pred. of lignite part.; 3" fine gravel seam, subangular, very milky; 4½" brown-gray, fine to med. sand, trace coarse sand, lignite part., subrounded to subangular, med. density to dense, sat. | SP<br>Gravel<br>SP | 11/11/15 | 10" Recov. | | D-13 | |
| 64 | | | | | | | |
| 65 | | | | | | | |
| 66 | | | | | | | |
| 67 | | | | | | | |

BURNS & McDONNELL ENGINEERING COMPANY

# DRILLING LOG

PROJECT PHSIKEMO HOLE NO. P-20 SHEET 5 OF 6

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|---|
| 68 | Brown-gray, fine sand, some med. sand, trace coarse sand & fine gravel pocket, lignite part. & seam, red-tint, subrounded to subangular, very dense, sat. | SP | 11/20/31 | 8" Recov. | | D-14 | |
| 69 | | | | | | | |
| 70 | | | | | | | |
| 71 | | | | | | | |
| 72 | | | | | | | |
| 73 | Brown-gray, fine sand to med. sand, trace coarse sand, red-milky tint, lignite part., subrounded to subangular, very dense, sat. | SP | 16/22/26 | 10" Recov. | | D-15 | |
| 74 | | | | | | | |
| 75 | | | | | | | plugging & caving caused delay – |
| 76 | | | | | | | |
| 77 | | | | | | | |
| 78 | Brown-gray, fine to med. sand, ~~trace~~ lignite, red-milky tint, subrounded to subangular, (chert), dense to very dense, sat. | SP | 10/17/23 | 9" Recov. | | D-16 | |
| 79 | | | | | | | |
| 80 | | | | | | | |
| 81 | | | | | | | gravel from @ 81± to 83± |
| 82 | Red-brown, very fine sand, subrounded to subangular, lignite, dense, sat. | SP | 11/14/18 | 1½" Recov. | | D-17 | |
| 83 | | | | | | | Coarse gravel placed in jar – from gravel layer |
| 84 | | | | | | | |
| 85 | | | | | | | |

11/27/63 BURNS & McDONNELL ENGINEERING COMPANY FORM J-2-1-18

---

BURNS & McDONNELL ENGINEERING COMPANY

# DRILLING LOG

PROJECT PHSIKEMO HOLE NO. P-20 SHEET 6 OF 6

| DEPTH | DESCRIPTION | LOG OR CLASS | NO. BLOWS | CORE RECOV. & LOSS | | BOX OR SAMPLE NO. | REMARKS |
|---|---|---|---|---|---|---|---|
| 87 | | | | | | | |
| 88 | Blue-gray, clay, very stiff to hard, mottled, high plast., high dry strength, moist. ~~trace of black~~ | CH | 6/9/14 | 9½ Recov. | | D-18 | |
| 89 | | | | | | | |
| 90 | | | | | | | |
| 91 | | | | | | | blue-gray water return |
| 92 | | | | | | | |
| 93 | | | | | | | |
| 94 | Same | CH | 7/7/9 | Full Recov. | | D-19 | |
| 95 | | | | | | | caved in @ 40± end drilling. |
| 96 | | | | | | | |
| 97 | T.D 95± | | | | | | |
| 98 | | | | | | | |
| 99 | | | | ~~Recov.~~ | | D-20 | |
| 100 | | | | | | | |

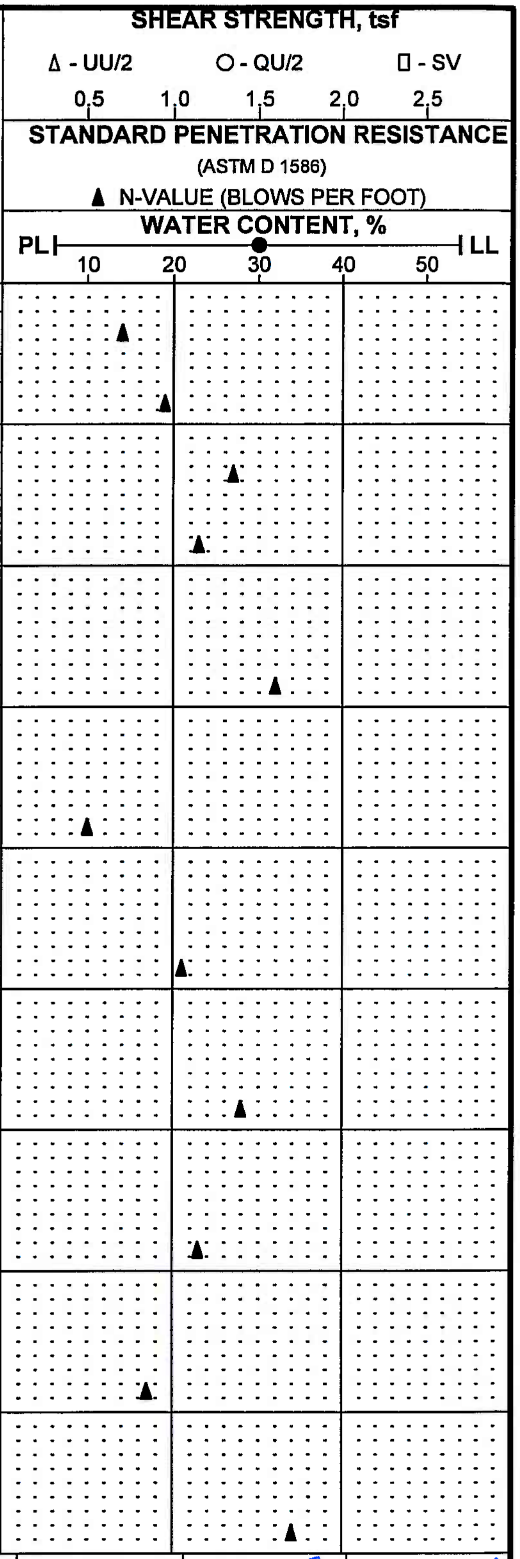
11/27/63 BURNS & McDONNELL ENGINEERING COMPANY FORM J-2-1-18

Surface Elevation: 322.2

Datum msl

Completion Date: 8/30/11

| DEPTH IN FEET | DESCRIPTION OF MATERIAL | GRAPHIC LOG | DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD | SAMPLES |
|---|---|---|---|---|
| | FILL: brown, fine sand | | 3-6-8 | SS1 |
| 5 | FILL: brown, clayey sand | | 3-5-14 | SS2 |
| | FILL: brown and gray, fine sand | | 6-12-15 | SS3 |
| 10 | | | 7-12-11 | SS4 |
| | Loose to dense, brown and gray, fine to medium SAND - SP | | | |
| 15 | | | 7-16-16 | SS5 |
| 20 | | | 3-3-7 | SS6 |
| 25 | | | 8-10-11 | SS7 |
| 30 | | | 11-14-14 | SS8 |
| 35 | | | 10-11-12 | SS9 |
| 40 | | | 8-8-9 | SS10 |
| | Boring terminated at 45 feet. | | 12-17-17 | SS11 |



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

## DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM 20 FEET

PH DRILLER RFW LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

**REMARKS: Groundwater not encountered prior to commencement of washboring.**

| | | |
|---|---|---|
| Drawn by: KSA | Checked by: | App'vd. by: MHM |
| Date: 9/7/11 | Date: 10/3/11 | Date: 10/3/11 |

GEOTECHNOLOGY INC
FROM THE GROUND UP

**Sikeston Ash Ponds**

**LOG OF BORING: B-6**

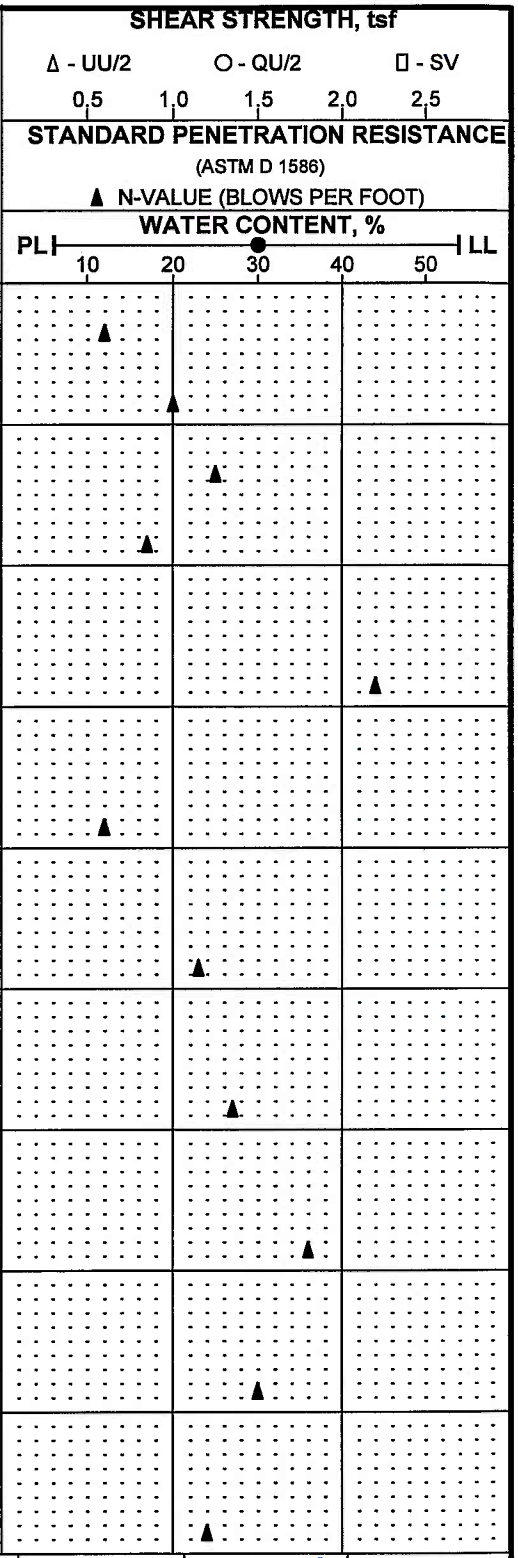
**Project No. J019302.01**

Surface Elevation: 322.1

Datum msl

Completion Date: 8/30/11

| DEPTH IN FEET | DESCRIPTION OF MATERIAL | DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD | SAMPLES |
|---|---|---|---|
| | FILL: brown, fine sand | | |
| | | 4-5-7 | SS1 |
| | | 5-9-11 | SS2 |
| 5 | | | |
| | | 7-12-13 | SS3 |
| | FILL: brown and gray, clayey SAND - SC | | |
| | | 7-6-11 | SS4 |
| 10 | | | |
| | Medium dense to dense, brown, fine to coarse SAND - SP | | |
| | | 11-19-25 | SS5 |
| 15 | | | |
| | | 4-5-7 | SS6 |
| 20 | | | |
| | | 7-10-13 | SS7 |
| 25 | | | |
| | | 12-12-15 | SS8 |
| 30 | | | |
| | | 13-15-21 | SS9 |
| 35 | | | |
| | | 10-14-16 | SS10 |
| 40 | | | |
| | Boring terminated at 45 feet. | 10-10-14 | SS11 |



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

## DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM 20 FEET

PH DRILLER RFW LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

**REMARKS: Groundwater not encountered prior to commencement of washboring.**

| | | |
|---|---|---|
| Drawn by: KSA | Checked by: SK | App'vd. by: MHM |
| Date: 9/7/11 | Date: 10/3/11 | Date: 10/3/11 |

GEOTECHNOLOGY INC
FROM THE GROUND UP

**Sikeston Ash Ponds**

**LOG OF BORING: B-7**

**Project No. J019302.01**

Surface Elevation: 322.0 Completion Date: 8/30/11

Datum msl

| DEPTH IN FEET | DESCRIPTION OF MATERIAL | GRAPHIC LOG | DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD | SAMPLES |
|---|---|---|---|---|
| 0 | FILL: brown, fine sand | | | |
| 4 | | | 4-11-14 | SS1 |
| 7 | FILL: brown, silty sand | | | |
| 9 | | | 9-12-14 | SS2 |
| 14 | | | 18-36-26 | SS3 |
| 15 | Medium dense, brown, silty SAND - (SM) | | | |
| 19 | | | 9-8-8 | SS4 |
| 22 | Medium dense, brown, fine to medium SAND - SP | | | |
| 24 | | | 6-8-9 | SS5 |
| 25 | Boring terminated at 25 feet. | | | |

SHEAR STRENGTH, tsf

∆ - UU/2 ○ - QU/2 ☐ - SV

0.5 1.0 1.5 2.0 2.5

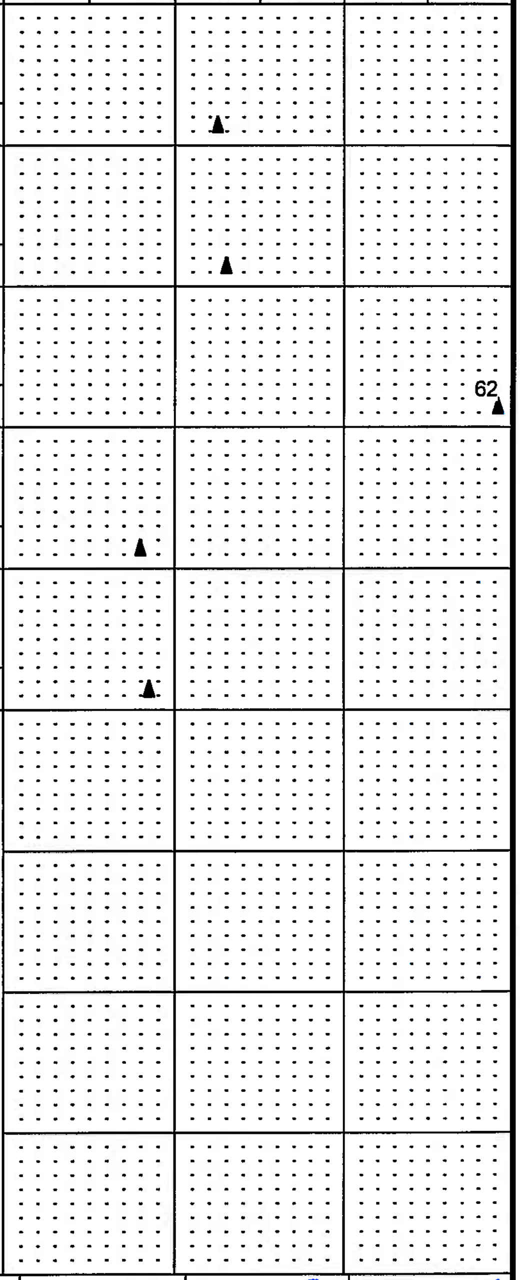
STANDARD PENETRATION RESISTANCE (ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL LL

10 20 30 40 50



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

**GROUNDWATER DATA**

X FREE WATER NOT ENCOUNTERED DURING DRILLING

**DRILLING DATA**

__ AUGER 4 1/4" HOLLOW STEM

WASHBORING FROM __ FEET

PH DRILLER RFW LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

**REMARKS:**

| | | |
|---|---|---|
| Drawn by: KSA | Checked by: SK | App'vd. by: MHM |
| Date: 9/7/11 | Date: 10/3/11 | Date: 10/3/11 |

GEOTECHNOLOGY INC
FROM THE GROUND UP

**Sikeston Ash Ponds**

**LOG OF BORING: P-8**

**Project No. J019302.01**

Surface Elevation: 322.2

Datum msl

Completion Date: 8/31/11

| DEPTH IN FEET | DESCRIPTION OF MATERIAL | GRAPHIC LOG | DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD | SAMPLES |
|---|---|---|---|---|
| | FILL: brown, fine sand | ▩ | | |
| 5 | | ▩ | 2-3-5 | SS1 |
| 10 | | ▩ | 8-22-23 | SS2 |
| 15 | Coal debris | ▩ | 12-14-17 | SS3 |
| | ▽ Medium dense, brown and gray, fine to medium SAND -SP | ⛆ | | |
| 20 | | ⛆ | 8-11-14 | SS4 |
| | Boring terminated at 20 feet. | | | |
| 25 | | | | |
| 30 | | | | |
| 35 | | | | |
| 40 | | | | |

SHEAR STRENGTH, tsf

Δ - UU/2 ○ - QU/2 ▯ - SV

0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

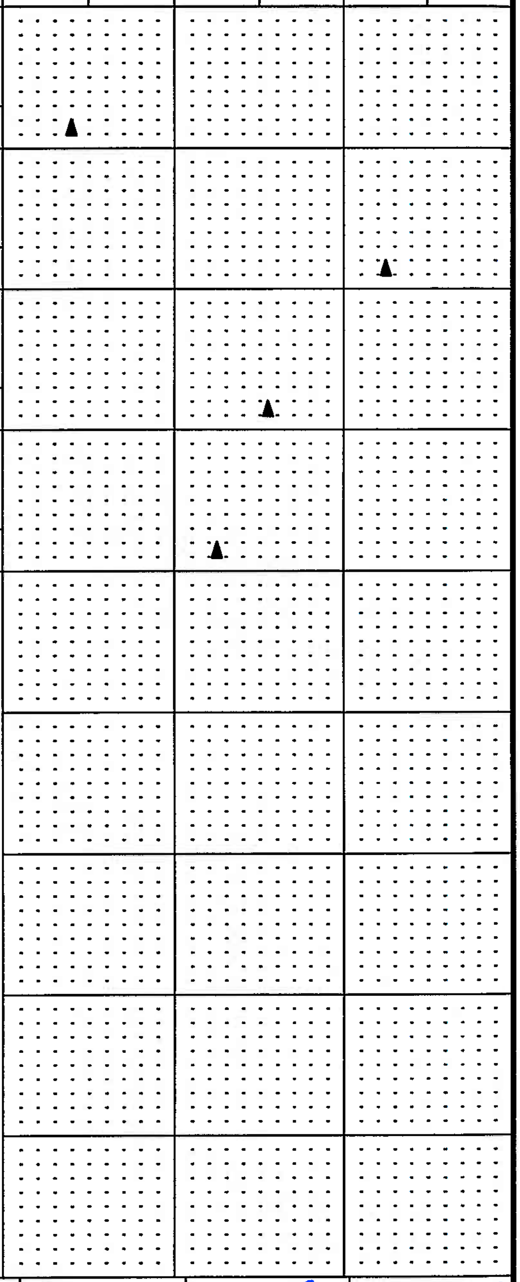
(ASTM D 1586)

▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL ⊢—●—⊣ LL

10 20 30 40 50



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

**GROUNDWATER DATA**

ENCOUNTERED AT 17 FEET ⊻

**DRILLING DATA**

___ AUGER 4 1/4" HOLLOW STEM

WASHBORING FROM ___ FEET

PH DRILLER RFW LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

**REMARKS:**

| | | |
|---|---|---|
| Drawn by: KSA | Checked by: SA | App'vd. by: MHM |
| Date: 9/7/11 | Date: 10/3/11 | Date: 10/3/11 |

GEOTECHNOLOGY INC

FROM THE GROUND UP

**Sikeston Ash Ponds**

**LOG OF BORING: P-10**

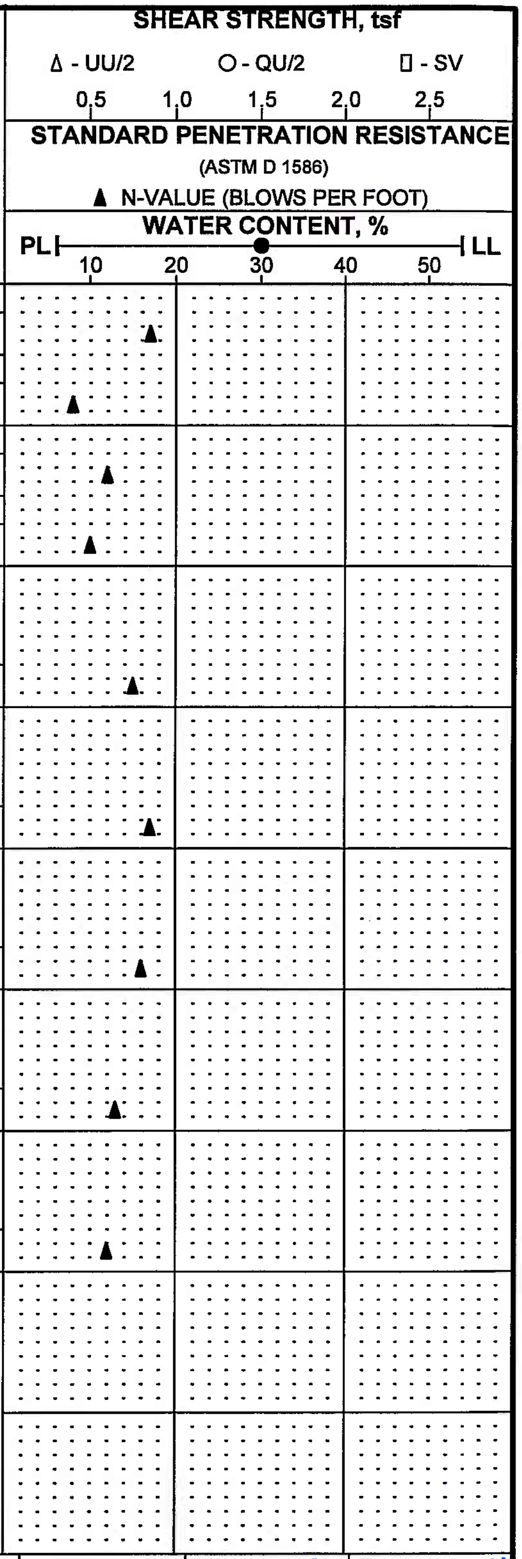
**Project No. J019302.01**

Surface Elevation: 306.2

Datum msl

Completion Date: 9/1/11

| DEPTH IN FEET | DESCRIPTION OF MATERIAL | GRAPHIC LOG | DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD | SAMPLES |
|---|---|---|---|---|
| | Medium dense, gray, silty SAND - SM | | 5-8-9 | SS1 |
| | Loose to medium dense, brown and gray, fine to medium SAND - (SP) | | 3-4-4 | SS2 |
| 5 | | | | |
| | | | 4-6-6 | SS3 |
| | | | 3-4-6 | SS4 |
| 10 | | | | |
| | | ⊽ | | |
| | | | 4-6-9 | SS5 |
| 15 | | | | |
| | | | 8-8-9 | SS6 |
| 20 | | | | |
| | | | 9-8-8 | SS7 |
| 25 | | | | |
| | Medium dense, brown and gray, fine to coarse SAND with gravel - SP | | | |
| | | | 5-6-7 | SS8 |
| 30 | | | | |
| | | | 6-6-6 | SS9 |
| 35 | Boring terminated at 35 feet. | | | |
| 40 | | | | |



