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 1
November 30, 2020

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Prepared for

Sikeston Board of Municipal Utilities
Sikeston Power Station

Project No. 122575
Sikeston, MO

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Prepared by

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

INDEX AND CERTIFICATION

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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).

STATE OF MISSOURI
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LIST OF ABBREVIATIONS

<u>**Abbreviation**</u>	<u>**Term/Phrase/Name**</u>
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 Power Station (Sikeston). 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). The Sikeston facility has two CCR units, both of which are existing CCR surface impoundments known as the Scrubber Sludge/Bottom Ash Pond (Bottom Ash Pond) and the Fly Ash Pond. The Fly Ash Pond will cease receiving wastestreams and initiate closure by April 11, 2021. This document serves as SBMU's Demonstration for a Site-Specific Alternate to Initiation of Closure Deadline for the Bottom Ash Pond at 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 facility is in compliance with all the requirements of the CCR Rule. 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 and Fly Ash Pond are 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 facility 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 has been classified with a significant hazard potential. 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

[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.

chose to form an independent power pool as their best option to supply power to their 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 the 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

[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.

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 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 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.

[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 commingled 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	Dry Belt/Tray Conveying System	Feasible
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	

Year or Progress Reporting Period	Status	Milestone Description	SBMU Notes
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
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.	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[6] 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

[6] 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.

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, 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.

<u>Construction Activities:</u> 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 facility is in compliance with the CCR Rule. The Sikeston facility includes the following CCR units:

- The Bottom Ash Pond (which is the subject of this demonstration)
- The Fly Ash Pond (which will cease receiving wastestreams and initiate closure by April 11, 2021)

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 facility is in compliance with all of the requirements contained in 40 C.F.R. Part 257, Subpart D – Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments. 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 McGill
(Printed Name)

Plant Manager
(Title)

November 30, 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 units (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)

In addition, Sikeston provides EPA with a summary of the facility and region's geology and hydrogeology as follows. The Sikeston area is located in the Southeastern Lowland Province, a vast alluvial plain representing the northernmost point of the Mississippi River Embayment. Unlike other parts of the state, the geologic and hydrologic setting of the Southeastern Lowland Province is relatively straightforward. This is due to the relatively young geologic age of the region and to the consistency in depositional processes that have resulted in a thick accumulation of fluvial and deltaic sediments that range from Late Mesozoic (Cretaceous) to Recent (Holocene) in age.

Unconsolidated material deposits encountered in or near the perimeter of the ash ponds extend from ground surface to at least the total depth of investigation. The deposits encountered generally consist of two to three fining upward sequences representing a braided fluvial depositional environment where channels migrate and cross-cut earlier deposits. Where complete, these sequences consist of medium- to coarse-grained sand with varying amounts of gravel, overlain by fine- to medium-grained sand, that are overlain by silty sand. In some areas, native alluvial materials are overlain by fill consisting of sand and clay that were emplaced during construction of the power plant and its supporting structures. Regionally, groundwater movement within the unconfined alluvial aquifer in the vicinity of the site is to the south and southwest. Movement is along a shallow hydraulic gradient estimated at approximately one foot per mile. Locally, groundwater is believed to flow toward Richland Drainage Ditch #4, one of several north-south trending surface runoff control ditches in the area that flows to the south to a larger irrigation channel.

At SBMU, the water table surface consistently slopes gently to the west-southwest within the uppermost continuous aquifer and shows little variability or change during the characterization time period. This west-southwesterly direction of groundwater flow is characterized by a relatively shallow hydraulic gradient. Given the relatively narrow range of hydraulic gradients and consistent direction of groundwater flow, the character of the granular materials comprising the uppermost continuous aquifer is apparently uniform in terms of permeability, suggesting a lack of preferential flow pathways beneath the site.

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. The groundwater monitoring program at Sikeston has been administered in compliance with the groundwater sampling and analysis requirements of § 257.93. Sikeston's procedures are documented in a Plan for the purposes of this CCR Program and for Missouri Department of Natural Resources NPDES requirements (Attachment D4, Sikeston Power Station, Groundwater Sampling and Analysis Plan (September 2017)).

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 facility.

Sikeston is in compliance with the requirements in § 257.93(f) to select an appropriate statistical method that complies with the performance standards articulated in § 257.93(g). (Attachment D5, Sikeston Power Station Baseline Statistical Evaluations). The statistical analysis method used to evaluate groundwater at both CCR Units at Sikeston consists of intrawell analysis using prediction limits. The analysis is conducted separately for each constituent in each monitoring well for each sampling event in accordance with § 257.93(f)(3). This statistical method complies with the accepted performance standards listed in § 257.93(g). The background data used to evaluate current groundwater quality is based on the initial eight rounds of groundwater sampling from each of the monitoring wells. Statistical analysis is performed in accordance with § 257.93 using Sanitas© for Ground Water (Version 9.6.14; 2019). Intrawell prediction intervals are compared at the 99 percent confidence level for each Appendix III constituent. The groundwater analytical results are compared to the prediction limits to determine if SSIs over background exist in the data set.

Intrawell analysis was chosen for the site after comparison of values among upgradient to downgradient wells. Intrawell analysis was recommended for the following reasons:

- Box and Whisker Plots indicate the presence of spatial variation among the upgradient wells;
- As verified by ANOVA testing, there is spatial variation among the upgradient wells;
- Evidence of decreasing data trends among an upgradient well (Chloride and Sulfate in MW-6), and;
- Evidence of increasing data trends among an upgradient well (Boron and Calcium in MW-2).

For these reasons, there is more than one statistically different target population within the groundwater detection monitoring well network. The different target populations are attributable to the natural spatial variation inherent in an alluvial setting, where groundwater flow conditions are variable and alluvial sediments are a heterogeneous mixture of sands, silts, and clays. The dissimilarity in water quality data among wells indicates that intrawell analysis is the most appropriate statistical method to evaluate possible changes in groundwater quality during semi-annual detection monitoring events.

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 D6 for each impoundment. Attachment D6 also includes the most recent alternate source demonstrations (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)

Stratigraphic cross-sections of the site in the vicinity of the CCR units are included as Attachment D7.

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 and Fly Ash Pond are 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 reports for the Bottom Ash Pond (prepared in October 2016) and the Fly Ash Pond (prepared in April 2018). The Fly Ash Pond was originally classified as an inactive impoundment. On June 14, 2016, the D.C. Circuit vacated certain provisions for inactive impoundments under 40 CFR § 257.100, making these impoundments newly subject to CCR Rule requirements. EPA responded by providing a compliance date of April 17, 2018 for completion of the Structural Stability Assessment and other requirements for this Unit. 81 Fed. Reg. 51802, 51808 (Aug. 6, 2016). In response to these regulatory changes, Sikeston opted to place the Fly Ash Pond back in service. See Attachment D8. As required for compliance, another stability assessment will be completed five years from the assessments currently in place.

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

Pursuant to § 257.73(e), the initial safety factor assessment reports for the Bottom Ash Pond (prepared in October 2016) and the Fly Ash Pond (prepared in March 2018). As noted with respect to the Structural Stability Assessment, the Fly Ash Pond had a later compliance due date of April 17, 2018 for completion of the Safety Factor Assessment and other requirements for this Unit. 81 Fed. Reg. 51802, 51808 (Aug. 6, 2016). See Attachment D9. As required for compliance, another safety factor assessment will be completed five years from the current assessments in place.

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

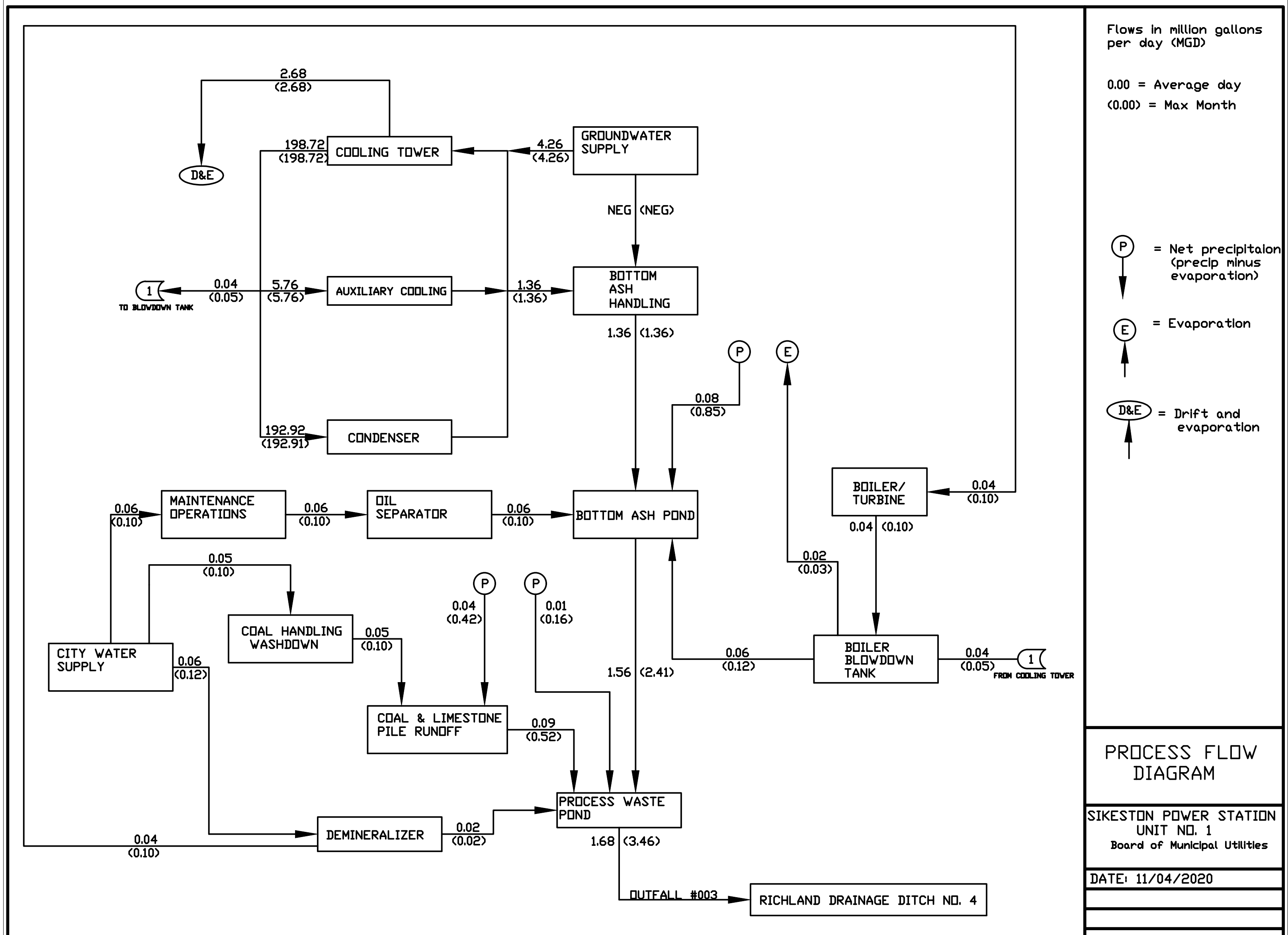
SIKESTON POWER STATION
SITE PLAN

project 122575

contract -

dwg **FIGURE 1**

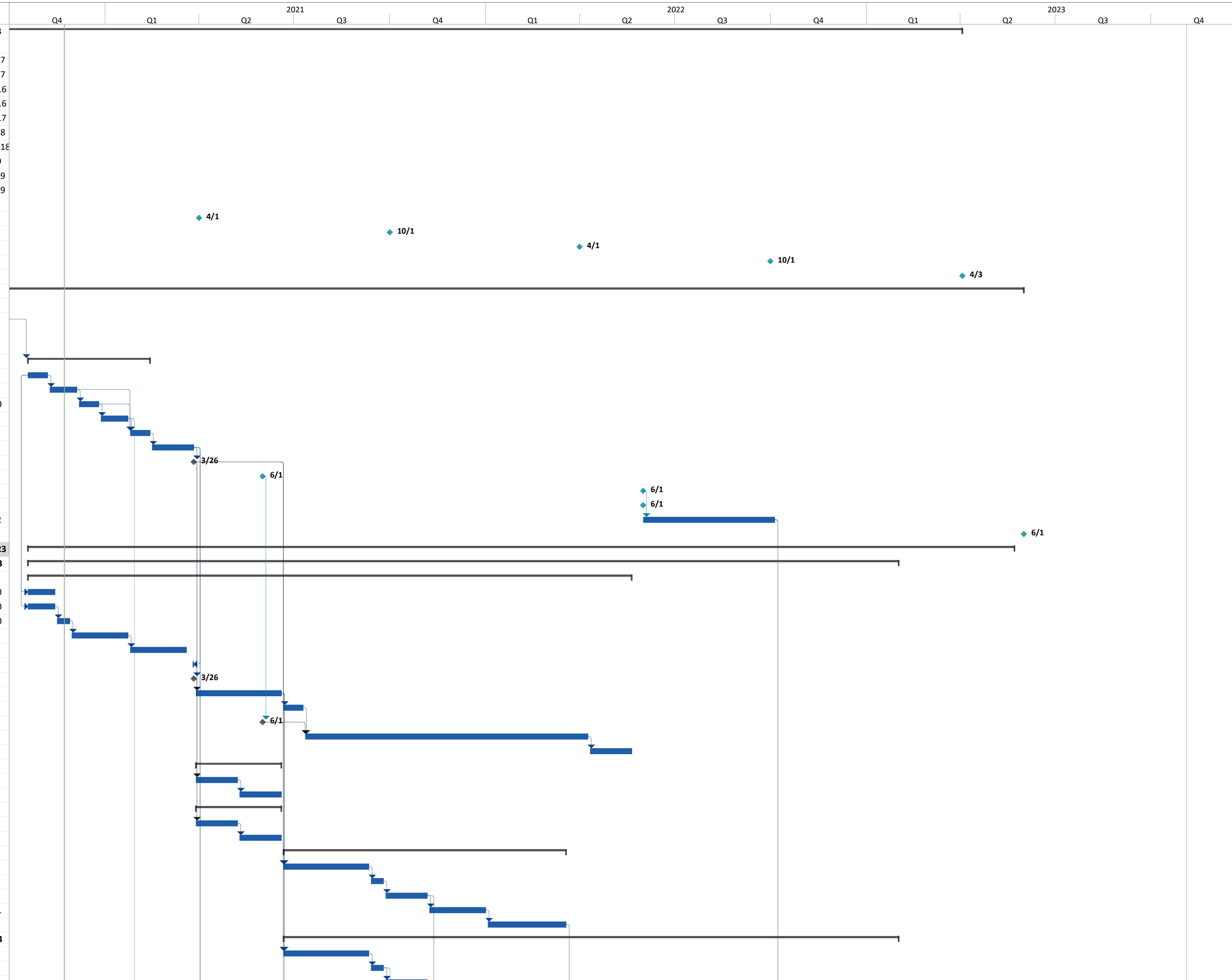
APPENDIX B – WATER BALANCE



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
GROUNDWATER SUPPLY
COOLING TOWER
D&E
2.68 (2.68)
198.72 (198.72)
4.26 (4.26)
NEG (NEG)
AUXILIARY COOLING
BOTTOM ASH HANDLING
1
TO BLOWDOWN TANK
0.04 (0.05)
5.76 (5.76)
1.36 (1.36)
1.36 (1.36)
CONDENSER
192.92 (192.91)
P
E
0.08 (0.85)
MAINTENANCE OPERATIONS
OIL SEPARATOR
BOTTOM ASH POND
BOILER/ TURBINE
0.06 (0.10)
0.06 (0.10)
0.06 (0.10)
0.04 (0.10)
0.04 (0.10)
0.02 (0.03)
0.05 (0.10)
COAL HANDLING WASHDOWN
0.05 (0.10)
CITY WATER SUPPLY
0.06 (0.12)
0.04 (0.42)
0.01 (0.16)
1.56 (2.41)
0.06 (0.12)
BOILER BLOWDOWN TANK
0.04 (0.05)
FROM COOLING TOWER
COAL & LIMESTONE PILE RUNOFF
0.09 (0.52)
PROCESS WASTE POND
DEMINERALIZER
0.02 (0.02)
0.04 (0.10)
1.68 (3.46)
OUTFALL #003
RICHLAND DRAINAGE DITCH NO. 4

APPENDIX C – SCHEDULE

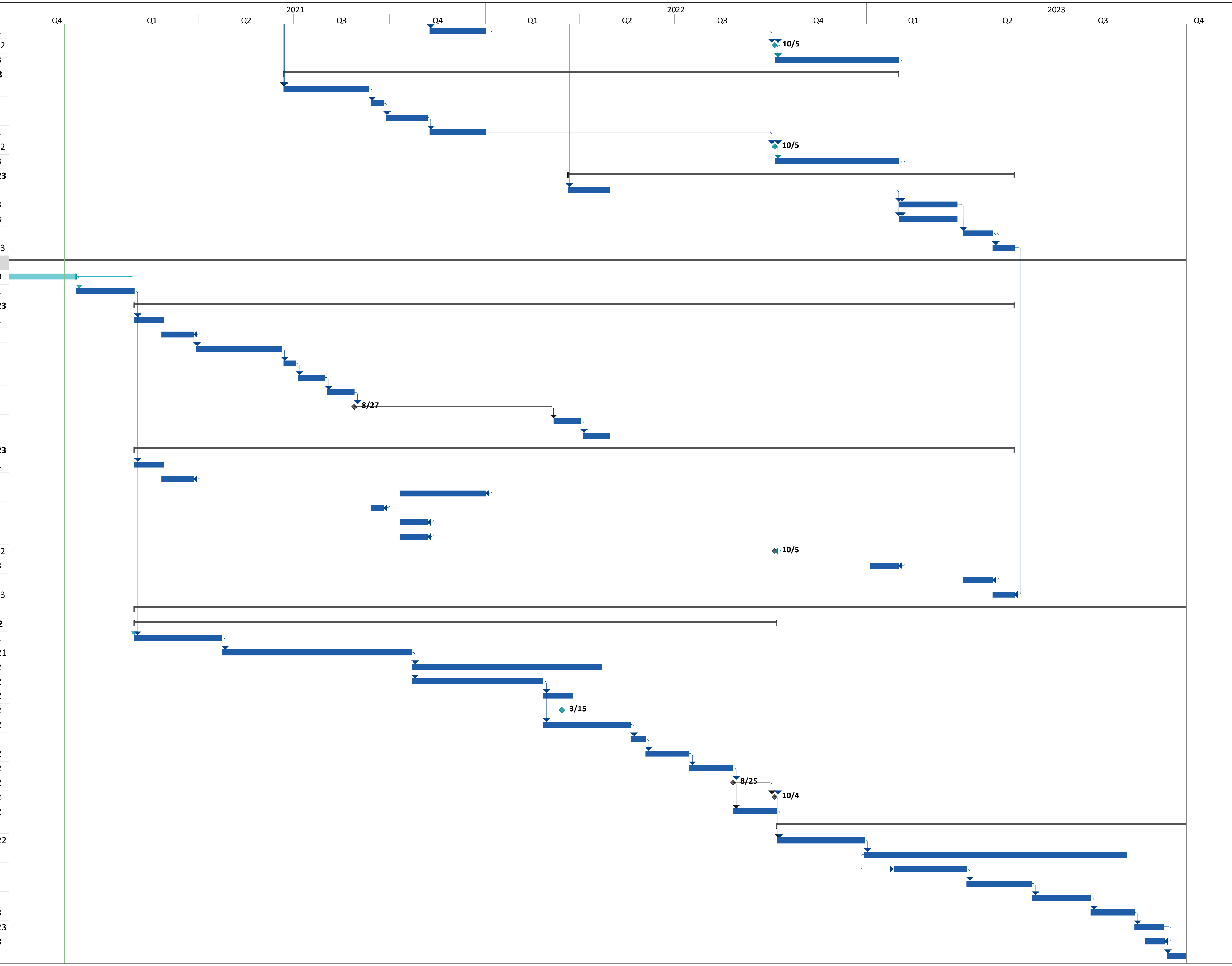
ID	Task Name	Duration	Start	Finish
1	**CCR Compliance Efforts**	**2076 days**	**Fri 4/17/15**	**Mon 4/3/23**
2	Final CCR Rule Published in Federal Register	0 days	Fri 4/17/15	Fri 4/17/15
3	Installed Groundwater Monitoring Wells	10 days	Tue 2/28/17	Mon 3/13/17
4	Background Groundwater Sampling	360 days	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 11/26/1(	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
21	**AACE Class 3 Budgetary and Feed Study**	**85 days**	**Mon 10/19/2(**	**Fri 2/12/21**
22	Perform Laser Scan & Transmit Results	15 days	Mon 10/19/2(	Fri 11/6/20
23	Update Initial Vendor Budget Quotes	20 days	Mon 11/9/20	Fri 12/4/20
24	Local Subcontractor Budget Quotes	15 days	Mon 12/7/20	Fri 12/25/20
25	Water Balance Investigation	20 days	Mon 12/28/2(	Fri 1/22/21
26	Finalize Estimate and Report	15 days	Mon 1/25/21	Fri 2/12/21
27	Sikeston BMU Annual Budget Approval	30 days	Mon 2/15/21	Fri 3/26/21
28	Engineering FNTP	0 days	Fri 3/26/21	Fri 3/26/21
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
33	FY 2023 Start	0 days	Thu 6/1/23	Thu 6/1/23
34	**CCR WASTESTREAMS**	**676 days**	**Mon 10/19/2(**	**Mon 5/22/23**
35	**Bottom Ash Conversion - Procurement**	**597 days**	**Mon 10/19/2(**	**Tue 1/31/23**
36	**Compact Submerged Conveyor System**	**415 days**	**Mon 10/19/2(**	**Fri 5/20/22**
37	Develop Technical Specification	20 days	Mon 10/19/2(	Fri 11/13/20
38	Develop Commercial Terms	20 days	Mon 10/19/2(	Fri 11/13/20
39	Issue Bid Package	10 days	Mon 11/16/2(	Fri 11/27/20
40	Bid Period	40 days	Mon 11/30/2(	Fri 1/22/21
41	Bid Evaluation	40 days	Mon 1/25/21	Fri 3/19/21
42	2021 Budget Presentation to Board	1 day	Fri 3/26/21	Fri 3/26/21
43	Award LNTP CSC Contract	0 days	Fri 3/26/21	Fri 3/26/21
44	Issue Vendor Submittals	60 days	Mon 3/29/21	Fri 6/18/21
45	Review and Approve Submittals	15 days	Mon 6/21/21	Fri 7/9/21
46	Award FNTP CSC Contract (After FY 2021 Start)	0 days	Tue 6/1/21	Tue 6/1/21
47	Conveyor Fabrication	195 days	Mon 7/12/21	Fri 4/8/22
48	Delivery Window	30 days	Mon 4/11/22	Fri 5/20/22
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
51	Perform & Transmit	30 days	Mon 5/10/21	Fri 6/18/21
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
54	Perform & Transmit	30 days	Mon 5/10/21	Fri 6/18/21
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
57	Issue Bid Package	10 days	Mon 9/13/21	Fri 9/24/21
58	Bid Period	30 days	Mon 9/27/21	Fri 11/5/21
59	Bid Evaluation/Award	40 days	Mon 11/8/21	Fri 12/31/21
60	Pre-Plan, Procure, and Mobilize	55 days	Mon 1/3/22	Fri 3/18/22
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
63	Issue Bid Package	10 days	Mon 9/13/21	Fri 9/24/21
64	Bid Period	30 days	Mon 9/27/21	Fri 11/5/21



Project: Sikeston CCR Surface Impoundment Extension Demonstration
Date: Mon 11/23/20

Task | Split | Milestone | Summary | Project Summary | External Tasks | External Milestone | Inactive Task | Inactive Milestone | Inactive Summary | Manual Task | Duration-only | Manual Summary Rollup | Manual Summary | Start-only | Finish-only | Deadline | Progress | Manual Progress

ID	Task Name	Duration	Start	Finish
65	Bid Evaluation	40 days	Mon 11/8/21	Fri 12/31/21
66	Award (after FY 2022 Budget Approval)	0 days	Wed 10/5/22	Wed 10/5/22
67	Pre-Plan, Procure, and Mobilize	85 days	Wed 10/5/22	Tue 1/31/23
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
70	Issue Bid Package	10 days	Mon 9/13/21	Fri 9/24/21
71	Bid Period	30 days	Mon 9/27/21	Fri 11/5/21
72	Bid Evaluation	40 days	Mon 11/8/21	Fri 12/31/21
73	Award	0 days	Wed 10/5/22	Wed 10/5/22
74	Pre-Plan, Procure, and Mobilize	85 days	Wed 10/5/22	Tue 1/31/23
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
77	A/G Pre-Outage Mech/Struct Construction	40 days	Wed 2/1/23	Tue 3/28/23
78	A/G Pre-Outage Elect Construction	40 days	Wed 2/1/23	Tue 3/28/23
79	2023 Outage	20 days	Tue 4/4/23	Mon 5/1/23
80	Final Walkdown & Punchlist	15 days	Tue 5/2/23	Mon 5/22/23
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
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
86	Sikeston BMU Annual Budget Approval	23 days	Wed 2/24/21	Fri 3/26/21
87	Develop Drawings and Specs	60 days	Mon 3/29/21	Fri 6/18/21
88	Issue Bid Package	10 days	Mon 6/21/21	Fri 7/2/21
89	Bid Period	20 days	Mon 7/5/21	Fri 7/30/21
90	Bid Evaluation	20 days	Mon 8/2/21	Fri 8/27/21
91	Award	0 days	Fri 8/27/21	Fri 8/27/21
92	Pre-Plan, Procure, Mobilize	20 days	Mon 3/7/22	Fri 4/1/22
93	2022 Outage	20 days	Mon 4/4/22	Fri 4/29/22
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
96	Sikeston BMU Annual Budget Approval	23 days	Wed 2/24/21	Fri 3/26/21
97	Develop Drawings and Specs	60 days	Mon 10/11/21	Fri 12/31/21
98	Issue Bid Package	10 days	Mon 9/13/21	Fri 9/24/21
99	Bid Period	20 days	Mon 10/11/21	Fri 11/5/21
100	Bid Evaluation	20 days	Mon 10/11/21	Fri 11/5/21
101	Award	0 days	Wed 10/5/22	Wed 10/5/22
102	Pre-Plan, Procure, Mobilize	20 days	Wed 1/4/23	Tue 1/31/23
103	2023 Outage	20 days	Tue 4/4/23	Mon 5/1/23
104	Final Walkdown & Punchlist	15 days	Tue 5/2/23	Mon 5/22/23
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
108	Geotech Investigation/Permit Drawing Development	130 days	Fri 4/23/21	Thu 10/21/21
109	Permitting with MDNR/USACE	130 days	Fri 10/22/21	Thu 4/21/22
110	Detailed Design	90 days	Fri 10/22/21	Thu 2/24/22
111	Develop Budget Estimate	20 days	Fri 2/25/22	Thu 3/24/22
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
114	Issue Bid Package	10 days	Fri 5/20/22	Thu 6/2/22
115	Bid Period	30 days	Fri 6/3/22	Thu 7/14/22
116	Bid Evaluation	30 days	Fri 7/15/22	Thu 8/25/22
117	Award LNTP	0 days	Thu 8/25/22	Thu 8/25/22
118	Award FNTP	0 days	Tue 10/4/22	Tue 10/4/22
119	Pre-Plan, Procure, and Mobilize	30 days	Fri 8/26/22	Thu 10/6/22
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
122	Dewatering	180 days	Fri 12/30/22	Thu 9/7/23
123	Remove CCR & Underlying Soil from Portion of Pond Bottom	50 days	Fri 1/27/23	Thu 4/6/23
124	Build Divider Berm Construction	45 days	Fri 4/7/23	Thu 6/8/23
125	Install Composite Liner System	40 days	Fri 6/9/23	Thu 8/3/23
126	Install Protective Cover	30 days	Fri 8/4/23	Thu 9/14/23
127	Install Riprap on Pond Slopes	20 days	Fri 9/15/23	Thu 10/12/23
128	Reroute Piping to new LVWW Pond	15 days	Mon 9/25/23	Fri 10/13/23
129	Final Walkdown & Punchlist	15 days	Mon 10/16/23	Fri 11/3/23