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

**GROUNDWATER DATA**

ENCOUNTERED AT 11.5 FEET ⊻

**DRILLING DATA**

__ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM 15 FEET
PH DRILLER RFW LOGGER
CME 550X DRILL RIG
HAMMER TYPE Auto

**REMARKS:**

| Drawn by: KSA | Checked by: SLC | App'vd. by: MHM |
|---|---|---|
| Date: 9/7/11 | Date: 10/3/11 | Date: 10/3/11 |

GEOTECHNOLOGY INC
FROM THE GROUND UP

**Sikeston Ash Ponds**

**LOG OF BORING: B-13**

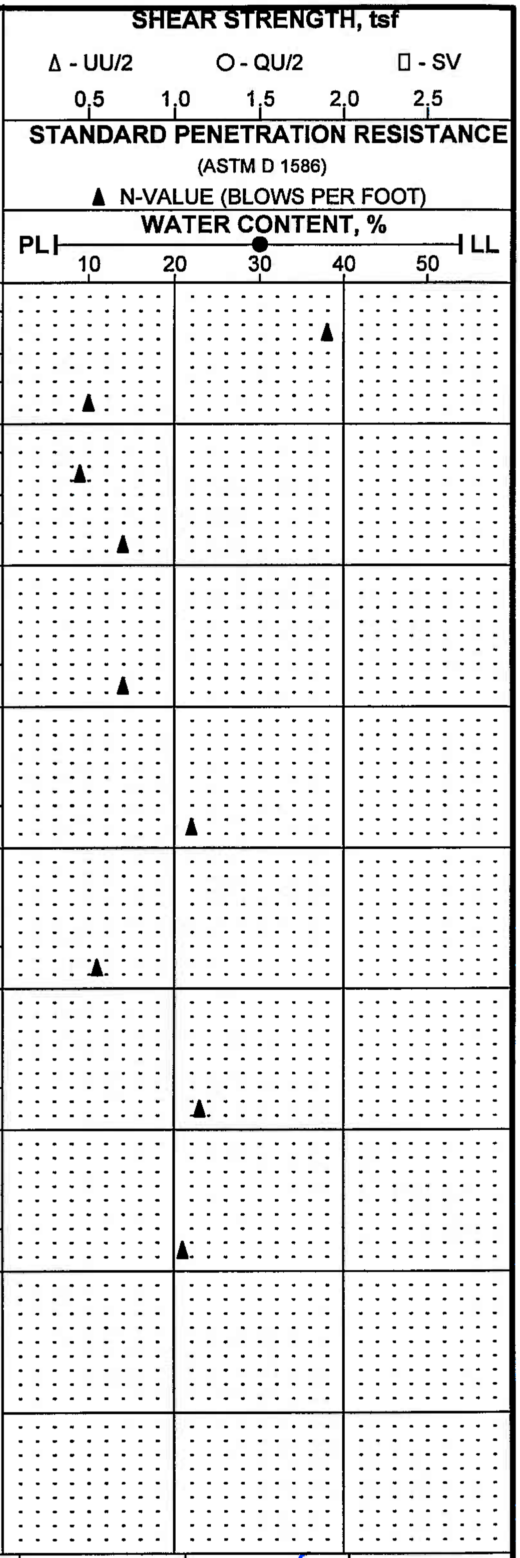
**Project No. J019302.01**

Surface Elevation: 305.0

Datum msl

Completion Date: 9/1/11

| DEPTH IN FEET | DESCRIPTION OF MATERIAL | GRAPHIC LOG | DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD | SAMPLES |
|---|---|---|---|---|
| | Hard, gray SILT - ML | | | |
| | | | 14-24-14 | SS1 |
| | Loose to medium dense, brown to gray, fine to medium SAND - (SP) | | | |
| | | | 3-5-5 | SS2 |
| 5 | | | | |
| | | | 4-4-5 | SS3 |
| | | | 4-6-8 | SS4 |
| 10 | | | | |
| | | ⊻ | | |
| | | | 3-5-9 | SS5 |
| 15 | | | | |
| | | | 9-10-12 | SS6 |
| 20 | | | | |
| | | | 8-6-5 | SS7 |
| 25 | | | | |
| | with gravel | | | |
| | | | 6-9-14 | SS8 |
| 30 | | | | |
| | | | 6-9-12 | SS9 |
| 35 | Boring terminated at 35 feet. | | | |
| 40 | | | | |



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

**GROUNDWATER DATA**

ENCOUNTERED AT 11.5 FEET ⊻

**DRILLING DATA**

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM 15 FEET
PH DRILLER RFW LOGGER
CME 550X DRILL RIG
HAMMER TYPE Auto

**REMARKS:**

| Drawn by: KSA | Checked by: Sk | App'vd. by: MHM |
|---|---|---|
| Date: 9/7/11 | Date: 10/3/11 | Date: 10/3/11 |

GEOTECHNOLOGY INC
FROM THE GROUND UP

**Sikeston Ash Ponds**

**LOG OF BORING: B-14**

**Project No. J019302.01**

# WELL INFORMATION

# Layne-Western Co. Inc.

1. CONTRACT Sikeston Power Station
Unit 1 - Contract 37 - Water Wells
2. City, State Sikeston, Missouri
3. Well No. 3 at Test Hole No. 1-78
4. Well Location (attach map)

5. Driller F. Frederick
6. DATE 1/22/80
7. Date Started 8/15/79
Completed 9/11/79
8. Drill Crew Man Hrs
9. Working Days
Drilling
Other

| 10. MATERIAL IN WELL | LENGTH FT. IN. | DIA. IN. | GAGE NO. | WALL THICKNESS IN. | MATERIAL | TYPE | NO. |
|---|---|---|---|---|---|---|---|
| Screen | 43 | 18 | | | Stainless Steel | Cook<br>~~Shutter~~ ~~Keystone~~ | 0.060<br>Openings |
| Inner Casing | 140 | 18 | | 0.375 | Carbon Steel | [✓ Welded] Screwed | |
| Outer Casing | 33 | 30 | | 0.281 | Carbon Steel | [✓ Welded] Screwed | |

11. GRAVEL
Size WB50 & Lemons 3/8 x 3/4
Tons 27 54

12. SEALING CASING
Puddled Clay (Yes) (No)
With ........ Bags Bentonite Added
or
With ........ Bags Cement
Seal Material Placed in Well With neat cement grout
Bottom of Well Screen Sealed With steel plate

13. WELL DIMENSIONS
A. Total Depth 183'
(From Top of Inner Casing to Bottom of Well)
B. Height of Inner Casing
(Above Ground Level)
C. Distance to Top of Gravel 4'
(From Ground Level)
D. Diameter of Drill Hole 36"

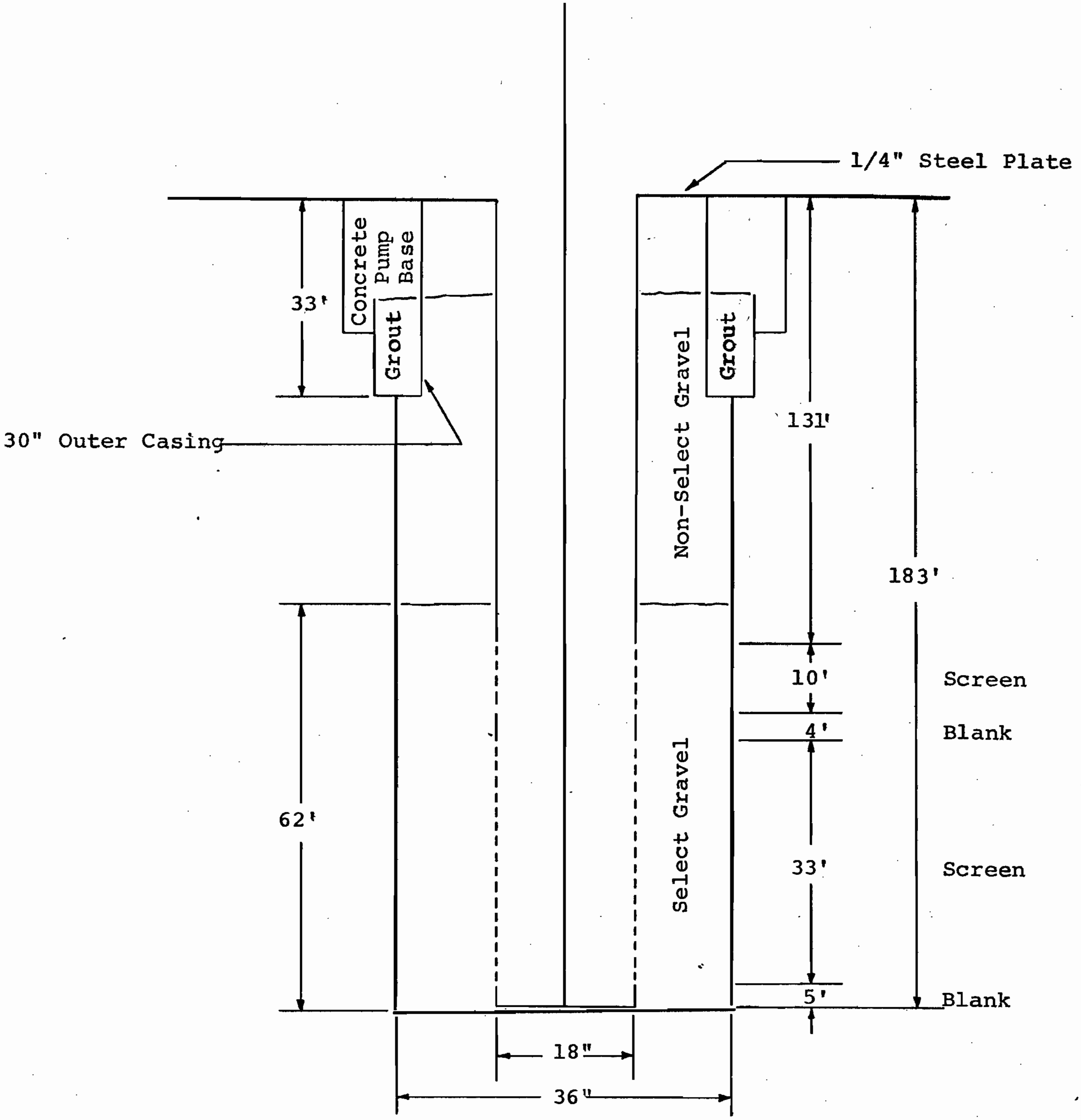
Comments

LW-39

# CONSTRUCTION OF WELL

No. 3

Sikeston Power Station - Unit 1
Contract 37



# LOG OF WELL

| Ft. | In. | to | Ft. | In. | Formation |
|---|---|---|---|---|---|
| 0 | | | 10 | | Silty sand |
| 10 | | | 16 | | Clay |
| 16 | | | 35 | | Coarse sand |
| 35 | | | 55 | | Fine sand |
| 55 | | | 96 | | Medium sand |
| 96 | | | 128 | | Clay |
| 128 | | | 138 | | Coarse sand |
| 138 | | | 140 | | Clay |
| 140 | | | 175 | | Coarse sand and gravel |
| 175 | | | 180 | | Clay |
| 180 | | | 181 | | Fine sand |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

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

# MONITORING WELL CERTIFICATION RECORD

REF NO
00517353

DATE RECEIVED
06/22/2016

CR NO

CHECK NO.
10044

STATE WELL NO
A208215 06/24/2016

REVENUE NO.
062216

ENTERED NRBASSM
PH1 PH2 PH3
06/22/2016 06/22/2016 06/22/2016

APPROVED BY

ROUTE

## INFORMATION SUPPLIED BY PRIMARY CONTRACTOR OR DRILLING CONTRACTOR

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

OWNER NAME
SIKESTON BOARD OF MUNICIPAL UTILITIES

CONTACT NAME
SIKESTON BOARD OF MUNICIPAL UTILITIES

VARIANCE GRANTED BY DNR
NUMBER ____________

OWNER ADDRESS
1551 WEST WAKEFIELD STREET

CITY
SIKESTON

STATE
MO

ZIP
63801

SITE NAME
SIKESTON POWER STATION

WELL NUMBER
TPZ3

COUNTY
SCOTT

SITE ADDRESS

CITY

STATIC WATER LEVEL
10.09 FT

**SURFACE COMPLETION**
TYPE
☒ ABOVE GROUND
☐ FLUSH MOUNT

LENGTH AND DIAMETER OF SURFACE COMPLETION
LENGTH 5.0 FT.
DIAMETER 4.0 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED
DIAMETER 12.0 IN.
LENGTH 2.5 FT.

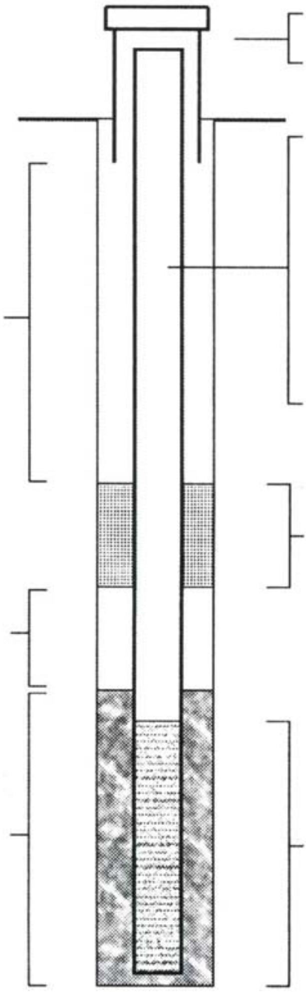
SURFACE COMPLETION GROUT
☒ CONCRETE
☐ OTHER

LOCATION OF WELL
LAT. 36 ° 52' 37.11"
LONG. 89 ° 36' 43.07"

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

SEC. 24 TWN. 26 NORTH
RANGE 13 Direction E

☐ LOCKING CAP
☐ WEEP HOLE



**SURFACE COMPLETTION**
☒ STEEL ☐ ALUMINUM ☐ PLASTIC

ELEVATION ______FT.

**RISER**
RISER PIPE DIAMETER 2.0IN.
RISER PIPE LENGTH 27.1FT.
HOLE DIAMETER 8.5IN.
WEIGHT OR SDR# SCH40

**ANNULAR SEAL**
LENGTH 16.5FT.

☐ 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 ______

**BENTONITE SEAL**
LENGTH: 3.1
☐ CHIPS ☐ PELLETS ☐ GRANULAR
☐ SLURRY
☐ SATURATED ZONE ☐ HYDRATED

**SECONDARY FILTER PACK**
LENGTH: 0.0FT.

**SCREEN**
SCREEN DIAMETER: 2.0IN.
SCREEN LENGTH: 10.0FT.
DIAMETER OF DRILL HOLE: 8.5IN.
DEPTH TO TOP 25.5FT.

**DEPTH TO TOP OF PRIMARY**
FILTER PACK: 22.1FT.

**SCREEN MATERIAL**
☐ STEEL ☒ THERMOPLASTIC (PVC)
☐ OTHER

**LENGTH OF PRIMARY FILTER PACK:** 13.4FT.

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 | 2.0 | LOAM |
| 2.0 | 35.5 | SND |

TOTAL DEPTH: 35.5 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 KEN EWERS

PERMIT NUMBER
006218

DATE WELL DRILLING WAS COMPLETED
05/13/2016

**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

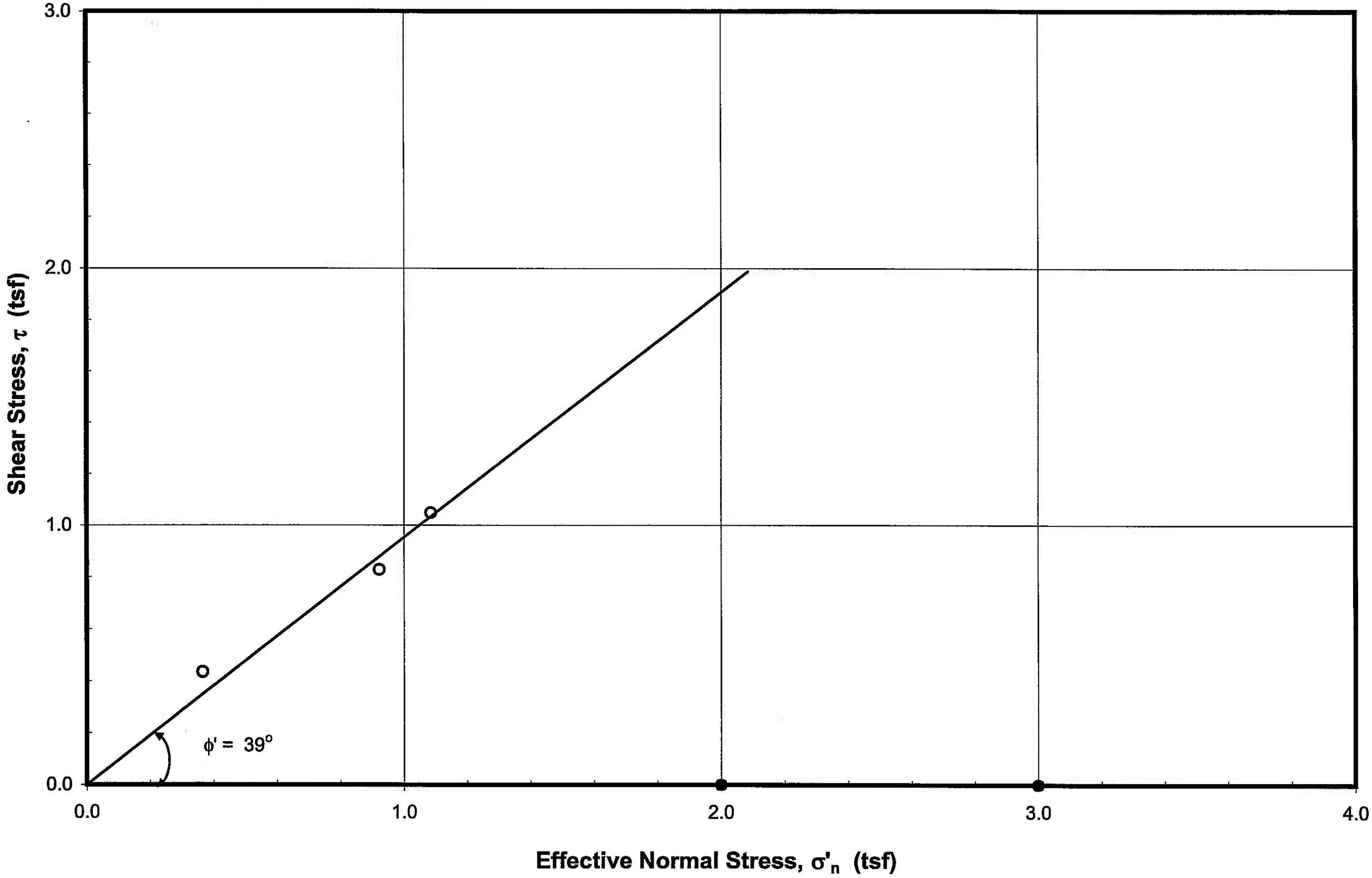
**SIGNATURE (WELL DRILLER)**
x FELIX DEKEN

PERMIT NUMBER
006065

SIGNATURE (APPRENTICE)
x ____________

APPRENTICE PERMIT NUMBER
____________

GEOTECHNOLOGY INC
FROM THE GROUND UP



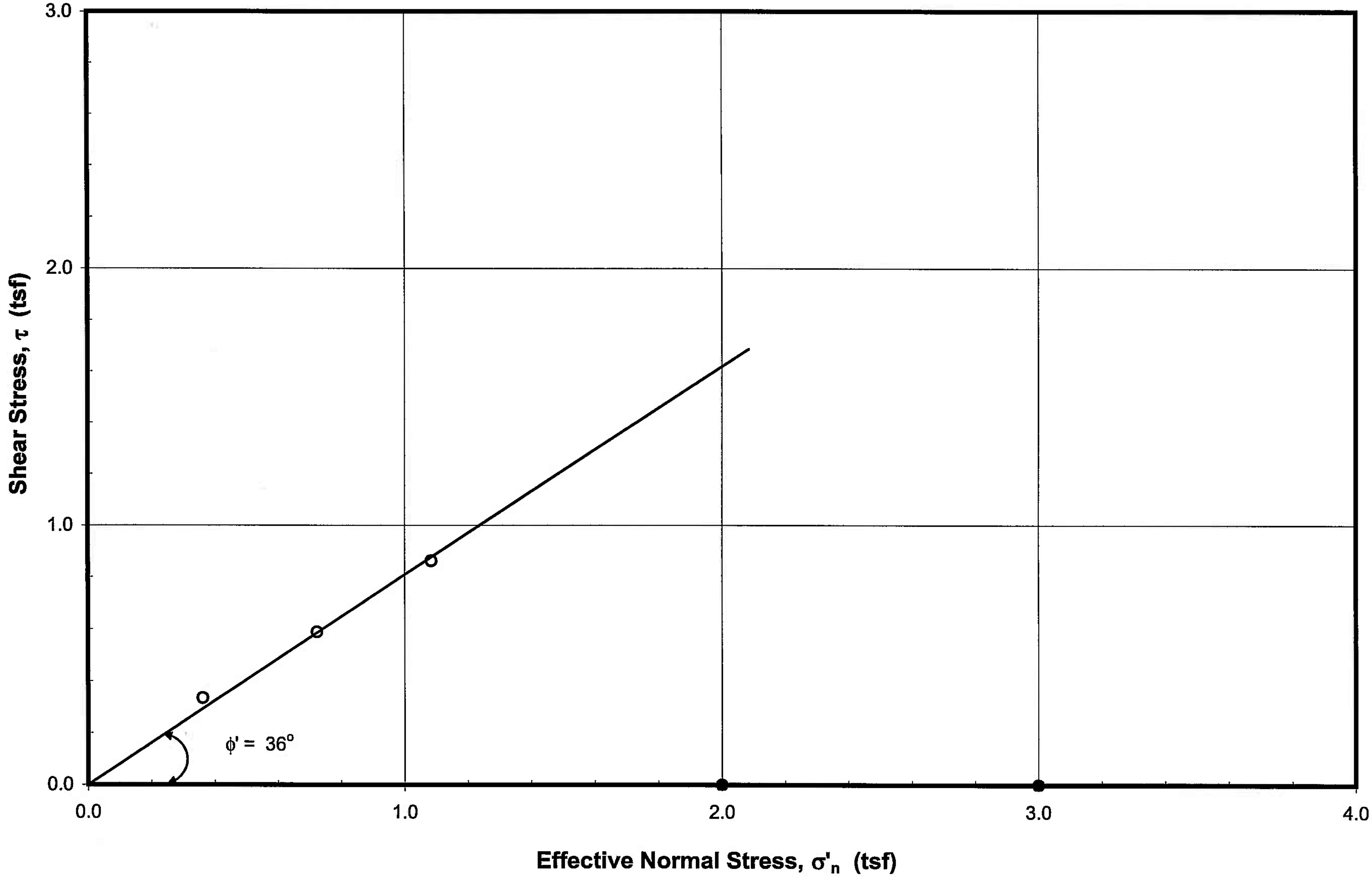
## DRAINED DIRECT SHEAR TEST

ASTM D 3080

Boring: Composite B-1 & 2 (From auger cuttings 0-20 ft)

GEOTECHNOLOGY INC

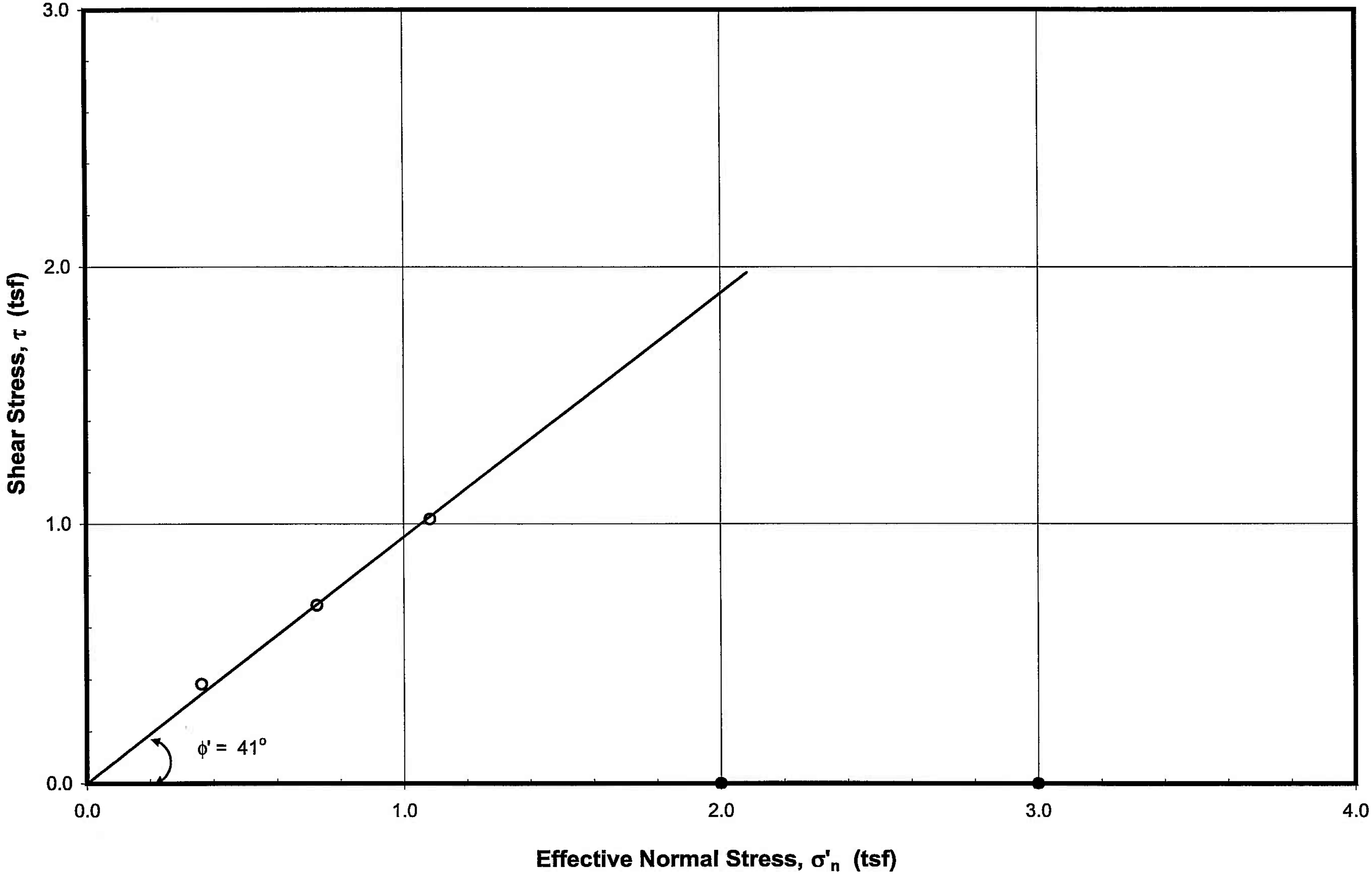
FROM THE GROUND UP



**DRAINED DIRECT SHEAR TEST**

ASTM D 3080

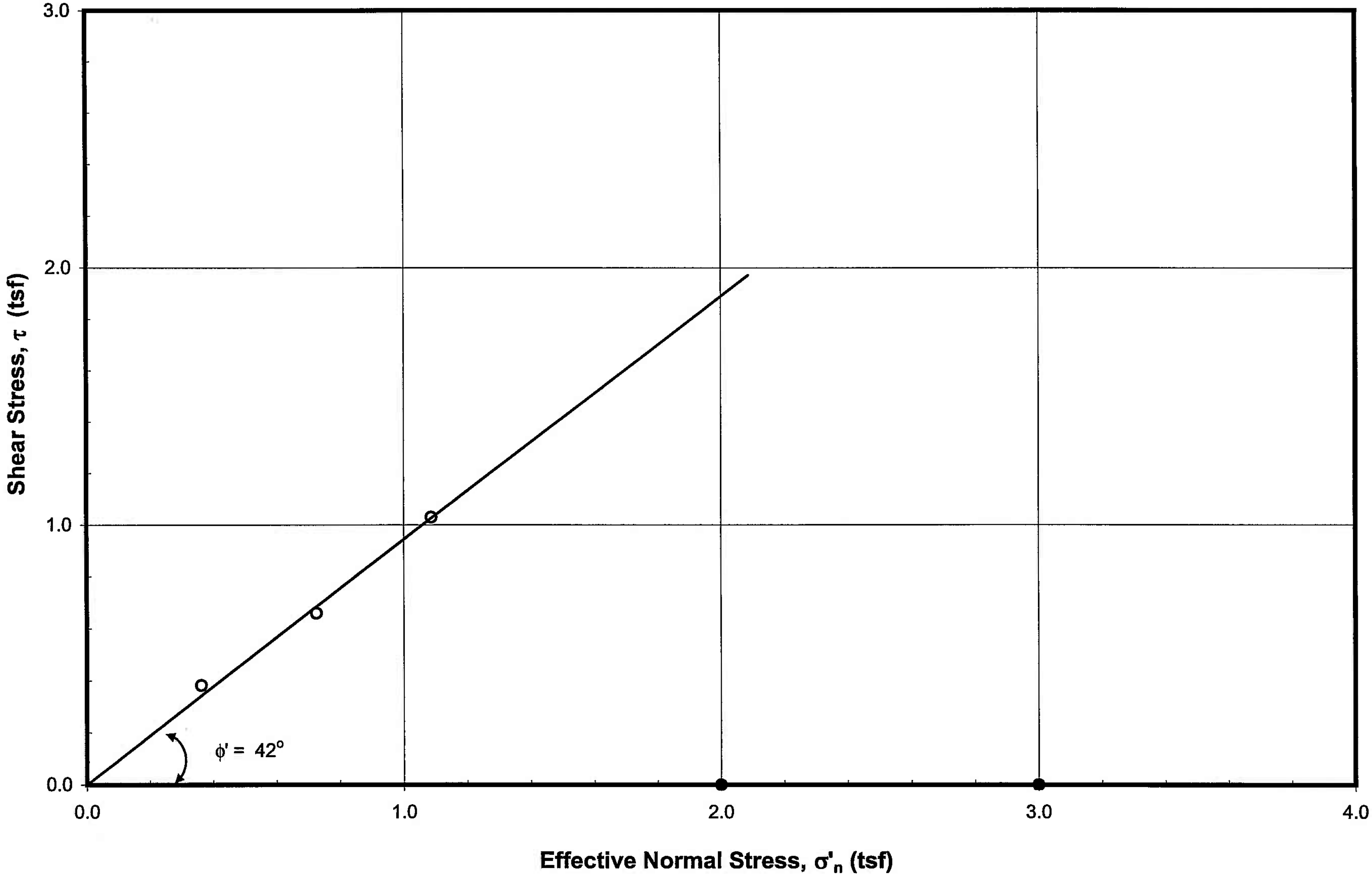
Boring: Composite B-6 & 7 (From auger cuttings 0-20 ft)



## DRAINED DIRECT SHEAR TEST

ASTM D 3080

Boring: Composite B-11 & 12 (From auger cuttings 0-15 ft)



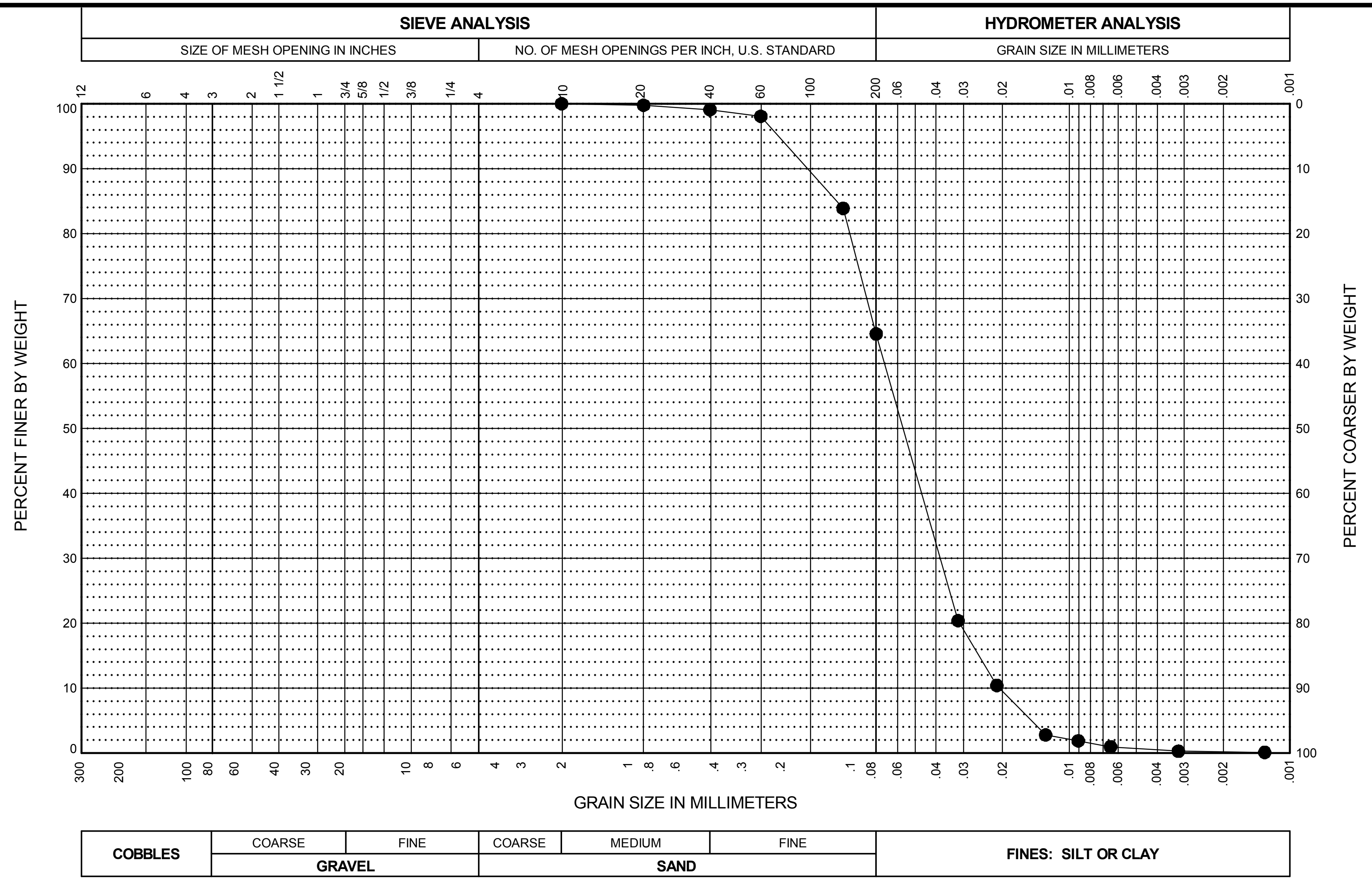
**DRAINED DIRECT SHEAR TEST**

ASTM D 3080

Boring: Composite B-13 & 14 (From auger cuttings 0-15 ft)

# APPENDIX B

# Current Laboratory Test Results



| SAMPLE NO. | U.S.C.S. SYMBOL | SAMPLE DESCRIPTION | FINES % | NAT. W.C. % | LL % | PL % | PI % |
|---|---|---|---|---|---|---|---|
| ● Bulk P-1 | ML | Light tan, Sandy Silt. | 64.6 | 34.4 | | | |

Sikeston Project
Sikeston, Missouri

# GRAIN SIZE DISTRIBUTION

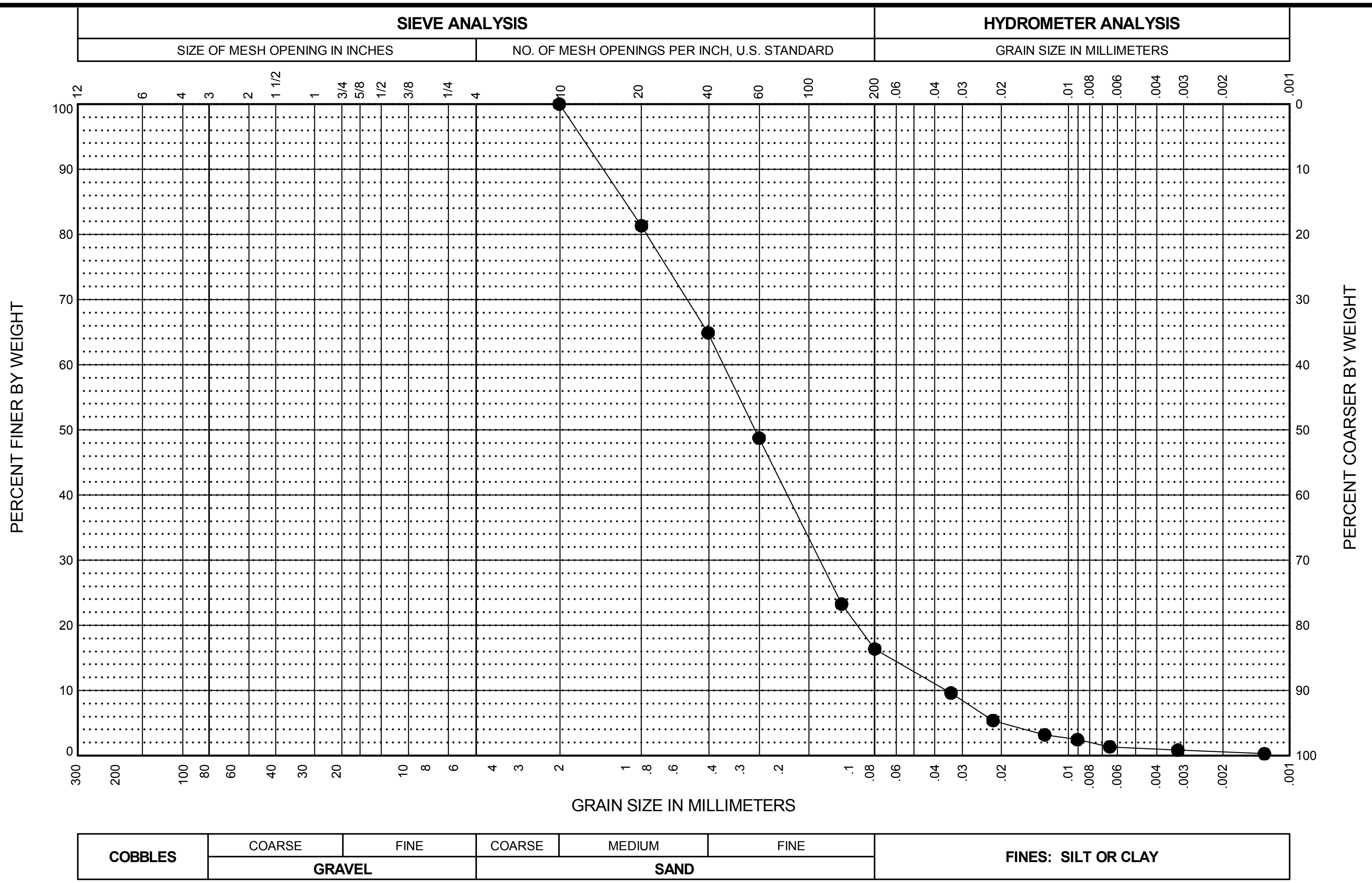
41-1-37431-005

**SHANNON & WILSON, INC.**
Geotechnical and Environmental Consultants

FIG.

FIG.