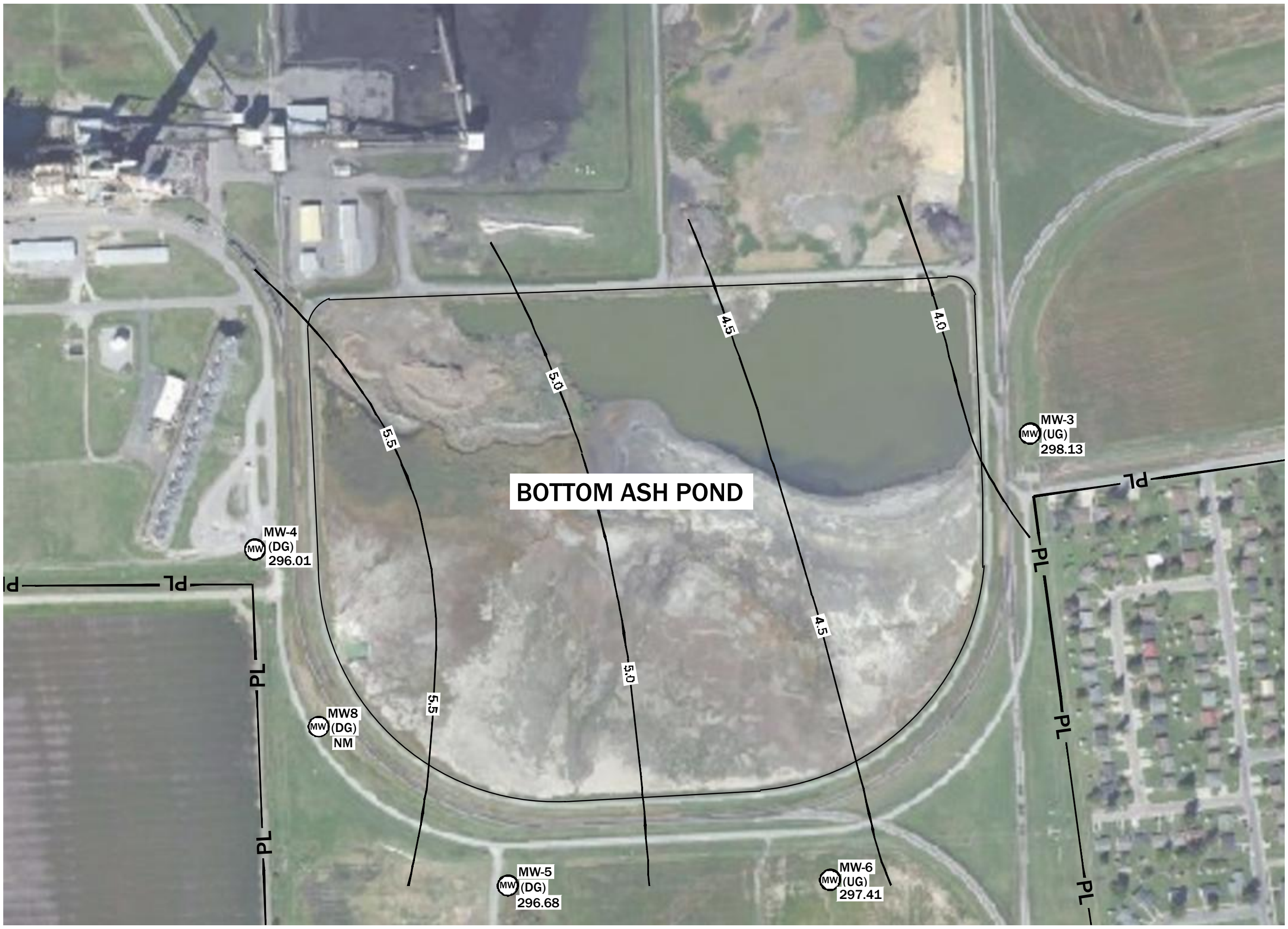


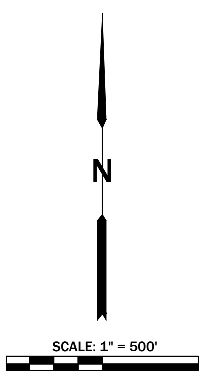
Project: Sikeston CCR Surface Impoundment Extension Demonstration
Date: Mon 11/23/20

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

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 MARCH 27, 2019.
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	297.69	312.77	383119.51	1078467.90
MW-2	298.93	308.01	383207.42	1079751.30
MW-3	298.51	308.55	381130.00	1079946.62
MW-7	297.58	315.03	381584.50	1078847.00
MW-9	297.93	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
GROUNDWATER CONTOUR MAP
MARCH 27, 2019

SIKESTON POWER STATION
FLY ASH POND
2019 ANNUAL GROUNDWATER
MONITORING & REPORT

SURVEYED	DESIGNED	DRAWN	CHECKED	APPROVED	DATE	SCALE	PROJECT NAME	FILE NAME	SHEET #
NA	NA	FL	KE	MCC	8/2019	AS NOTED	SIKESTON/GWMAP/FAP	GWCONT FAP 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

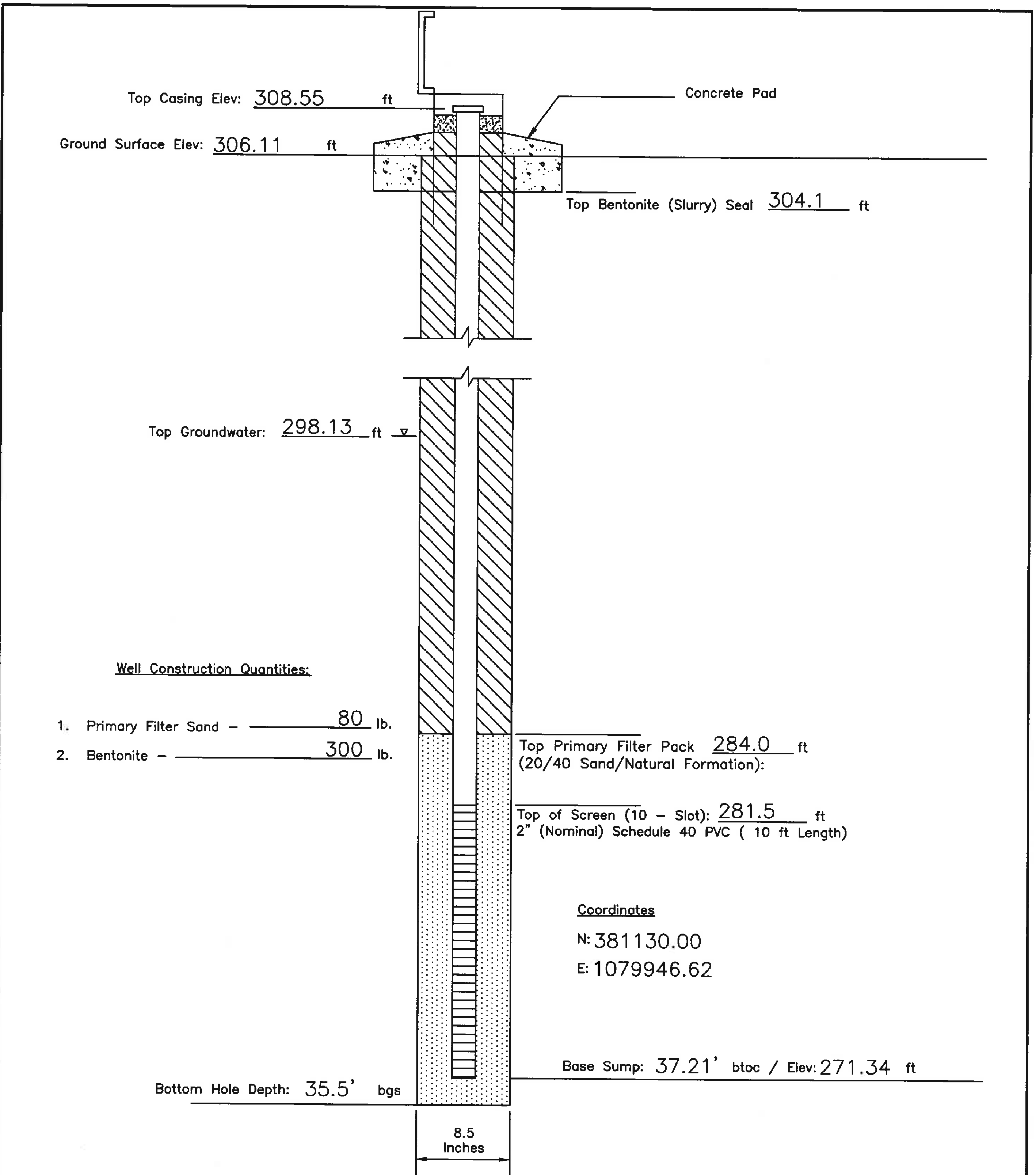
O:\CADDFiles\SIKESTON\GROUNDWATER MAP\FAP\GW CONT MAP FAP.dwg, GW CONT MAP BAP, 7/30/2019 9:59:31 AM

ATTACHMENT D2 – WELL CONSTRUCTION DOCUMENTS

ATTACHMENT D2

GROUNDWATER MONITORING SYSTEM – BOTTOM ASH POND

MONITORING WELL CONSTRUCTION DIAGRAMS AND DRILLING LOGS



TPZ-3/ MW-3	PIEZOMETER CONSTRUCTION DIAGRAM	**GREDELL Engineering Resources, Inc.** ENVIRONMENTAL ENGINEERING LAND AIR WATER			
Date Piezometer Completed: 4-26-16	SBMU - Sikeston Power Station	1505 East High Street Jefferson City, Missouri 65101			Telephone: (573) 659-9078 Facsimile: (573) 659-9079
	Site Characterization - NPDES Compliance	DATE 11/2016	SCALE N.T.S.	DRAWN BY: AJK	APPROVED BY: MCC

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
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		
18	288	72	SAND: Brown (10YR 5/3), fine- to medium-grained sand, trace medium-to coarse-grained sand, round to sub-round, medium dense.
20	286		SAND: Brown (10YR 5/3), fine-grained sand, medium dense.
		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.

Column headings: WELL CONSTRUCTION DIAGRAM; WATER TABLE; GRAPHIC LOG; SAMPLE TYPE; FACIES I.D.; 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: 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
24	282		
		83	SAND: Brown (10YR 4/3), medium-grained sand, few fine-grained sand, trace coarse-grained sand, trace woody (incipient) lignite, loose.
26	280		SILT: Very dark brown (10YR 2/2), well sorted, loose.
			SAND: Brown (10YR 4/3), medium-grained sand, few fine-grained sand, trace coarse-grained sand, trace woody (incipient) lignite, loose.
28	278	89	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.
			SAND: Grayish brown (10YR 5/2) fine- to medium-grained sand, loose.
32	274		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.

Column headings: 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

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.

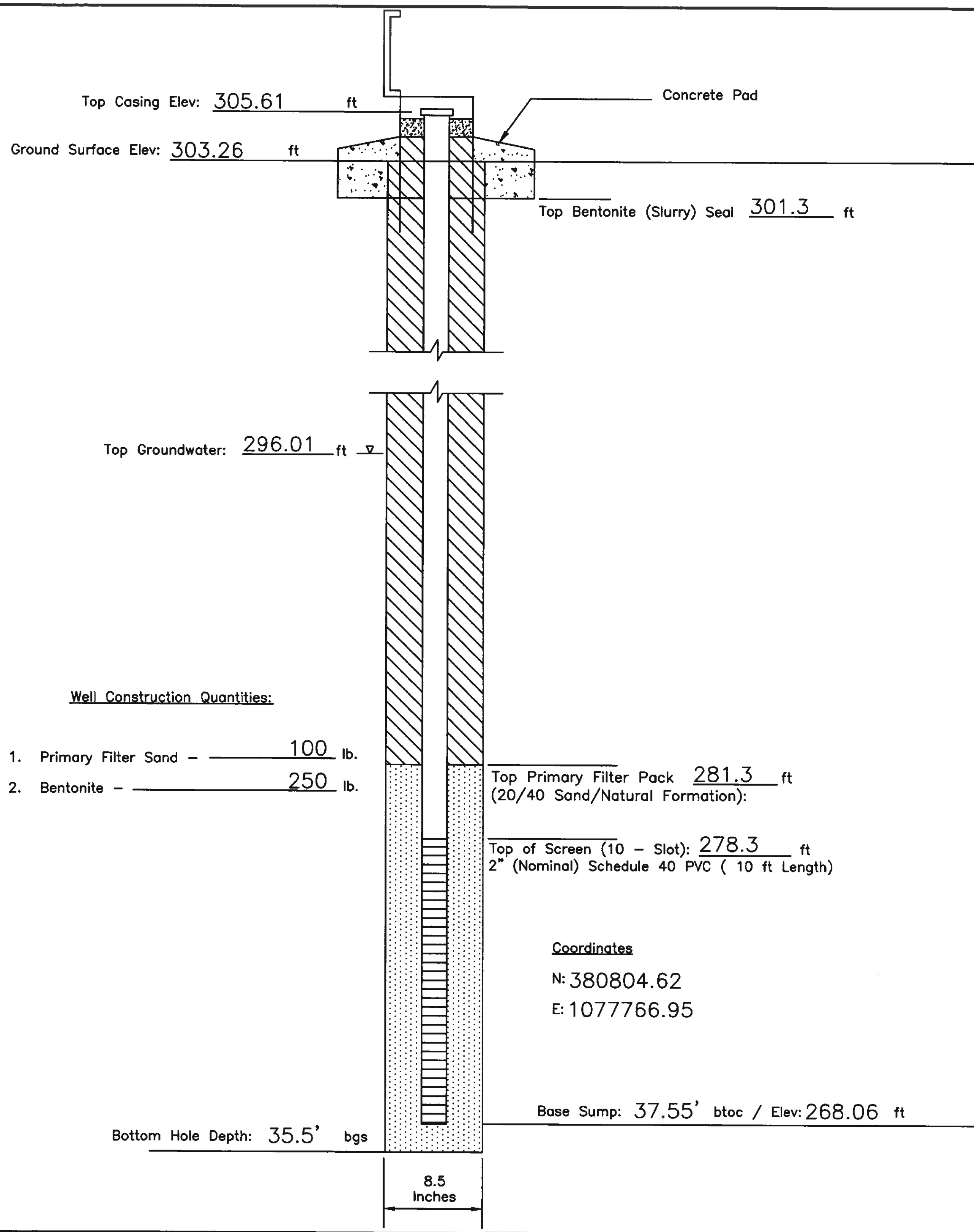
NOTES: Offset boring developed on 5-9-2016 for SPT sampling.

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



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	1505 East High Street, Jefferson City, Missouri 65101 — Telephone: (573) 659-9078, Facsimile: (573) 659-9079
	Site Characterization - NPDES Compliance	DATE 11/2016 — SCALE N.T.S. — DRAWN BY: AJK — APPROVED BY: 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

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION
0 – 1.0	303.3 – 302.3	73	FILL: Crushed stone.
1.0 – 2.0			SILTY SAND: Brown (7.5YR 4/4), fine-grained sand, some silt, trace medium-grained sand, round, gradational lower contact.
2.0 – 6.1			SILTY SAND: Brown (7.5YR 4/4), fine- to medium-grained sand, some silt, round.
6.1 – 8.6		100	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.
8.6 – 10.0			SAND: Brown (7.5YR 5/4), fine- to medium-grained sand, trace small gravel, trace coarse-grained sand, round.
10.0 –		89	SAND: Brown (10YR 5/3), medium-grained sand, round to sub-round; trace silt, trace coarse-grained sand, sub-round; medium dense.

Depth scale: 0, 2, 4, 6, 8, 10. Elevation scale: 302, 300, 298, 296, 294, 292.

Column headings: 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

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	PERCENT RECOVERY	DESCRIPTION
12			
	290	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.
14	288	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
16			SAND: Gray (10YR 5/1), medium-grained sand, few silt, trace fine-grained sand, medium dense.
	286	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.
18	284		
20	282	89	SAND: Grayish brown (10YR 5/2), medium-grained sand, round to sub-round; few small gravel, angular; few coarse sand, angular; medium dense.
22	280	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.

Columns also shown: WELL CONSTRUCTION DIAGRAM, WATER TABLE, GRAPHIC LOG, SAMPLE TYPE, FACIES I.D., 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.

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	PERCENT RECOVERY	DESCRIPTION
24			
	278	67	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.
26			
	276		
28		61	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.
	274		
30		67	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.
	272		
32			
	270		
34		78	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.
	268		Boring Terminated at 35.5 feet in SAND.

Other columns: WELL CONSTRUCTION DIAGRAM, WATER TABLE, GRAPHIC LOG, SAMPLE TYPE, FACIES I.D., LITHOLOGY (CLAY, SILTY CLAY, SILT, VF SAND, F SAND, M SAND, C SAND, VC SAND, SM GRAVEL, LG GRAVEL)

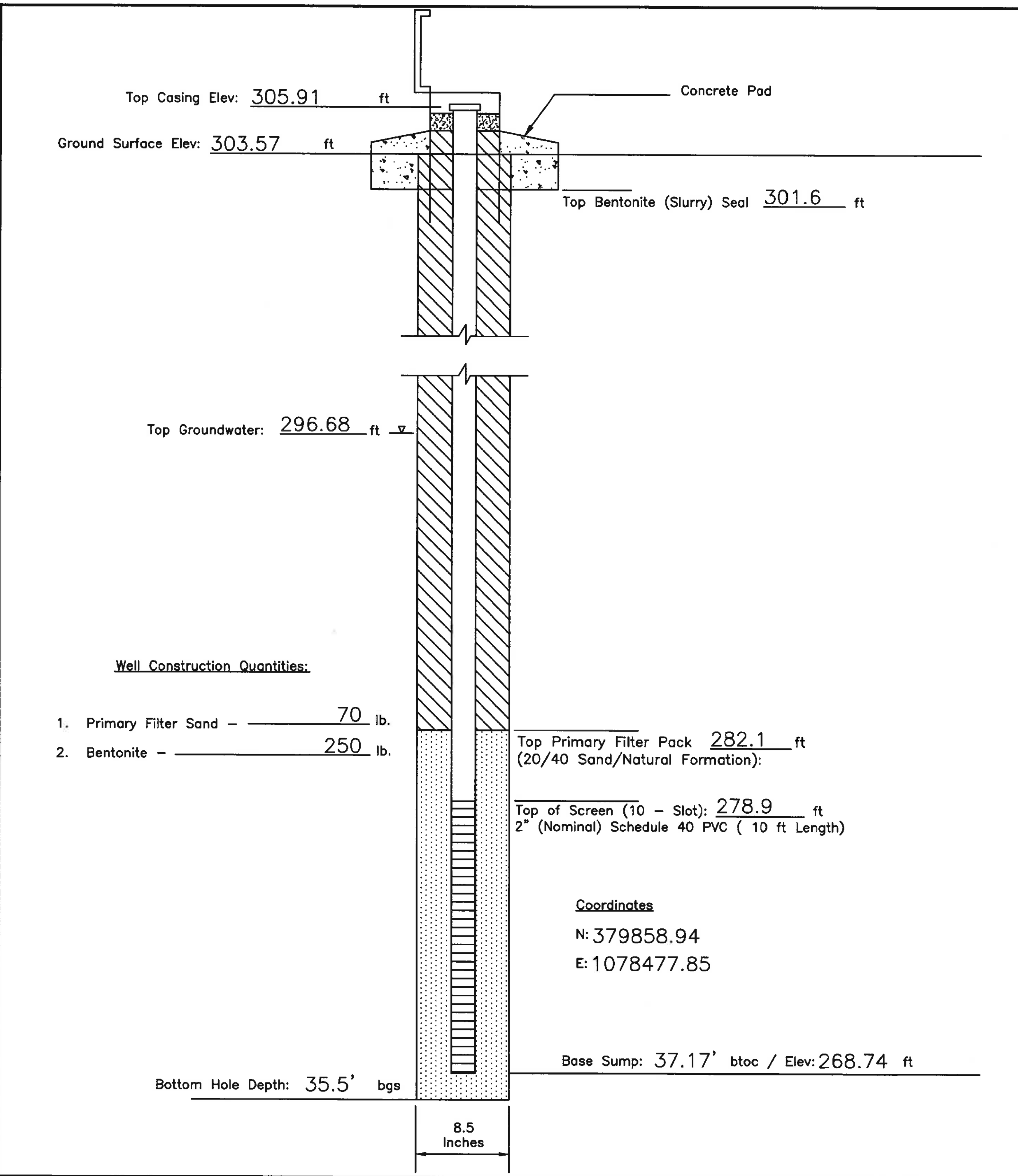
DRILLING CO.: Smith & Company
DRILLER: F. Deken
LOGGED BY: Ken Ewers, R.G.
DATE DRILLED: 4-26-2016
START TIME: 1610 4-26-2016
END TIME: 0838 4-27-2016
BOREHOLE DIA.: 8.5 in.

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.

Date Printed: 8/23/2017



TPZ-5/ MW-5	PIEZOMETER CONSTRUCTION DIAGRAM	GREDELL Engineering Resources, Inc. ENVIRONMENTAL ENGINEERING LAND AIR WATER			
Date Piezometer Completed:	SBMU - Sikeston Power Station	1505 East High Street Jefferson City, Missouri 65101		Telephone: (573) 659-9078 Facsimile: (573) 659-9079	
4-26-16	Site Characterization - NPDES Compliance	DATE 11/2016	SCALE N.T.S.	DRAWN BY: AJK	APPROVED BY: MCC

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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
0			FILL - Asphalt, gravel, aggregate.
2	302	80	SILTY SAND: Dark yellowish brown (10YR 4/4), fine-grained sand, some silt, reddish brown staining/mottling.
4	300		SILTY SAND: Gray (10YR 5/1), fine-grained sand, some silt.
6	298		SILTY SAND: Gray (10YR 5/1), fine-grained sand, some silt and clay, reddish brown stained root molds.
8	296	78	SAND: Brown (10YR 5/3), fine-grained sand, some very fine-grained sand, little silt, loose.
10	294	100	SAND: Yellowish brown (10YR 5/6), fine- to medium-grained, trace coarse-grained sand, round, medium dense.
	292		

Column headings: 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

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

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION
12			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.
	290	100	
14			SAND: Brown (10YR 5/3), medium-grained sand, few fine-grained sand, round to sub-round, medium dense.
	288	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.
16			
	286	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.
18			
	284		
20		89	SAND: Brown (10YR 5/3), medium- to coarse-grained sand, few coarse-grained sand, few small gravel, round to sub-angular, medium dense.
	282		SAND: Brown (10YR 5/3), fine-grained sand with thin beds of lignite.
22			SAND: Brown (10YR 5/3), medium- to coarse-grained sand, few coarse-grained sand, few small gravel, round to sub-angular, medium dense.
	280	94	SAND: Brown (10YR 5/2), fine-grained sand, few silt and very fine-grained sand, round,

Column headings: WELL CONSTRUCTION DIAGRAM, WATER TABLE, GRAPHIC LOG, SAMPLE TYPE, FACIES I.D., 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:	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

DEPTH (FEET)	ELEVATION	SAMPLE TYPE	PERCENT RECOVERY	DESCRIPTION
24				medium dense.
				- dark gray (10YR 4/1).
24.5–26.5	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.
27–29	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.
29.5–32	274, 272		61	SAND: Brown (10YR 5/3), coarse- to very coarse-grained sand, few small gravel, few medium sand, round to angular, medium dense.
33–35	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.
35.5	268			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.
				Boring Terminated at 35.5 feet in SAND.

Column headings also include: WELL CONSTRUCTION DIAGRAM, WATER TABLE, GRAPHIC LOG, FACIES I.D., 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: 1405 4-26-2016
END TIME: 1435 4-26-2016
BOREHOLE DIA.: 8.5 in.

STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.

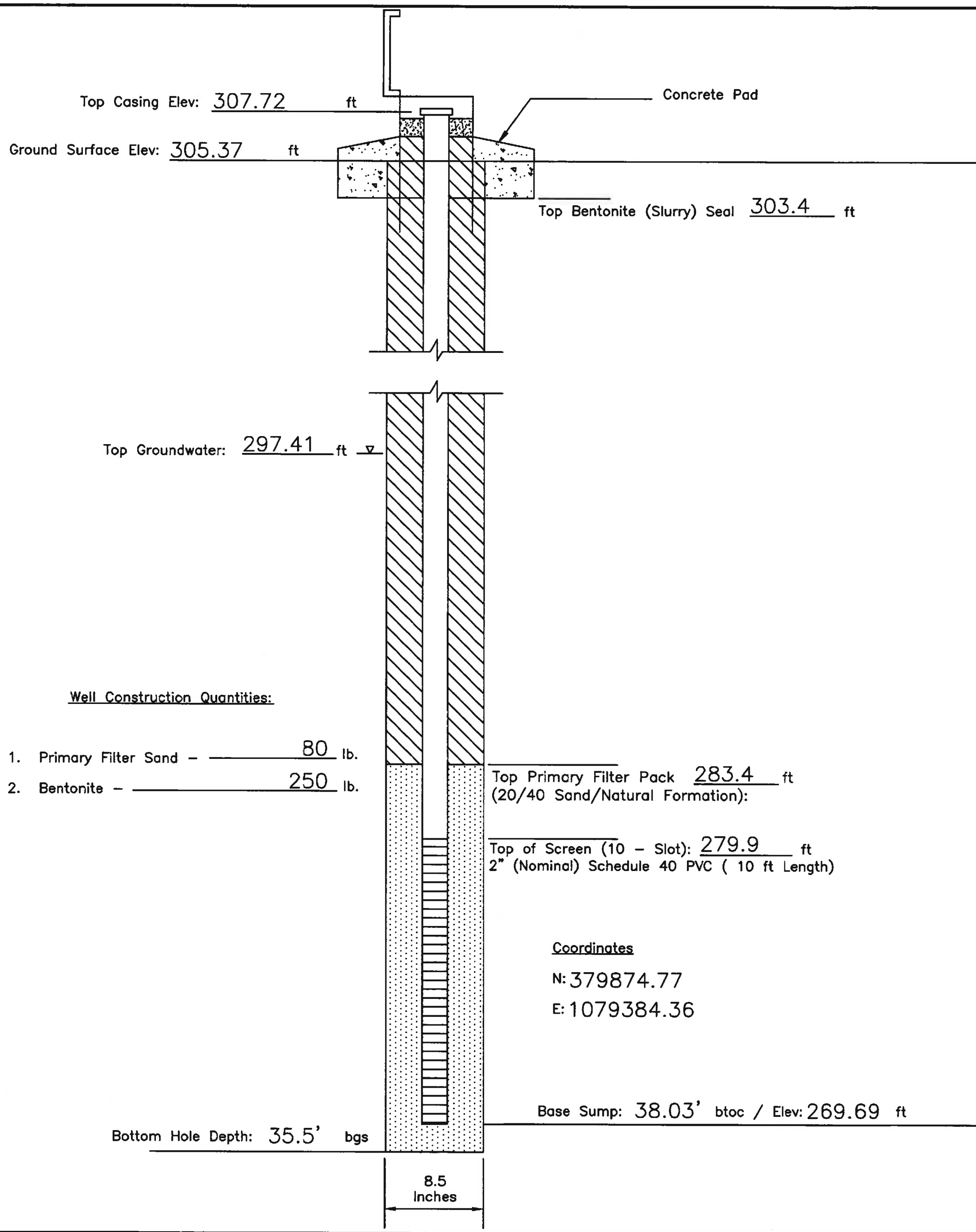
NOTES: Offset boring developed on 5-10-2016 for SPT sampling.

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



TPZ-6/ MW-6	**PIEZOMETER CONSTRUCTION DIAGRAM**	**GREDELL Engineering Resources, Inc.** ENVIRONMENTAL ENGINEERING — LAND AIR WATER
Date Piezometer Completed:	**SBMU - Sikeston Power Station**	1505 East High Street, Jefferson City, Missouri 65101 — Telephone: (573) 659-9078, Facsimile: (573) 659-9079
4-26-16	Site Characterization - NPDES Compliance	DATE 11/2016 — SCALE N.T.S. — DRAWN BY: AJK — APPROVED BY: MCC

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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

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION
0			SILTY SAND: Very dark grayish brown (10YR 3/2), some clay, with roots.
	304		
2		60	
	302		SANDY SILT: Light gray (10YR 7/2), fine-grained sand, leached appearance with reddish 1/4 inch diameter concretions, trace reddish stained clayey laminae.
4			
	300		CLAYEY SAND: Brown (7.5YR 4/4), fine- to medium-grained sand, clayey, non-plastic.
6			
	298	70	SAND: Brown (7.5YR 4/4), fine- to medium-grained sand, trace coarse-grained sand, round.
8			
	296		SAND: Light brownish gray (10YR 6/2), fine-grained sand, round, loose.
10			SAND: Grayish brown (10YR 5/2), fine-grained sand, trace small gravel, round, loose.
	294		

Column headings: 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)

STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.

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.

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

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION
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		67	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		

Column headings: 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)

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

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION
24			
	280	78	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.
26			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.
	278		
28		72	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.
	276		
30			SAND: Grayish brown (10YR 5/2), medium- to coarse-grained sand, few coarse-grained sand, few small gravel, round to sub-angular, medium dense.
		83	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.
	274		
32			
	272		
34		100	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).
	270		
			Boring Terminated at 35.5 feet in SAND.

Column headers: WELL CONSTRUCTION DIAGRAM, WATER TABLE, GRAPHIC LOG, SAMPLE TYPE, FACIES I.D.; LITHOLOGY: CLAY, SILTY CLAY, SILT, VF SAND, F SAND, M SAND, C SAND, VC SAND, SM GRAVEL, LG GRAVEL

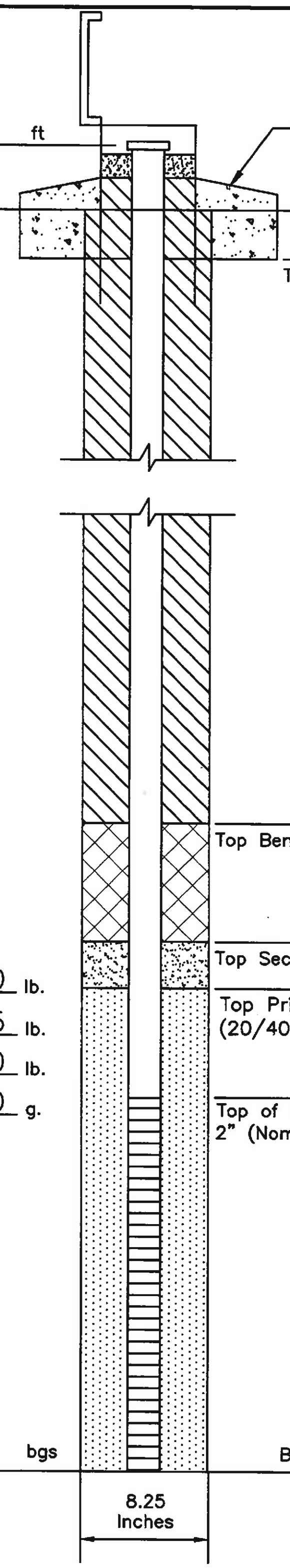
DRILLING CO.: Smith & Company
DRILLER: F. Deken
LOGGED BY: Ken Ewers, R.G.
DATE DRILLED: 4-26-2016
START TIME: 1106 4-26-2016
END TIME: 1239 4-26-2016
BOREHOLE DIA.: 8.5 in.