HAL 41-1-37431-005 LAB DATA.GPJ SHAN_WIL.GDT 8/5/16



| SAMPLE NO. | U.S.C.S. SYMBOL | SAMPLE DESCRIPTION | FINES % | NAT. W.C. % | LL % | PL % | PI % |
|---|---|---|---|---|---|---|---|
| ● Bulk P-2 | SM | Light tan, Silty Sand. | 16.4 | 22.1 | | | |

Sikeston Project
Sikeston, Missouri

## GRAIN SIZE DISTRIBUTION

41-1-37431-005

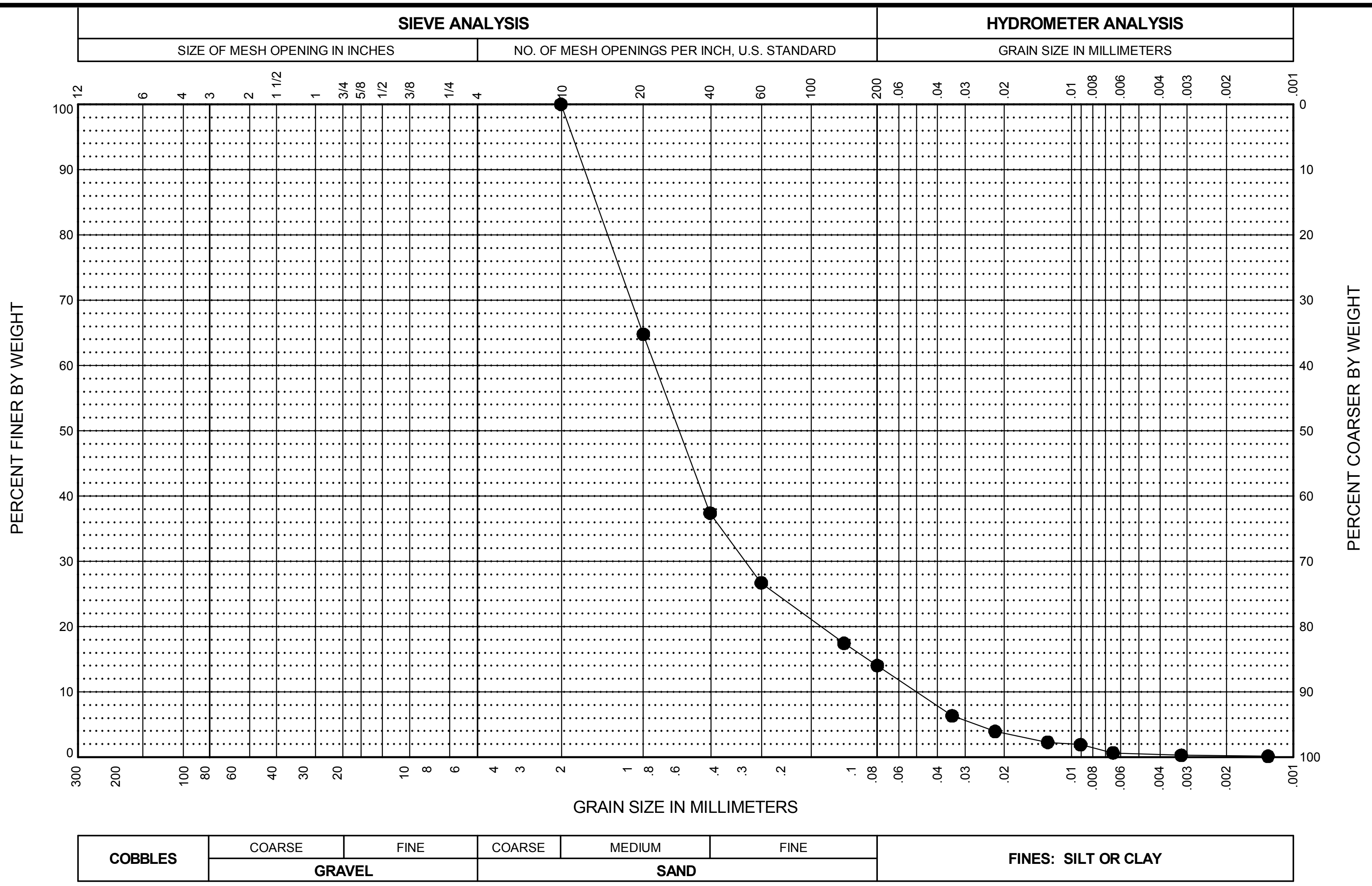
**SHANNON & WILSON, INC.**
**Geotechnical and Environmental Consultants**

**FIG.**

**FIG.**

HAL 41-1-37431-005 LAB DATA.GPJ SHAN_WIL.GDT 8/5/16

FIG.



| SAMPLE NO. | U.S.C.S. SYMBOL | SAMPLE DESCRIPTION | FINES % | NAT. W.C. % | LL % | PL % | PI % |
|---|---|---|---|---|---|---|---|
| ● Bulk P-3 | SM | Light tan, Silty Sand. | 14.0 | 27.5 | | | |

Sikeston Project
Sikeston, Missouri

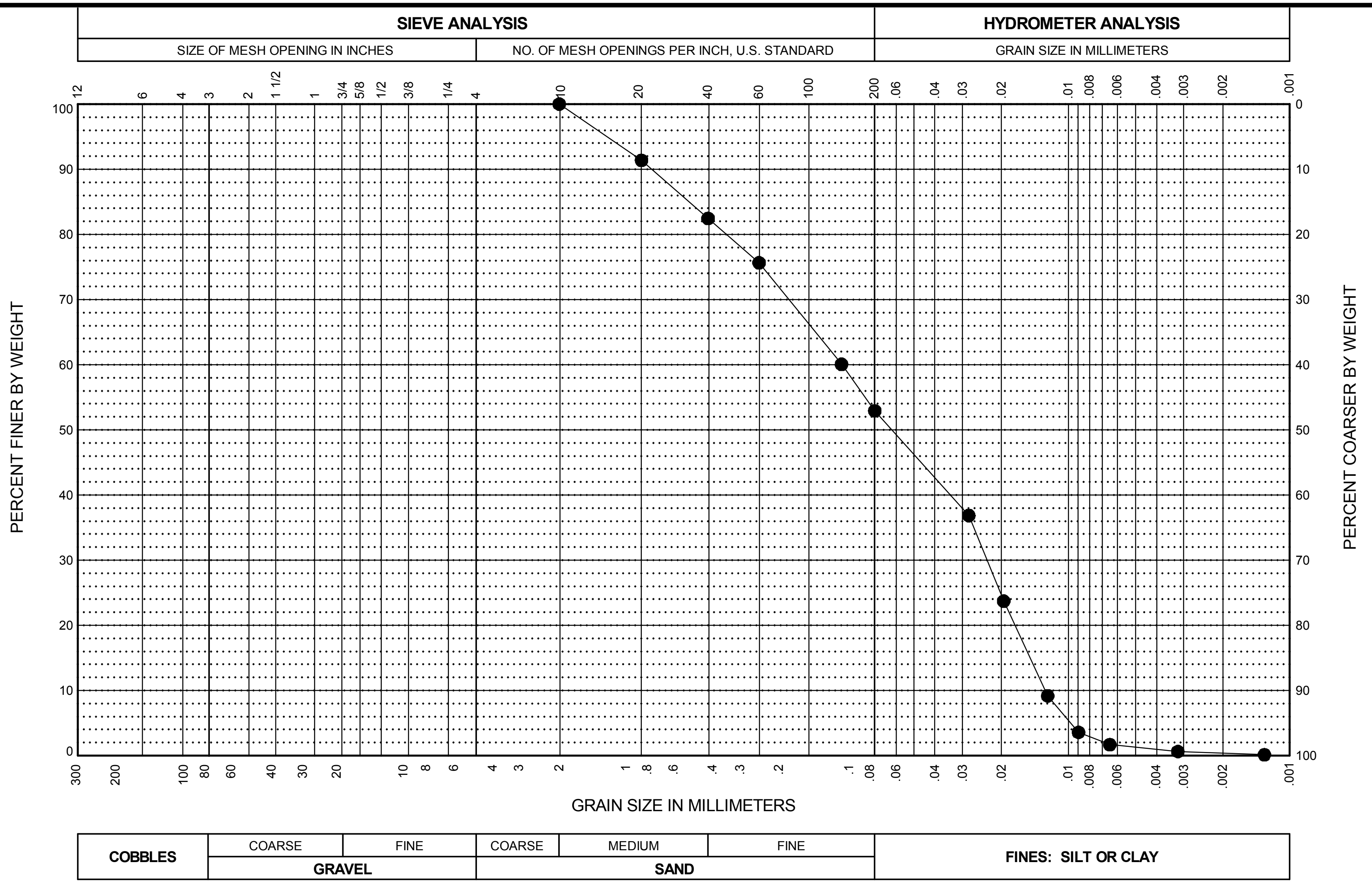
## GRAIN SIZE DISTRIBUTION

41-1-37431-005

**SHANNON & WILSON, INC.**
**Geotechnical and Environmental Consultants**

**FIG.**

HAL 41-1-37431-005 LAB DATA.GPJ SHAN_WIL.GDT 8/5/16



| SAMPLE NO. | U.S.C.S. SYMBOL | SAMPLE DESCRIPTION | FINES % | NAT. W.C. % | LL % | PL % | PI % |
|---|---|---|---|---|---|---|---|
| ● Bulk P-4 | ML | Light tan and gray, Sandy Silt. | 52.9 | 54.1 | | | |

Sikeston Project
Sikeston, Missouri

## GRAIN SIZE DISTRIBUTION

41-1-37431-005

**SHANNON & WILSON, INC.**
Geotechnical and Environmental Consultants

**FIG.**

**FIG.**

# APPENDIX C

# Seismic Survey

# Shear-Wave Velocity Profile Results for Sikeston Power Plant, Missouri

By

Chris Cramer, Ph.D. (ccramer@memphis.edu),
Shahram Pezeshk, Ph.D., P.E. (spezeshk@memphis.edu),
Alireza Soltani,
and
Oluwaseyi Bolarinwa

August 15, 2016

# TABLE OF CONTENTS

# Shear-Wave Velocity Profile Results for Sikeston Power Plant, Missouri

## EXECUTIVE SUMMARY

We conducted a seismic survey near the Sikeston Power Plant at Sikeston, MO on July 21, 2016 in order to better characterize the soil profile beneath the plant. We used multi-channel analysis of surface waves (MASW), Refraction Microtremor (ReMi), and refraction/reflection techniques to characterize the shear-wave ($V_S$) profile to bedrock (Paleozoic Limestones). The surface-wave techniques successfully characterized the soil profile and the refraction/reflection techniques provided constraints on the depth to the top of the Cretaceous sediments (95±10 m) and the Paleozoic bedrock (235±20 m). The $V_s$ profile is summarized in the results section below.

## INTRODUCTION

A seismic field survey was conducted near the Sikeston Power Plant on July 21, 2016. Figure 1 shows the location of the survey line along a road SW of the plant. We conducted shallow MASW and ReMi and deep refraction/reflection and ReMi surveys. Figure 2 shows us conducting the seismic surveys near the power plant. Figure 3 shows the 40 kg Propelled Energy Generator (PEG) source used in the shallow MASW survey. We also used a 450 lb weight drop source for the deeper refraction/reflection survey. The MASW survey also provided refraction/reflection information at 19 shot points along that survey.

## METHODS

The seismic survey techniques employed at the Sikeston Power Plant used both active and passive source surface-wave methods and active source refraction/reflection methods. Both shallow and deep passive (ambient noise) Refraction Microtremor (ReMi) surveys (Louie, 2001; Stephenson et al., 2005; Donghong et al., 2008) were conducted using 180 m (7.5 m geophone spacing) and 400 m (20 m spacing) long survey lines. An active source Multichannel Analysis of Surface Waves (MASW) survey (Park et al., 1999) was conducted using a 144 m (2 m spacing) line and the PEG source. A deeper refraction line (415 m with variable geophone spacing) was conducted using the 450 lb. weight-drop source (Dobrin, 1960; Telford et al., 1976). Reflections were observed on both the MASW and the refraction surveys, and analyzed for depth of the reflectors (Dobrin, 1960; Telford et al., 1976).

*Figure 1: Location of University of Memphis seismic survey near the Sikeston MO power plant (red line SW of plant).*

*Figure 2: Picture of the MASW survey being conducted next to the road with the power plant in the background.*

*Figure 3: Picture of the PEG source used in the MASW survey.*

## RESULTS

The shallow profiling and reflection results provide the best information about the $V_S$ profile near the power plant. Surface-waves in the form of Rayleigh Waves were very efficiently generated by the PEG and weight-drop systems. Also the ambient noise consisted of Rayleigh Waves travelling along the line of geophones. The shallow MASW and ReMi results provided $V_S$ estimates down to 125 m because of the efficient generation of surface waves, which is much deeper than the usual 30 to 60 m with these geophone spreads (lines). The results from the deep ReMi survey, although seemingly providing $V_S$ information down to 175 m, were judged to not be reliable enough to be used. Because most of the shot energy went into surface-waves, refracted phases were weak. However, two strong reflections were noted on the deep refraction profile on the record closest to the shot and the first (shallowest) reflection also appeared on the MASW shot records.

The shallow MASW and ReMi combined results are in Table 1 and Figure 4. The strong $V_S$ increase from 636 m/s to 1284 m/s at 100 m depth is interpreted as the top of the Cretaceous sediments based on deep borehole logs in the Mississippi embayment (see discussion below).

The uncertainty in these estimates, both in depth and velocity, is probably on the order of 10 – 20%.

Table 1: Table of $V_s$ results from shallow MASW and ReMi.

| Depth(m) | Vs(m/s) | Depth(ft) | Vs(ft/s) |
|---|---|---|---|
| -3.9 | 160 | -12.7 | 526 |
| -3.9 | 252 | -12.7 | 826 |
| -8.7 | 252 | -28.5 | 826 |
| -8.7 | 180 | -28.5 | 591 |
| -14.7 | 180 | -48.3 | 591 |
| -14.7 | 350 | -48.3 | 1148 |
| -22.3 | 350 | -73.1 | 1148 |
| -22.3 | 300 | -73.1 | 983 |
| -31.7 | 300 | -104.0 | 983 |
| -31.7 | 488 | -104.0 | 1600 |
| -43.5 | 488 | -142.7 | 1600 |
| -43.5 | 473 | -142.7 | 1553 |
| -58.2 | 473 | -191.0 | 1553 |
| -58.2 | 423 | -191.0 | 1386 |
| -76.7 | 423 | -251.5 | 1386 |
| -76.7 | 636 | -251.5 | 2086 |
| -99.7 | 636 | -327.0 | 2086 |
| -99.7 | 1284 | -327.0 | 4211 |
| -124.6 | 1284 | -408.7 | 4211 |

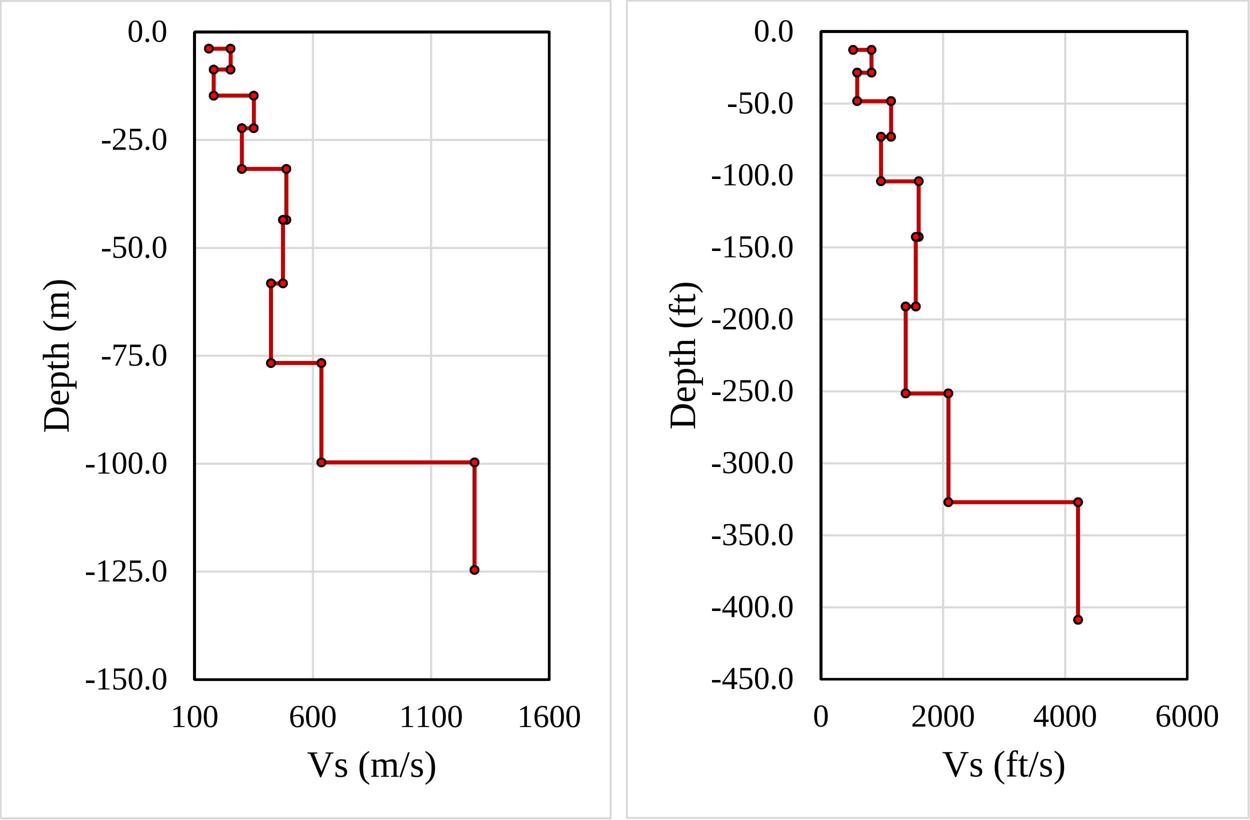


*Figure 4: Graph of shallow $V_s$ profile in meters (left) and feet (right).*

The refraction results are limited because most of the shot energy went into surface (Rayleigh) waves. Above the shallow water table, the average $V_p$ = 600 ± 100 m/s. The thickness of this shallow $V_p$ layer is 6 ± 1 m. Below the water table, likely to the Cretaceous sediments, the average $V_p$ = 1700 ± 100 m/s, which is near the $V_p$ through saturated sediments.

Reflectors were noted on the near shot geophone records for both the shallow and deep surveys (Figures 5 and 6). The first reflection was clearly visible on both the shallow and deep shot records. The second reflection was only visible on the deep (450 lb weight-drop) shot record. The two-way travel time to these two reflections are 0.124 s and 0.265 s. The first reflecting layer appears to be flat laying in Figure 6.

Given the refraction $V_p$ information above, the first reflector has an estimated depth of 95 ± 10 m. This corresponds to the top of the $V_s$ = 1284 m/s layer at 100 m from the shallow MASW and ReMi profile. We believe this reflection is from the top of the Cretaceous sediments as it is the first strong velocity contrast in the soil profile. Assuming the Cretaceous sediments have a uniform $V_p$ of 2,000 to 2,200 m/s based on deep boring loggings in the Mississippi embayment (Figures 7 and 8), the second reflector has an estimated depth of 235 ± 20 m. Projecting the change in $V_p$ with depth trend for the deeper lying Cretaceous sediments to a 200 m depth in Figure 7 and using the $V_p$ range for the Memphis Sand at 200-300 m depth in Figures 7 and 8, we arrived at the 2,000 to 2,200 m/s $V_p$ range for the Cretaceous sediments beneath the Sikeston

Power Plant. We believe the second reflection is from the top of the Paleozoic Limestone, which from deep boring logs elsewhere has a $V_p$ = 5,500 ± 500 m/s (Figure 7) and a $V_s$ of 3,300 ± 200 m/s (Cramer et al., 2004).

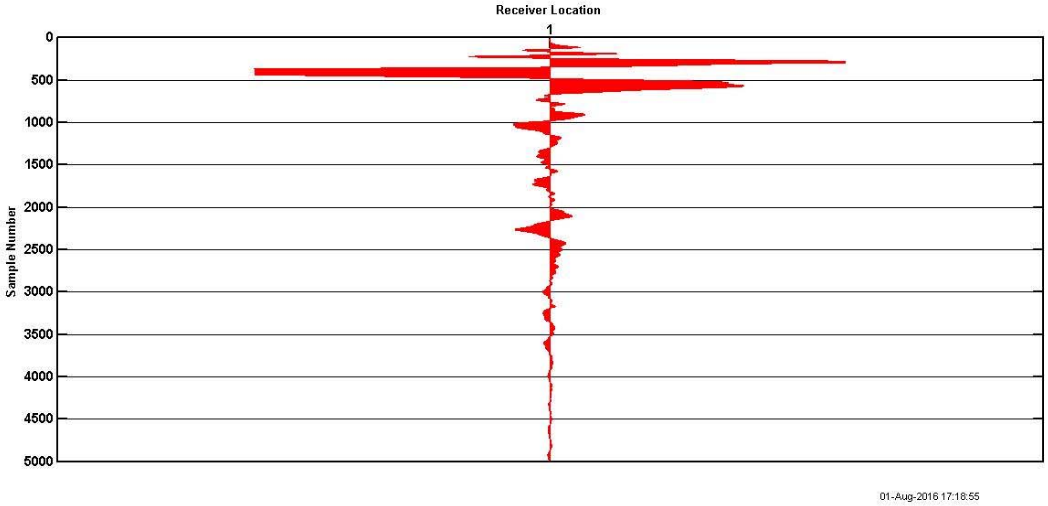


*Figure 5: Single 450 lb. weight-drop shot record from the geophone nearest the shot. Two reflections are located near sample 1000 and 2200 (breaking to the left). The reflection amplitudes are greater than the shot noise on either side of them. Adjacent geophone records suggest that these reflections have normal moveout (confirming them as reflections).*

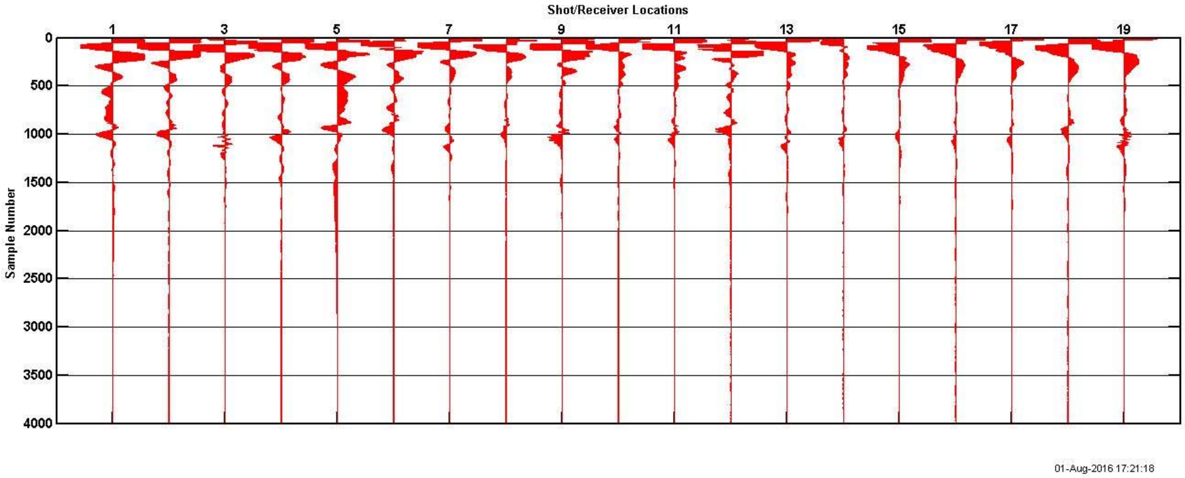


*Figure 6: 19 at shot point geophone records (3 stacked records per shot point) from the MASW survey. The shot points are spaced 4 m apart along the spread. The shallow reflector in Figure 5 also appears on these records near sample 1000. There is variation in the arrival time along this profile likely from variations in the first layer (above water table) thickness and shear-wave velocity.*

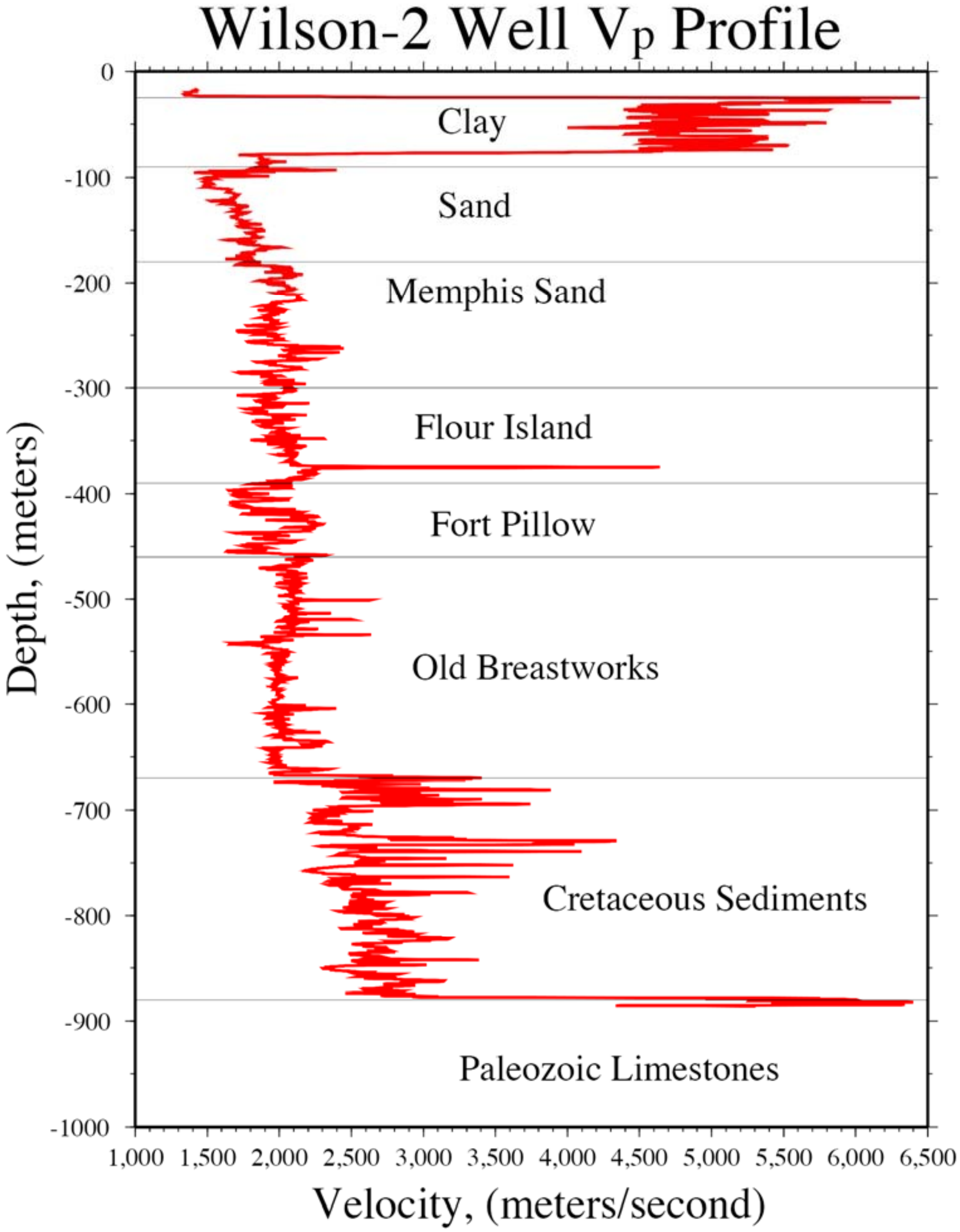


*Figure 7: Wilson-2 $V_p$ log with geology (Cramer et al., 2004, Figure 6).*

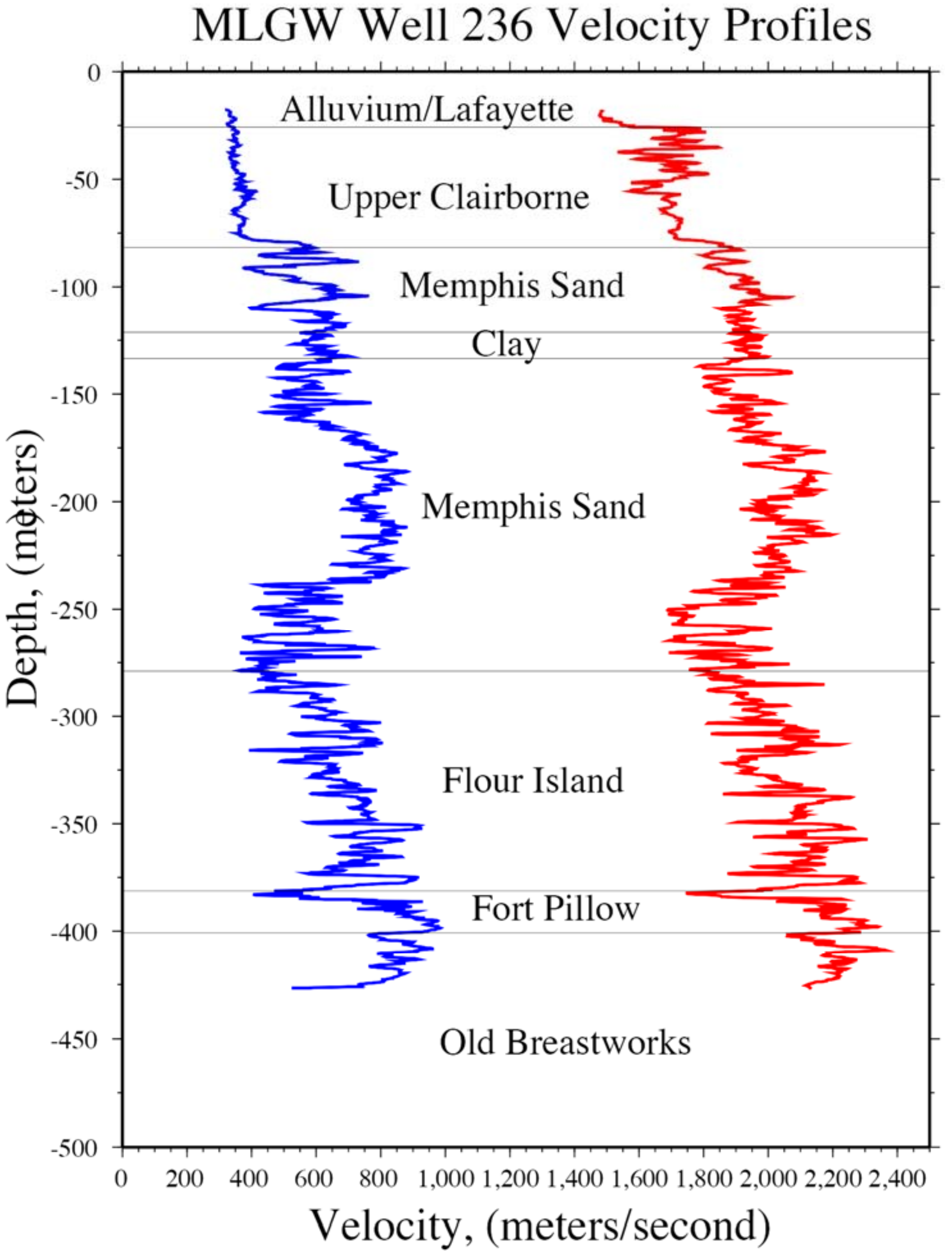


*Figure 8: MLGW well 236 $V_P$ and $V_s$ logs with geology (Cramer et al., 2004, Figure 5).*

## GEOLOGY CORRELATIONS

There is borehole information about the geology in the Sikeston area. The nearest distance to boreholes providing geologic layer information vary from 1.2 to 7.4 km from the power plant. For the shallow layers (silt/clay, sand, gravel, Eocene) the nearest borehole (index SC-67) is 1.2 NE at 36.888681°N, 89.612902°W. In this borehole the Holocene silt/clay is at the surface, the top of the Quaternary sand is at 4 m, the top of the Quaternary gravel is at 19 m, and the top of the Eocene is at 60 m. These depths correlate fairly well with the $V_S$ profile in Table 1, suggesting that at the power plant site Holocene silt/clay is at the surface, the top of the Quaternary sand is at 3.9 m, the top of the Quaternary gravel is at 22.3 m, and the top of the Eocene is at 58.2 m.

Boreholes with deeper geology are farther away from the plant and do not correlate as well in their depths-to-top with the $V_S$ values in Table 1. The top of the Paleocene Midway Group is at 123 m depth in a borehole 3 km to the NE at 36.89N, 89.59W and the top of the Cretaceous and Paleozoic are at 135 m and 209 m in a borehole 7.4 km away to the SW at 36.8454N, 89.6925W. From Figures 7 and 8 and Cramer et al. (2004), we see that the Cretaceous layer is the first geological layer that exceeds a $V_S$ of 1000 m/s, and the 1284 m/s at 100 m in Table 1 is similar to the mean $V_S$ estimate of 1175 m/s for the Cretaceous in Cramer et al. (2004). Thus we judge that the top of the Cretaceous is at 100 m beneath the plant from the $V_S$ profile in Table 1, which is much shallower than observed in the borehole 7.4 km away. This also correlates well with the first reflector seen in our seismic survey (95 ± 10 m). From this we estimate that the top of the Midway Group is at 76.7 m beneath the power plant, which is much shallower than in the borehole 3 km away. The second reflector being from the top of the Paleozoic at 235 ± 20 m corresponds fairly well with the 209m depth observed in the borehole 7.4 km away from the site.

## REFERENCES

Cramer, C.H., J.S. Gomberg, E.S. Schweig, B. A. Waldron, and K. Tucker, 2004, *Memphis, Shelby County, Tennessee, seismic hazard maps*, U.S. Geological Survey, Open-File Report 04-1294, 41pp.

Dobrin, M.B. (1960), *Introduction to Geophysical Prospecting* (second edition), McGraw-Hill, New York.

Donghong, P., J. N. Louie, and S. K. Pullammanappallil (2008), Improvements on computation of phase velocities of Rayleigh waves based on generalized R/T coefficient method, *Bull. Seismol. Soc. Amer.*, Vol. 98, 280-287.

Louie, J. (2001), Faster, better: shear-wave velocity to 100 meters depth from refraction microtremor arrays, *Bull. Seismol. Soc. Amer.* **91**, 347-364.

Park C.B, R.D. Miller, and J. Xia (1999), Multi-channel analysis of surface waves, *Geophysics* **64**, 800-808.

Stephenson, W. J., J. N. Louie, S. Pullammanappallil, R. A. Williams, and J. K. Odum (2005). Blind shear-wave velocity comparison of ReMi and MASW results with boreholes to 200 m in Santa Clara Valley: Implications for earthquake ground motion assessment: *Bull. Seismol. Soc. Amer.*, **95**, 2506-2516, doi: 10.1785/0120040240.

Telford,W.M., L.P. Geldart, R.E. Sheriff, and D.A. Keys (1976), *Applied Geophysics*, Cambridge University Press, Cambridge.

# APPENDIX D

# Analyses

# Design Soil Properties

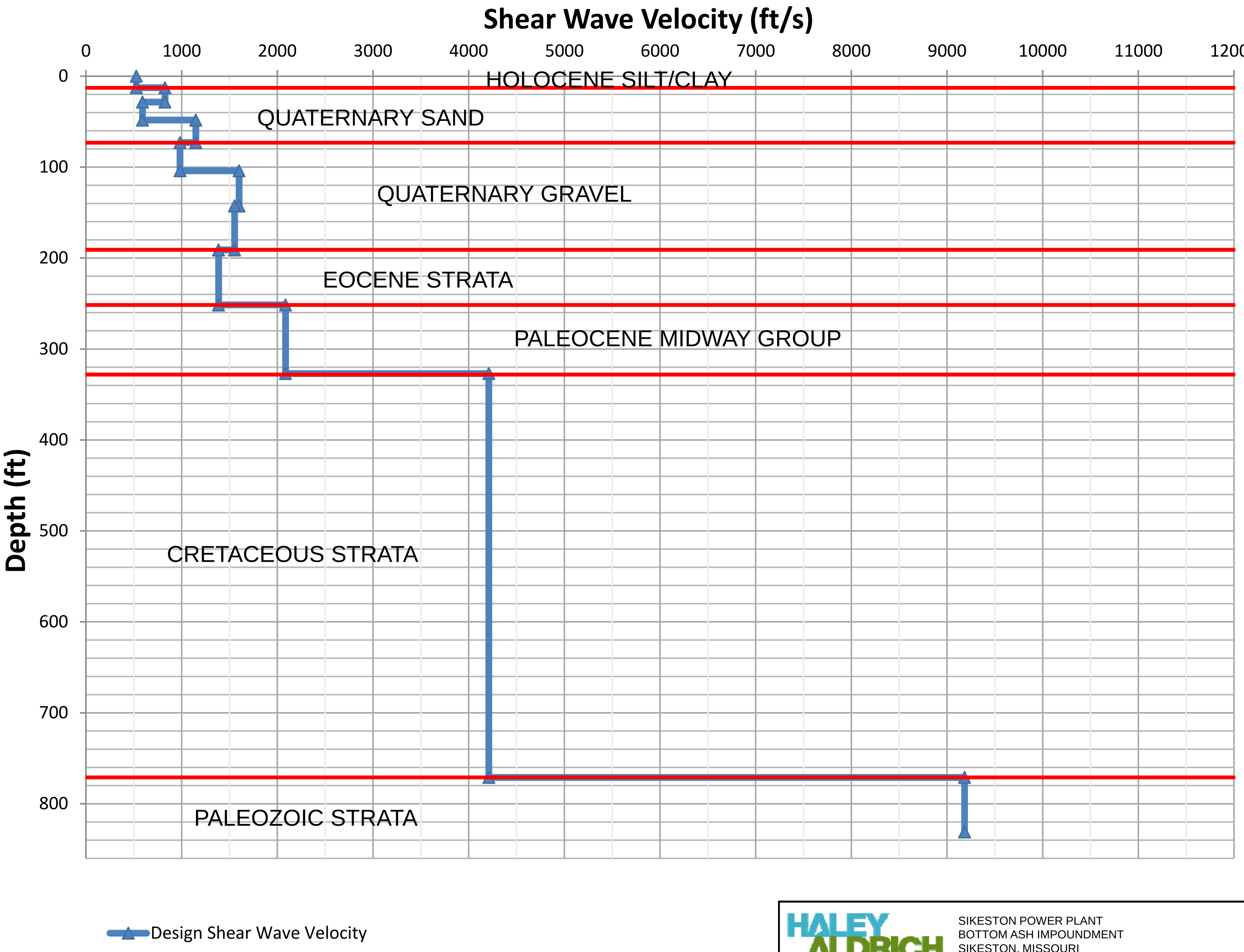
## SOIL PROPERTY CHARACTERIZATION - SIKESTON BOTTOM ASH POND

| Material | Total Unit Weight, $\gamma_T$ | | | | | Undrained Shear Strength, $S_u$ | | | | | | | | | Drained Shear Strength | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CPT | Laboratory | | Historic Design[1] | Current Design | SPT | | CPT | | UU and CIU Trx | Historic Design[1] | Current Design | | | SPT | | CPT | | Laboratory CIU Trx | | | | | | Historic Design[1] | | Current Design | |
| | avg | Test Avg. | Tube Avg. | | | avg | avg - 1σ | avg | avg - 1σ | avg | | | | | avg | avg - 1σ | avg | avg - 1σ | avg | | min. | | max. | | | | | |
| | $\gamma_T$ | $\gamma_T$ | $\gamma_T$ | | $\gamma_T$ | $S_u$ | $S_u$ | $S_u$ | $S_u$ | $S_u$ | | c' | φ' | $S_u$ | φ' | | φ' | φ' | c' | φ' | c' | φ' | c' | φ' | c' | φ' | c' | φ' |
| Clay Liner[2] | -- | -- | -- | -- | **125 pcf** | -- | -- | -- | -- | -- | -- | **--** | **--** | **1,000 psf** | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | **0 psf** | **28°** |
| Sluiced Bottom Ash/FGD[2] | -- | -- | -- | -- | **90 pcf** | -- | -- | -- | -- | -- | -- | **--** | **--** | **750 psf** | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | **0 psf** | **30°** |
| Embankment Fill | -- | -- | -- | 120 pcf | **120 pcf** | -- | -- | -- | -- | -- | -- | **100 psf** | **35°** | **--** | 38° | 36° | -- | -- | -- | -- | -- | -- | -- | -- | 0 psf | 35° | **50 psf** | **35°** |
| Foundation Sand | -- | -- | -- | 120 pcf | **120 pcf** | -- | -- | -- | -- | -- | -- | **0 psf** | **35°** | **--** | 42° | 41° | -- | -- | -- | -- | -- | -- | -- | -- | 0 psf | 35° | **0 psf** | **35°** |

Notes:

1. Based on historic analyses performed by Geotechnology Associates.
2. Current design properties for these materials are conservatively estimated using typical published values and Haley & Aldrich's experience with similar materials.

D



HALEY ALDRICH

SIKESTON POWER PLANT
BOTTOM ASH IMPOUNDMENT
SIKESTON, MISSOURI

DESIGN SHEAR WAVE VELOCITY PROFILE

SCALE : AS SHOWN
SEPTEMBER 2016

FIGURE D1

128065-001_FIG D1.PPT

# Seismic Response Analysis

## SITE SPECIFIC SEISMIC RESPONSE ANALYSIS

### Introduction

The Sikeston Power Plant is located within the New Madrid Seismic Zone (NMSZ) and the Mississippi embayment. The NMSZ is associated with strong ground motions and the Mississippi embayment is associated with thick soil. The natural embayment soils underlying the impoundments are estimated to be 770-ft thick. It has been demonstrated that the strong ground motions migrating up through the thick soil alter the spectral response at the ground surface so that it is much different than the response in the bedrock below the site. At short periods increasing soil thickness correlates with a decreasing hazard due to the nonlinear soil behavior. Similarly, at long periods, increasing soil thickness correlates with increasing hazard due to soil resonance (Cramer, 2015).

### Overview of Site-Specific Seismic Analysis

A one-dimensional ground response analysis was performed to estimate the subsurface response to an earthquake event at Sikeston. Due to the complex nature of the analyses required, Dr. Professor Edward Kavazanjian, Jr. at Arizona State University and Dr. Professor Chris Cramer at the University of Memphis were retained as part of our team to assist with the site-specific seismic analyses.

It is important that the rock and soil characteristics used to develop the ground response model match the engineering and seismic characteristics of the soil and rock at the Sikeston Power Plant. Properly conditioned bedrock strong ground motions (acceleration time histories) are required to perform a site-specific seismic analysis. These rock motions should match the spectral response of characteristic ground motions with respect to the dominant seismic sources affecting Sikeston. Unfortunately, strong motion records from large magnitude events are not available for Central U.S. (Romero and Rix, 2001). Therefore, records were obtained from other sources that approximate the spectral response characteristics at the site.

A site-specific target response spectrum was created for the site to be used as a guide in selecting the proper ground motions for the study. This target spectrum was developed following well established criteria developed for building and infrastructure standards. The common design is based on the maximum critical risk-targeted ($MCE_R$) spectral response acceleration. Two different design methods (probabilistic and deterministic) are used to approximate the $MCE_R$ spectrum and the lesser of the spectral response accelerations from each method at each period is used to create the site-specific target spectrum. The probabilistic target spectrum is created from the uniform hazard spectrum (UHS) by performing a probabilistic seismic hazard analysis (PSHA). [1] It is then adjusted for maximum ground motion and targeted risk. The deterministic target spectrum is calculated from 84th-percentile ground motions representing a characteristic earthquake on a known or perceived active fault within the region.

---

[1] The uniform hazard spectrum is calculated by research on potential sources of earthquakes (e.g., faults and locations of past earthquakes), the potential magnitudes of earthquakes from these sources and their frequencies of occurrence, and the potential ground motions generated by these earthquakes. Uncertainty and randomness in each of these components is accounted for in the computation.