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



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**
Date Well Completed: 4-19-17	**SBMU - Sikeston Power Station** Groundwater Monitoring & Sampling Plan	1505 East High Street Jefferson City, Missouri 65101 Telephone: (573) 659-9078 Facsimile: (573) 659-9079 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	PERCENT RECOVERY	DESCRIPTION
0	302	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.
2	300		- fine-grained, dark yellowish brown (10YR 4/2).
4	298		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.
6	296		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.
8	294		- very fine- to fine-grained sand, trace medium- and coarse-grained sand, very dark greenish gray (10Y 3/1), trace silt.
10	292		- trace fine gravel.

Column headings: WELL CONSTRUCTION DIAGRAM, WATER TABLE, GRAPHIC LOG, SAMPLE TYPE, FACIES I.D., LITHOLOGY: CLAY, SILTY CLAY, SILT, VF SAND, F SAND, M SAND, C SAND, VC SAND, SM GRAVEL, LG GRAVEL

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

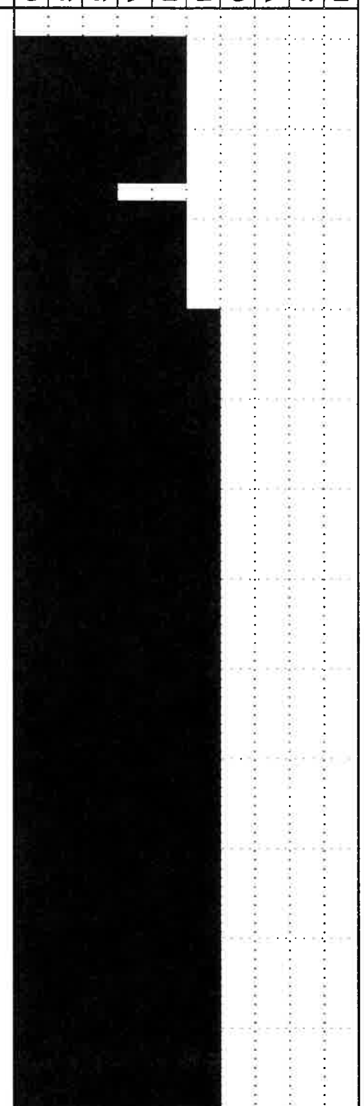
LOCATION: See Plan of Boring Locations

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

NORTHING: 380311.20 **EASTING:** 1077940.08

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION
12	290	94	
14	288		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).
16	286		- medium-grained sand, subrounded, trace fine to coarse angular gravel, trace black lignite (0.43 - 2.0 mm).
18	284	66	
20	282		
22	280		
			- dark grayish brown (10YR 4/2), subrounded to rounded medium-grained sand.

Column headings: 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)



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

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION	LITHOLOGY
24	278	60		CLAY to M SAND
25–28	276		- some coarse-grained sand.	CLAY to C SAND
28–29.8	274	100		CLAY to C SAND
29.8–33.3	272, 270		- very fine-grained sand, subangular to subrounded, trace medium-grained sand, some black lignite (0.08 to 0.22 mm),	CLAY to VF SAND
33.3–35	268	100	- fine- to medium-grained sand, subrounded to subangular, trace coarse-grained sand, trace fine gravel, some black lignite (4.8 - 19 mm).	CLAY to M SAND
35			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

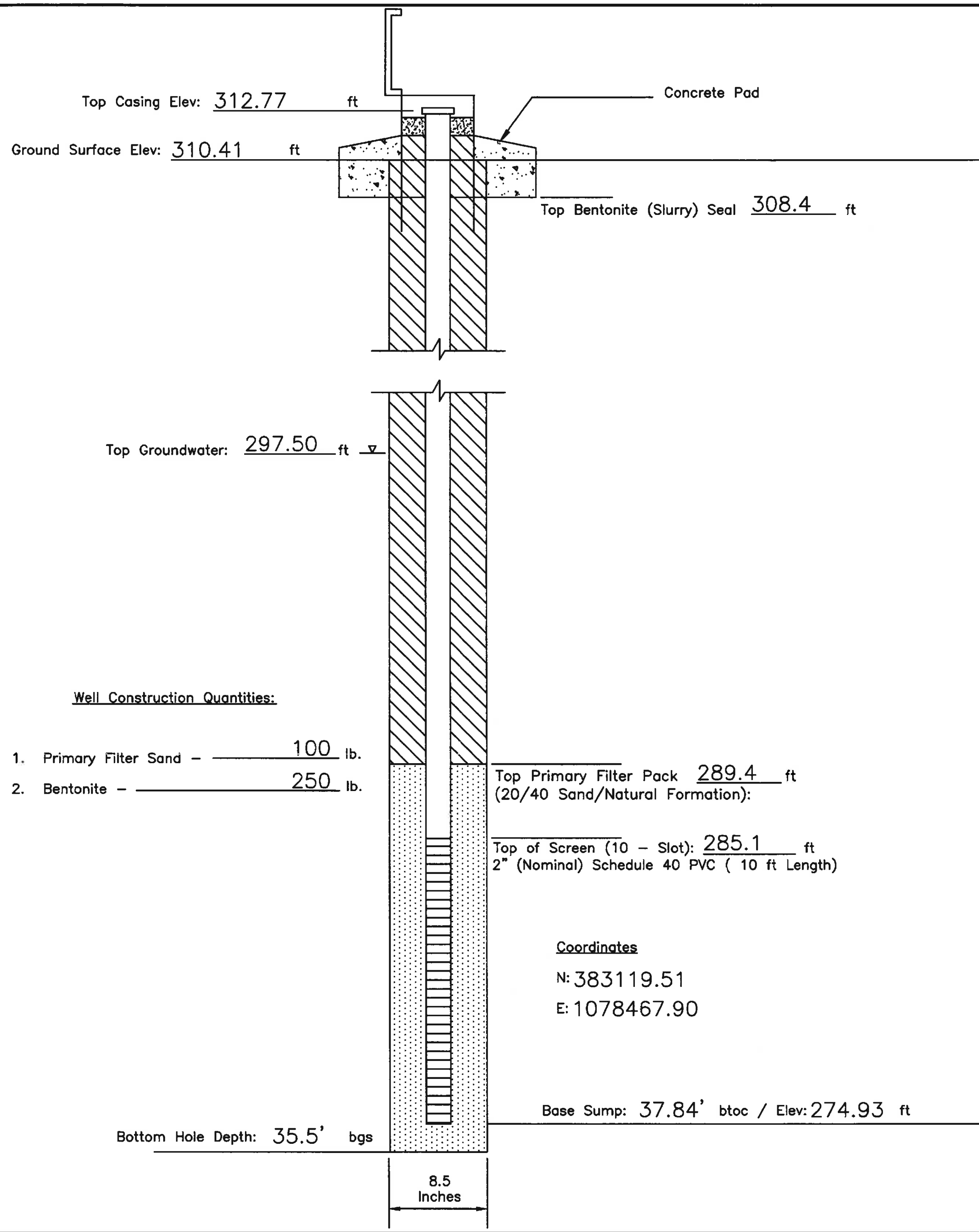
VERTICAL DATUM: NAD 1983
HORIZONTAL DATUM: NAVD 1988
WEATHER: Warm, 75°F, Mostly Sunny, 5 MPH S. Wind, Humid

Date Printed: 8/23/2017

ATTACHMENT D2

GROUNDWATER MONITORING SYSTEM – FLY ASH POND

MONITORING WELL CONSTRUCTION DIAGRAMS AND DRILLING LOGS



TPZ-1/ MW-1	**PIEZOMETER CONSTRUCTION DIAGRAM**	**GREDELL Engineering Resources, Inc.** **ENVIRONMENTAL ENGINEERING** LAND AIR WATER
Date Piezometer Completed:	**SBMU - Sikeston Power Station**	1505 East High Street Jefferson City, Missouri 65101 Telephone: (573) 659-9078 Facsimile: (573) 659-9079
4-25-16	Site Characterization - NPDES Compliance	DATE 11/2016 · SCALE N.T.S. · DRAWN BY: AJK · APPROVED BY: MCC

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GREDELL Engineering Resources, Inc.

BORING LOG TPZ-1/MW-1

NPDES Site Characterization
Sikeston, MO

CLIENT: SBMU-SPS

LOCATION: See Plan of Boring Locations
G.S. ELEVATION: 310.4 **T.O.C. ELEVATION:** 312.77
NORTHING: 383119.51 **EASTING:** 1078467.89

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION
0	310		FILL - CLAY, SOME SILT: Black (7.5YR 2.5/1), medium plasticity, trace small gravel, trace very coarse-grained sand, root hairs present.
2	308	60	FILL - SAND: Brown (7.5YR 5/4), fine-grained sand, some silt, trace medium-grained sand, trace clay, round, moist.
4	306		
6	304	100	
8	302		FILL - SAND AND SILT, SOME CLAY: Dark gray (2.5YR 4/1), medium-grained sand with dark greenish gray (GLEY2 4/1) laminations of medium dense clayey silt.
		100	SILT, SOME CLAY: Dark gray (2.5Y 4/1), few sand and organic material, low plasticity, medium dense, root hairs present.
10	300		
			SAND: Greenish gray (GLEY2 5/1), fine-

Other columns: WELL CONSTRUCTION DIAGRAM, WATER TABLE, GRAPHIC LOG, SAMPLE TYPE, FACIES I.D., 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: 4-25-2016
START TIME: 1405 4-25-2016
END TIME: 1605 4-25-2016
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: 297.50 FEET
DATE: 5-12-2016

PIEZOMETER: INSTALLED AT +/- 35.5 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-1/MW-1

NPDES Site Characterization
Sikeston, MO

CLIENT: SBMU-SPS

LOCATION: See Plan of Boring Locations
G.S. ELEVATION: 310.4 **T.O.C. ELEVATION:** 312.77
NORTHING: 383119.51 **EASTING:** 1078467.89

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION
12	298	100	grained sand, silty, firm, root hairs present.
14	296		CLAY: Greenish gray (GLEY2 5/1), few fine-grained sand, firm to soft, medium to low plasticity, two-inch thick interbeds of medium-grained sand, wet, few reddish mottles.
16	294	80	
18	292		SAND: Reddish gray (2.5YR 5/1), fine-grained sand, trace organic/carbonaceous silty material as black laminae.
20	290		
22	288	100	- grading to fine- to medium-grained sand.
			SAND: Reddish gray (2.5YR 5/1), fine- to medium-grained sand, round; little coarse-grained sand, few small gravel round to sub-

Column headings: 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)

DRILLING CO.: Smith & Company
DRILLER: F. Deken
LOGGED BY: Ken Ewers, R.G.
DATE DRILLED: 4-25-2016
START TIME: 1405 4-25-2016
END TIME: 1605 4-25-2016
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: 297.50 FEET
DATE: 5-12-2016
PIEZOMETER: INSTALLED AT +/- 35.5 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-1/MW-1

NPDES Site Characterization
Sikeston, MO

CLIENT: SBMU-SPS

LOCATION: See Plan of Boring Locations
G.S. ELEVATION: 310.4 **T.O.C. ELEVATION:** 312.77
NORTHING: 383119.51 **EASTING:** 1078467.89

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION	FACIES I.D.
24	286		angular.	
25–27	284	67	SAND: Grayish brown (10YR 5/2), medium-grained sand, some fine-grained sand, trace coarse-grained sand, trace small gravel, medium dense.	
27–29	282	89	SAND: Grayish brown (10YR 5/2), medium-grained sand, some fine-grained sand, trace coarse-grained sand, trace small gravel, medium dense.	
30	280	67	SAND: Very dark grayish brown (10YR 3/2), medium-grained sand, little small gravel, little fine-grained sand, few coarse-grained sand, poorly sorted, round to angular, medium dense.	
32–34	278, 276	72	SAND: Very dark grayish brown (10YR 3/2), medium-grained sand, little small gravel, little fine-grained sand, few coarse-grained sand, round to angular; few large gravel, angular, poorly sorted, medium dense.	
			Boring Terminated at 35.5 feet in SAND.	

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

Columns: WELL CONSTRUCTION DIAGRAM, WATER TABLE, GRAPHIC LOG, SAMPLE TYPE

DRILLING CO.: Smith & Company
DRILLER: F. Deken
LOGGED BY: Ken Ewers, R.G.
DATE DRILLED: 4-25-2016
START TIME: 1405 4-25-2016
END TIME: 1605 4-25-2016
BOREHOLE DIA.: 8.5 in.

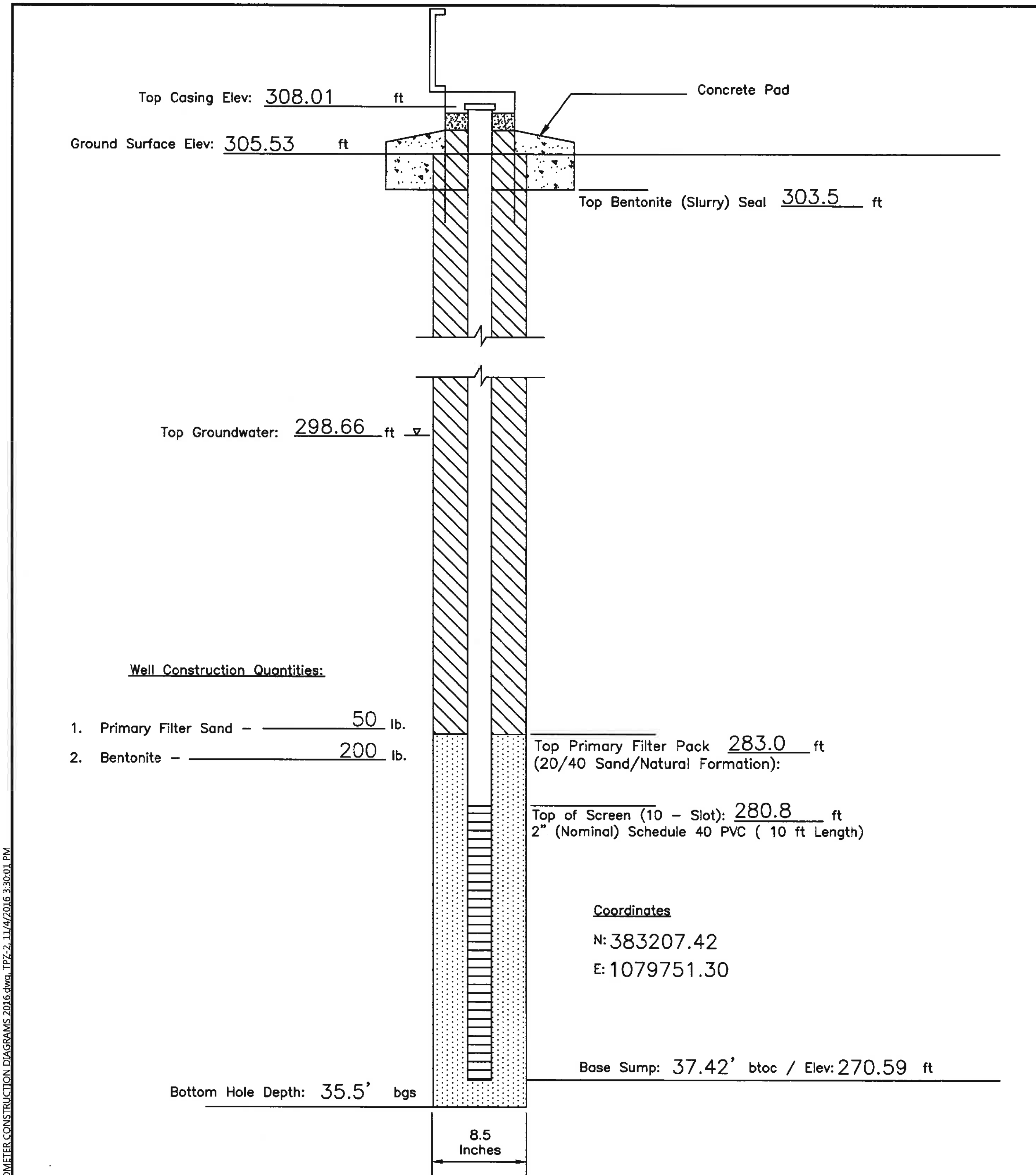
STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.

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

WATER LEVELS: DURING DRILLING NA FEET
AFTER DRILLING: 297.50 FEET
DATE: 5-12-2016

PIEZOMETER: INSTALLED AT +/- 35.5 FEET
VERTICAL DATUM: NAVD 1988
HORIZONTAL DATUM: NAD 1983
WEATHER: 70 degrees, wind south 10 MPH, sunny.

Date Printed: 8/23/2017



TPZ-2/ MW-2	PIEZOMETER CONSTRUCTION DIAGRAM	GREDELL Engineering Resources, Inc. ENVIRONMENTAL ENGINEERING LAND AIR WATER		
Date Piezometer Completed: 4-25-16	SBMU - Sikeston Power Station	1505 East High Street Jefferson City, Missouri 65101		Telephone: (573) 659-9078 Facsimile: (573) 659-9079
	Site Characterization - NPDES Compliance	DATE 11/2016	SCALE N.T.S.	DRAWN BY: AJK / APPROVED BY: MCC

GREDELL Engineering Resources, Inc.

BORING LOG TPZ-2/MW-2

NPDES Site Characterization
Sikeston, MO

CLIENT: SBMU-SPS

LOCATION: See Plan of Boring Locations
G.S. ELEVATION: 305.5 **T.O.C. ELEVATION:** 308.01
NORTHING: 383207.42 **EASTING:** 1079751.30

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							SILTY SAND: Brown (7.5YR 5/4), some clay.		
2	304					80	CLAYEY SAND: Brown (7.5YR 5/4), fine-grained sand, some clay and silt, strong brown (7.5YR 5/8) staining or mottling, few 1/4 inch-diameter cemented nodules.		
4	302						- graded transition.		
6	300						SAND: Brown (7.5YR 5/4), fine- to medium-grained sand, rounded.		
8	298					72	SAND: Light brown (7.5YR 6/4), fine- to medium-grained sand, rounded, trace small gravel, trace coarse-grained sand, round to sub-angular.		
10	296						SAND: Strong brown (7.5YR 5/6), medium-grained sand, trace coarse-grained sand, trace small gravel, rounded.		
	294								

DRILLING CO.:	Smith & Company
DRILLER:	F. Deken
LOGGED BY:	Ken Ewers, R.G.
DATE DRILLED:	4-25-2016
START TIME:	1015 4-25-2016
END TIME:	1138 4-25-2016
BOREHOLE DIA.:	8.5 in.

STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.

NOTES: Offset boring developed on 5-11-2016 for SPT sampling.

WATER LEVELS: DURING DRILLING NA FEET
AFTER DRILLING: 298.66 FEET
DATE: 5-12-2016

PIEZOMETER: INSTALLED AT +/- 35.0 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-2/MW-2

NPDES Site Characterization
Sikeston, MO

CLIENT: SBMU-SPS

LOCATION: See Plan of Boring Locations
G.S. ELEVATION: 305.5 **T.O.C. ELEVATION:** 308.01
NORTHING: 383207.42 **EASTING:** 1079751.30

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION
12		75	
	292		
14			
	290	100	SAND: Yellowish brown (10YR 5/4), medium-grained sand, few fine-grained sand, round to sub-round, few silt and very fine-grained sand, trace coarse-grained sand, medium dense.
16			- grading to fine- to medium-grained sand.
	288		
18		94	SAND: Yellowish brown (10YR 5/4), medium-grained sand, few fine-grained sand, round to sub-round; few small and large gravel, very angular; few silt, poorly sorted, medium dense.
	286		
20		83	SILTY SAND: Dark yellowish brown (10YR 4/4), medium-grained sand, some silt, few fine- to very fine-grained sand, round to sub-round, medium dense.
	284		
22			
	282	94	SILTY SAND: Dark yellowish brown (10YR 4/4), medium-grained sand, little silt, few fine- to very fine-grained sand, trace medium- to coarse-grained sand, round to sub-round,

Column headings: 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

DRILLING CO.: Smith & Company
DRILLER: F. Deken
LOGGED BY: Ken Ewers, R.G.
DATE DRILLED: 4-25-2016
START TIME: 1015 4-25-2016
END TIME: 1138 4-25-2016
BOREHOLE DIA.: 8.5 in.

STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.

NOTES: Offset boring developed on 5-11-2016 for SPT sampling.

WATER LEVELS: DURING DRILLING NA FEET
AFTER DRILLING: 298.66 FEET
DATE: 5-12-2016
PIEZOMETER: INSTALLED AT +/- 35.0 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-2/MW-2

NPDES Site Characterization
Sikeston, MO

CLIENT: SBMU-SPS

LOCATION: See Plan of Boring Locations
G.S. ELEVATION: 305.5 **T.O.C. ELEVATION:** 308.01
NORTHING: 383207.42 **EASTING:** 1079751.30

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION
24			medium dense, poorly sorted.
26	280	61	SAND: Dark grayish brown (10YR 4/2), medium-grained sand, few silt, round to sub-round, medium dense. Few 1-inch thick lenses of medium- to coarse-grained sand.
28	278	67	SAND: Brown (10YR 5/3), medium- to coarse-grained sand, few coarse-grained sand, round to sub-round; few small gravel, round to angular; trace silt, poorly sorted, medium dense.
30	276	61	SAND: Brown (10YR 5/3), medium- to coarse-grained sand, few coarse-grained sand, few small and large gravel, sub-round to sub-angular; trace silt, poorly sorted, medium dense.
32	274		
34	272	11	SAND: Brown (10YR 5/3), medium- to coarse-grained sand, little coarse-grained sand, round to sub-round; few small and large gravel, sub-round to angular; trace silt, poorly sorted, medium dense.
	270		Boring Terminated at 35.5 feet in SAND.

Column headings: WELL CONSTRUCTION DIAGRAM, WATER TABLE, GRAPHIC LOG, SAMPLE TYPE, FACIES I.D.; 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: 4-25-2016
START TIME: 1015 4-25-2016
END TIME: 1138 4-25-2016
BOREHOLE DIA.: 8.5 in.

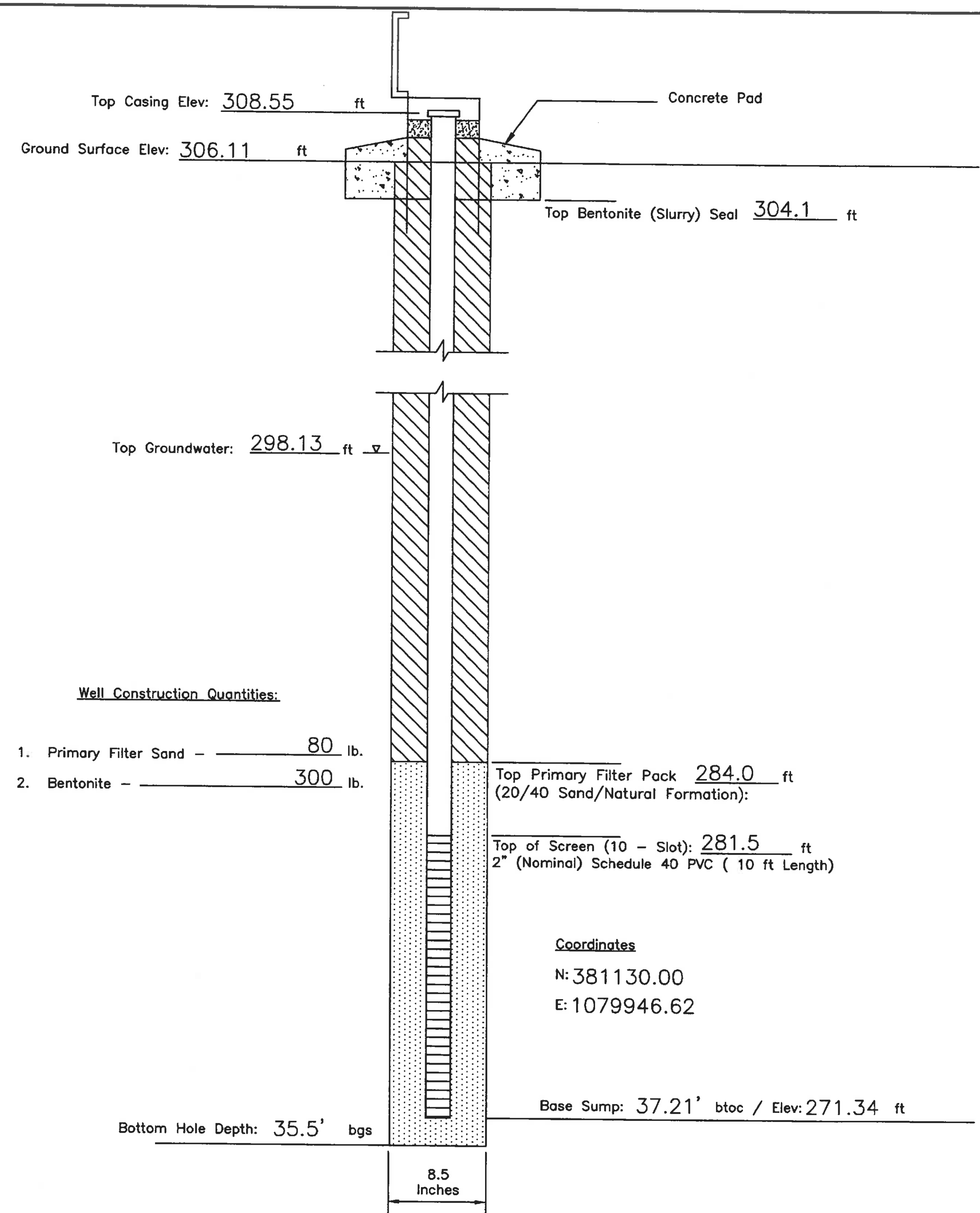
STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.

NOTES: Offset boring developed on 5-11-2016 for SPT sampling.

WATER LEVELS: DURING DRILLING NA FEET
AFTER DRILLING: 298.66 FEET
DATE: 5-12-2016

PIEZOMETER: INSTALLED AT +/- 35.0 FEET
VERTICAL DATUM: NAVD 1988
HORIZONTAL DATUM: NAD 1983
WEATHER: 70 degrees, wind south 10 MPH, sunny.

Date Printed: 8/23/2017



TPZ-3/ MW-3	PIEZOMETER CONSTRUCTION DIAGRAM	**GREDELL Engineering Resources, Inc.** ENVIRONMENTAL ENGINEERING LAND AIR WATER
Date Piezometer Completed: 4-26-16	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

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
0	306	88	SILTY SAND: Very dark brown (10YR 2/2), some clay, with roots.
2	304		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	67	SAND: Dark yellowish brown (10YR 4/6), fine-grained sand, few very fine-grained sand, trace medium-grained sand, round.
8	298		
10	296		SAND: Dark yellowish brown (10YR 3/4), fine-grained sand, trace medium-grained sand, trace coarse-grained sand, round.

Column headings: WELL CONSTRUCTION DIAGRAM; WATER TABLE; GRAPHIC LOG; SAMPLE TYPE; FACIES I.D.; 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: 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	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
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																	
18	288					72	SAND: Brown (10YR 5/3), fine- to medium-grained sand, trace medium-to coarse-grained sand, round to sub-round, medium dense.											
20	286					78	SAND: Brown (10YR 5/3), fine-grained sand, medium dense.											
22	284						SAND: Brown (10YR 5/3), fine-grained sand, medium dense, few reddish laminae underlain by black laminae.											
						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

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION
24	282		
		83	SAND: Brown (10YR 4/3), medium-grained sand, few fine-grained sand, trace coarse-grained sand, trace woody (incipient) lignite, loose.
26	280		SILT: Very dark brown (10YR 2/2), well sorted, loose.
			SAND: Brown (10YR 4/3), medium-grained sand, few fine-grained sand, trace coarse-grained sand, trace woody (incipient) lignite, loose.
28	278	89	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.

Column headings: 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)

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.

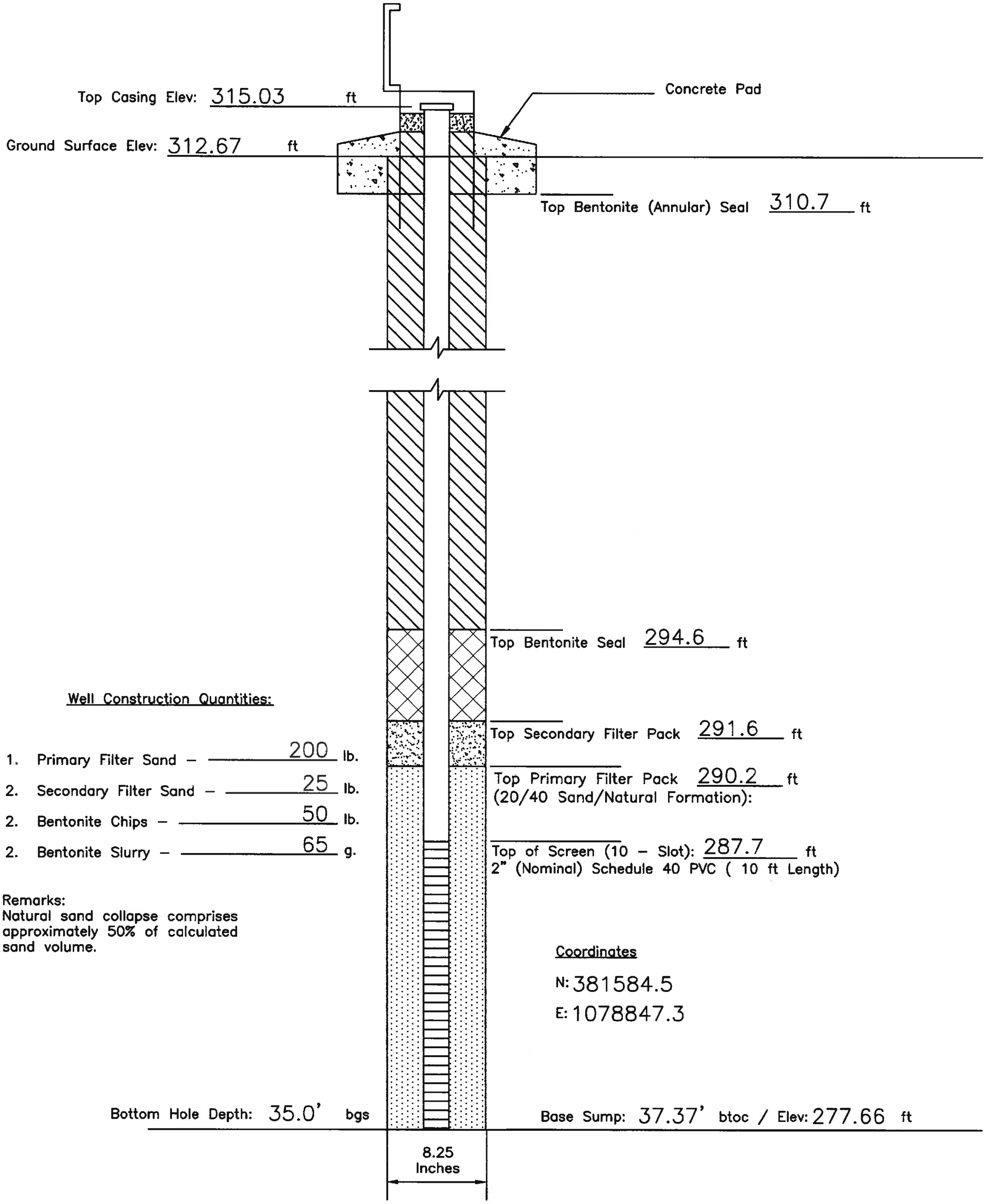
NOTES: Offset boring developed on 5-9-2016 for SPT sampling.

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



MW-7	MONITORING WELL CONSTRUCTION DIAGRAM	GREDELL Engineering Resources, Inc. ENVIRONMENTAL ENGINEERING LAND AIR WATER
Date Well Completed: 4-18-17	SBMU - Sikeston Power Station Groundwater Monitoring & Sampling Plan	1505 East High Street Jefferson City, Missouri 65101 Telephone: (573) 659-9078 Facsimile: (573) 659-9079
		DATE 9/2017 · SCALE N.T.S. · DRAWN BY: AJK · APPROVED BY: MCC

GREDELL Engineering Resources, Inc.

BORING LOG MW-7

CCR Rule Compliance

1551 W. Wakefield Ave., Sikeston, MO

CLIENT: SBMU Sikeston Power Station

LOCATION: See Plan of Boring Locations

G.S. ELEVATION: 312.7 **T.O.C. ELEVATION:** 315.03

NORTHING: 381584.50 **EASTING:** 1078847.26

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION	LITHOLOGY
0			FILL: Grass/Sandy Silt; Dark brown, moist, soft, roots.	
	312		FILL: Sand; Dark yellowish brown (10YR 4/6), moist, loose, fine-grained, trace medium-grained sand.	
2		81	- very dark gray (5GY 4/1).	
4	308		FILL: Sandy Clay; Very dark gray (5GY 4/1), moist, firm, low to medium plasticity, trace fine gravel.	
			- trace coarse gravel.	
6	306		SAND: Very dark grayish brown (10YR 3/2), moist, dense, very fine-grained, trace fine- and medium-grained sand.	CLAY–VF SAND
8	304	84	- dark grayish brown (10YR 4/2).	CLAY–VF SAND
10	302		SILTY SAND: Dark grayish brown (10YR 4/2), stained brown (7.5YR 4/3), very fine-	CLAY–VF SAND

Columns also printed: WELL CONSTRUCTION DIAGRAM, WATER TABLE, GRAPHIC LOG, SAMPLE TYPE, FACIES I.D.; LITHOLOGY: CLAY, SILTY CLAY, SILT, VF SAND, F SAND, M SAND, C SAND, VC SAND, SM GRAVEL, LG GRAVEL.

DRILLING CO.: Bulldog Drilling, Inc.
DRILLER: Chad Dutton
LOGGED BY: Travis Doll
DATE DRILLED: 04-18-17
START TIME: 1349
END TIME: 1553
BOREHOLE DIA.: 8.25"

STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.

NOTES:

WATER LEVELS: DURING DRILLING 14.7 FEET; AFTER DRILLING: 16.6 FEET; DATE: 04-18-17

PIEZOMETER: INSTALLED AT +/- 37.37 FEET

VERTICAL DATUM: NAD 1983
HORIZONTAL DATUM: NAVD 1988
WEATHER: Warm, 75°F, Partly Cloudy, Humid

GREDELL Engineering Resources, Inc.

BORING LOG MW-7

CCR Rule Compliance
1551 W. Wakefield Ave., Sikeston, MO
CLIENT: SBMU Sikeston Power Station

LOCATION: See Plan of Boring Locations
G.S. ELEVATION: 312.7 **T.O.C. ELEVATION:** 315.03
NORTHING: 381584.50 **EASTING:** 1078847.26

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION
12			grained.
	300	76	- greenish gray (5GY 5/1), trace clay.
			SAND: Brown (10YR 5/3), moist, fine-grained, subrounded.
			- medium-grained sand, trace coarse-grained sand.
14	298		
16			- dark yellowish brown (10YR 4/6), fine-grained sand, trace medium-grained sand, subangular.
	296	70	
18	294		
20	292		- some very fine-grained sand, trace black staining.
			- trace coarse-grained sand.
22	290	76	- trace fine and coarse gravel, subangular.

Column headings: 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)

DRILLING CO.: Bulldog Drilling, Inc.
DRILLER: Chad Dutton
LOGGED BY: Travis Doll
DATE DRILLED: 04-18-17
START TIME: 1349
END TIME: 1553
BOREHOLE DIA.: 8.25"

STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.

NOTES:

WATER LEVELS: DURING DRILLING 14.7 FEET; AFTER DRILLING: 16.6 FEET; DATE: 04-18-17
PIEZOMETER: INSTALLED AT +/- 37.37 FEET
VERTICAL DATUM: NAD 1983
HORIZONTAL DATUM: NAVD 1988
WEATHER: Warm, 75°F, Partly Cloudy, Humid

Date Printed: 8/23/2017

GREDELL Engineering Resources, Inc.

BORING LOG MW-7

CCR Rule Compliance

1551 W. Wakefield Ave., Sikeston, MO

CLIENT: SBMU Sikeston Power Station

LOCATION: See Plan of Boring Locations

G.S. ELEVATION: 312.7 **T.O.C. ELEVATION:** 315.03

NORTHING: 381584.50 **EASTING:** 1078847.26

DEPTH (FEET)	ELEVATION	WELL CONSTRUCTION DIAGRAM	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	DESCRIPTION	FACIES I.D.	LITHOLOGY
24	288								
26	286					70	- yellowish brown (10YR 5/4), fine- to medium-grained sand, trace coarse-grained sand.		
28	284								
30	282						- trace fine gravel.		
32	280					60	- some black lignite (0.08 - 0.43 mm). - fine- to coarse-grained sand. - very fine- to fine-grained sand, some medium- to coarse- grained sand, rounded to subrounded, trace fine to coarse subangular gravel.		
34	278								
							Boring terminated at 35.0 feet in Sand.		

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

DRILLING CO.: Bulldog Drilling, Inc.
DRILLER: Chad Dutton
LOGGED BY: Travis Doll
DATE DRILLED: 04-18-17
START TIME: 1349
END TIME: 1553
BOREHOLE DIA.: 8.25"

STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.

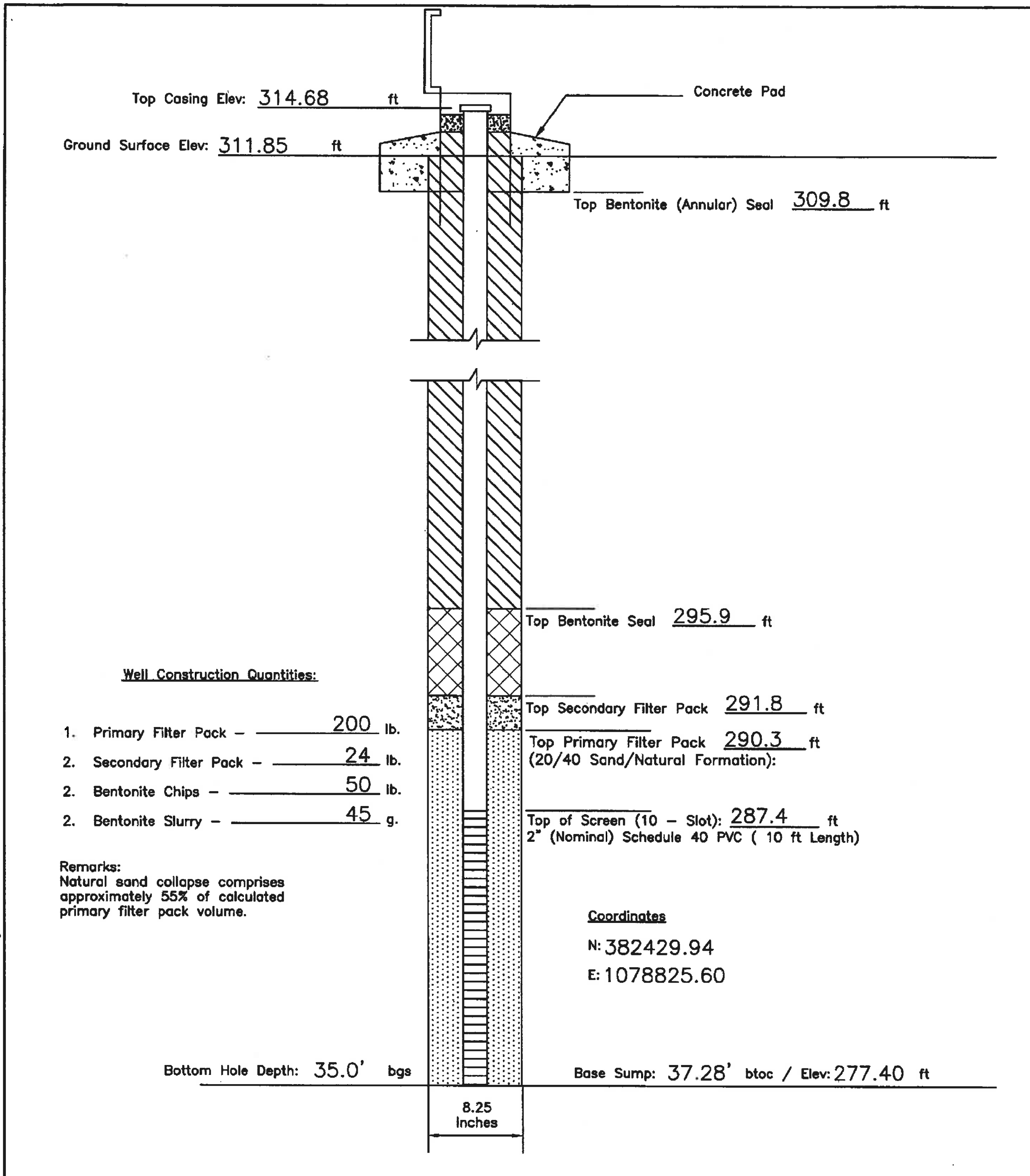
NOTES:

WATER LEVELS: DURING DRILLING 14.7 FEET
AFTER DRILLING: 16.6 FEET
DATE: 04-18-17

PIEZOMETER: INSTALLED AT +/- 37.37 FEET

VERTICAL DATUM: NAD 1983
HORIZONTAL DATUM: NAVD 1988
WEATHER: Warm, 75°F, Partly Cloudy, Humid

Date Printed: 8/23/2017



MW-9	**MONITORING WELL CONSTRUCTION DIAGRAM**	**GREDELL Engineering Resources, Inc.** **ENVIRONMENTAL ENGINEERING** **LAND AIR WATER**			
Date Well Completed: 11-14-17	**SBMU - Sikeston Power Station**	1505 East High Street Jefferson City, Missouri 65101			Telephone: (573) 659-9078 Facsimile: (573) 659-9079
	Groundwater Monitoring & Sampling Plan	DATE 12/2017	SCALE N.T.S.	DRAWN BY: CP	APPROVED BY: KE

M:\Share\CADDFiles\SIKESTON\DSN\GROUNDWATER MONITORING WELL CONSTRUCTION DIAGRAM.dwg, MW-9, 1/2/2018 2:11:37 PM

GREDELL Engineering Resources, Inc.

BORING LOG MW-9

Groundwater Monitoring and Sampling
1551 W. Wakefield Ave., Sikeston, MO

CLIENT: SBMU Sikeston Power Station

LOCATION: See Plan of Boring Locations
G.S. ELEVATION: 311.85 **T.O.C. ELEVATION:** 314.68
NORTHING: 382429.94 **EASTING:** 1078825.60

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION	LITHOLOGY
0			FILL: Grass/Sandy Silt; Dark brown, moist, soft, roots.	
			FILL: Clayey Fine Sand; Yellowish brown (10YR 5/6), moist, loose, fine-grained, trace large gravel.	
2	310	72	FILL: Silty Clay; Very dark greenish gray (Gley1 10GY/3), moist, firm, high plasticity, trace brown mottling.	
4	308		CLAYEY SAND: Very dark greenish gray (Gley1 10GY/3), dense, fine-grained.	CLAY – SILTY CLAY
6	306		SAND: Dark grayish brown (10YR 4/2), moist, dense, fine-grained, few silt.	CLAY – F SAND
8	304	90	- yellowish brown (10YR 5/6), little medium-grained, little silt.	CLAY – F SAND
10	302		- few medium-grained, clean.	CLAY – F SAND
	300			

Columns also shown: WELL CONSTRUCTION DIAGRAM, WATER TABLE, GRAPHIC LOG, SAMPLE TYPE, FACIES I.D.; LITHOLOGY: CLAY, SILTY CLAY, SILT, VF SAND, F SAND, M SAND, C SAND, VC SAND, SM GRAVEL, LG GRAVEL

DRILLING CO.: Bulldog Drilling, Inc.
DRILLER: Chad Dutton
LOGGED BY: Ken Ewers
DATE DRILLED: 11-13-17
START TIME: 1148
END TIME: 1352
BOREHOLE DIA.: 8.25"

STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.

NOTES:

WATER LEVELS: DURING DRILLING 17.0 FEET
AFTER DRILLING: 17.3 FEET
DATE: 11-14-17

PIEZOMETER: INSTALLED AT +/- 34.35 FEET

VERTICAL DATUM: NAD 1983
HORIZONTAL DATUM: NAVD 1988
WEATHER: Cool, 45°F, Partly Cloudy, Wind NNE 5-10

Date Printed: 12/22/2017

GREDELL Engineering Resources, Inc.

BORING LOG MW-9

Groundwater Monitoring and Sampling
1551 W. Wakefield Ave., Sikeston, MO

CLIENT: SBMU Sikeston Power Station

LOCATION: See Plan of Boring Locations
G.S. ELEVATION: 311.85 **T.O.C. ELEVATION:** 314.68
NORTHING: 382429.94 **EASTING:** 1078825.60

Columns: 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

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION
12		83	
14	298		- some medium-grained, trace silt.
16	296		SAND: dark yellowish brown (10YR 4/6), dense, medium-grained, some fine-grained, clean.
			- wet.
18	294	82	
			- some fine-grained, trace coarse-grained, trace small gravel, lignite lamination at 19 ft.
20	292		
22	290	85	- little fine-grained, few coarse-grained, trace small gravel.
	288		SAND: Dark yellowish brown (10YR 4/6), dense, fine-grained, trace medium-grained, clean.

DRILLING CO.: Bulldog Drilling, Inc.
DRILLER: Chad Dutton
LOGGED BY: Ken Ewers
DATE DRILLED: 11-13-17
START TIME: 1148
END TIME: 1352
BOREHOLE DIA.: 8.25"

STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.

NOTES:

WATER LEVELS: DURING DRILLING 17.0 FEET
AFTER DRILLING: 17.3 FEET
DATE: 11-14-17

PIEZOMETER: INSTALLED AT +/- 34.35 FEET

VERTICAL DATUM: NAD 1983
HORIZONTAL DATUM: NAVD 1988
WEATHER: Cool, 45°F, Partly Cloudy, Wind NNE 5-10

Date Printed: 12/22/2017

GREDELL Engineering Resources, Inc.

BORING LOG MW-9

Groundwater Monitoring and Sampling
1551 W. Wakefield Ave., Sikeston, MO

CLIENT: SBMU Sikeston Power Station

LOCATION: See Plan of Boring Locations
G.S. ELEVATION: 311.85 **T.O.C. ELEVATION:** 314.68
NORTHING: 382429.94 **EASTING:** 1078825.60

Columns: 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)

Depth scale: 24, 26, 28, 30, 32, 34. Elevation scale: 286, 284, 282, 280, 278, 276.

Percent Recovery	Description
	SAND: Dark yellowish brown (10YR 4/6), wet, dense, medium-grained, some fine-grained, trace coarse-grained, trace silt.
60	SAND: Dark yellowish brown (10YR 4/6), wet, dense, fine-grained, trace silt.
	SAND: Dark yellowish brown (10YR 4/6), wet, dense, medium-grained, few silt, trace coarse-grained.
50	SAND: Dark yellowish brown (10YR 4/6), wet, dense, fine- and medium-grained, trace silt, few lignite laminations.
	SAND: Dark yellowish brown (10YR 4/6), wet, dense, medium-grained, few coarse-grained, few fine-grained, trace silt, trace small gravel, occasional lignite lamination.
	Boring terminated at 35.0 feet in Sand.

DRILLING CO.: Bulldog Drilling, Inc.
DRILLER: Chad Dutton
LOGGED BY: Ken Ewers
DATE DRILLED: 11-13-17
START TIME: 1148
END TIME: 1352
BOREHOLE DIA.: 8.25"

STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.

NOTES:

WATER LEVELS: DURING DRILLING 17.0 FEET
AFTER DRILLING: 17.3 FEET
DATE: 11-14-17

PIEZOMETER: INSTALLED AT +/- 34.35 FEET

VERTICAL DATUM: NAD 1983
HORIZONTAL DATUM: NAVD 1988
WEATHER: Cool, 45°F, Partly Cloudy, Wind NNE 5-10

Date Printed: 12/22/2017

KEY TO SYMBOLS

Groundwater Monitoring and Sampling

Symbol Description

Fill: As described

Clayey Sand

Very Fine to Fine Sand

Medium Sand

Coarse to Very Coarse Sand

Misc. Symbols

Boring continues

Water table during drilling/excavation

Water table at boring/test pit completion

Soil Samplers

CME Continuous Sampler

Description Line Types

Abrupt boundary

Gradual boundary

Notes:

mm millimeters

Trace	< 5%
Few	6 - 15%
Little	16 - 30%
Some	31 - 49%

Coarse Gravel size	19 - 75 mm
Fine Gravel size	4.8 - 19 mm
Coarse Sand size	2.0 - 4.8 mm
Medium Sand size	0.43 - 2.0 mm
Fine Sand size	0.08 - 0.43 mm

ATTACHMENT D3 – GROUNDWATER FLOW MAPS

N

SCALE: 1" = 400'

0 200 400

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

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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

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Jefferson City, Missouri
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Facsimile: (573) 659-9079
MO CORP. ENGINEERING LICENSE NO. E-2001001669-D

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 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

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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

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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

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FIGURE 2
GROUNDWATER CONTOUR MAP
NOVEMBER 26, 2018

PROJECT NAME	FILE NAME	SHEET #
SIKESTON/GWMAP/BAP	GWCONT BAP 11-2018	1 OF 1

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

SURVEYED	DESIGNED	DRAWN	CHECKED	APPROVED	DATE	SCALE
NA	NA	CP	KE	MCC	12/2018	AS NOTED

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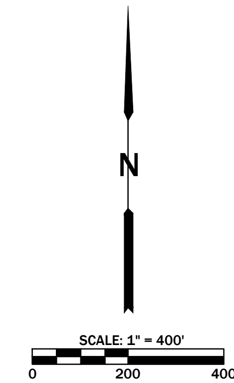
Facsimile: (573) 659-9079
MO CORP. ENGINEERING LICENSE NO. E-2001001669-D



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 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

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FIGURE 2
GROUNDWATER CONTOUR MAP
MAY 28, 2019

SHEET #	FILE NAME	PROJECT NAME
1 OF 1	GWCONT BAP 05-2019	SIKESTON/GWMAP/BAP

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

SCALE	DATE	APPROVED	CHECKED	DRAWN	DESIGNED	SURVEYED
AS NOTED	1/2020	MCC	GE	CP	NA	NA

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Jefferson City, Missouri
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Facsimile: (573) 659-9079
MO CORP. ENGINEERING LICENSE NO. E-2001001669-D

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 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

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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

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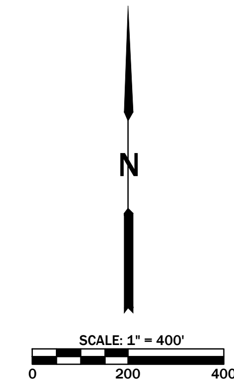
Facsimile: (573) 659-9079
MO CORP. ENGINEERING LICENSE NO. E-2001001169-D

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



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 MARCH 27, 2019.
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	297.69	312.77	383119.51	1078467.90
MW-2	298.93	308.01	383207.42	1079751.30
MW-3	298.51	308.55	381130.00	1079946.62
MW-7	297.58	315.03	381584.50	1078847.00
MW-9	297.93	314.68	382429.94	1078825.60

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FIGURE 1
GROUNDWATER CONTOUR MAP
MARCH 27, 2019

SIKESTON POWER STATION
FLY ASH POND
2019 ANNUAL GROUNDWATER MONITORING & REPORT

SURVEYED	DESIGNED	DRAWN	CHECKED	APPROVED	DATE	SCALE	PROJECT NAME	FILE NAME	SHEET #
NA	NA	FL	KE	MCC	8/2019	AS NOTED	SIKESTON/GWMAP/FAP	GWCONT FAP 2019	1 OF 1

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

O:\CADDFiles\SIKESTON\GROUNDWATER MAP\FAP\GW CONT MAP FAP.dwg, GW CONT MAP BAP, 7/30/2019 9:59:31 AM

N

SCALE: 1" = 400'

0 200 400

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 SEPTEMBER 24, 2019.
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	296.09	312.77	383119.51	1078467.90
MW-2	297.53	308.01	383207.42	1079751.30
MW-3	297.05	308.55	381130.00	1079946.62
MW-7	295.98	315.03	381584.50	1078847.00
MW-9	296.33	314.68	382429.94	1078825.60

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FIGURE 1
GROUNDWATER CONTOUR MAP
SEPTEMBER 24, 2019

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

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

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ATTACHMENT D4 – GROUNDWATER SAMPLING AND ANALYSIS PLAN

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Facsimile (573) 659-9079

GREDELL Engineering Resources, Inc.

Sikeston Power Station

Groundwater Monitoring and Sampling Plan
For Compliance with
Missouri State Operating Permit #MO-0095575

Prepared for:

BMU Sikeston
Board of Municipal Utilities

Mr. Mark McGill
Sikeston Power Station
1551 West Wakefield Avenue
Sikeston, Missouri 63801

STATE OF MISS
MIKEL C. CARLSON
9-1-17
RG 0126
REGISTERED GEOLOGIST

September 2017

Sikeston Power Station

Groundwater Monitoring and Sampling Plan
For Compliance with
Missouri State Operating Permit #MO-0095575

Prepared for:

Sikeston Board of Municipal Utilities
1551 West Wakefield Avenue
Sikeston, Missouri 63801

September 2017

Prepared by:

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Phone: (573) 659-9078
Fax: (573) 659-9079

Sikeston Power Station

Groundwater Monitoring and Sampling Plan
For Compliance with
Missouri State Operating Permit #MO-0095575

September 2017

Table of Contents

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1.0 INTRODUCTION

This Groundwater Monitoring and Sampling Plan (GMSAP) has been prepared by GREDELL Engineering Resources, Inc. for the Sikeston Board of Municipal Utilities (SBMU) coal ash impoundments located at the Sikeston Power Station (SPS). It is being submitted in partial fulfillment of the requirements contained in Special Condition #17 of Missouri State Operating Permit #MO-0095575, issued to the SPS on March 1, 2015. Subpart (a)(3) of Special Condition #17 requires that a GMSAP be submitted for approval to the Missouri Department of Natural Resources, Water Protection Program (MDNR-WPP) within 30 months from the date of permit issuance, or by September 1, 2017. This GMSAP was preceded by submittal of a Site Characterization Report on June 1, 2017 to the MDNR-WPP in accordance with subpart (a)(2) of Special Condition #17.

In order to ensure the implementation of an effective groundwater monitoring program, this GMSAP sets forth the procedures and techniques to be following during groundwater sampling events for the coal ash impoundments. Therefore, this GMSAP includes the following information:

- A description of the groundwater monitoring system;
- A listing of chemical parameters to be monitored and the associated methods of analysis;
- A schedule for sampling;
- Sample collection;
- Sample preservation and shipment;
- Analytical procedures;
- Chain of custody control;
- Quality assurance and quality control, and;
- The format and content for reporting of analytical results.

Implementation of the procedures and techniques described herein will enable SBMU-SPS personnel to conduct operations in a safe, prudent, and environmentally sound fashion.

This document is also intended to fulfill the requirements of the Federal Coal Combustion Residual (CCR) Rule promulgated by the United States Environmental Protection Agency (USEPA) under 40 CFR Part 257.93(a) through (e). Therefore, reference to these rules are made as appropriate. A description of statistical methods to be used in evaluating groundwater monitoring data as required under 40 CFR Part 257.93(f) is also provided for reference, but the selection and certification of an appropriate statistical method will be completed in October 2017, subsequent to the submittal of this document.

2.0 FACILITY INFORMATION

SBMU-SPS is an electric power producer and distributor located within the western city limits of Sikeston, in southern Scott County, Missouri (Figure 1). The legal description of the power station facility is the SE/4 of Section 23, SW/4 of Section 24, NW/4 of Section 25, and NE/4 of Section 26, Township 26 North, Range 13 East. The facility is located in a part of Missouri that is generally known as the "Bootheel", but is more formally considered part of the Southeastern Lowland Groundwater Province (Miller and Vandike, 1997). Mean annual rainfall in the region is 44 to 47 inches (Miller and Vandike, 1997). Average monthly temperatures are variable, with the lowest average low temperature of 27°F in January and the highest average high temperature of 92°F in July (U.S. Climate Data, 2015).

The SBMU-SPS began operation in 1981 and produces approximately 235 megawatts of power. Coal combustion residuals (approximately 52,500 tons per annum) are currently sold or placed in the facility's two coal ash impoundments located immediately east of the power station (Figure 1). Both impoundments are on properties owned and controlled by SBMU. One coal ash impoundment is actively used for bottom ash disposal. It measures approximately 61 acres in size. Bottom ash is slurried and conveyed to the disposal area via pipeline. The second coal ash impoundment was primarily used for fly ash disposal, but is currently inactive due to reuse and recycling efforts. It measures approximately 30 acres in size. Historically, fly ash was handled as a dry waste product and transported to the disposal area by truck.

3.0 HYDROGEOLOGIC SETTING

The Sikeston area is located in the Southeastern Lowland Physiographic Province, an extensive alluvial plain representing the northernmost point of the Mississippi River Embayment. The surficial geologic and hydrologic setting of the Southeastern Lowland Province is less complex than other provinces in the state due to its young geologic age and due to the consistency in depositional processes that have resulted in a thick accumulation of fluvial and deltaic sediments that range in age from Upper Mesozoic (Cretaceous) to Recent (Holocene).

Unlike many other power plant facilities, the SBMU-SPS is not located adjacent to a major river (the Mississippi River is located approximately 16 miles northeast of the site). Consequently, groundwater levels in the alluvial (uppermost) aquifer fluctuate predominantly as a result of precipitation, which is the predominant source of recharge in the area (Miller and Vandike, 1997).

Records specific to the high-capacity industrial wells used by the SBMU-SPS for power plant operations report static water level depths of between 10 and 20 feet below ground surface. These wells, which vary from 155 to 185 feet in completion depth, reportedly yield between 1,000 and 2,500 gallons per minute (gpm) at maximum production rates. Piezometers installed during the site characterization demonstrate that groundwater in the alluvial (uppermost) aquifer occurs at elevations ranging between 294 and 299 feet, or approximately 9 to 17 feet below ground surface along the perimeter of the coal ash impoundments.

3.1 Hydrostratigraphy

Extensive deposits of Holocene age (Recent) alluvial sediment represent the youngest geological unit in the “Bootheel” region. Most, if not all, of these sediments were derived from the development of the Mississippi-Ohio River system (Luckey, 1985). They consist of a complex sequence of gravel, sand, silt, and clay and reflect a predominantly fluvial depositional setting. The Holocene age alluvium has a cumulative thickness of between 100 and 200 feet in the vicinity of the SPS, dependent on where the upper limit of the underlying Wilcox Group is placed. According to Miller and Vandike (1997), the alluvial deposits form an important hydrologic unit and are the most utilized aquifer in the region. Consequently, this unconfined hydrologic unit is considered the uppermost aquifer in the vicinity of the site, as defined in 40 CFR Part 257.53.