The bedrock at the site is classified as NEHRP Site Class A, hard rock. The 2008 UHS, provided by USGS, for a hypothetical Site Class A rock, based on the 2,500 –year return period ground motions, was used to identify the Probabilistic Target Spectrum used for the site-specific evaluation. Ground motions scaled to this spectrum were input in Shake at the base of the soil column as outcrop motions. Shake performs the necessary deconvolution techniques on the motions to adjust to within motions used for the one dimensional analysis.

## USGS Deaggregation and Deterministic Target Spectrum

Unlike the west coast, central and eastern U.S. does not have a well-defined fault system and associated seismic sources needed to properly develop a Deterministic spectral response. Therefore, it is common practice to use pseudo fault locations to develop the deterministic target. Deaggregation data obtained from a probabilistic seismic hazard analysis (PSHA) is used to provide the relevant information needed to develop the deterministic target. The NSHMP PSHA interactive deaggregation web site was used to obtain the characteristics of the most significant earthquakes deemed to contribute the most to the seismic activity at the Sikeston power plant. It should be noted that USGS has not yet released the deaggregation data for the 2014 hazard maps, therefore the 2008 deaggregation data available on the USGS website were used to determine the most significant earthquakes that are considered for the seismic hazard for Sikeston. The deaggregation data suggests that the representative design earthquake for ground motions with a return period of 2,500 years should be between magnitude 7.5 and 8.0 at a distance of approximately 18 km from the site (Figure 1). The deterministic spectrum for scenario events (i.e. for events that conformed to the CMS to be discussed later) was based upon the information on the location and magnitude obtained from the PSHA.

The deterministic target spectrum is based on ground motion prediction equations (GMPEs) that use magnitude and distance to predict the spectral response of the ground motion. According to the USGS PSHA, the largest event predicted to affect Sikeston Power Plant is a magnitude 8 earthquake that is 17.7 km from the site. The computer software program Shake 2000, developed by GeoMotions, provided the central and eastern U.S. (CEUS) GMPEs and the CMS algorithms used to create the target spectrum. Site-specific spectral responses were generated from two appropriate CEUS attenuation relationships using Shake 2000 as shown on Figure 2. These attenuation relationships were based on a magnitude 8 earthquake as a distance of 17.7 km from the source. The GMPE representing the Campbell 2003 attenuation relationship was selected to produce the deterministic target spectrum for the site because it had the largest spectral response among all GMPEs tested.

A special type of target spectrum, called the conditional mean spectrum (CMS), was created for the study because it focuses the mean spectral response of all the ground motions to a particular period along the target spectrum (Baker, 2011). According to a joint venture between NIST and NEHRP (2011):[2]

> *"The Uniform Hazard Spectrum (UHS) is constructed by enveloping the spectral amplitudes at all periods that are exceeded with a given probability, computed using probabilistic seismic hazard analysis. However, those spectral values at each period are unlikely to all occur in a single ground motion. These conditional spectra instead condition the spectrum calculation on spectral acceleration at a single period, and then compute associated spectral acceleration*

---

[2] Selecting and Scaling Earthquake Ground Motions for Performing Response-History Analyses; joint venture NEHRP Consultants and NIST, NIST GCR 11-917-15, 2011

> *values at all other periods. This conditional calculation assures that ground motions selected to match that spectrum have appropriate properties for naturally occurring ground motions that would occur at the site of interest."*

The particular target period selected is related to fundamental period of the structure being analyzed. The fundamental period for the impoundment at Sikeston is related to the anticipated height of the sliding mass should failure occur and predicted to be around T* = 0.1s. However, it can be argued that at least until a slide is triggered the appropriate value to use is the resonant period of the soil layer itself as there is no impedance contrast to trigger the slide.[3] Therefore, CMS target spectrums were generated for both the short (T*=0.1s) period related to the sliding mass and long (T*=1.0 s) period related to the soil column. Separate sets of ground motions were scaled to each target spectrum and complete and separate analyses were performed. The CMS spectrum corresponding to the long period was shown to be the most conservative. The remaining portion of this report will focus on results obtained from using the long period CMS.

## Conditional Mean Spectrum Groundmotions Scaled to Target Period T=1.0 s

The CMS spectrum according to Baker, 2011 is to be constructed with the ground motion scaled so that its mean spectral response at the target period, T* matches the spectral response of the uniform hazard spectrum at the same period. The target period, T*= 1.0s is chosen to approximate the fundamental frequency of the soil column. The difference between the mean response of the ground motion at the target period and the mean value of the UHS at the same period is the standard deviation. The mean values of all points on the UHS are conditioned to the standard deviation of the ground motion at T*= 1.0 s.

Shake 2000 by Geomotion, Inc. was used to provide the CMS spectrum for Campbell 2003 CEUS GMPE using a target period T* = 1.0 s . The standard deviation between the Campell GMPE and UHS spectral response at T* was estimated to be 0.66. this value was used to adjust the Campbell GMPE to provide the CMS Target used for the Shake models. Figure 3 presents the CMS target spectrum that was used for the Sikeston Power Plant.

## Rock Motions for The CMS

Seven time-history records were selected to match the target response spectrum for the site. A primary focus was to match the ground motion spectra to the CMS target spectrum, as suggested by NEHRP (2011) when considering magnitude, distance, and focal mechanism. Rock motion records were selected from the Pacific Earthquake Engineering Research (PEER) Center's Strong Motion Database. The motions are summarized below in Table IV. As shown on Figure 4, the arithmetic mean spectrum of the generated records closely matches the CMS bedrock spectrum over the period range of significance.

---

[3] Conversation with Edward Kavazanjian

**TABLE IV**
EARTHQUAKE RECORDS (Long Period CMS)

| Event | Return Period | PEER File Name | Earthquake Record Used | | | |
|---|---|---|---|---|---|---|
| | | | Earthquake | M | Mechanism | Distance (km) |
| Conditional Mean Response | 2,500-year | RSN6_IMPVALL.I_I-ELC180.AT2 | "Imperial Valley-02" | 6.95 | strike slip | 6.09 |
| | | RSN15_KERN_TAF021.AT2 | "Kern County" | 7.36 | Reverse | 38.42 |
| | | RSN28_PARKF_C12050.AT2 | "Parkfield" | 6.19 | strike slip | 17.64 |
| | | RSN59_SFERN_CSM095.AT2 | "San Fernando" | 6.61 | Reverse | 89.37 |
| | | RSN122_FRIULI.A_A-COD000.AT2 | "Friuli_ Italy-01" | 6.5 | Reverse | 33.32 |
| | | RSN126_GAZLI_GAZ000.AT2 | "Gazli_ USSR" | 6.8 | Reverse | 3.92 |
| | | RSN143_TABAS_TAB-L1.AT2 | "Tabas_ Iran" | 7.35 | Reverse | 1.79 |

## One-Dimensional Ground Response Analysis

As mentioned previously, a one-dimensional ground response analysis was performed to estimate the surface ground motion at the site. The soil column used as input into the model was constructed from the shear wave velocity profile at the site (from in-situ testing provided by earthquake specialists at the University of Memphis) along with other characteristics such as layer thickness, soil density and the dynamic behavior. The dynamic geotechnical properties (damping, modulus-damping curves, density, etc.) used in the ground response analysis were obtained from EPRI (1993) and are based on extensive laboratory testing and literature review. The modulus reduction and damping curves were developed for various confining pressures corresponding to depths ranging from 0 to 305 meters. These curves are shown in Figure 5.

The computer software program Shake 2000 by Geomotion was used to numerically simulate the propagation of rock motions applied to the base of the soil column up through the soil layers to the top of the soil column. Shake2000 uses an equivalent linear numerical technique to model the non-linear dynamic soil behavior in the soil column. Figure 6 shows the results of the Shake ground response analysis for the seven representative rock motions. This figure compares the spectral response of the scaled bedrock motions to the surface ground response and shows the transformation in response caused by wave propagation through the 770-ft thick soil column. Table V summarizes the surface PGA estimates at the Sikeston Power Plant.

**TABLE V**
PREDICTED SURFACE PGA AND NEWMARK MAGNITUDE CORRECTION FACTOR

| Earthquake | Original Magnitude | CMS Scaled PGA[1] | Shake Surface PGA | Newmark Magnitude Correction Factor[2] |
|---|---|---|---|---|
| "Imperial Valley-02" | 6.95 | 0.36 g | 0.37 g | 1.34 |
| "Kern County" | 7.36 | 0.55 g | 0.49 g | 1.19 |
| "Parkfield" | 6.19 | 0.70 g | 0.50g | 1.65 |
| "San Fernando" | 6.61 | 0.45 g | 0.39 g | 1.47 |
| "Friuli_ Italy-01" | 6.5 | 0.30 g | 0.44 g | 1.52 |
| "Gazli_ USSR" | 6.8 | 0.58g | 0.43 g | 1.40 |
| "Tabas_ Iran" | 7.35 | 0.73g | 0.44 g | 1.20 |

[1] CMS scaled to period range of significance at T*=1.0s

[2] Determined using the method developed by Bray and Traversarou

## Newmark Displacement Analysis

The Newmark method predicts the amount of block displacement for a given value of yield acceleration. The Newmark displacement analysis is based on the shear stress time history acting along the failure plane within the slope. The yield acceleration is the minimum amount of ground acceleration necessary to initiate motion along the failure surface and is used to determine the appropriate pseudo-static coefficient for seismic stability analyses.

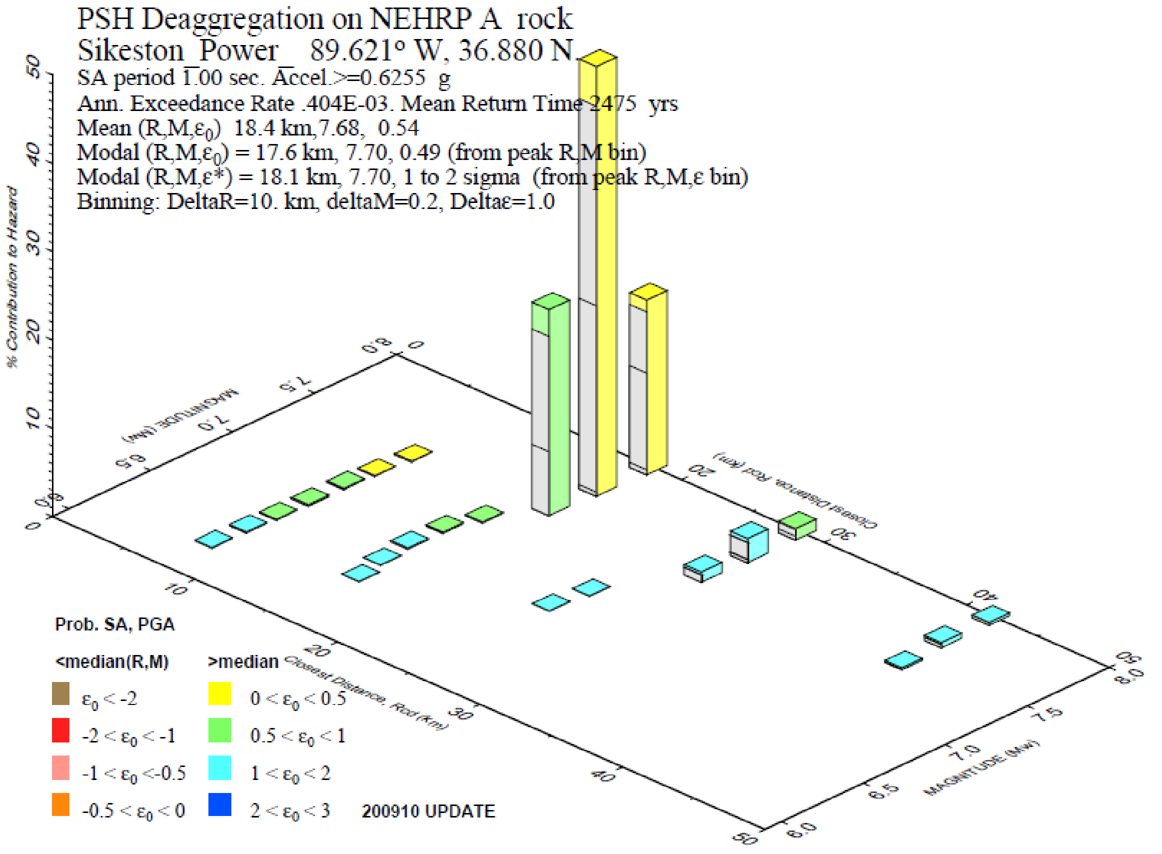
Shake 2000 was used to perform the Newmark displacement analysis by incorporating the results of the one-dimensional ground response analysis to estimate slope displacement. Shake 2000 incorporates several different variants of the Newmark block displacement method and the numerical approach known as YSLIP developed by Kavazanjian and Matasovic (1996) was chosen for our analysis. All seven site-specific bedrock motions were used to evaluate relationships between the Newmark permanent displacements and the associated yield acceleration. Several impoundment cross-sections were evaluated and the most conservative location of the failure plane was determined to be 10 to 12 ft below the top of slope.

After performing the Newmark displacement analysis, it was necessary to adjust the displacement predictions to correspond to the difference between the magnitudes of the ground motions used in the analysis and the magnitude of the representative earthquake event established for the New Madrid Power Plant. Correction factors were applied to scale the displacements to the target magnitude 8 event (Figure 7). The correction factors were determined using the approach developed by Bray and Travasarou (2007), which relates permanent displacement from a Newmark analysis with the magnitude of the earthquake event (Bray, 2007). Figure 8 presents the magnitude scaled permanent displacement versus yield acceleration. When seven or more ground motions are used in the analysis, it is common practice to use the average of the scaled relationships.[4]

---

[4] ASCE/SEI 7-10; “Minimum Design Loads for Buildings and Other Structures”

# FIGURES



GMT 2016 May 3 18:42:13 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on rock with average vs=2000. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

*Figure 1: Deaggregation Plot for Sikeston at T = 1.0 s*

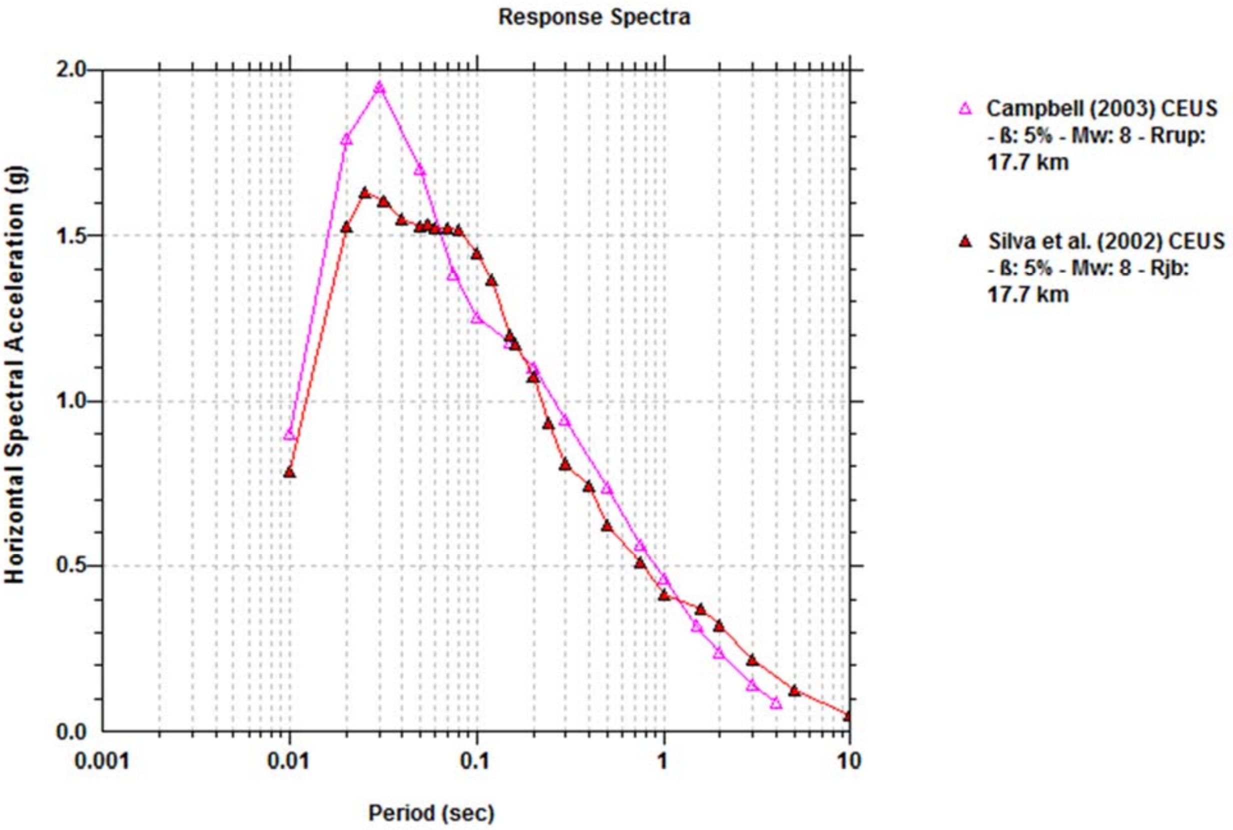


*Figure 2: GMPE's -Attenuation models for Sikeston*

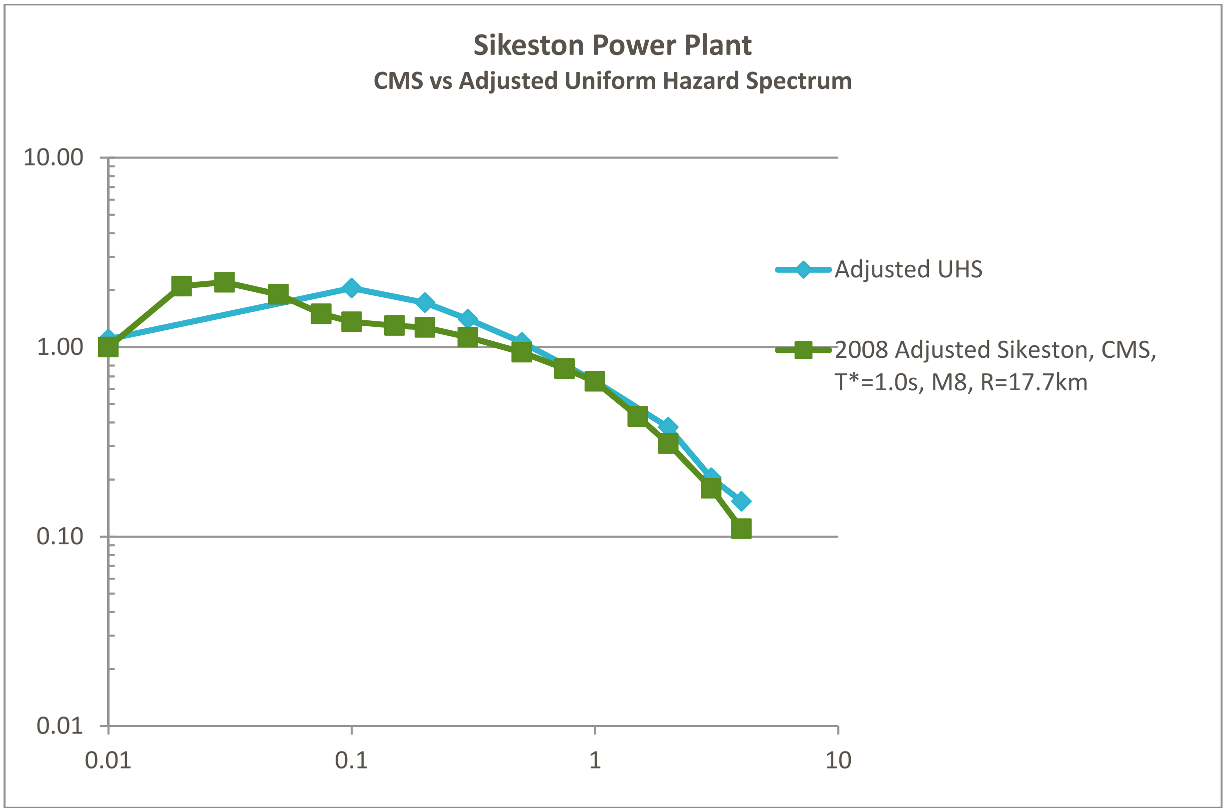


*Figure 3: 2008 Uniform Hazard Spectrum and Conditional Mean Spectrum for Sikeston Power Plant*