The underlying Wilcox Group constitutes what is generally considered the “uppermost rock” unit in the “Bootheel” region. It is considered Middle Tertiary (Eocene) in age. Wilcox Group strata consist of a complex sequence of sands with some clay and thin beds of lignite. It is a prominent aquifer that is used for municipal drinking water supplies in the region (Miller and Vandike, 1997). From its outcrop area along Crowley’s Ridge located north of the SPS, Wilcox Group strata thicken markedly southward to approximately 1,400 feet in extreme southeastern Missouri. Site-specific drilling records for wells located on

SBMU-SPS property identify the top of the Wilcox at a depth of between 174 and 192 feet below ground surface. However, drilling records for a more recently installed water supply well (Well H) suggest that uppermost Wilcox Group strata are encountered as shallow as 103 feet below ground surface (Brotcke, 2009). That interpretation is apparently based on the presence of two, relatively thick (7-8 ft), clay units. The upper clay unit was also noted in other drilling records for SBMU-SPS, specifically for Well C, where the clay is thicker and extends from a depth of 96 to 128 feet. The lower five feet reported on the drilling log for Well D (150-155 ft) may also represent this upper clay layer. Elsewhere, it either thins, is not present, or was not reported on drilling logs. The lower clay unit was also apparently encountered in Well C, where it extends from a depth of 175 to 180 feet. It may also have been recorded at the base of Wells E and F, at depths of 173 and 185 feet below ground surface, respectively.

Wilcox Group sediments are unconformable with the underlying Porters Creek Formation, which is considered a regional aquitard, or confining unit, in the Southeastern Lowland Province (Miller, 1993). Miller and Vandike (1997) indicate that it has very low hydraulic conductivity and, when combined with the underlying Clayton and Owl Creek formations, forms an effective lower limit to the Wilcox/Alluvial aquifer. The Porters Creek Formation is a thick, relatively homogenous unit consisting almost exclusively of dark gray to black clay. The formation is up to 650 feet thick and, based on site-specific drilling records for wells drilled on SMBU-SPS property, lies at least 226 feet below ground surface. The Porters Creek is considered Early Tertiary (Paleocene) in age.

Based on the previous investigations identified above, as well as the recently completed site characterization effort (Gredell Engineering, 2017), a summary of local hydrologic conditions within the alluvial (uppermost) aquifer is presented below.

3.2 Characteristics of the Alluvial (Uppermost) Aquifer

Piezometric measurements demonstrate that the depth to groundwater ranges from 9 to 17 feet below ground surface. These differences in depth are largely a reflection of the differences in elevation between piezometers. The variability in groundwater levels in any given piezometer from month-to-month is very similar and only ranged from 2.19 to 2.02 feet. Over the 12-month monitoring period, the maximum fluctuation in groundwater levels occurred in June 2016 and observed differences between piezometers was 3.26 feet. The minimum fluctuation occurred in March 2017 and was recorded as a difference of 1.86 feet.

Groundwater movement within the alluvial (uppermost) aquifer is to the west and southwest along a shallow hydraulic gradient estimated at between one and seven feet per mile. Hydraulic conductivity values range between 0.04 and 0.10 centimeters per second. The calculated groundwater velocity ranges from 0.10 to 2.0 feet per day, based on an effective porosity value of 20 percent as recommended by Unified Guidance (USEPA, 2009).

4.0 GROUNDWATER MONITORING SYSTEM

The groundwater monitoring system as recommended in the site characterization report (Gredell Engineering, 2017) consists of eight permanent wells (Figure 2). All existing wells and any future wells will monitor shallow groundwater contained within the alluvial (uppermost) aquifer that underlies the coal ash impoundments. Wells that are hydraulically downgradient from the coal ash impoundments are designated MW-1, MW-4, MW-5, MW-7, and MW-8. Wells that are hydraulically upgradient from the impoundments are designated MW-2, MW-3 and MW-6. Construction information for each of the eight monitoring wells is summarized in Table 1.

4.1 Well Construction

All monitoring wells have been drilled and installed in accordance with Missouri Well Construction Rules provided in 10 CSR 23-4. Well depths have been designed to ensure full saturation of the 10-ft screen interval in each well. All drilling and well construction was completed by a monitoring well installation contractor holding an unrestricted permit. Drilling logs and well construction diagrams for each of the eight wells are included in Appendix 1 for reference.

The location of each monitoring well is such that reasonable access can be gained for the purpose of maintenance and repairs. Proper drainage has been established to the extent practicable to prevent the accumulation and pooling of surface water within ten feet of the wells. For those wells located in high traffic areas, the wells are protected by heavy gauge steel bollards. None of the current monitoring wells has been completed as a surface flush mount.

4.2 Well Development

Each well was developed using of combination of disposal bailers and a non-dedicated, submersible pump to preclude the possible introduction of contaminants. A minimum of three well volumes of water was removed from each well. A “well volume” includes both the saturated parts of the filter pack and PVC casing, as measured from the base of the well to the static groundwater level. In addition, the volume of potable water introduced into the well bore while drilling and/or constructing the well, if any, was removed.

Field measurements of groundwater temperature, pH, and specific conductivity were recorded during the development process. Field measurements continued until both temperature and specific conductivity stabilized to within ten percent between three successive readings. Similarly, pH readings were allowed to stabilize within 0.2 pH units. In addition, development records document both pre- and post-development water levels and observed water clarity. Well development records are included in Appendix 1 for reference.

Future re-development of monitoring wells will be undertaken if 20 percent of the well screen is occluded by sediments, as determined during routine measurements of the depth of the well taken during field sampling events.

5.0 GROUNDWATER MONITORING - SAMPLING FREQUENCY

Requirements specified for groundwater monitoring in State Operating Permit MO-0095575 indicate that the collection of groundwater samples shall be performed, at a minimum, on a quarterly basis. The current permit expires December 31, 2017. Consequently, it is assumed that the initial round of sampling from all eight wells will be conducted during the fourth quarter of 2017. A listing of the groundwater monitoring parameters to be analyzed are identified in Appendix 2. It is similar to that referenced in 10 CSR 80-11.010(11) Appendix I, except for the addition of molybdenum, as requested by MDNR-WPP. It is anticipated that an alternative sampling frequency schedule will be specified when the State Operating Permit is re-issued, along with a potentially revised listing of chemical parameters to be tested. SBMU-SPS will comply with the applicable requirements during future permit cycles.

For CCR compliance purposes, both background and detection water quality sampling are required in accordance with 40 CFR Parts 257.93 and 257.94. Background data collection requires a minimum of eight independent samples from each monitoring well to be obtained no later than October 17, 2017 and analyzed for the constituents listed in 40 CFR Part 257 Appendix III and IV (referenced in Appendix 2). This timeframe is specific to the bottom ash pond monitoring system, which consists of wells MW-3, MW-4, MW-5, MW-6, and MW-8. The timeframe for the fly ash pond differs due to the remand issued by USEPA concerning inactive surface impoundments and subsequent vacatur rules adopted on August 4, 2016. Consequently, background sampling for the fly ash pond will be completed no later than April 17, 2019. In both instances, the selection of the most appropriate statistical method for analysis and evaluation of groundwater quality based on the background data is also required by the referenced compliance due dates.

Detection monitoring is required shortly after the referenced compliance due dates for the completion of background sampling. For the bottom ash pond, the timeframe to conduct the initial detection monitoring event is within 16 days of the October 17, 2017 compliance due date. For the fly ash pond, it is within 16 days of the April 17, 2019 compliance due date. These timeframes are partly based on the requirement that the initial groundwater monitoring and corrective action report must be prepared no later than January 31, 2018 for the bottom ash pond and no later than August 1, 2019 for the fly ash pond (reference 40 CFR Parts 257.90(e) and 257.100(a)(5)). They are also based on the requirement that statistically significant increases over background must be determined within 90 days after the completion of sampling and analysis (reference 40 CFR Part 257.93(h)(2)). Following the initial sampling event, the frequency of detection monitoring shall be at least semi-annually during the active life of the CCR unit (reference 40 CFR Part 257.94(b)).

If statistically significant increases are identified following the completion of a given detection monitoring event, assessment monitoring may be required in accordance with 40 CFR Part 257.95.

6.0 FIELD SAMPLING EQUIPMENT - QA/QC PROCEDURES

All field personnel must read and familiarize themselves with the protocol established in this section. All personnel involved in the sampling process must wear Level D Protective clothing as defined by OSHA. This includes, but is not limited to, safety boots/shoes, safety glasses, and disposable gloves. No smoking is allowed during sampling. A first aid kit must be accessible to field personnel during each well sampling event.

The following equipment, at a minimum, will be available in the field during each sampling event: purging and sampling equipment, both dedicated and non-dedicated; an electronic water level measurement device; pH, temperature, specific conductivity, oxidation-reduction potential (ORP), and turbidity meters; sample containers, and coolers.

The probes and attachments of each pH, temperature, specific conductivity, ORP, and turbidity meter will be triple rinsed in distilled water. The meters will then be calibrated in accordance with manufacturer's recommendations or as otherwise specified in the *Field Equipment Calibration Forms and Procedures* included in Appendix 3. Any malfunction will be corrected or the meter will be replaced.

Sample containers will be pre-cleaned by the manufacturer by washing in a laboratory grade, non-phosphate detergent, triple rinsed in deionized water, and sufficiently dried to remove all moisture. The contract laboratory will perform batch testing of all sample containers per lot. The sample containers will be checked/inventoried for proper container volume, material, preservatives, labels and any observed defects (e.g., preservative leakage) at the time of receipt from the laboratory and documented on the *Groundwater Sampling Bottle Inventory* form (Appendix 4).

Prior to collecting a sample, the following decontamination procedures will be implemented.

1. Purging and Sampling Equipment will be handled and decontaminated as necessary to prevent contamination of the wells.
    a. If non-dedicated purging and sampling equipment is used, it will be thoroughly decontaminated and tested by collecting an equipment blank prior to use (see Section 7.4 Equipment Blank).
    b. If dedicated pumps/tubing are used, care will be taken to prevent cross contamination.
2. Water level measuring device, including sensor probe and the entire length of graduated tape encountering groundwater/well riser will be washed in laboratory grade, non-phosphate detergent followed by a triple rinse in distilled water.
    a. As the tape is reeled back onto the carrying spool, it will be wiped and dried using clean, paper towels.
3. Prior to sampling, carefully lower the purging and sampling equipment into the well, handling it only with clean, disposable gloves. The intake of the sampling

equipment should be suspended above the base of the well to avoid churning of potential sediment within the sump.

4. After each well is sampled or during sampling events, as necessary, disposable gloves should be discarded, hands washed with soap and water, and fresh disposable gloves applied before the next sampling.
5. After use, the non-dedicated purging and sampling equipment will be washed in laboratory grade, non-phosphate detergent, followed by a triple rinse with distilled water, prior to any further use.
6. Should purging and sampling equipment malfunction or not be available for use during the sampling event, substitute equipment may be used.

If dedicated pumps are used, care should be taken to prevent any foreign objects from being part of the sample. The outside of the sample discharge tubing should be cleaned to prevent introduction of foreign objects into the sample container.

7.0 GROUNDWATER SAMPLING - QA/QC PROCEDURES

7.1 General

Precautions must be taken during both sampling and shipping procedures so that representative groundwater is obtained. Sample blanks and sample duplicates are therefore required to guard against and/or identify accidental, "induced" contamination from these sources. Sample blanks include trip blanks, field blanks, and equipment blanks. Sample duplicates are self-explanatory, but can include both laboratory-prepared matrix spike and matrix spike duplicates. Each of these quality control features is explained more fully as follows.

7.2 Trip Blanks

Trip blanks are prepared in the laboratory. They are designed to detect contamination, typically volatile or semi-volatile organics, resulting from improper or inadequately cleaned containers, sample coolers used for transport, or from chemical preservatives. A trip blank is prepared by filling an appropriately sized container with deionized water and any applicable chemical preservative (e.g., hydrochloric acid). Prior to filling the sample container, the deionized water is carbon-filtered to remove any potential organics. It is then shipped with the sample containers from the laboratory and subsequently accompanies groundwater samples on the "trip" back to the laboratory. Trip blanks must be clearly identified as such along with the analyses to be performed. One trip blank per sampling event is required and must be analyzed for Total Organic Halogens (TOX). However, since the 40 CFR Part 257 Appendix III & IV constituents do not include organics, a trip blank is optional for these sampling events.

7.3 Field Blanks

Field blanks are prepared in the field. A field blank is prepared by directly filling an appropriately sized container with laboratory-supplied deionized water. Prior to filling the sample container, the deionized water is carbon-filtered to remove any potential organics. Field blanks are used to detect contamination resulting from changed ambient air conditions. They also serve as a check against trip blanks. Field blanks should be clearly identified in the sampler's field notes and appropriately labeled for their inclusion in the laboratory analytical results. One field blank will be collected per sampling event for both MDNR and USEPA compliance purposes.

7.4 Equipment Blanks

Equipment blanks are prepared in the field when non-dedicated sampling equipment is used. They are used to ensure that non-dedicated equipment is properly decontaminated. An equipment blank is prepared by directly filling an appropriately sized container with laboratory-supplied deionized water. Prior to filling the sample container, the deionized water is carbon-filtered to remove any potential organics. This is accomplished by collecting a sample of deionized water passed through non-dedicated equipment after they have been decontaminated. Equipment blanks should also be collected anytime new, dedicated equipment is introduced into the water sampling process. Equipment blanks should be clearly identified in the sampler's field notes and appropriately labeled for their inclusion in the laboratory analytical results. At a minimum, or as necessary, one equipment blank per sampling event will be collected.

7.5 Sample Duplicates

Sample duplicates are independent samples collected as close in time as possible to the original sample collected from any given well. They are stored and analyzed separately from the original sample and are a check on the precision of the analytical results. The filling of sample duplicate containers must immediately follow original sample collection for the same suite of chemical parameters. Because sample duplicates serve as a check on the reproducibility of data generated by the analytical laboratory, labeling should follow a format that does not reveal the identity of the replicate sample on the labels or on the chain-of-custody record. The identity should be clearly recorded in the sampler's field notes to ensure its later identification in laboratory analytical results. At a minimum, one sample duplicate per day will be collected during a sampling event.

7.6 Matrix Spikes

Matrix spikes are prepared in the laboratory by adding a known amount of target analyte to a sample prior to preparation and analysis. They are used to determine the bias of a method in a given sample matrix.

7.7 Matrix Spike Duplicates

Matrix spike duplicates are intra-laboratory split samples containing identical concentrations of target analytes. They are used to substantiate matrix spike samples.

8.0 FIELD SAMPLING PROCEDURES

8.1 General

Upon arrival at each monitoring well, its physical condition must be documented. Appendix 5 contains a *Monitoring Well Field Inspection* form that must be filled out for each well each time it is sampled. Any irregularities in the condition of the well must be immediately reported and corrective action implemented prior to the next sampling event.

8.2 Water Level Measurements

The next procedure is to obtain water level measurements. They must be obtained immediately prior to any attempt to purge the well. All water level measuring equipment will be thoroughly decontaminated as previously described and checked for wear and abrasion prior to use. Clean, disposable gloves will be worn. All measurements must be recorded to ±0.01 foot and should be based on a permanent reference point located at the top of the well, the elevation of which is established by a licensed surveyor.

Once the sample is collected, it is also necessary to measure the depth of the well. This is required to determine if the well screen is partially blocked by sediment, thus inhibiting recharge. If accumulated sediment obstructs more than twenty percent of the well screen height, it will be reported and arrangements made to redevelop the well prior to the next sampling event. Record all data gathered during water level measurements on the *Field Sampling Log* form provided in Appendix 6.

After measurements are complete, the well cap must be clean prior to returning the well cap onto the riser. Do not leave the well cap off for any reason, even for brief periods, except during purging and sampling activities.

8.3 Purging

The next procedure is to purge the wells using the Low-Flow Sampling method. All purge volumes should be documented on the *Field Sampling Log* form provided in Appendix 6.

When using dedicated low-flow pumps and automatic stabilization parameter sensors, such as the In Situ SmarTROLL Multiparameter sonde and flow cell, the following procedures will be followed to assess the stability of a water sample. At a minimum, all water will be purged from the line between the low-flow pump and the automatic sensors. This will be done by allowing a minimum of one volume within the connecting sampling tubing to flow from the well before assessing the stability of the water sample.

To be considered stable, the reading from each respective stabilization parameter sensor will be compared to the previous two values (collected at least one minute apart), within the following limits:

- pH +/- 0.1 S.U.
- Specific Conductance +/- 3% umhos/cm

Once sampling is complete, properly dispose of all purge water. Record all purge data on the *Field Sampling Log* form provided in Appendix 6.

8.4 Sample Collection

The next procedure entails the collection of groundwater samples from the monitoring wells. As much as practical, sampling should take place within two hours of the final purge event. In some instances, the recharge characteristics of the screened interval may be such that the two-hour stipulation is not feasible. In that event, sampling should be performed no later than 24 hours after final purging. Wells should be sampled in the order that precludes as much, to the extent practical, any potential cross-contamination. Typically, the upgradient wells are purged prior to the downgradient wells. Samples from each well will be collected in the following order, based on their sensitivity to volatilization:

- TOX
- TOC
- TDS
- Metals
- Non-Metals
- COD
- Radium Isotopes (USEPA requirement)

Samples must be carefully decanted into the appropriate sample containers. Agitation must be minimized to avoid altering the chemical makeup of the sample. If well pumps are being used, care should be taken to prevent any contaminant from the exterior of the sample tubing from contaminating the water sample. Field filtration of samples is not allowed. Consequently, sample clarity must be documented and efforts made to minimize turbidity beyond what naturally occurs in the well environment. Once a sample is collected, it will be preserved according to the guidelines provided in Appendix 4. Samples requiring storage at low temperature will be immediately placed in coolers packed with ice. The temperature of the storage coolers will be monitored to verify appropriate temperatures are maintained. All sampling data will be documented on the *Field Sampling Log* form provided in Appendix 6.

9.0 SAMPLE TRANSPORT AND DELIVERY, CHAIN-OF-CUSTODY

A chain-of-custody procedure is necessary to ensure the integrity of samples from the time of collection through delivery and final analysis. A sample is considered in someone's custody if:

1. It is in that person's physical possession;
2. In view of that person once he/she has taken possession;
3. Has been secured by that person so as to prevent tampering, or;
4. Has been placed by that person in an area restricted to authorized personnel.

Any person with custody as defined above must comply with the procedures established herein.

Prior to transport, the person collecting the samples must properly label each sample container and complete a *Chain-of-Custody Field Record* form. An example chain-of-custody field record form is provided in Appendix 7. Each label must be secured to the container and the following information clearly described on the label in indelible ink:

1. Collector's name
2. Date and time of sampling
3. Monitoring Well ID
4. Sample ID
5. Preservative(s) used, if any
6. Required analytical test(s)

A chain-of-custody summarizing the samples to be transported is also required. This form should be prepared by the collector and completed upon final sampling. A copy of the form(s) should accompany the person responsible for transporting the samples so that it can be included with the final analytical report as support documentation. The sample collector also initializes the chain-of-custody record process. It is his/her responsibility to verify that the record is maintained upon relinquishment of the samples for transport to the laboratory. If the samples are intended for commercial transport (e.g., FedEx®), each sample containing cooler must also have a tamper proof seal affixed by the collector across the lid.

When samples are transported, the carrier assumes responsibility for the chain-of-custody record and for ensuring safe transport of the samples to the laboratory. The carrier must recognize the contents of the shipment, the potential hazards they entail, and demonstrate an understanding of the proper handling precautions to be used during transport. The carrier is responsible for ensuring that all samples are properly stored to avoid leakage or breakage. Sample coolers should be checked to ensure required temperatures are maintained and any additional ice is added as necessary. Do not use dry ice during transport. The carrier must also ensure that all relevant shipping manifests are properly and fully completed. Other individuals who might accompany the carrier must be advised of the nature of the shipment and must not be allowed direct contact with any of the samples.

Any transfer of samples from one carrier to another must be accompanied by the chain-of-custody record and the above process repeated prior to relinquishment of the samples. The carrier must deliver the samples to the laboratory as soon as practicable after sampling, generally no later than 48 hours. The carrier should ensure that the samples are delivered to the person in the laboratory qualified to receive samples prior to relinquishment of the chain-of-custody record to that individual.

The laboratory should assign a specific individual to be responsible for the samples. This individual should first inspect the condition of the sample containers and any seals, and then reconcile the information on sample labels with that listed on the chain-of-custody record prior to signing the record. This individual should then assign laboratory numbers to each sample, enter these numbers on the laboratory logbook and on each sample container label, and should store the samples in a secured storage area until ready for analysis. This individual is ultimately responsible for completion of the chain-of-custody record and for ensuring that it is included as part of the final analytical report.

10.0 ANALYTICAL LABORATORY - REPORTING AND QA/QC PROCEDURES

The contract laboratory must have the ability to produce reliable quantitative results in accordance with established protocol. At a minimum, the laboratory must use analytical methods that will achieve the nominal target reporting limits for the groundwater monitoring parameters listed in Appendix 2. Adequate levels of accuracy, precision, and completeness must be maintained.

10.1 Accuracy

Accuracy is defined as the degree of agreement between the measured amount of a species and the amount actually known to be present, expressed as a percentage. To achieve an adequate appraisal of accuracy, spikes and/or control samples should be made for one of every twenty samples analyzed. Minimum levels for accuracy should be listed in specific laboratory quality assurance plans.

10.2 Precision

Precision is a measure of the reproducibility of analytical results, generally expressed as a *Relative Percent Difference*. To achieve an adequate appraisal of precision, duplicate analyses should be performed at a ratio of one per every twenty samples collected. Minimum levels for precision should be listed in specific laboratory quality assurance plans.

The relative standard deviation is a measure of the variability of the results from an analytical procedure. The relative standard deviation is calculated by taking the difference between a sample result, x, and the average of sample results from numerous laboratories, x_{bar}, for each analyte divided by x_{bar} [$(x-x_{bar})/x_{bar}$ expressed as a percentage].

The relative percent difference is the difference, by analyte, between the results of duplicate sample divided by the average value for those samples [$(x_1-x_2)/((x_1+ x_2)/2)$ expressed as a percentage]. It is a measure of the variation in the results of an analyte for duplicate samples.

If the results for duplicate samples of an analyte for relative percent difference are within 2.5 times the percent relative standard deviation, the analytical data for the parameter may be accepted as being comparable results. If the results of an analyte for duplicate samples for relative percent difference are not within 2.5 times the percent relative standard deviation, the results of the analyte should be checked for comparability.

10.3 Completeness

Completeness is a comparison of the amount of valid data acquired to the amount of valid data planned to be obtained, expressed as a percentage. Should the percentage of completeness fall below 90 percent for the analytical results of any given sampling event, the laboratory should be prepared to present a corrective action narrative prior to receiving additional groundwater samples.

10.4 Laboratory Analytical Reporting Requirements

Minimum analytical reporting requirements for the laboratory responsible for analytical results of groundwater monitoring well samples are as follows:

1. A table summary of all analytical test methods used in the analysis, including references for each to the method manual and test method number.
2. A summary of all analytical results. This must include use of appropriate units, reporting Practical Quantitation Limit (PQL), and appropriate signature on all data sheets. Units must be shown for each analyte. Data cannot be method blank corrected. Data must be appropriately flagged.
3. A complete chain-of-custody record(s). A complete record includes name and affiliation of sample collector, time and date of sampling, and all appropriate signatures denoting custody changes. The chain-of-custody record should be an original or a highly legible copy.
4. Method detection limits must be established for all metals analysis. Method blank results are required.
5. All laboratory results will be accompanied by a Quality Assurance data form that includes minimum detection limits, method blanks, field or trip blanks, and laboratory replicate. If spiked samples are used, these data will also be included.

Supplemental laboratory data will include a summary that chronicles laboratory procedures, including date of sampling, sample receipt, preservation, preparation, analysis, and approval signature of the results.

MDNR-WPP requires that groundwater monitoring results be submitted electronically on forms provided by the department.

11.0 STATISTICAL ANALYSIS

The statistical analysis procedure(s) for the SBMU-SPS pertain to compliance with 40 CFR Part 257.93. These or similar procedures may be incorporated at a later date by MDNR-WPP in future re-issued State Operating Permit criteria. This section therefore presents a general discussion of the type of statistical methods available to the facility. The statistical approach should consider, at a minimum, that the facility is located in a floodplain and that groundwater from an alluvial aquifer will be monitored.

The selection of statistics follows the completion of background groundwater quality sampling and analysis. The statistical test chosen shall be conducted separately for each constituent in each monitoring well. A certification must be obtained from a qualified professional engineer no later than October 17, 2017 stating that the selected statistical method is appropriate for evaluating the groundwater monitoring data for each of the coal ash impoundments. The certification must include a narrative description of the statistical method selected to evaluate the groundwater monitoring data.

The statistical methods available to SBMU-SPS and specified in 40 CFR Part 257.93(f) are provided below for reference.

1. A parametric analysis of variance followed by multiple comparison procedures to identify statistically significant evidence of contamination. The method must include estimation and testing of the contrasts between each compliance well's mean and the background mean levels for each constituent.
2. An analysis of variance based on ranks followed by multiple comparison procedures to identify statistically significant evidence of contamination. The method must include estimation and testing of the contrasts between each compliance well's median and the background median levels for each constituent.
3. A tolerance or prediction interval procedure, in which an interval for each constituent is established from the distribution of the background data and the level of each constituent in each compliance well is compared to the upper tolerance or prediction limit.
4. A control chart approach that gives control limits for each constituent.
5. Another statistical test method that meets the performance standards of 40 CFR Part 257.93(g).

12.0 REFERENCES

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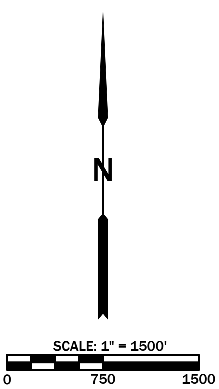
Figures



NOTES:

1. PROPERTY LINE TAKEN FROM THE SCOTT COUNTY ASSESSOR'S WEBSITE (SCOTTGIS.COUNTYPORTAL.NET) 6-8-15.
2. IMAGE PROVIDED BY BING MAPS.

LEGEND

SBMU PROPERTY LINE (APPROXIMATE)	——PL——

GROUNDWATER MONITORING AND SAMPLING PLAN 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 - SITE LOCATION MAP	DATE 9/2017	SCALE AS NOTED	PROJECT NAME SIKESTON	REVISION
	DRAWN AJK	APPROVED MCC	FILE NAME GMSAP	SHEET # 1 OF 1

N

SCALE: 1" = 400'

0 200 400

LEGEND

PROPERTY LINE	PL
PROPOSED 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 & UNDERGROUND CULVERT ELEVATIONS SURVEYED BY BOWEN ENGINEERING & SURVEYING.