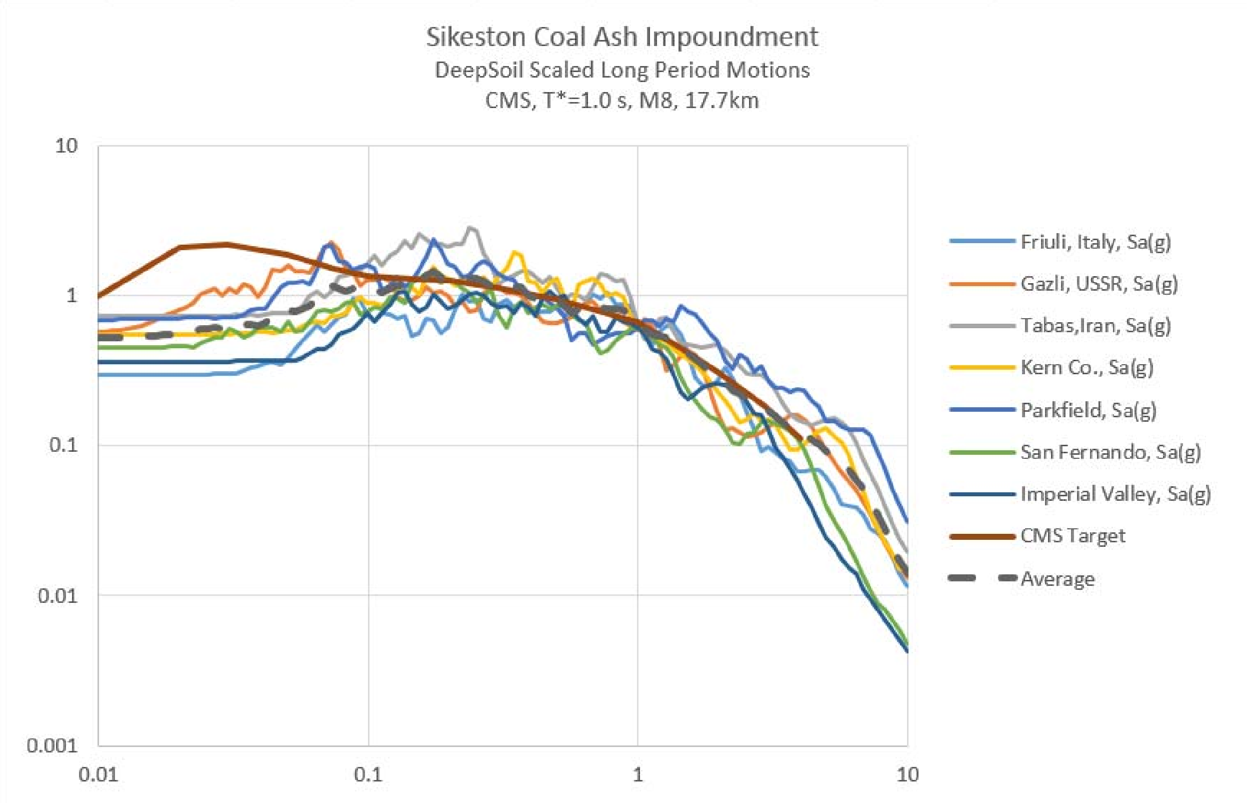
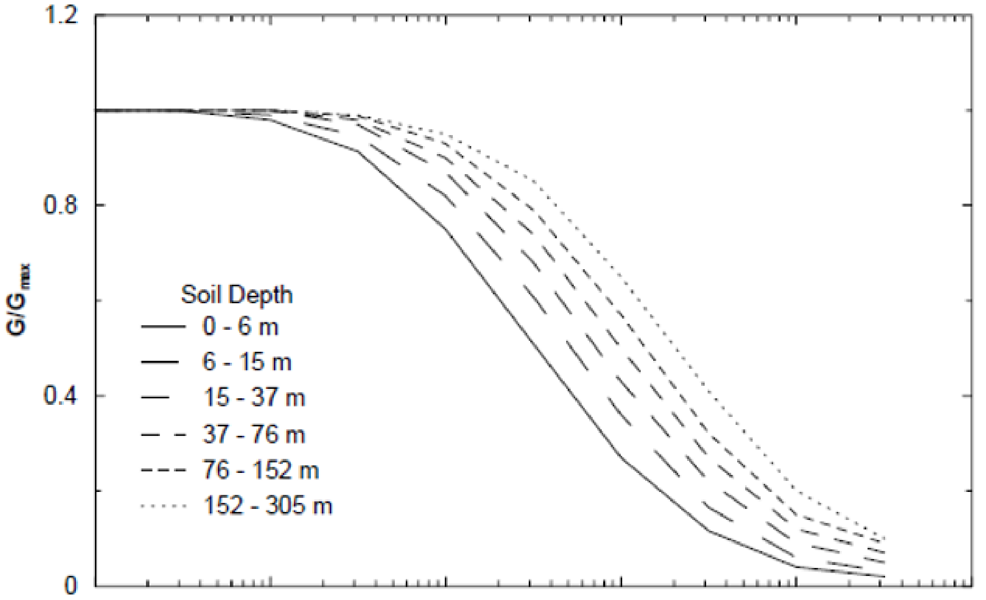


***Figure 4: Ground motions scaled to CMS at target T*=1.0s***



(a) Modulus reduction curves

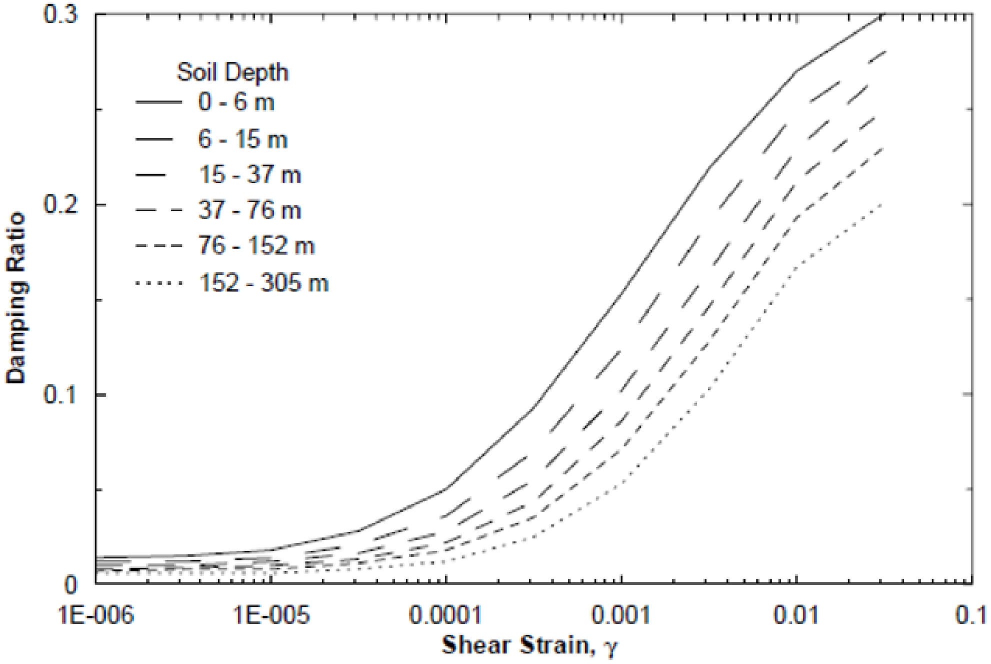


***Figure 5: EPRI (1993) (a) modulus reduction and (b) damping curves***

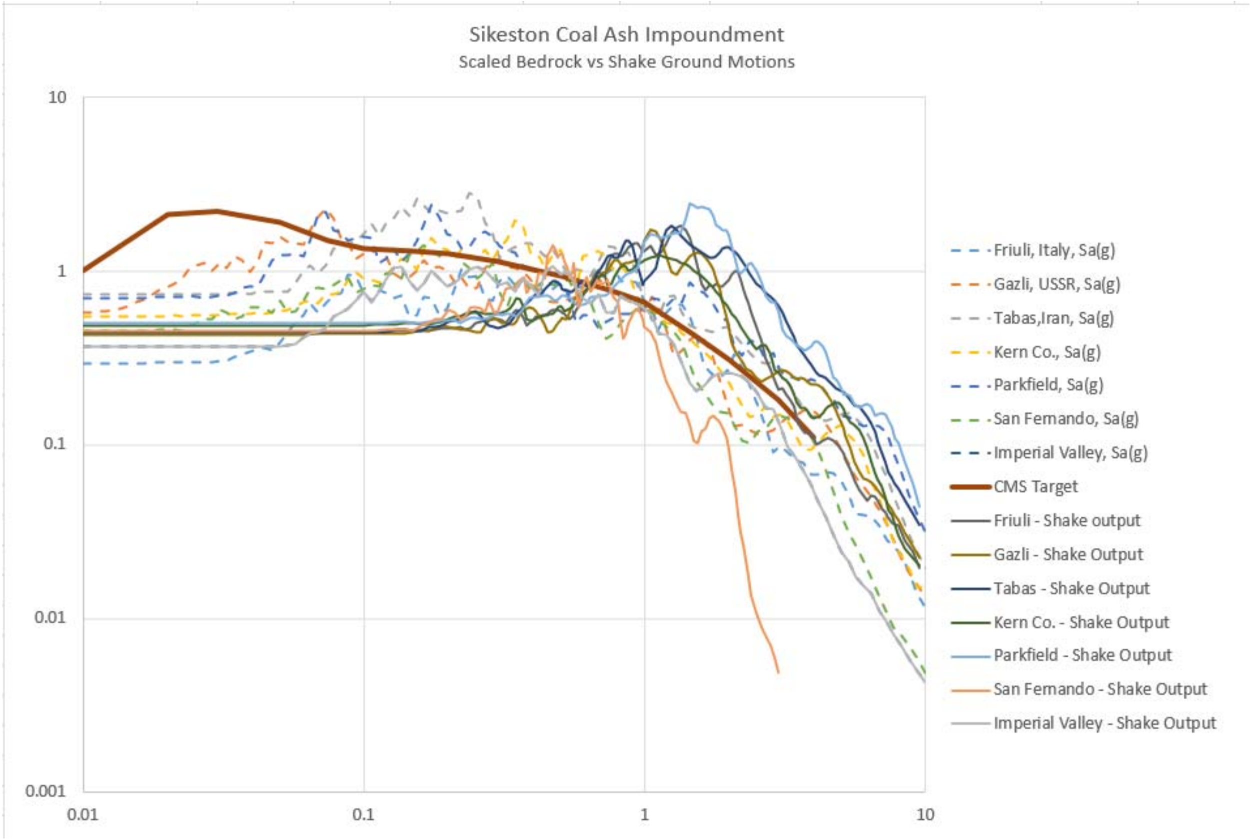
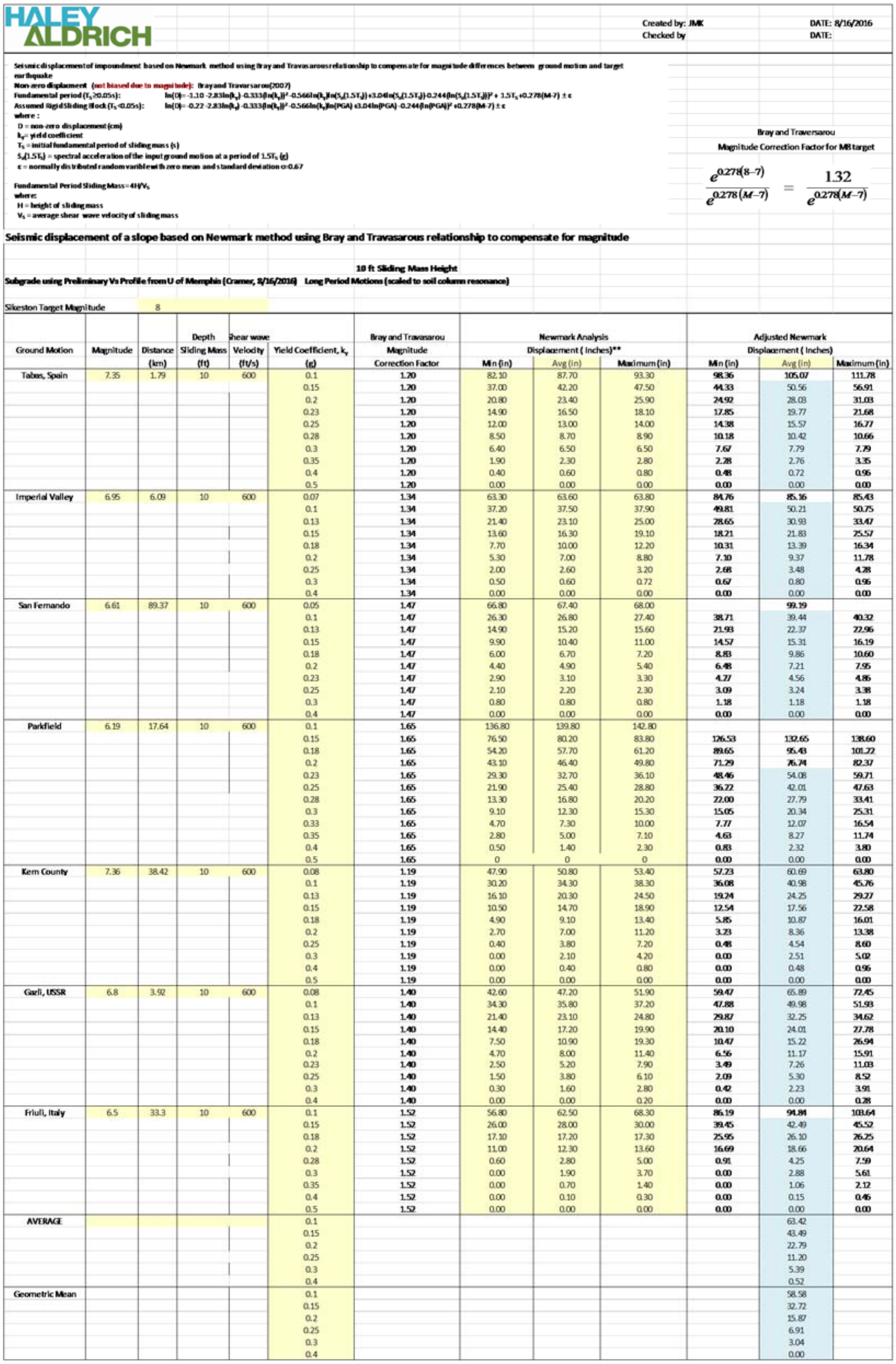


***Figure 6: Comparison between input motions to Shake and output. Note that spectral response has shifted to longer periods***



HALEY ALDRICH

Created by: JMK DATE: 8/16/2016
Checked by DATE:

Seismic displacement of impoundment based on Newmark method using Bray and Travasarous relationship to compensate for magnitude differences between ground motion and target earthquake

**Non-zero displacment (not biased due to magnitude):** Bray and Travarsarou(2007)

**Fundamental period ($T_s \geq 0.05s$):** $\ln(D) = -1.10 - 2.83\ln(k_y) - 0.333(\ln(k_y))^2 - 0.566\ln(k_y)\ln(S_a(1.5T_s)) + 3.04\ln(S_a(1.5T_s)) - 0.244(\ln(S_a(1.5T_s)))^2 + 1.5T_s + 0.278(M-7) \pm \varepsilon$

**Assumed Rigid Sliding Block ($T_s < 0.05s$):** $\ln(D) = -0.22 - 2.83\ln(k_y) - 0.333(\ln(k_y))^2 - 0.566\ln(k_y)\ln(PGA) + 3.04\ln(PGA) - 0.244(\ln(PGA))^2 + 0.278(M-7) \pm \varepsilon$

where :

D = non-zero displacement (cm)
$k_y$ = yield coefficient
$T_s$ = initial fundamental period of sliding mass (s)
$S_a(1.5T_s)$ = spectral acceleration of the input ground motion at a period of $1.5T_s$ (g)
ε = normally distributed random varible with zero mean and standard deviation σ=0.67

Fundamental Period Sliding Mass = $4H/V_s$
where:
H = height of sliding mass
$V_s$ = average shear wave velocity of sliding mass

Bray and Traversarou
Magnitude Correction Factor for M8 target

$$\frac{e^{0.278(8-7)}}{e^{0.278(M-7)}} = \frac{1.32}{e^{0.278(M-7)}}$$

**Seismic displacement of a slope based on Newmark method using Bray and Travasarous relationship to compensate for magnitude**

**10 ft Sliding Mass Height**

**Subgrade using Preliminary Vs Profile from U of Memphis (Cramer, 8/16/2016) Long Period Motions (scaled to soil column resonance)**

Sikeston Target Magnitude 8

| Ground Motion | Magnitude | Distance (km) | Depth Sliding Mass (ft) | Shear wave Velocity (ft/s) | Yield Coefficient, $k_y$ (g) | Bray and Travasarou Magnitude Correction Factor | Newmark Analysis Displacement ( Inches)** | | | Adjusted Newmark Displacement ( Inches) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Min (in) | Avg (in) | Maximum (in) | Min (in) | Avg (in) | Maximum (in) |
| Tabas, Spain | 7.35 | 1.79 | 10 | 600 | 0.1 | 1.20 | 82.10 | 87.70 | 93.30 | 98.36 | 105.07 | 111.78 |
| | | | | | 0.15 | 1.20 | 37.00 | 42.20 | 47.50 | 44.33 | 50.56 | 56.91 |
| | | | | | 0.2 | 1.20 | 20.80 | 23.40 | 25.90 | 24.92 | 28.03 | 31.03 |
| | | | | | 0.23 | 1.20 | 14.90 | 16.50 | 18.10 | 17.85 | 19.77 | 21.68 |
| | | | | | 0.25 | 1.20 | 12.00 | 13.00 | 14.00 | 14.38 | 15.57 | 16.77 |
| | | | | | 0.28 | 1.20 | 8.50 | 8.70 | 8.90 | 10.18 | 10.42 | 10.66 |
| | | | | | 0.3 | 1.20 | 6.40 | 6.50 | 6.50 | 7.67 | 7.79 | 7.79 |
| | | | | | 0.35 | 1.20 | 1.90 | 2.30 | 2.80 | 2.28 | 2.76 | 3.35 |
| | | | | | 0.4 | 1.20 | 0.40 | 0.60 | 0.80 | 0.48 | 0.72 | 0.96 |
| | | | | | 0.5 | 1.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Imperial Valley | 6.95 | 6.09 | 10 | 600 | 0.07 | 1.34 | 63.30 | 63.60 | 63.80 | 84.76 | 85.16 | 85.43 |
| | | | | | 0.1 | 1.34 | 37.20 | 37.50 | 37.90 | 49.81 | 50.21 | 50.75 |
| | | | | | 0.13 | 1.34 | 21.40 | 23.10 | 25.00 | 28.65 | 30.93 | 33.47 |
| | | | | | 0.15 | 1.34 | 13.60 | 16.30 | 19.10 | 18.21 | 21.83 | 25.57 |
| | | | | | 0.18 | 1.34 | 7.70 | 10.00 | 12.20 | 10.31 | 13.39 | 16.34 |
| | | | | | 0.2 | 1.34 | 5.30 | 7.00 | 8.80 | 7.10 | 9.37 | 11.78 |
| | | | | | 0.25 | 1.34 | 2.00 | 2.60 | 3.20 | 2.68 | 3.48 | 4.28 |
| | | | | | 0.3 | 1.34 | 0.50 | 0.60 | 0.72 | 0.67 | 0.80 | 0.96 |
| | | | | | 0.4 | 1.34 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| San Fernando | 6.61 | 89.37 | 10 | 600 | 0.05 | 1.47 | 66.80 | 67.40 | 68.00 | | 99.19 | |
| | | | | | 0.1 | 1.47 | 26.30 | 26.80 | 27.40 | 38.71 | 39.44 | 40.32 |
| | | | | | 0.13 | 1.47 | 14.90 | 15.20 | 15.60 | 21.93 | 22.37 | 22.96 |
| | | | | | 0.15 | 1.47 | 9.90 | 10.40 | 11.00 | 14.57 | 15.31 | 16.19 |
| | | | | | 0.18 | 1.47 | 6.00 | 6.70 | 7.20 | 8.83 | 9.86 | 10.60 |
| | | | | | 0.2 | 1.47 | 4.40 | 4.90 | 5.40 | 6.48 | 7.21 | 7.95 |
| | | | | | 0.23 | 1.47 | 2.90 | 3.10 | 3.30 | 4.27 | 4.56 | 4.86 |
| | | | | | 0.25 | 1.47 | 2.10 | 2.20 | 2.30 | 3.09 | 3.24 | 3.38 |
| | | | | | 0.3 | 1.47 | 0.80 | 0.80 | 0.80 | 1.18 | 1.18 | 1.18 |
| | | | | | 0.4 | 1.47 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Parkfield | 6.19 | 17.64 | 10 | 600 | 0.1 | 1.65 | 136.80 | 139.80 | 142.80 | | | |
| | | | | | 0.15 | 1.65 | 76.50 | 80.20 | 83.80 | 126.53 | 132.65 | 138.60 |
| | | | | | 0.18 | 1.65 | 54.20 | 57.70 | 61.20 | 89.65 | 95.43 | 101.22 |
| | | | | | 0.2 | 1.65 | 43.10 | 46.40 | 49.80 | 71.29 | 76.74 | 82.37 |
| | | | | | 0.23 | 1.65 | 29.30 | 32.70 | 36.10 | 48.46 | 54.08 | 59.71 |
| | | | | | 0.25 | 1.65 | 21.90 | 25.40 | 28.80 | 36.22 | 42.01 | 47.63 |
| | | | | | 0.28 | 1.65 | 13.30 | 16.80 | 20.20 | 22.00 | 27.79 | 33.41 |
| | | | | | 0.3 | 1.65 | 9.10 | 12.30 | 15.30 | 15.05 | 20.34 | 25.31 |
| | | | | | 0.33 | 1.65 | 4.70 | 7.30 | 10.00 | 7.77 | 12.07 | 16.54 |
| | | | | | 0.35 | 1.65 | 2.80 | 5.00 | 7.10 | 4.63 | 8.27 | 11.74 |
| | | | | | 0.4 | 1.65 | 0.50 | 1.40 | 2.30 | 0.83 | 2.32 | 3.80 |
| | | | | | 0.5 | 1.65 | 0 | 0 | 0 | 0.00 | 0.00 | 0.00 |
| Kern County | 7.36 | 38.42 | 10 | 600 | 0.08 | 1.19 | 47.90 | 50.80 | 53.40 | 57.23 | 60.69 | 63.80 |
| | | | | | 0.1 | 1.19 | 30.20 | 34.30 | 38.30 | 36.08 | 40.98 | 45.76 |
| | | | | | 0.13 | 1.19 | 16.10 | 20.30 | 24.50 | 19.24 | 24.25 | 29.27 |
| | | | | | 0.15 | 1.19 | 10.50 | 14.70 | 18.90 | 12.54 | 17.56 | 22.58 |
| | | | | | 0.18 | 1.19 | 4.90 | 9.10 | 13.40 | 5.85 | 10.87 | 16.01 |
| | | | | | 0.2 | 1.19 | 2.70 | 7.00 | 11.20 | 3.23 | 8.36 | 13.38 |
| | | | | | 0.25 | 1.19 | 0.40 | 3.80 | 7.20 | 0.48 | 4.54 | 8.60 |
| | | | | | 0.3 | 1.19 | 0.00 | 2.10 | 4.20 | 0.00 | 2.51 | 5.02 |
| | | | | | 0.4 | 1.19 | 0.00 | 0.40 | 0.80 | 0.00 | 0.48 | 0.96 |
| | | | | | 0.5 | 1.19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Gazli, USSR | 6.8 | 3.92 | 10 | 600 | 0.08 | 1.40 | 42.60 | 47.20 | 51.90 | 59.47 | 65.89 | 72.45 |
| | | | | | 0.1 | 1.40 | 34.30 | 35.80 | 37.20 | 47.88 | 49.98 | 51.93 |
| | | | | | 0.13 | 1.40 | 21.40 | 23.10 | 24.80 | 29.87 | 32.25 | 34.62 |
| | | | | | 0.15 | 1.40 | 14.40 | 17.20 | 19.90 | 20.10 | 24.01 | 27.78 |
| | | | | | 0.18 | 1.40 | 7.50 | 10.90 | 19.30 | 10.47 | 15.22 | 26.94 |
| | | | | | 0.2 | 1.40 | 4.70 | 8.00 | 11.40 | 6.56 | 11.17 | 15.91 |
| | | | | | 0.23 | 1.40 | 2.50 | 5.20 | 7.90 | 3.49 | 7.26 | 11.03 |
| | | | | | 0.25 | 1.40 | 1.50 | 3.80 | 6.10 | 2.09 | 5.30 | 8.52 |
| | | | | | 0.3 | 1.40 | 0.30 | 1.60 | 2.80 | 0.42 | 2.23 | 3.91 |
| | | | | | 0.4 | 1.40 | 0.00 | 0.00 | 0.20 | 0.00 | 0.00 | 0.28 |
| Friuli, Italy | 6.5 | 33.3 | 10 | 600 | 0.1 | 1.52 | 56.80 | 62.50 | 68.30 | 86.19 | 94.84 | 103.64 |
| | | | | | 0.15 | 1.52 | 26.00 | 28.00 | 30.00 | 39.45 | 42.49 | 45.52 |
| | | | | | 0.18 | 1.52 | 17.10 | 17.20 | 17.30 | 25.95 | 26.10 | 26.25 |
| | | | | | 0.2 | 1.52 | 11.00 | 12.30 | 13.60 | 16.69 | 18.66 | 20.64 |
| | | | | | 0.28 | 1.52 | 0.60 | 2.80 | 5.00 | 0.91 | 4.25 | 7.59 |
| | | | | | 0.3 | 1.52 | 0.00 | 1.90 | 3.70 | 0.00 | 2.88 | 5.61 |
| | | | | | 0.35 | 1.52 | 0.00 | 0.70 | 1.40 | 0.00 | 1.06 | 2.12 |
| | | | | | 0.4 | 1.52 | 0.00 | 0.10 | 0.30 | 0.00 | 0.15 | 0.46 |
| | | | | | 0.5 | 1.52 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| AVERAGE | | | | | 0.1 | | | | | | 63.42 | |
| | | | | | 0.15 | | | | | | 43.49 | |
| | | | | | 0.2 | | | | | | 22.79 | |
| | | | | | 0.25 | | | | | | 11.20 | |
| | | | | | 0.3 | | | | | | 5.39 | |
| | | | | | 0.4 | | | | | | 0.52 | |
| Geometric Mean | | | | | 0.1 | | | | | | 58.58 | |
| | | | | | 0.15 | | | | | | 32.72 | |
| | | | | | 0.2 | | | | | | 15.87 | |
| | | | | | 0.25 | | | | | | 6.91 | |
| | | | | | 0.3 | | | | | | 3.04 | |
| | | | | | 0.4 | | | | | | 0.00 | |