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FIGURE 2
MONITORING WELL LOCATION MAP

SIKESTON POWER STATION GROUNDWATER MONITORING AND SAMPLING PLAN

SURVEYED	DESIGNED	DRAWN	CHECKED	APPROVED	DATE	SCALE	PROJECT NAME	FILE NAME	SHEET #
NA	NA	AJK	KE	MCC	9/2017	AS NOTED	SIKESTON/GWMASP	SAP FIGS	1 OF 1

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

Tables

Groundwater Monitoring and Sampling Plan for Compliance with Missouri State Operating Permit #MO-0095575
Sikeston Power Station
Sikeston, Missouri

Well Construction Summary
Table 1

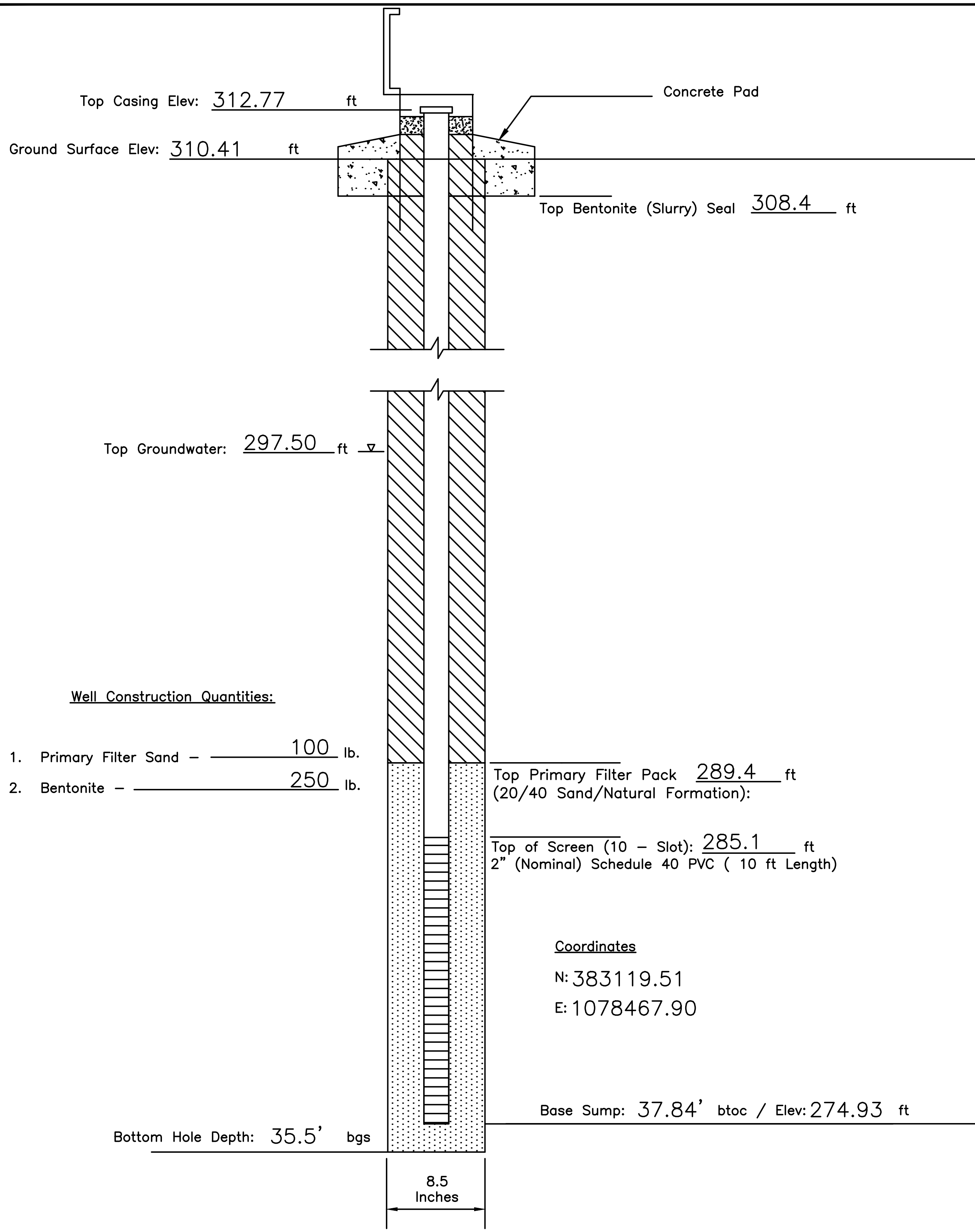
Monitoring Well ID[1,2]	Northing Location[3]	Easting Location[3]	Ground Surface Elevation[3] (feet)	Top of Riser Elevation[3] (feet)	Well Depth[4] (feet)	Base of Well Elevation (feet)	Screen Length[5] (feet)	Top of Screen Elevation (feet)
MW-1	383119.51	1078467.90	310.41	312.77	37.84	274.93	10	285.1
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-4	380804.62	1077766.95	303.26	305.61	37.55	268.06	10	278.3
MW-5	379858.94	1078477.85	303.57	305.91	37.17	268.74	10	278.9
MW-6	379874.77	1079384.36	305.37	307.72	38.03	269.69	10	279.9
MW-7	381584.50	1078847.26	312.67	315.03	37.37	277.66	10	287.7
MW-8	380311.20	1077940.08	302.37	304.77	37.41	267.36	10	277.4

NOTES:
1. MW-1 through MW-6 formerly termed TPZ-1 through TPZ-6 in Site Characterization Report (May 2017).
2. Refer to Figure 2 for monitoring well locations.
3. Refer to Appendix 1 for well construction diagrams.
4. Monitoring well survey data provided by Bowen Engineering & Surveying, Inc.
5. Horizontal Datum: Missouri State Plane Coordinates - NAD 83 (Feet), Vertical Datum: NAVD 88 (Feet).
6. Depth measurements relative to surveyed point on top of well casing.
7. Actual screen length (9.7 feet) is the machine-slotted section of the 10-foot length of Schedule 40 PVC pipe.

Appendices

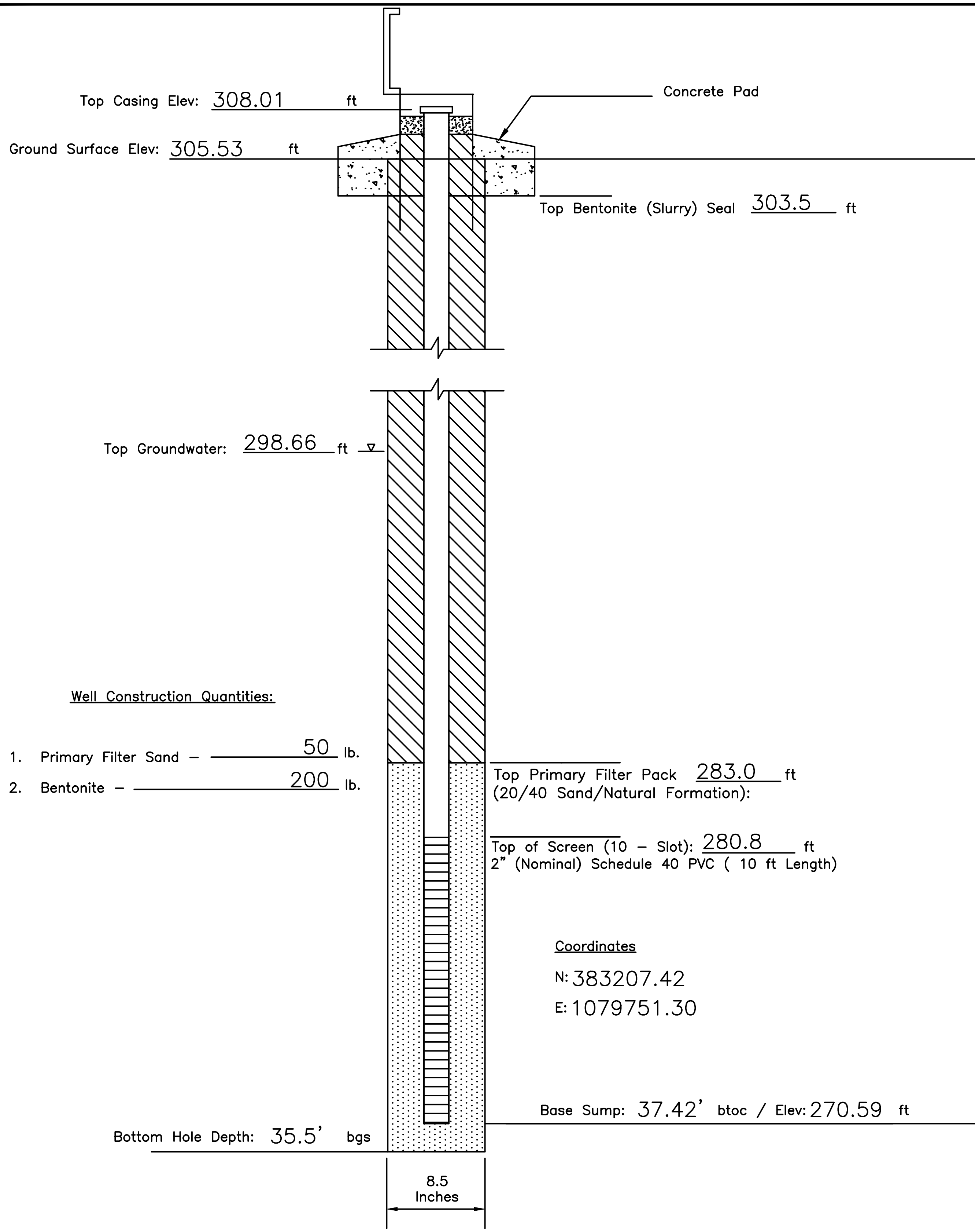
Appendix 1

Monitoring Well Construction Information

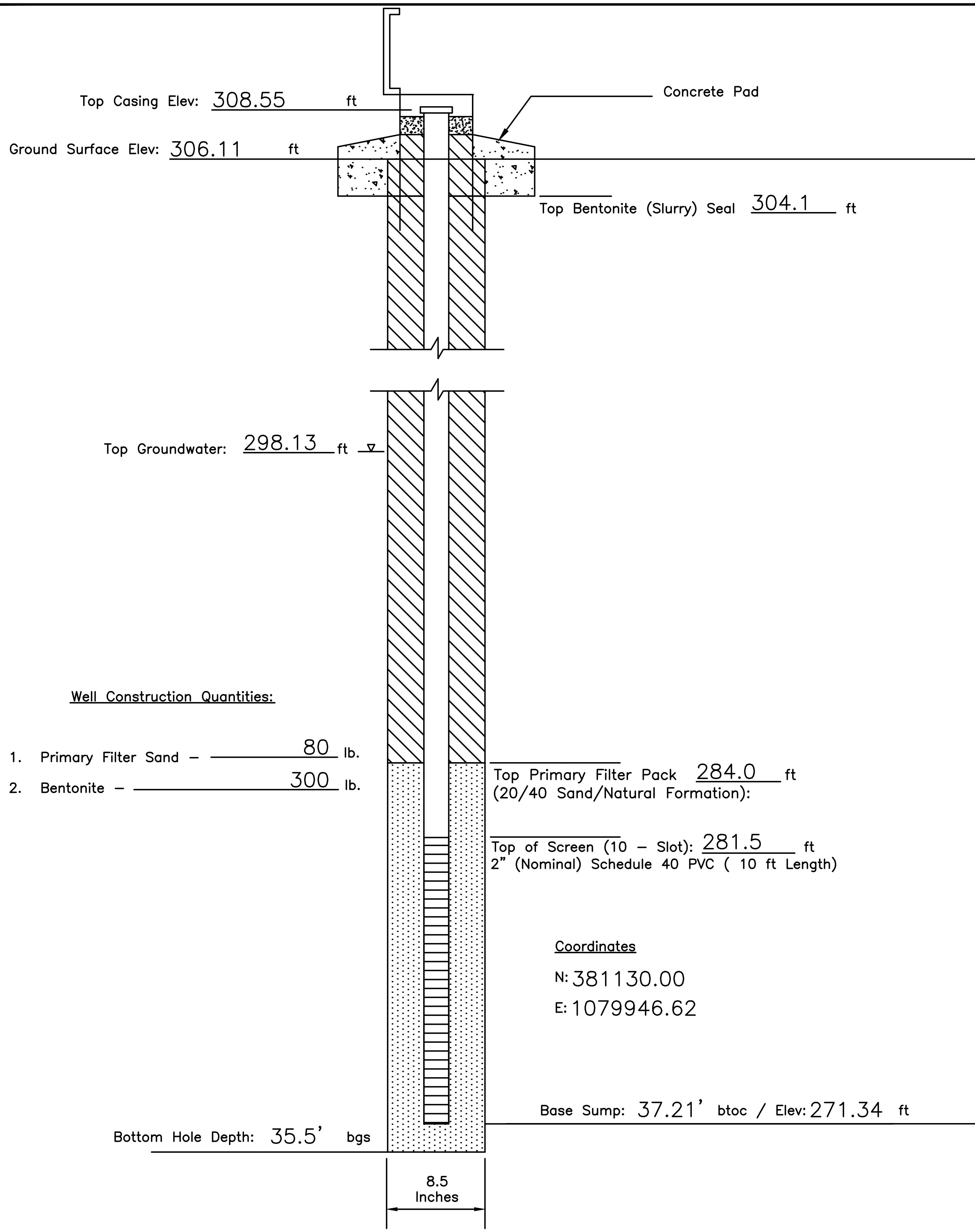


TPZ-1/ MW-1	PIEZOMETER CONSTRUCTION DIAGRAM	**GREDELL Engineering Resources, Inc.** ENVIRONMENTAL ENGINEERING LAND AIR WATER
Date Piezometer Completed: 4-25-16	SBMU - Sikeston Power Station	1505 East High Street, Jefferson City, Missouri 65101 / Telephone: (573) 659-9078 Facsimile: (573) 659-9079
	Site Characterization - NPDES Compliance	DATE 11/2016 / SCALE N.T.S. / DRAWN BY: AJK / APPROVED BY: MCC

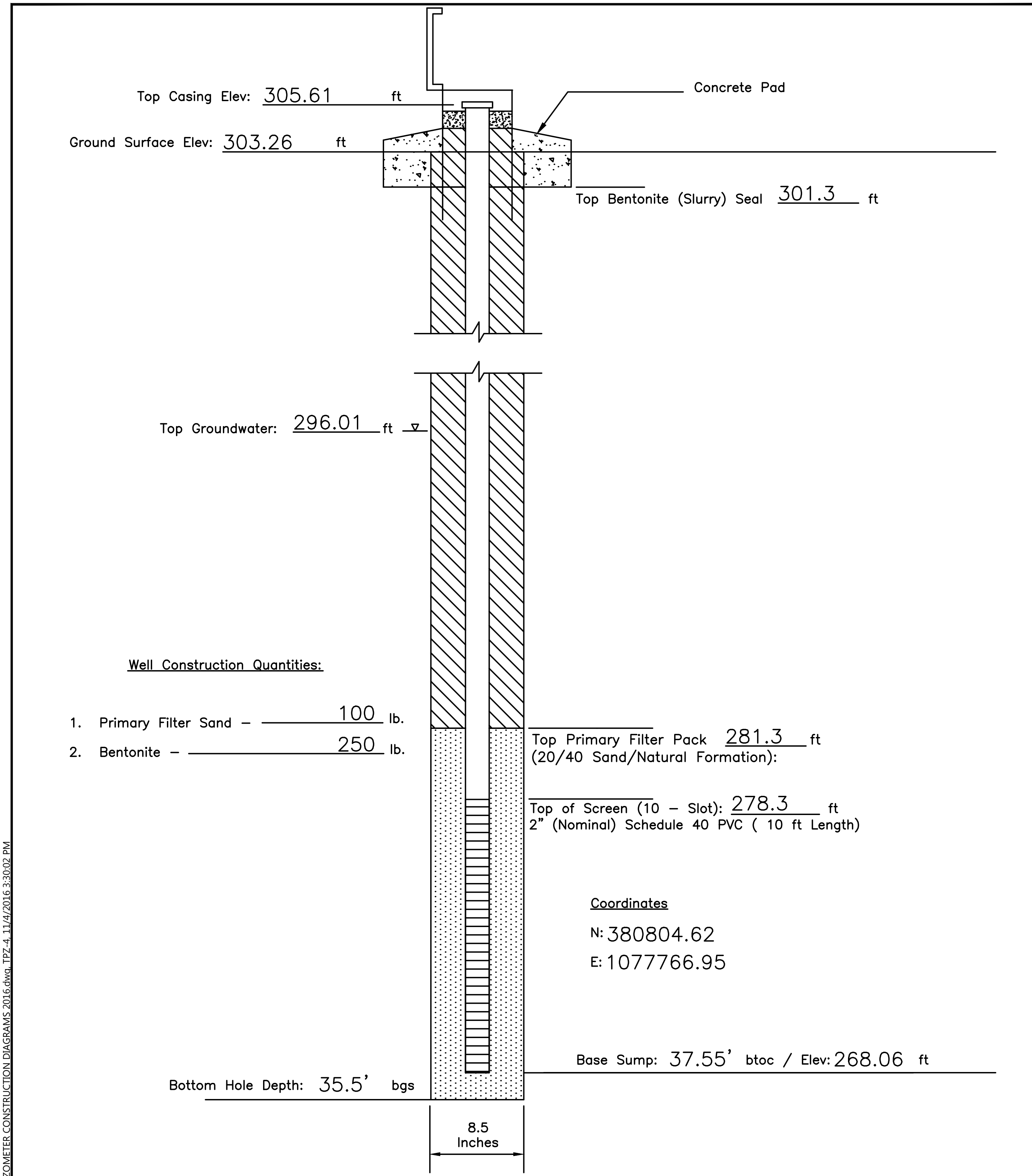
M:\Share\CADDFiles\SIKESTON\DS\PIEZOMETER CONSTRUCTION DIAGRAMS 2016.dwg, TPZ-1, 11/4/2016 3:30:01 PM



TPZ-2/ MW-2	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: 4-25-16	SBMU - Sikeston Power Station Site Characterization - NPDES Compliance	DATE 11/2016 · SCALE N.T.S. · DRAWN BY: AJK · APPROVED BY: MCC



TPZ-3/ MW-3	PIEZOMETER CONSTRUCTION DIAGRAM	GREDELL Engineering Resources, Inc. ENVIRONMENTAL ENGINEERING LAND AIR WATER		
Date Piezometer Completed: 4-26-16	SBMU - Sikeston Power Station	1505 East High Street Jefferson City, Missouri 65101		Telephone: (573) 659-9078 Facsimile: (573) 659-9079
	Site Characterization - NPDES Compliance	DATE 11/2016	SCALE N.T.S.	DRAWN BY: AJK / APPROVED BY: MCC



TPZ-4/ MW-4	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: 4-27-16	SBMU - Sikeston Power Station Site Characterization - NPDES Compliance	DATE 11/2016 | SCALE N.T.S. | DRAWN BY: AJK | APPROVED BY: MCC

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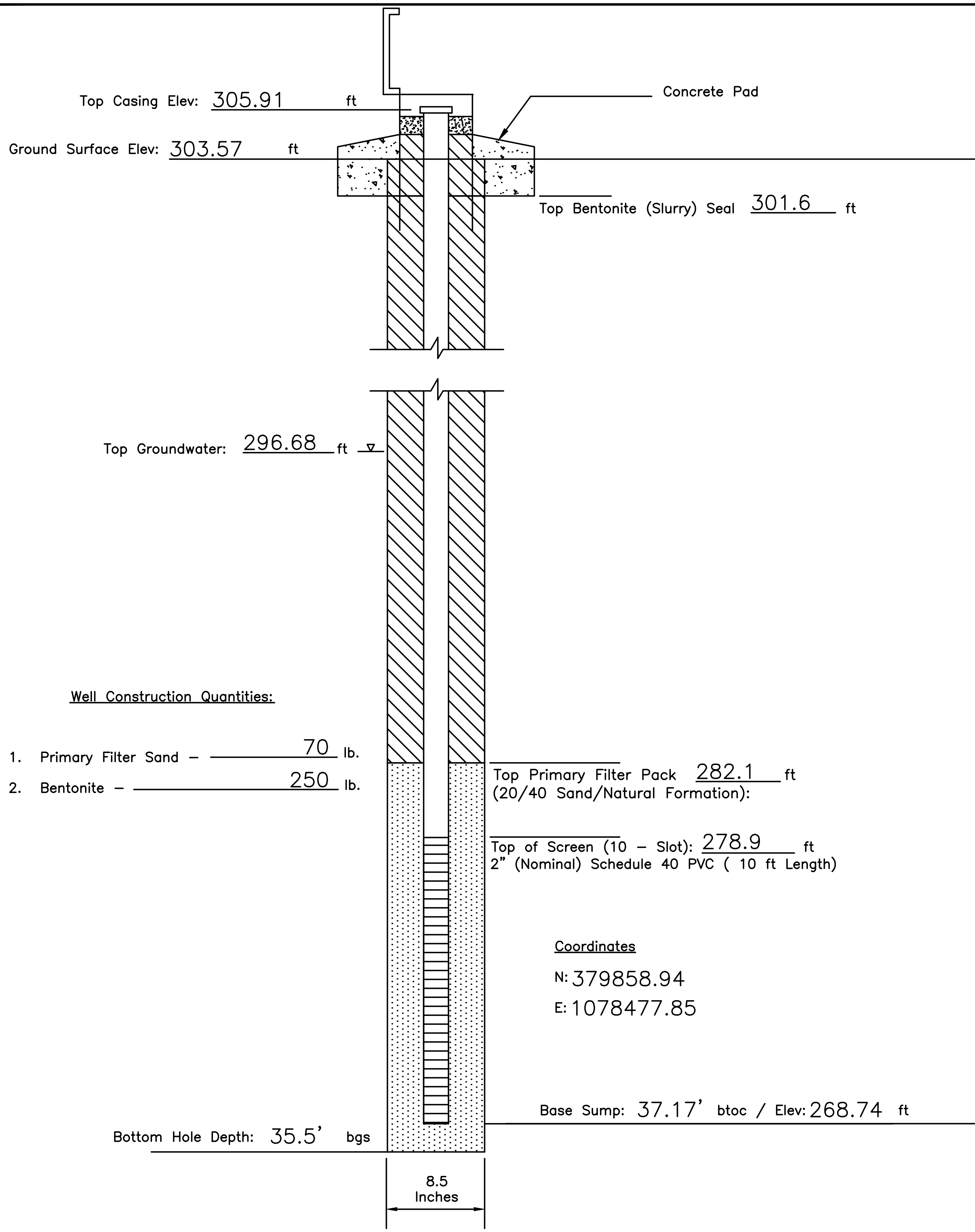
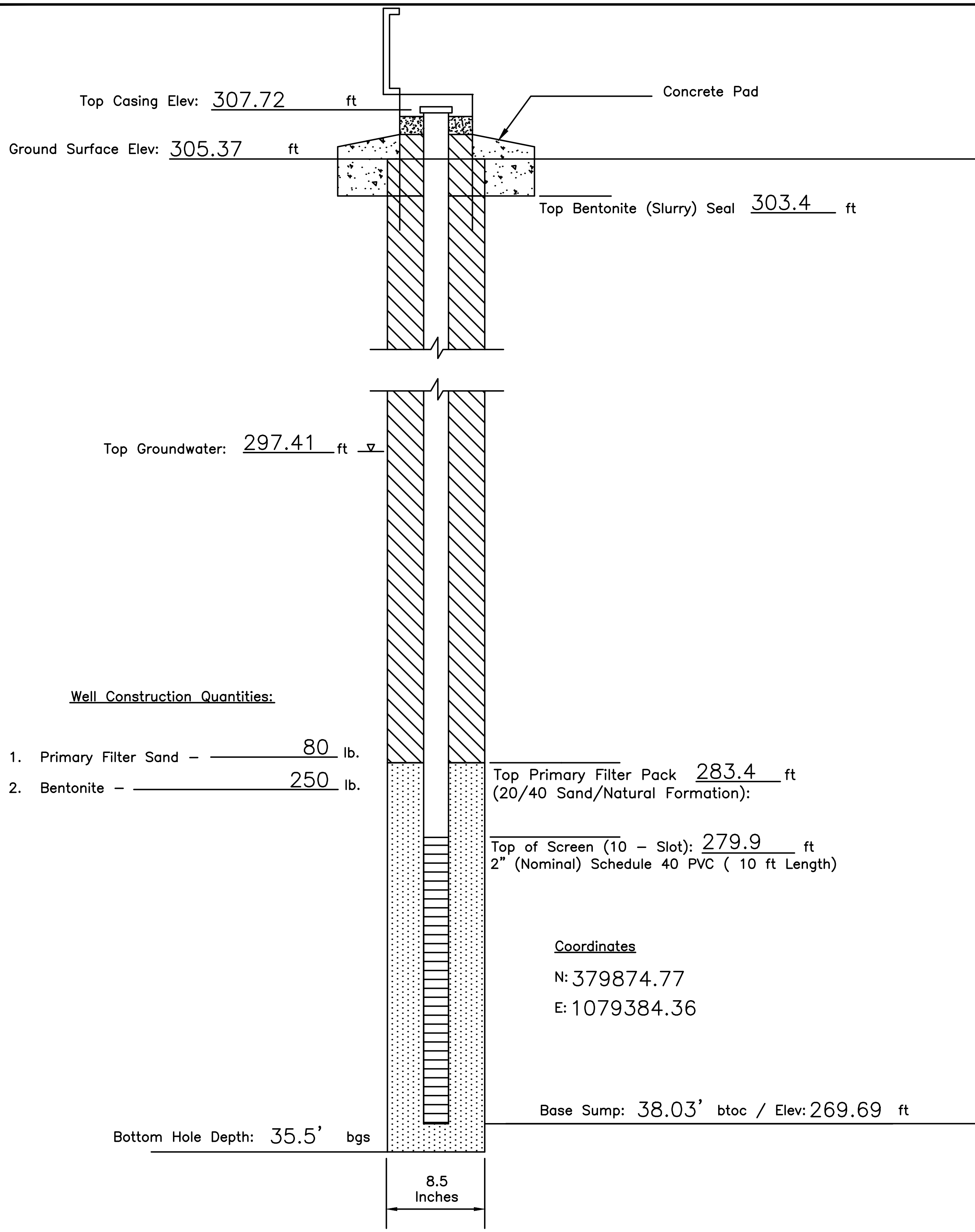


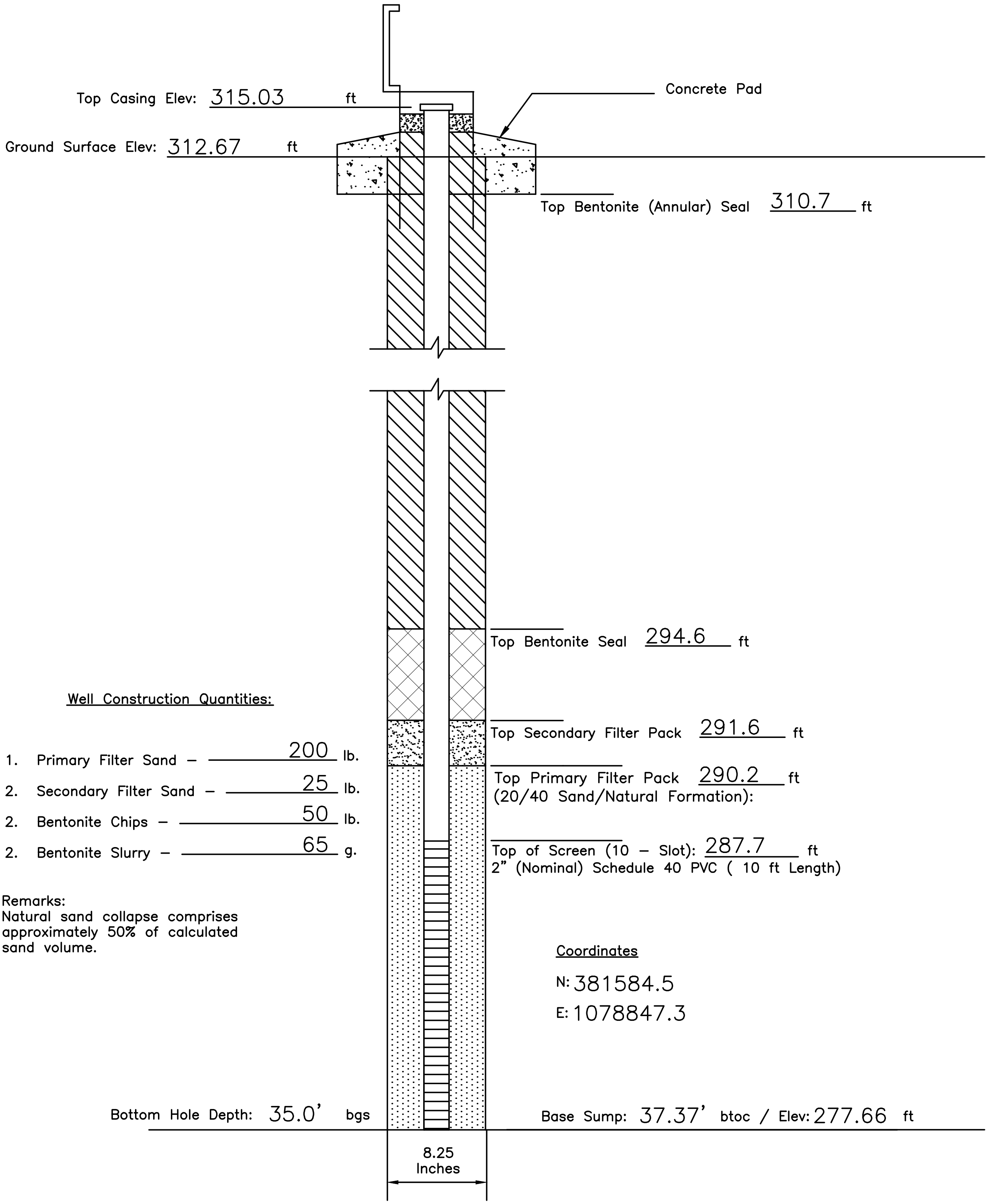
TPZ-5/ MW-5	PIEZOMETER CONSTRUCTION DIAGRAM	GREDELL Engineering Resources, Inc. ENVIRONMENTAL ENGINEERING LAND AIR WATER
Date Piezometer Completed: 4-26-16	SBMU - Sikeston Power Station	1505 East High Street, Jefferson City, Missouri 65101 Telephone: (573) 659-9078 Facsimile: (573) 659-9079
	Site Characterization - NPDES Compliance	DATE 11/2016 | SCALE N.T.S. | DRAWN BY: AJK | APPROVED BY: MCC

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



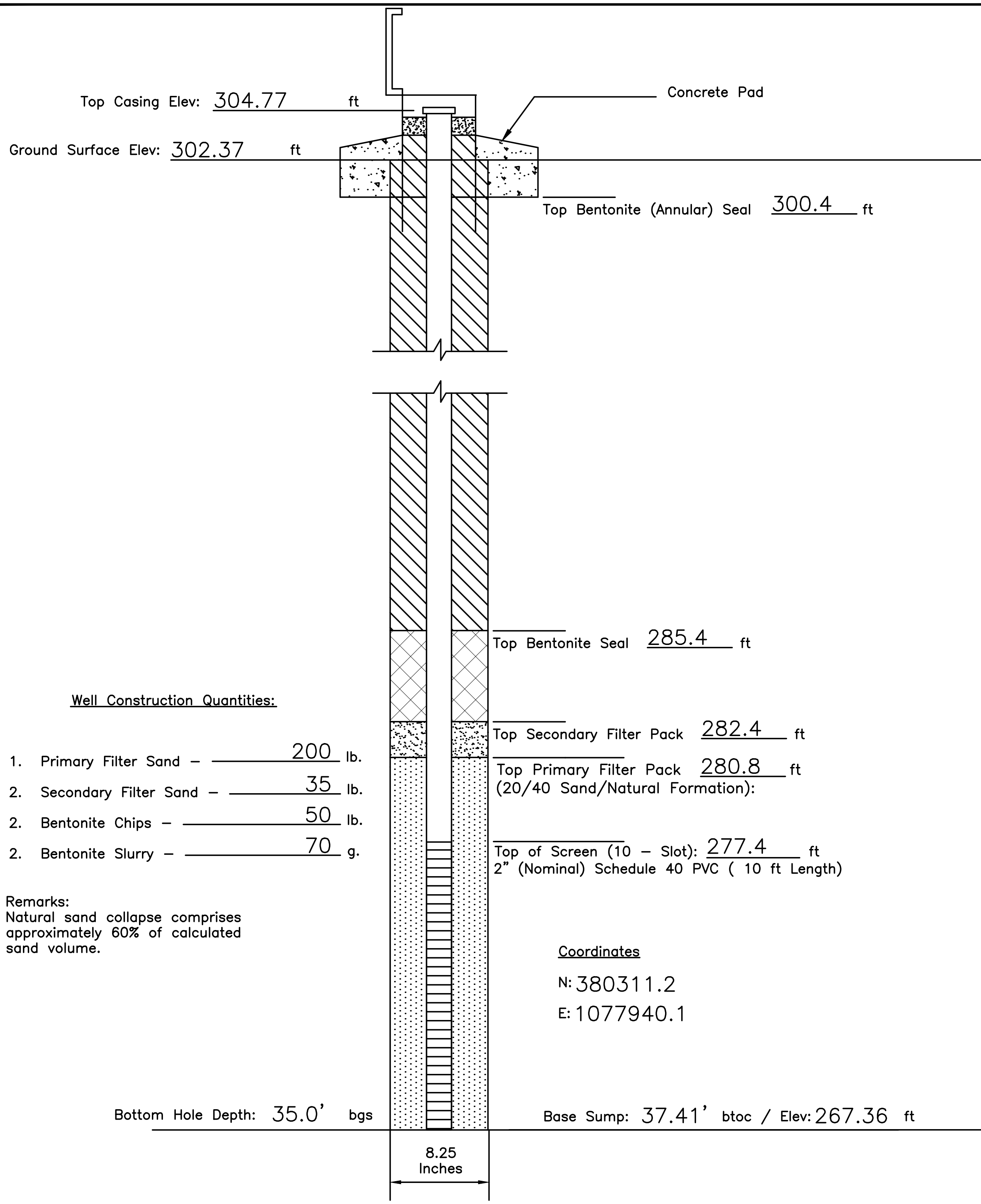
TPZ-6/ MW-6	PIEZOMETER CONSTRUCTION DIAGRAM	**GREDELL Engineering Resources, Inc.** ENVIRONMENTAL ENGINEERING — LAND AIR WATER
Date Piezometer Completed: 4-26-16	SBMU - Sikeston Power Station	1505 East High Street, Jefferson City, Missouri 65101 — Telephone: (573) 659-9078, Facsimile: (573) 659-9079
	Site Characterization - NPDES Compliance	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



MW-7	MONITORING WELL CONSTRUCTION DIAGRAM	**GREDELL Engineering Resources, Inc.** ENVIRONMENTAL ENGINEERING LAND AIR WATER
Date Well Completed: 4-18-17	SBMU - Sikeston Power Station Groundwater Monitoring & Sampling Plan	1505 East High Street Jefferson City, Missouri 65101 Telephone: (573) 659-9078 Facsimile: (573) 659-9079

DATE	SCALE	DRAWN BY:	APPROVED BY:
9/2017	N.T.S.	AJK	MCC



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
Date Well Completed: 4-19-17	SBMU - Sikeston Power Station	1505 East High Street, Jefferson City, Missouri 65101 — Telephone: (573) 659-9078, Facsimile: (573) 659-9079
	Groundwater Monitoring & Sampling Plan	DATE 9/2017 — SCALE N.T.S. — DRAWN BY: AJK — APPROVED BY: MCC

GREDELL Engineering Resources, Inc.

BORING LOG TPZ-1/MW-1

NPDES Site Characterization
Sikeston, MO

CLIENT: SBMU-SPS

LOCATION: See Plan of Boring Locations
G.S. ELEVATION: 310.4 **T.O.C. ELEVATION:** 312.77
NORTHING: 383119.51 **EASTING:** 1078467.89

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION
0	310		FILL - CLAY, SOME SILT: Black (7.5YR 2.5/1), medium plasticity, trace small gravel, trace very coarse-grained sand, root hairs present.
2.5	308	60	FILL - SAND: Brown (7.5YR 5/4), fine-grained sand, some silt, trace medium-grained sand, trace clay, round, moist.
7	304	100	FILL - SAND AND SILT, SOME CLAY: Dark gray (2.5YR 4/1), medium-grained sand with dark greenish gray (GLEY2 4/1) laminations of medium dense clayey silt.
9	302	100	SILT, SOME CLAY: Dark gray (2.5Y 4/1), few sand and organic material, low plasticity, medium dense, root hairs present.
11.5	300		SAND: Greenish gray (GLEY2 5/1), fine-

Column headings: 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)

Depth scale: 0, 2, 4, 6, 8, 10. Elevation scale: 310, 308, 306, 304, 302, 300.

STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.

DRILLING CO.: Smith & Company
DRILLER: F. Deken
LOGGED BY: Ken Ewers, R.G.
DATE DRILLED: 4-25-2016
START TIME: 1405 4-25-2016
END TIME: 1605 4-25-2016
BOREHOLE DIA.: 8.5 in.

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

WATER LEVELS: DURING DRILLING NA FEET
AFTER DRILLING: 297.50 FEET
DATE: 5-12-2016
PIEZOMETER: INSTALLED AT +/- 35.5 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-1/MW-1

NPDES Site Characterization
Sikeston, MO

CLIENT: SBMU-SPS

LOCATION: See Plan of Boring Locations
G.S. ELEVATION: 310.4 **T.O.C. ELEVATION:** 312.77
NORTHING: 383119.51 **EASTING:** 1078467.89

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION
12	298	100	grained sand, silty, firm, root hairs present.
14	296		CLAY: Greenish gray (GLEY2 5/1), few fine-grained sand, firm to soft, medium to low plasticity, two-inch thick interbeds of medium-grained sand, wet, few reddish mottles.
16	294		
18	292	80	SAND: Reddish gray (2.5YR 5/1), fine-grained sand, trace organic/carbonaceous silty material as black laminae.
20	290		
22	288	100	- grading to fine- to medium-grained sand.
			SAND: Reddish gray (2.5YR 5/1), fine- to medium-grained sand, round; little coarse-grained sand, few small gravel round to sub-

Column headings: 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)

DRILLING CO.: Smith & Company
DRILLER: F. Deken
LOGGED BY: Ken Ewers, R.G.
DATE DRILLED: 4-25-2016
START TIME: 1405 4-25-2016
END TIME: 1605 4-25-2016
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: 297.50 FEET
DATE: 5-12-2016

PIEZOMETER: INSTALLED AT +/- 35.5 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-1/MW-1

NPDES Site Characterization
Sikeston, MO

CLIENT: SBMU-SPS

LOCATION: See Plan of Boring Locations
G.S. ELEVATION: 310.4 **T.O.C. ELEVATION:** 312.77
NORTHING: 383119.51 **EASTING:** 1078467.89

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION
24	286		angular.
26	284	67	SAND: Grayish brown (10YR 5/2), medium-grained sand, some fine-grained sand, trace coarse-grained sand, trace small gravel, medium dense.
28	282	89	SAND: Grayish brown (10YR 5/2), medium-grained sand, some fine-grained sand, trace coarse-grained sand, trace small gravel, medium dense.
30	280	67	SAND: Very dark grayish brown (10YR 3/2), medium-grained sand, little small gravel, little fine-grained sand, few coarse-grained sand, poorly sorted, round to angular, medium dense.
32	278		
34	276	72	SAND: Very dark grayish brown (10YR 3/2), medium-grained sand, little small gravel, little fine-grained sand, few coarse-grained sand, round to angular; few large gravel, angular, poorly sorted, medium dense.
			Boring Terminated at 35.5 feet in SAND.

Columns: WELL CONSTRUCTION DIAGRAM, WATER TABLE, GRAPHIC LOG, SAMPLE TYPE, FACIES I.D., 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: 4-25-2016
START TIME: 1405 4-25-2016
END TIME: 1605 4-25-2016
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: 297.50 FEET
DATE: 5-12-2016

PIEZOMETER: INSTALLED AT +/- 35.5 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-2/MW-2

NPDES Site Characterization
Sikeston, MO

CLIENT: SBMU-SPS

LOCATION: See Plan of Boring Locations
G.S. ELEVATION: 305.5 **T.O.C. ELEVATION:** 308.01
NORTHING: 383207.42 **EASTING:** 1079751.30

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION
0			SILTY SAND: Brown (7.5YR 5/4), some clay.
1			CLAYEY SAND: Brown (7.5YR 5/4), fine-grained sand, some clay and silt, strong brown (7.5YR 5/8) staining or mottling, few 1/4 inch-diameter cemented nodules.
2	304	80	
4	302		- graded transition.
5			SAND: Brown (7.5YR 5/4), fine- to medium-grained sand, rounded.
6	300		
7			SAND: Light brown (7.5YR 6/4), fine- to medium-grained sand, rounded, trace small gravel, trace coarse-grained sand, round to sub-angular.
8	298	72	
10	296		SAND: Strong brown (7.5YR 5/6), medium-grained sand, trace coarse-grained sand, trace small gravel, rounded.
	294		

Columns also present: WELL CONSTRUCTION DIAGRAM, WATER TABLE, GRAPHIC LOG, SAMPLE TYPE, FACIES I.D., 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: 4-25-2016
START TIME: 1015 4-25-2016
END TIME: 1138 4-25-2016
BOREHOLE DIA.: 8.5 in.

STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.

NOTES: Offset boring developed on 5-11-2016 for SPT sampling.

WATER LEVELS: DURING DRILLING NA FEET
AFTER DRILLING: 298.66 FEET
DATE: 5-12-2016
PIEZOMETER: INSTALLED AT +/- 35.0 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-2/MW-2

NPDES Site Characterization
Sikeston, MO

CLIENT: SBMU-SPS

LOCATION: See Plan of Boring Locations
G.S. ELEVATION: 305.5 **T.O.C. ELEVATION:** 308.01
NORTHING: 383207.42 **EASTING:** 1079751.30

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION
12		75	
	292		
14			
	290	100	SAND: Yellowish brown (10YR 5/4), medium-grained sand, few fine-grained sand, round to sub-round, few silt and very fine-grained sand, trace coarse-grained sand, medium dense.
16			- grading to fine- to medium-grained sand.
	288		
18		94	SAND: Yellowish brown (10YR 5/4), medium-grained sand, few fine-grained sand, round to sub-round; few small and large gravel, very angular; few silt, poorly sorted, medium dense.
	286		
20		83	SILTY SAND: Dark yellowish brown (10YR 4/4), medium-grained sand, some silt, few fine- to very fine-grained sand, round to sub-round, medium dense.
	284		
22			
	282	94	SILTY SAND: Dark yellowish brown (10YR 4/4), medium-grained sand, little silt, few fine- to very fine-grained sand, trace medium- to coarse-grained sand, round to sub-round,

Columns also shown: WELL CONSTRUCTION DIAGRAM, WATER TABLE, GRAPHIC LOG, SAMPLE TYPE, FACIES I.D., 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: 4-25-2016
START TIME: 1015 4-25-2016
END TIME: 1138 4-25-2016
BOREHOLE DIA.: 8.5 in.

STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.

NOTES: Offset boring developed on 5-11-2016 for SPT sampling.

WATER LEVELS: DURING DRILLING NA FEET; AFTER DRILLING: 298.66 FEET; DATE: 5-12-2016
PIEZOMETER: INSTALLED AT +/- 35.0 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-2/MW-2

NPDES Site Characterization

Sikeston, MO

CLIENT: SBMU-SPS

LOCATION: See Plan of Boring Locations

G.S. ELEVATION: 305.5 **T.O.C. ELEVATION:** 308.01

NORTHING: 383207.42 **EASTING:** 1079751.30

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
24							medium dense, poorly sorted.											
26	280					61	SAND: Dark grayish brown (10YR 4/2), medium-grained sand, few silt, round to sub-round, medium dense. Few 1-inch thick lenses of medium- to coarse-grained sand.											
28	278					67	SAND: Brown (10YR 5/3), medium- to coarse-grained sand, few coarse-grained sand, round to sub-round; few small gravel, round to angular; trace silt, poorly sorted, medium dense.											
30	276					61	SAND: Brown (10YR 5/3), medium- to coarse-grained sand, few coarse-grained sand, few small and large gravel, sub-round to sub-angular; trace silt, poorly sorted, medium dense.											
32	274																	
34	272					11	SAND: Brown (10YR 5/3), medium- to coarse-grained sand, little coarse-grained sand, round to sub-round; few small and large gravel, sub-round to angular; trace silt, poorly sorted, medium dense.											
	270						Boring Terminated at 35.5 feet in SAND.											

DRILLING CO.: Smith & Company
DRILLER: F. Deken
LOGGED BY: Ken Ewers, R.G.
DATE DRILLED: 4-25-2016
START TIME: 1015 4-25-2016
END TIME: 1138 4-25-2016
BOREHOLE DIA.: 8.5 in.

STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.

NOTES: Offset boring developed on 5-11-2016 for SPT sampling.

WATER LEVELS: DURING DRILLING NA FEET
AFTER DRILLING: 298.66 FEET
DATE: 5-12-2016

PIEZOMETER: INSTALLED AT +/- 35.0 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-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
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.

Column headings: 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)

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
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		
18	288	72	SAND: Brown (10YR 5/3), fine- to medium-grained sand, trace medium-to coarse-grained sand, round to sub-round, medium dense.
			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.

Column headings: WELL CONSTRUCTION DIAGRAM; WATER TABLE; GRAPHIC LOG; SAMPLE TYPE; FACIES I.D.; 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: 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
24	282		
		83	SAND: Brown (10YR 4/3), medium-grained sand, few fine-grained sand, trace coarse-grained sand, trace woody (incipient) lignite, loose.
26	280		SILT: Very dark brown (10YR 2/2), well sorted, loose.
			SAND: Brown (10YR 4/3), medium-grained sand, few fine-grained sand, trace coarse-grained sand, trace woody (incipient) lignite, loose.
28	278	89	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.

Column headings: WELL CONSTRUCTION DIAGRAM, WATER TABLE, GRAPHIC LOG, SAMPLE TYPE, FACIES I.D., 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: 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-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	SAMPLE TYPE	PERCENT RECOVERY	DESCRIPTION
0				FILL: Crushed stone.
	302			SILTY SAND: Brown (7.5YR 4/4), fine-grained sand, some silt, trace medium-grained sand, round, gradational lower contact.
2			73	SILTY SAND: Brown (7.5YR 4/4), fine- to medium-grained sand, some silt, round.
	300			
4				
	298			
6				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.
	296		100	
8				SAND: Brown (7.5YR 5/4), fine- to medium-grained sand, trace small gravel, trace coarse-grained sand, round.
	294			
10			89	SAND: Brown (10YR 5/3), medium-grained sand, round to sub-round; trace silt, trace coarse-grained sand, sub-round; medium dense.
	292			

Other column headings: WELL CONSTRUCTION DIAGRAM, WATER TABLE, GRAPHIC LOG, FACIES I.D., 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.

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	PERCENT RECOVERY	DESCRIPTION
12–14	290	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.
14–16	288	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
16			SAND: Gray (10YR 5/1), medium-grained sand, few silt, trace fine-grained sand, medium dense.
17–18	286	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.
19–21	284, 282	89	SAND: Grayish brown (10YR 5/2), medium-grained sand, round to sub-round; few small gravel, angular; few coarse sand, angular; medium dense.
22–23	280	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.

Column headings: 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)

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	PERCENT RECOVERY	DESCRIPTION
24			
	278	67	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.
26			
	276		
28		61	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.
	274		
30		67	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.
	272		
32			
	270		
34		78	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.
	268		Boring Terminated at 35.5 feet in SAND.

Column headings: 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

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-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
0–2	302		FILL - Asphalt, gravel, aggregate.
2–4	300	80	SILTY SAND: Dark yellowish brown (10YR 4/4), fine-grained sand, some silt, reddish brown staining/mottling.
4–5			SILTY SAND: Gray (10YR 5/1), fine-grained sand, some silt.
5–7.3	298		SILTY SAND: Gray (10YR 5/1), fine-grained sand, some silt and clay, reddish brown stained root molds.
7.3–10	296, 294	78	SAND: Brown (10YR 5/3), fine-grained sand, some very fine-grained sand, little silt, loose.
10–	292	100	SAND: Yellowish brown (10YR 5/6), fine- to medium-grained, trace coarse-grained sand, round, medium dense.

Column headings: 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

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

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION
12			
		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.
	290		
14			SAND: Brown (10YR 5/3), medium-grained sand, few fine-grained sand, round to sub-round, medium dense.
	288	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.
16			
	286		
18		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.
	284		
20		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.
	282		
22			SAND: Brown (10YR 5/3), medium- to coarse-grained sand, few coarse-grained sand, few small gravel, round to sub-angular, medium dense.
		94	SAND: Brown (10YR 5/2), fine-grained sand, few silt and very fine-grained sand, round,
	280		

Column headings: 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)

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

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION	FACIES I.D.
24			medium dense. - dark gray (10YR 4/1).	
26	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.	
28	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.	
30	274	61	SAND: Brown (10YR 5/3), coarse- to very coarse-grained sand, few small gravel, few medium sand, round to angular, medium dense.	
32	272			
34	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.	
			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.	

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

Column headings: WELL CONSTRUCTION DIAGRAM | WATER TABLE | GRAPHIC LOG | SAMPLE TYPE

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-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

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION
0		60	SILTY SAND: Very dark grayish brown (10YR 3/2), some clay, with roots.
2	304		
3	302		SANDY SILT: Light gray (10YR 7/2), fine-grained sand, leached appearance with reddish 1/4 inch diameter concretions, trace reddish stained clayey laminae.
4			
5	300	70	CLAYEY SAND: Brown (7.5YR 4/4), fine- to medium-grained sand, clayey, non-plastic.
6			
7.5	298		SAND: Brown (7.5YR 4/4), fine- to medium-grained sand, trace coarse-grained sand, round.
8			
9	296		SAND: Light brownish gray (10YR 6/2), fine-grained sand, round, loose.
10			SAND: Grayish brown (10YR 5/2), fine-grained sand, trace small gravel, round, loose.
	294		

Column headings: 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)

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

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION
12		57	
			SAND: Grayish brown (10YR 5/2), fine- to medium-grained sand, trace small gravel, round, loose.
	292		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.
14			
	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	

Column headings: 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

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

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION
24			
	280	78	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.
26			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.
28	278	72	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.
30	276	83	SAND: Grayish brown (10YR 5/2), medium- to coarse-grained sand, few coarse-grained sand, few small gravel, round to sub-angular, medium dense.
32	274		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.
34	272	100	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).
	270		Boring Terminated at 35.5 feet in SAND.

Columns also present: WELL CONSTRUCTION DIAGRAM, WATER TABLE, GRAPHIC LOG, SAMPLE TYPE, FACIES I.D., 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 MW-7

CCR Rule Compliance

1551 W. Wakefield Ave., Sikeston, MO

CLIENT: SBMU Sikeston Power Station

LOCATION: See Plan of Boring Locations

G.S. ELEVATION: 312.7 **T.O.C. ELEVATION:** 315.03

NORTHING: 381584.50 **EASTING:** 1078847.26

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION
0			FILL: Grass/Sandy Silt; Dark brown, moist, soft, roots.
	312		FILL: Sand; Dark yellowish brown (10YR 4/6), moist, loose, fine-grained, trace medium-grained sand.
2	310	81	- very dark gray (5GY 4/1).
4	308		FILL: Sandy Clay; Very dark gray (5GY 4/1), moist, firm, low to medium plasticity, trace fine gravel.
			- trace coarse gravel.
6	306		SAND: Very dark grayish brown (10YR 3/2), moist, dense, very fine-grained, trace fine- and medium-grained sand.
8	304	84	- dark grayish brown (10YR 4/2).
10	302		
			SILTY SAND: Dark grayish brown (10YR 4/2), stained brown (7.5YR 4/3), very fine-

Column headings: WELL CONSTRUCTION DIAGRAM; WATER TABLE; GRAPHIC LOG; SAMPLE TYPE; FACIES I.D.; LITHOLOGY: CLAY, SILTY CLAY, SILT, VF SAND, F SAND, M SAND, C SAND, VC SAND, SM GRAVEL, LG GRAVEL

DRILLING CO.: Bulldog Drilling, Inc.
DRILLER: Chad Dutton
LOGGED BY: Travis Doll
DATE DRILLED: 04-18-17
START TIME: 1349
END TIME: 1553
BOREHOLE DIA.: 8.25"

STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.

NOTES:

WATER LEVELS: DURING DRILLING 14.7 FEET
AFTER DRILLING: 16.6 FEET
DATE: 04-18-17

PIEZOMETER: INSTALLED AT +/- 37.37 FEET

VERTICAL DATUM: NAD 1983
HORIZONTAL DATUM: NAVD 1988
WEATHER: Warm, 75°F, Partly Cloudy, Humid

Date Printed: 8/23/2017

GREDELL Engineering Resources, Inc.

BORING LOG MW-7

CCR Rule Compliance
1551 W. Wakefield Ave., Sikeston, MO
CLIENT: SBMU Sikeston Power Station

LOCATION: See Plan of Boring Locations
G.S. ELEVATION: 312.7 **T.O.C. ELEVATION:** 315.03
NORTHING: 381584.50 **EASTING:** 1078847.26

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION
12			grained.
	300	76	- greenish gray (5GY 5/1), trace clay.
			SAND: Brown (10YR 5/3), moist, fine-grained, subrounded.
			- medium-grained sand, trace coarse-grained sand.
14	298		
16			- dark yellowish brown (10YR 4/6), fine-grained sand, trace medium-grained sand, subangular.
	296	70	
18	294		
20	292		- some very fine-grained sand, trace black staining.
			- trace coarse-grained sand.
22	290	76	- trace fine and coarse gravel, subangular.

Columns also shown: WELL CONSTRUCTION DIAGRAM, WATER TABLE, GRAPHIC LOG, SAMPLE TYPE, FACIES I.D., LITHOLOGY (CLAY, SILTY CLAY, SILT, VF SAND, F SAND, M SAND, C SAND, VC SAND, SM GRAVEL, LG GRAVEL)

DRILLING CO.: Bulldog Drilling, Inc.
DRILLER: Chad Dutton
LOGGED BY: Travis Doll
DATE DRILLED: 04-18-17
START TIME: 1349
END TIME: 1553
BOREHOLE DIA.: 8.25"

STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.

NOTES:

WATER LEVELS: DURING DRILLING 14.7 FEET
AFTER DRILLING: 16.6 FEET
DATE: 04-18-17
PIEZOMETER: INSTALLED AT +/- 37.37 FEET
VERTICAL DATUM: NAD 1983
HORIZONTAL DATUM: NAVD 1988
WEATHER: Warm, 75°F, Partly Cloudy, Humid

Date Printed: 8/23/2017

GREDELL Engineering Resources, Inc.

BORING LOG MW-7

CCR Rule Compliance

1551 W. Wakefield Ave., Sikeston, MO

CLIENT: SBMU Sikeston Power Station

LOCATION: See Plan of Boring Locations

G.S. ELEVATION: 312.7 **T.O.C. ELEVATION:** 315.03

NORTHING: 381584.50 **EASTING:** 1078847.26

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION	LITHOLOGY
24–25	288			
25–30	286, 284	70	- yellowish brown (10YR 5/4), fine- to medium-grained sand, trace coarse-grained sand.	M SAND
30–31.8	282		- trace fine gravel.	C SAND
31.8–35	280, 278	60	- some black lignite (0.08 - 0.43 mm). - fine- to coarse-grained sand. - very fine- to fine-grained sand, some medium- to coarse- grained sand, rounded to subrounded, trace fine to coarse subangular gravel.	VC SAND
35.0			Boring terminated at 35.0 feet in Sand.	

Depth scale: 24, 26, 28, 30, 32, 34. Elevation scale: 288, 286, 284, 282, 280, 278.

Column headings: 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

DRILLING CO.: Bulldog Drilling, Inc.
DRILLER: Chad Dutton
LOGGED BY: Travis Doll
DATE DRILLED: 04-18-17
START TIME: 1349
END TIME: 1553
BOREHOLE DIA.: 8.25"

STRATIFICATION LINES ARE APPROXIMATE LITHOLOGIC BOUNDARIES ONLY.

NOTES:

WATER LEVELS: DURING DRILLING 14.7 FEET; AFTER DRILLING: 16.6 FEET; DATE: 04-18-17

PIEZOMETER: INSTALLED AT +/- 37.37 FEET

VERTICAL DATUM: NAD 1983
HORIZONTAL DATUM: NAVD 1988
WEATHER: Warm, 75°F, Partly Cloudy, 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

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	DESCRIPTION
0	302	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.
2	300		- fine-grained, dark yellowish brown (10YR 4/2).
4	298		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.
6	296		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.
8	294		- very fine- to fine-grained sand, trace medium- and coarse-grained sand, very dark greenish gray (10Y 3/1), trace silt.
10	292		- trace fine gravel.

Column headers: WELL CONSTRUCTION DIAGRAM; WATER TABLE; GRAPHIC LOG; SAMPLE TYPE; FACIES I.D.; LITHOLOGY: CLAY, SILTY CLAY, SILT, VF SAND, F SAND, M SAND, C SAND, VC SAND, SM GRAVEL, LG GRAVEL

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

DEPTH (FEET)	ELEVATION	WELL CONSTRUCTION DIAGRAM	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	DESCRIPTION	FACIES I.D.	LITHOLOGY
12	290					94			
14	288						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).		
16	286						- medium-grained sand, subrounded, trace fine to coarse angular gravel, trace black lignite (0.43 - 2.0 mm).		
18	284					66			
20	282								
22	280								
							- dark grayish brown (10YR 4/2), subrounded to rounded medium-grained sand.		

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

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

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
24	278					60			
25							- some coarse-grained sand.		
26	276								
28	274					100			
29.8							- very fine-grained sand, subangular to subrounded, trace medium-grained sand, some black lignite (0.08 to 0.22 mm),		
30	272								
32	270								
33							- fine- to medium-grained sand, subrounded to subangular, trace coarse-grained sand, trace fine gravel, some black lignite (4.8 - 19 mm).		
34	268					100			
35							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

Monitoring Well Development Record

Location: Sikeston Groundwater Monitoring and Sampling						*Date: 5/12/16*				
Well:		*MW-1 (TPZ-1)*				*Initial Depth to Groundwater (ft, btoc):*			15.33 ft.	
Borehole Diameter:		*8.5 "*				*Base of Well (ft, btoc):*			37.84 ft.	
Casing Diameter:		*2 "*				*Filter Pack Hgt (ft):*			14.25 ft.	
Development method:		*Bailer / Submersible Pump*				*Screened Interval Lithology: Medium-Grained Sand*				
Date/Time		Purge Volume (cummulative) *(gallons)*	Casing Volume *(gallons)*	Annular Volume *(gallons)*	Tremie Volume *(gallons)*	pH *(s.u.)*	Specific Conductance *(umhos/cm)*	Temperature *(°C)*	Initial Water Level *(ft., btoc)*	Ending Water Level *(ft., btoc)*
5/12	7:45	8 Bailed	3.8	11.6	10				15.33	
5/12	12:06	10 Begin Pumping			GrayTurbid	7.25	400	17.0	15.33	
5/12	12:09	15			GrayTurbid	6.89	381	16.7		
5/12	12:11	20			Clearing	6.82	377	16.6		
5/12	12:14	25			Clearing	6.82	370	16.5		
5/12	12:16	30			Clearing	6.78	368	16.5		
5/12	12:19	35			Clearing	6.80	370	16.5		
5/12		Stop to Cool Pump	Surge Piezometer							
5/12	12:25	Restart Pump								
5/12	12:27	40			GrayTurbid	6.80	365	16.5		
5/12	12:30	45			Clearing	6.80	368	16.4		
5/12	12:38	50			Clear	6.77	365	16.4		
		60			Clear	6.81	367	16.4		15.28
Comments:		Well volume calculation based on initial depth to groundwater.								
		Water Added During Construction = 10 gallons					Three Well Volumes =		46.4	gallons
							Calculated total purge =		56.4	gallons
Name: Ken Ewers						*Company:*	GREDELL Engineering Resources, Inc.			

Monitoring Well Development Record

Location: *Sikeston Groundwater Monitoring and Sampling*	*Date:* *5/11/16*
Well: *MW-2 (TPZ-2)*	*Initial Depth to Groundwater (ft, btoc):* 9.01 ft.
Borehole Diameter: *8.5 "*	*Base of Well (ft, btoc):* 37.37 ft.
Casing Diameter: *2 "*	*Filter Pack Hgt (ft):* 12.5 ft.
Development method: *Bailer / Submersible Pump*	*Screened Interval Lithology: Medium- to Coarse-Grained Sand*

Date/Time		*Purge Volume (cummulative) (gallons)*	*Casing Volume (gallons)*	*Annular Volume (gallons)*	*Tremie Volume (gallons)*	*pH (s.u.)*	*Specific Conductance (umhos/cm)*	*Temperature (° C)*	*Initial Water Level (ft., btoc)*	*Ending Water Level (ft., btoc)*
5/11	10:55	5 Bailed	4.8	10.2	10				9.41	9.55
5/12	15:45	8 Bailed							9.32	
5/12	15:57	Begin Pumping			Brown Turbid					
5/12	16:00	13			Brown Turbid	6.34	195	17.4		
5/12	16:02	18			Brown Turbid	6.07	209	17.1		
5/12	16:04	23			Brown Turbid	6.00	214	17.1		
5/12	16:07	28			Brown Turbid	5.97	218	17.1		
5/12	16:09	32			Brown Turbid	5.94	221	17.0		
5/12	16:11	35 Pause to Cool Pump			Brown Turbid					
5/12	16:20	40			Brown Turbid	5.94	225	17.1		
5/12	16:23	45			Brown Turbid	5.91	232	17.2		
5/12	16:25	50			Clearing	5.91	230	17.1		
5/12	16:27	55			Clearing	5.92	232	17.1		
5/12	16:30	60			Clearing	5.90	233	17.0		
5/12	16:30	Pause to Cool Pump			Clearing					
5/12	16:35	Resume Pumping			Clearing					
5/12	16:37	65			Clearing	5.91	232	17.0		
5/12	16:38	70			Clear	5.89	232	17.0		
5/12	16:41	75			Clear	5.91	231	17.0		9.35

Comments: Well volume calculation based on initial depth to groundwater.