*Figure 7: Results of Newmark analysis with Bray and Traversarou Corrections*

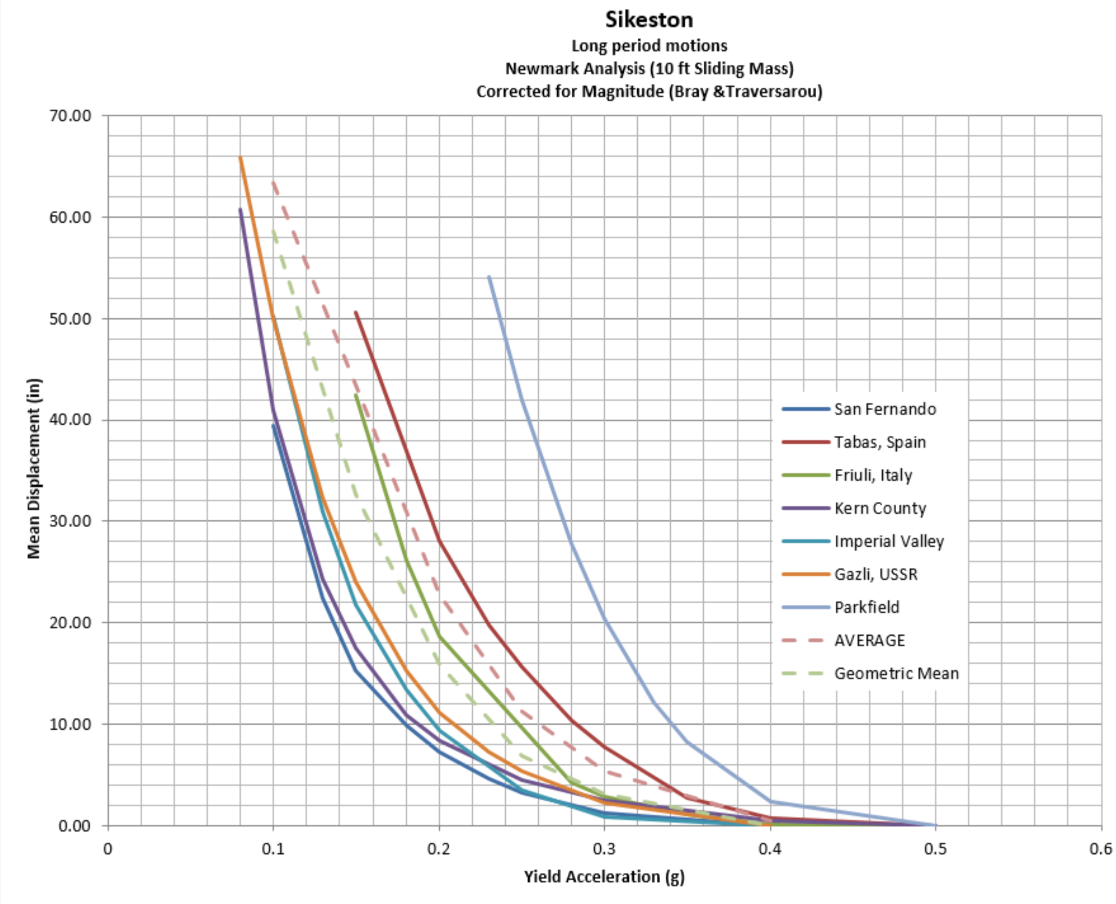
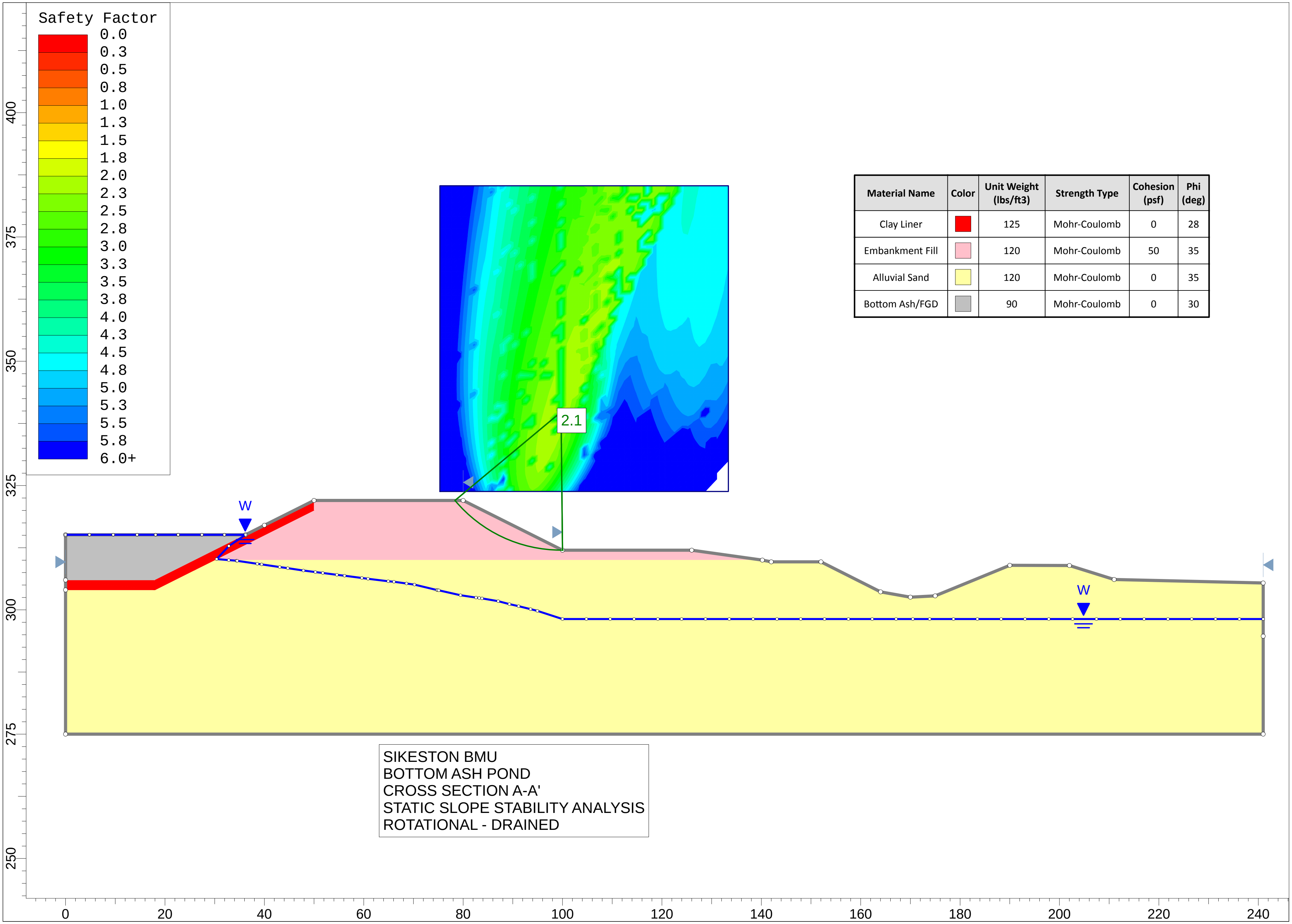


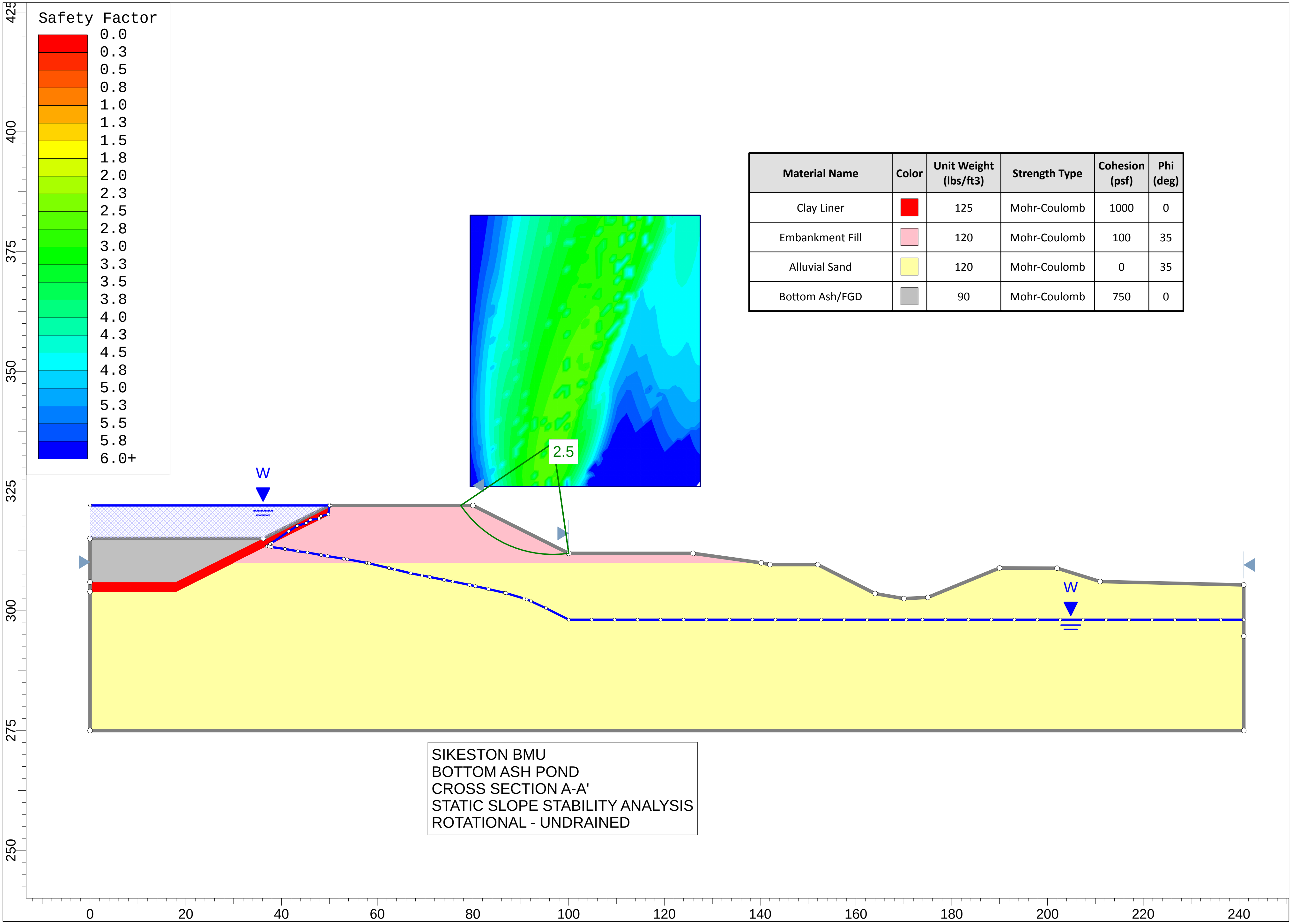
*Figure 8: Newmark Block Displacement Analysis for Sikeston*

# Slope Stability



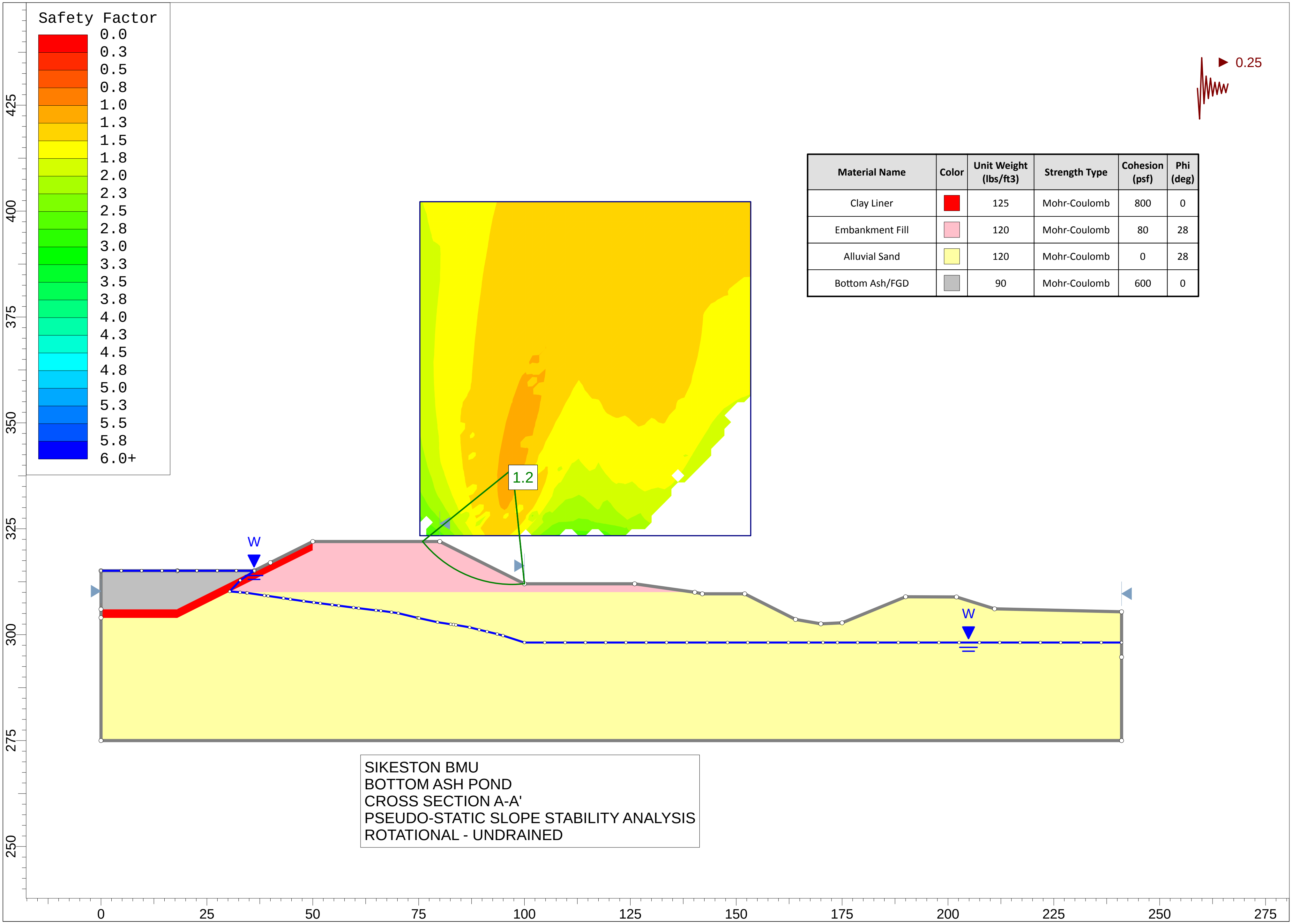
| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) |
|---|---|---|---|---|---|
| Clay Liner | 🟥 | 125 | Mohr-Coulomb | 0 | 28 |
| Embankment Fill | 🟪 | 120 | Mohr-Coulomb | 50 | 35 |
| Alluvial Sand | 🟨 | 120 | Mohr-Coulomb | 0 | 35 |
| Bottom Ash/FGD | ⬜ | 90 | Mohr-Coulomb | 0 | 30 |

SIKESTON BMU
BOTTOM ASH POND
CROSS SECTION A-A'
STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - DRAINED



| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) |
|---|---|---|---|---|---|
| Clay Liner | 🟥 | 125 | Mohr-Coulomb | 1000 | 0 |
| Embankment Fill | 🟪 | 120 | Mohr-Coulomb | 100 | 35 |
| Alluvial Sand | 🟨 | 120 | Mohr-Coulomb | 0 | 35 |
| Bottom Ash/FGD | ⬜ | 90 | Mohr-Coulomb | 750 | 0 |

SIKESTON BMU
BOTTOM ASH POND
CROSS SECTION A-A'
STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - UNDRAINED



| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) |
|---|---|---|---|---|---|
| Clay Liner | 🟥 | 125 | Mohr-Coulomb | 800 | 0 |
| Embankment Fill | ■ | 120 | Mohr-Coulomb | 80 | 28 |
| Alluvial Sand | 🟨 | 120 | Mohr-Coulomb | 0 | 28 |
| Bottom Ash/FGD | ■ | 90 | Mohr-Coulomb | 600 | 0 |

SIKESTON BMU
BOTTOM ASH POND
CROSS SECTION A-A'
PSEUDO-STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - UNDRAINED

BURNS & McDONNELL

CREATE AMAZING.

Burns & McDonnell World Headquarters
9400 Ward Parkway
Kansas City, MO 64114
O 816-333-9400
F 816-333-3690
www.burnsmcd.com