Water Added During Construction = 10 gallons — Three Well Volumes = 45.1 gallons

Calculated total purge = 55.1 gallons

Name: *Ken Ewers* — *Company:* GREDELL Engineering Resources, Inc.

Monitoring Well Development Record

Location: Sikeston Groundwater Monitoring and Sampling	*Date: 5/11/16*
Well: *MW-3 (TPZ-3)*	*Initial Depth to Groundwater (ft, btoc):* 10.46 ft.
Borehole Diameter: *8.5 "*	*Base of Well (ft, btoc):* 37.21 ft.
Casing Diameter: *2 "*	*Filter Pack Hgt (ft):* 13 ft.
Development method: *Bailer / Submersible Pump*	*Screened Interval Lithology: Silt to Medium-Grained Sand*

Date/Time		*Purge Volume (cummulative) (gallons)*	*Casing Volume (gallons)*	*Annular Volume (gallons)*	*Tremie Volume (gallons)*	*pH (s.u.)*	*Specific Conductance (umhos/cm)*	*Temperature (^oC)*	*Initial Water Level (ft., btoc)*	*Ending Water Level (ft., btoc)*
5/11	16:40	10 Bailed	4.6	10.6	10				10.46	10.52
5/11	17:00	15 Pump			Turbid	7.07	252	21.1		
5/11	17:02	20			Turbid	6.89	233	19.7		
5/11	17:04	25			Turbid	6.84	242	17.4		
5/11	17:06	30			Turbid	6.86	239	16.9		
5/11	17:08	35			Turbid	6.85	242	16.5		
5/11	17:11	40 Pause Pumping			Clearing	6.86	240	16.4		
5/11	17:20	Resume Pumping								
5/11	17:23	45			Turbid	6.88	236	16.7		
5/11	17:25	50			Turbid	6.88	236	16.3		
5/11	17:28	55			Turbid	6.85	238	16.1		
5/11	17:30	60			Clear	6.84	234	16.1		10.50

Comments: Well volume calculation based on initial depth to groundwater.

Water Added During Construction = 10 gallons

Three Well Volumes = 45.5 gallons

Calculated total purge = 55.5 gallons

Name: Ken Ewers

Company: GREDELL Engineering Resources, Inc.

Monitoring Well Development Record

Location: Sikeston Groundwater Monitoring and Sampling		Date: 5/9/16	
Well:	MW -4 (TPZ-4)	Initial Depth to Groundwater (ft, btoc):	9.68 ft.
Borehole Diameter:	8.5 "	Base of Well (ft, btoc):	37.41 ft.
Casing Diameter:	2 "	Filter Pack Hgt (ft):	13.25 ft.
Development method:	Bailer / Submersible Pump	Screened Interval Lithology: Fine- to Coarse-Grained Sand	

Date/Time		Purge Volume (cummulative) (gallons)	Casing Volume (gallons)	Annular Volume (gallons)	Tremie Volume (gallons)	pH (s.u.)	Specific Conductance (umhos/cm)	Temperature (^oC)	Initial Water Level (ft., btoc)	Ending Water Level (ft., btoc)
5/9	9:15	10 Bailer	4.7	10.8	15	6.62	633	17.4	10.26	
5/9	9:25	15 Bailer				6.94	586	17.1		
5/9	9:37	17 Bailer				6.94	650	16.6		
5/9		20 Bailer				6.97	637	16.8		
5/9	9:40	22 Bailer				6.90	683	16.6		10.24
5/12	14:33	Begin Pumping			Gray Turbid				9.54	
5/12	14:36	27			Clear	7.08	603	17.0		
5/12	14:38	32			Clear	7.07	605	17.0		
5/12	14:41	37			Clear	7.02	630	16.9		
5/12	14:43	42 Pause Pumping			Clear	7.00	639	16.9		
5/12	14:51	Resume Pumping								
5/12	14:43	47			Clear	6.96	644	16.9		
5/12	14:55	52			Clear	6.95	644	16.8		
5/12	14:58	57			Clear	6.94	652	16.7		
5/12	15:01	62			Clear	6.93	656	16.8		9.57

Comments: Well volume calculation based on initial depth to groundwater.

Water Added During Construction = 15 gallons — Three Well Volumes = 46.6 gallons

Calculated total purge = 61.6 gallons

Name: Ken Ewers — *Company:* GREDELL Engineering Resources, Inc.

Monitoring Well Development Record

Location: Sikeston Groundwater Monitoring and Sampling		*Date: 5/12/16*	
Well:	*MW-5 (TPZ-5)*	*Initial Depth to Groundwater (ft, btoc):*	9.54 ft.
Borehole Diameter:	*8.5 "*	*Base of Well (ft, btoc):*	37.17 ft.
Casing Diameter:	*2 "*	*Filter Pack Hgt (ft):*	13.5 ft.
Development method:	*Bailer / Submersible Pump*	*Screened Interval Lithology: Fine- to Coarse-Grained Sand*	

Date/Time		*Purge Volume (cummulative) (gallons)*	*Casing Volume (gallons)*	*Annular Volume (gallons)*	*Tremie Volume (gallons)*	*pH (s.u.)*	*Specific Conductance (umhos/cm)*	*Temperature (°C)*	*Initial Water Level (ft., btoc)*	*Ending Water Level (ft., btoc)*
5/11	13:35	10 Bailed	4.7	11.0	15				9.54	9.56
5/12	13:45	15 Pump			Brown Turbid	6.78	504	16.6	9.32	
5/12	13:50	20			Clear	6.80	505	16.3		
5/12	13:52	25			Clear	6.80	507	16.2		
5/12	13:54	30			Clear	6.81	512	16.2		
5/12	13:57	35			Stop to Cool Pump	6.80	514	16.2		
5/12	14:03	Resume Pumping								
5/12	14:06	40			Brown Turbid	6.83	514	16.2		
5/12	14:08	45			Clearing	6.82	514	16.3		
5/12	14:10	50			Clear	6.81	521	16.4		
5/12	12:12	55			Clear	6.82	517	16.4		
5/12	14:15	60			Clear	6.81	521	16.4		
5/12	14:17	65			Clear	6.82	522	16.4		9.29

Comments: Well volume calculation based on initial depth to groundwater.

Water Added During Construction = 15 gallons

Three Well Volumes = 47.2 gallons

Calculated total purge = 62.2 gallons

Name: *Ken Ewers* *Company:* GREDELL Engineering Resources, Inc.

Monitoring Well Development Record

Location: Sikeston Groundwater Monitoring and Sampling	*Date: 5/11/16*
Well: *MW-6 (TPZ-6)*	*Initial Depth to Groundwater (ft, btoc):* 10.46 ft.
Borehole Diameter: *8.5 "*	*Base of Well (ft, btoc):* 38.03 ft.
Casing Diameter: *2 "*	*Filter Pack Hgt (ft):* 13.5 ft.
Development method: *Bailer / Submersible Pump*	*Screened Interval Lithology: Fine- to Coarse-Grained Sand*

Date/Time		*Purge Volume (cummulative) (gallons)*	*Casing Volume (gallons)*	*Annular Volume (gallons)*	*Tremie Volume (gallons)*	*pH (s.u.)*	*Specific Conductance (umhos/cm)*	*Temperature (°C)*	*Initial Water Level (ft., btoc)*	*Ending Water Level (ft., btoc)*
5/11	16:10	10 Bailed	4.7	11.0	10				10.46	10.54
5/12	12:58	Start Pumping							10.30	
5/12	13:01	15			Gray Turbid	6.65	354	16.5		
5/12	13:03	20			Gray Turbid	6.65	361	16.3		
5/12	13:06	25			Clearing	6.64	365	16.2		
5/12	13:09	30			Clearing	6.65	365	16.2		
5/12	13:12	35 Pause Pumping to Cool			Clearing	6.65	368	16.2		
5/12	13:18	Restart Pump								
5/12	13:20	40			Gray Turbid	6.64	362	16.3		
5/12	13:23	45			Clearing	6.65	365	16.2		
5/12	13:26	50			Clear	6.63	366	16.2		
5/12	13:28	55			Clear	6.64	366	16.2		
5/12	13:31	60			Clear	6.64	364	16.2		10.31

Comments: Well volume calculation based on initial depth to groundwater.

Water Added During Construction = 10 gallons — Three Well Volumes = 47.1 gallons

Calculated total purge = 57.1 gallons

Name: *Ken Ewers* — *Company:* GREDELL Engineering Resources, Inc.

Well Development Record

Location: Sikeston Groundwater Monitoring and Sampling	*Date:* 4/19/17
Well: MW-7	*Initial Depth to Groundwater (ft, btoc):* 19.13 ft.
Borehole Diameter: 8.25 "	*Base of Well (ft, btoc):* 37.37 ft.
Casing Diameter: 2 "	*Filter Pack Hgt (ft):* 13.5 ft.
Development method: Bailer / Submersible Pump	*Screened Interval Lithology:* Very fine- to medium-grained sand

Date/Time		*Purge Volume (cummulative) (gallons)*	*Casing Volume (gallons)*	*Annular Volume (gallons)*	*Tremie Volume (gallons)*	*pH (s.u.)*	*Specific Conductance (umhos/cm)*	*Temperature (°C)*	*Initial Water Level (ft., btoc)*	*Ending Water Level (ft., btoc)*
4/18	17:42	5 (bail)			150				19.13	
4/19	7:50	5 (bail)							19.13	
4/19	8:15	25 (pump)				7.12	773	21.1	19.25	
4/19	8:35	47 (pump)				7.55	729	20.9	19.25	
4/19	8:55	72 (pump)				7.63	794	21.5	19.24	
4/19	9:15	96 (pump)				7.67	813	21.5	19.24	
4/19	9:35	119 (pump)				7.67	836	19.8	19.24	
4/19	9:55	140 (pump)				7.57	871	18.4	19.24	
4/19	10:15	167 (pump)				7.59	811	18.3	19.24	
4/19	10:35	180 (pump)				7.58	879	17.3	19.23	
4/19	10:43	184 (pump)				7.58	906	17.5	19.23	
4/19	10:47	188 (pump)				7.57	868	17.3	19.23	
4/19	10:50	191 (pump)				7.59	898	17.9	19.23	
4/19	10:55	192 (pump)				7.59	898	18.3	19.23	
4/19	10:58	193 (pump)				7.56	891	18.3	19.23	
4/19	11:00	195 pump)				7.57	893	18.3	19.23	

Comments:

Well volume calculation based on initial depth to groundwater.

Initial purge conducted with bailer as indicated, subsequent purge via submersible pump. *Three Well Volumes =* 40.3 gallons

Pumping paused after approximately 15 minutes of pumping for pump cooling and formation surging. *Calculated Total Purge =* 190.3 gallons

Name: Chris Pagel *Company:* GREDELL Engineering Resources, Inc.

Well Development Record

Location: *Sikeston Groundwater Monitoring and Sampling*	*Date:* 4/19/17
Well: MW-8	*Initial Depth to Groundwater (ft, btoc):* 9.95 ft.
Borehole Diameter: 8.25 "	*Base of Well (ft, btoc):* 34.91 ft.
Casing Diameter: 2 "	*Filter Pack Hgt (ft):* 14.1 ft.
Development method: Bailer / Submersible Pump	*Screened Interval Lithology:* Very fine- to medium-grained sand

Date/Time		*Purge Volume (cummulative) (gallons)*	*Casing Volume (gallons)*	*Annular Volume (gallons)*	*Tremie Volume (gallons)*	*pH (s.u.)*	*Specific Conductance (umhos/cm)*	*Temperature (^oC)*	*Initial Water Level (ft., btoc)*	*Ending Water Level (ft., btoc)*
4/19	14:15	10 (bail)			130					
4/19	14:30	40 (pump)				7.14	789	18.2	10.50	
4/19		stop due to drillers installing bollards and pad								
4/19	16:15	70 (pump)				7.17	826	17.4	9.96	
4/19	16:35	95 (pump)				7.17	840	17.3	9.95	
4/19	16:55	125 (pump)				7.14	840	17.1	9.95	
4/19	17:15	155 (pump)				7.16	847	71.2	9.92	
4/19	17:35	160 (pump)				7.17	839	17.2	10.02	
4/19	17:40	165 (pump)				7.16	841	17.0	10.02	
4/19	17:42	170 (pump)				7.16	838	16.9	10.02	
4/19	17:45	175 (pump)				7.17	839	16.8	10.02	
4/19	17:47	178 (pump)				7.17	849	16.9	9.95	

Comments:

Well volume calculation based on initial depth to groundwater.

Initial purge conducted with bailer as indicated, subsequent purge via submersible pump. — *Three Well Volumes =* 45.1 gallons

Pumping paused after approximately 15 minutes of pumping for pump cooling and formation surging. — *Calculated Total Purge =* 175.1 gallons

Name: Chris Pagel — *Company:* GREDELL Engineering Resources, Inc.

Appendix 2

Groundwater Monitoring Parameters

Groundwater Monitoring and Sampling Plan
Sikeston Power Station
Sikeston, Missouri

Constituents for Groundwater Monitoring
(MDNR-WPP)

Chemical Constituent	Units[1]	Method[2]	PQL[3]
Aluminum (Al)	µg/L	6010	50
Antimony (Sb)	µg/L	6020	5
Arsenic (As)	µg/L	6020	3
Barium (Ba)	µg/L	6020	5
Beryllium (Be)	mg/L	6020	0.001
Boron (B)	µg/L	6020	20
Cadmium (Cd)	µg/L	6020	2
Calcium (Ca)	mg/L	6020	0.05
Chemical Oxygen Demand (COD)	mg/L	410.4	10
Chloride	mg/L	9251	5
Chromium (Cr)	µg/L	6020	10
Cobalt (Co)	µg/L	6020	10
Copper (Cu)	µg/L	6020	10
Fluoride	mg/L	9214	0.10
Hardness	mg/L	2340	NA
Iron (Fe)	µg/L	6010	20
Lead (Pb)	µg/L	6020	2
Lithium (Li)	µg/L	6010	10
Magnesium (Mg)	mg/L	6020	0.01
Manganese (Mn)	µg/L	6020	5
Mercury (Hg)	µg/L	7470	0.2
Molybdenum (Mo)	µg/L	6020	10
Nickel (Ni)	mg/L	6020	0.01
pH (Field)	S.U.	NA	NA
Radium 226 and 228 (Combined)	*pCi/L*	903.1/904	NA
Selenium (Se)	µg/L	6020	30
Silver (Ag)	µg/L	6020	10
Sodium (Na)	mg/L	6020	0.05
Specific Conductance (Field)	µmhos/cm	NA	NA
Sulfate	mg/L	9036	10
Thallium (Tl)	µg/L	6020	2
Total Dissolved Solids (TDS)	mg/L	2540	20
Total Organic Carbon (TOC)	mg/L	9060	1
Total Organic Halogens (TOX)	mg/L	9020	0.02
Zinc (Zn)	µg/L	6020	10

NOTES:

1. µg/L = micrograms per liter
   mg/L = milligrams per liter
   S.U. = Standard Unit
   pCi/L = picocuries per liter
2. Suggested Methods refer to analytical procedure numbers used in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA publication SW-846, Third Edition, November 1986, or applicable updates.
3. Practical Quantitation Limits are established by the contract laboratory.

Groundwater Monitoring and Sampling Plan
Sikeston Power Station
Sikeston, Missouri

Constituents for Detection and Assessment Monitoring
(Groundwater Monitoring Parameters 40 CFR Part 257.93)

Appendix III Detection Monitoring Constituents			
Chemical Constituent	Units[1]	Method[2]	PQL[3]
Boron (B)	µg/L	6020	10
Calcium (Ca)	mg/L	6020	0.1
Chloride	mg/L	300.0	1
Fluoride	mg/L	300.0	0.25
pH	S.U.	Field	NA
Sulfate	mg/L	300.0	1.0
Total Dissolved Solids (TDS)	mg/L	2540	17

Appendix IV Assessment Monitoring Constituents			
Chemical Constituent	Units[1]	Method[2]	PQL[3]
Antimony (Sb)	µg/L	6020	3
Arsenic (As)	µg/L	6020	1
Barium (Ba)	µg/L	6020	1
Beryllium (Be)	µg/L	6020	1
Cadmium (Cd)	µg/L	6020	1
Chromium (Cr)	µg/L	6020	4
Cobalt (Co)	µg/L	6020	2
Fluoride	mg/L	300.0	0.25
Lead (Pb)	µg/L	6020	1
Lithium (Li)	µg/L	6010	10
Mercury (Hg)	µg/L	6020	0.2
Molybdenum (Mo)	µg/L	6020	1
Selenium (Se)	µg/L	6020	1
Thallium (Tl)	µg/L	6020	1
Radium (Ra-226 + Ra-228)	pCi/L	903.1 & 904.0	NA

NOTES:

1. µg/L = micrograms per liter
   mg/L = milligrams per liter
   S.U. = Standard Unit
   pCi/L = picocuries per liter
2. Suggested Methods refer to analytical procedure numbers used in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA publication SW-846, Third Edition, November 1986, or applicable updates.
3. Practical Quantitation Limits are established by the contract laboratory.

Appendix 3

Field Equipment Calibration Forms and Procedures

FIELD EQUIPMENT CALIBRATION PROCEDURES

pH Calibration/Operation Procedures

(Reference Standard Methods 4500-H + EPA 150.2 EPA Method 9040 and In-Situ SmarTROLL Operator's Manual)

The field pH meter will be calibrated each day water samples are collected. Calibration results will be recorded on the Field Instrumentation Calibration Log in Appendix 3 of the Sampling and Analysis Plan. Do not proceed with sample collection without acceptable calibration.

pH Three-Point Calibration

This procedure is recommended for precise measurements.

1. Select three buffers which bracket the expected sample pH. One should be near the electrode isopotential point (pH 7) and the others should bracket the expected sample pH (e.g. pH 4 and pH 10).
2. Using iSitu software, select the **Calibration** icon.
3. Select **pH Sensor**.
4. Select **3-Point Calibration**.
5. Rinse sensor first with distilled water and then with the lowest pH buffer intended to be used for calibration (pH 4 buffer).
6. Fill the calibration cup to the fill line with pH 4 buffer and follow iSitu Calibration Wizard (Wizard) instructions, and place the sensor into the calibration cup as indicated by the Wizard.
7. Select **Start**.
8. Wait for stable display. Program Calibration Wizard pH value to the buffer value at its measured temperature. (ATC @ 25°C = 4.00).
9. When the calibration is stable as indicated by green checkmarks next to all readings on display, tap **Accept** button to accept calibration and note stabilized pH in units of mV on Field Instrumentation Calibration Log.
10. Rinse sensor first with distilled water and then with the second buffer (pH 7) and repeat steps 6 through 9 above with pH 7 buffer.
11. Rinse sensor first with distilled water and then with the third buffer (pH 10) and repeat steps 6 through 9 above with pH 10 buffer.
12. If all steps are performed correctly, and the calibration slope is between -54 and -62 mV/pH, proceed to pH Measurement. Note, a calculated slope greater than -50mV/pH or less than -66 mV/pH is acceptable but indicates that the sensor may soon require maintenance.
13. To view the calibration report, tap **View Report**.
14. Rinse the sensor thoroughly with deionized or distilled water.

FIELD EQUIPMENT CALIBRATION PROCEDURES

For detailed maintenance, calibration and temperature compensation procedures, consult In-Situ Operator's Manual.

pH Measurement

1. Obtain a neat sample from collection device and place sensor directly into sample.
2. Allow reading to stabilize.
3. Record pH reading directly on the Field Sampling Log.
4. Rinse the sensor thoroughly with deionized or distilled water when measurement is complete.

If the above procedures do not work, consult In-Situ Operator's Manual.

Measuring Hints

1. Ensure calibration buffers are not expired. The difference between adjacent buffers should be no more than 3 pH units.
2. Check electrode slope daily by performing a three-point calibration. Slope should be between -54 and -62 mV/pH. Note, a calculated slope greater than -50mV/pH or less than -66 mV/pH is acceptable but indicates that the sensor may soon require maintenance.
3. Between measurements, rinse electrodes with distilled water and then with the next solution to be measured.
4. Stir/agitate buffers and samples.
5. Avoid rubbing or wiping sensor to reduce chance of error due to polarization.

Interferences

Oily samples and salty samples may leave residues on the electrodes. The probe has to be rinsed thoroughly between measurements using distilled water to remove salt residues. If oily residues need to be removed, consult In-Situ Operator's Manual (p. 68). The electrodes need to be kept wet to ensure proper response.

FIELD EQUIPMENT CALIBRATION PROCEDURES

Conductivity/Temperature Calibration/Operation Procedures

(Reference EPA Method 9050, Std. Methods 2510 EPA 120.1 EPA 170.1 and In-Situ SmarTROLL Operator's Manual)

The field conductivity meter will be calibrated each day water samples are collected using 1,314 µS/cm commercial traceable standard. Calibration results will be recorded on the Field Instrumentation Calibration Log in Appendix 3 of the Sampling and Analysis Plan. Calibration checks outside of a ± 10% range are not acceptable and may require the sensor replacement and/or re-check of the standards. If calibration check standards are still outside ± 10% range, use alternate meter. Do not proceed with sample collection without acceptable calibration checks.

This procedure is recommended for precise conductivity calibration.

1. Using iSitu software, select the **Calibration** icon.
2. Select **Conductivity Sensor**.
3. With the Conductivity Calibration Wizard of the iSitu software, specify **1-Point Calibration**.
4. Ensure the vented cap is installed on the calibration cup. Fill the cup to the fill line with calibration standard. Place the sensor into the calibration cup as indicated by the Wizard.
5. Select **Start**.
6. The In-Situ SmarTROLL will automatically detect the calibration standard, however it may be necessary to indicate the standard value (1,413 µS/cm).
7. Once the calibration is stable, select **Accept** to accept calibration.
8. To view the calibration report, select **View Report.**
9. Rinse the sensor thoroughly with deionized or distilled water.

Conductivity Measurement

Report all values on the Field Sampling Log in µS/cm.

1. Immerse the temperature/conductivity sensor into the sample.
2. Record conductivity reading directly from meter and record on the Field Sampling Log.
3. Rinse the sensor thoroughly with deionized or distilled water when measurement is complete.

Temperature Calibration

Temperature measurement is factory calibrated. Temperature will be checked for calibration by comparison with a laboratory thermometer within a ± 10% range prior to the sample event.

FIELD EQUIPMENT CALIBRATION PROCEDURES

Temperature Measurement

Report all values on the Field Sampling Log in degrees Celsius (°C).

1. Immerse the temperature/conductivity sensor into the sample.
2. Record temperature reading directly on the Field Sampling Log.
3. Rinse the sensor thoroughly with deionized or distilled water when measurement is complete

FIELD EQUIPMENT CALIBRATION PROCEDURES

<u>Oxidation Reduction Potential (ORP) Calibration/ Operation Procedures</u>

(Reference Standard Methods 2580 and In-Situ SmarTROLL Operator's Manual)

The field ORP meter will be calibrated each day water samples are collected. Calibration results will be recorded on the Field Instrumentation Calibration Log in Appendix 3 of the Sampling and Analysis Plan. Calibration checks outside of a ± 10% range are not acceptable and may require the sensor replacement and/or re-check of the standards. If calibration check standards are still outside ± 10% range, use alternate meter. Do not proceed with sample collection without acceptable calibration checks.

ORP Calibration

Report all values on the Field Instrumentation Calibration Log in millivolts (mV).

1. Using iSitu software, select the **Calibration** icon.
2. Select **ORP Sensor**.
3. Select **1-Point Calibration**.
4. Ensure the vented cap is installed on the calibration cup. Fill the cup to the fill line with calibration standard. Place the sensor into the calibration cup as indicated by the Wizard.
5. Select **Start**.
6. Use the Calibration Wizard of the iSitu software and enter the correct value of the calibration solution.
7. When the calibration is stable as indicated with green checkmarks, select **Accept** to accept calibration.
8. Record ORP reading directly from meter and record on the Field Instrumentation Calibration Log.
9. To view the calibration report, select **View Report**.
10. Rinse the sensor thoroughly with deionized or distilled water.

ORP Measurement

Report all values on the Field Sampling Log in millivolts (mV).

1. Select ORP.
2. Immerse the sensor into the sample.
3. Record ORP reading directly on the Field Sampling Log.
4. Rinse the sensor thoroughly with deionized or distilled water when measurement is complete.

FIELD EQUIPMENT CALIBRATION PROCEDURES

Dissolved Oxygen Calibration/ Operation Procedures

(Reference EPA-approved In-Situ Method 1002-8-2009
and In-Situ SmarTROLL Operator's Manual)

The Rugged Dissolved Oxygen Sensor (RDO) allows for the measurement of dissolved oxygen in the field. The instrument measures and reports dissolved oxygen of a sample in percent (%) and milligrams per liter (mg/L).

Dissolved Oxygen Calibration

1. Tap the **Calibration** icon.
2. Select **RDO Sensor**.
3. Select **100% Saturation**.
4. Place a water-saturated sponge in the bottom of the calibration cup as indicated by the Wizard, and place the sensor into the calibration cup.
5. Select **Start**.

   The calibration cup must be vented to barometric pressure. Using the calibration cup pictured on page 40 of the Operators Manual, make sure the vented cap is installed. If you are using the twist-on storage cup, set the sensor assembly in the cup, but do not twist it into place.

6. When the calibration is stable as indicated with green checkmarks, select **Accept** to accept calibration.
7. Remove the sponge.
8. To view the calibration report, select **View Report**.
9. Rinse the sensor thoroughly with distilled water.

Dissolved Oxygen Measurement

1. Immerse the sensor into the sample.
2. Record DO reading directly on the Field Sampling Log.
3. Rinse the sensor thoroughly with deionized or distilled water when measurement is complete.

FIELD EQUIPMENT CALIBRATION PROCEDURES

Turbidimeter Calibration/ Operation Procedures

(Reference ISO7027 Method (IR) and HF Scientific MicroTPI Field Portable Turbidimeter Operator's Manual)

The Turbidimeter allows for the measurement of turbidity in the field. The instrument measures and reports the turbidity of a sample in nephelometric turbidity units (NTU's).

Indexing Calibration Cuvettes

Place the cuvette into the instrument and press it down until it snaps fully into the sample well. Index the cuvette by pressing and holding down the enter button while rotating the cuvette to identify the lowest reading (the displayed turbidity is continuously updated on the display). Once the cuvette is indexed, release the enter button to display the measured turbidity.

Turbidimeter Calibration

The instrument was calibrated and tested prior to leaving the factory. The instrument requires three (3) standards to be calibrated.

1. Select the calibration function of the instrument by pressing the CAL button once. The "CAL" block will be illuminated on the display with "1" indicating the standard required for this step of the calibration. This is the first standard that should be used in a full calibration.
2. Insert the 1000 NTU standard into the sample well and press down until the cuvette snaps fully into the instrument. Align the indexing ring with the arrow on the instrument.
3. Wait for the reading to stabilize. Once the reading has stabilized press the enter button to indicate to the instrument that it should calibrate on this point.
4. When the instrument has completed calibration on this point, it prompts you to insert the next calibration standard into the sample well (CAL 2).
5. Repeat steps 2-4 for each calibration standard. When calibrating CAL 3 (turbidity free water), the instrument will automatically exit out of calibration returning back to the normal operating mode.

Turbidimeter Measurement

Turn on the instrument by pressing the ON/OFF button continuously for 1 second. Allow 75-second warm-up period while preparing for the turbidity measurement as described in the following steps:

1. Sample approximately 100 mL of your process, as you would normally do for turbidity measurement.

2. Obtain a clean and dry sample cuvette.
3. Rinse the cuvette with approximately 10 mL of the sample water (2/3 of cuvette volume), capping the cuvette with the black light shield (cuvette top) and inverting several times. Discard the used sample and repeat the rinsing procedure two more times.
4. Completely fill the rinsed cuvette (from step 3) with the remaining portion (approximately 15 mL) of the grab sample and then cap the cuvette with the supplied cap. Ensure that the outside of the cuvette is dry, clean and free from smudges.

Field Instrumentation Calibration Log

Facility: **SBMU SPS Groundwater Sampling** **Calibrated by:** ______________________

Field Instruments: **In-Situ smarTROLL Field Meter** **HF scientific, inc. Micro TPI Field Portable Turbidimeter**

S/N #: ______________________ **S/N #:** ______________________

	Date	Time	pH Standards		pH Measure-ments	Specific Conductance Standard (µS/cm)		Specific Conductance Measurement (µS/cm)	Oxidation Reduction Potential Standard (mV)				Oxidation Reduction Potential Measurement (mV)	Dissolved Oxygen (%)			Turbidity Standards (NTU)		Turbidity Measurements (NTU)
Beginning of Day Calibration			4.00	=		1413	=		Temperature (ºC)	=		=		Temperature (ºC)	=		0.02	=	
			7.00	=										Tap Water Source	=		10.0	=	
			10.00	=					Standard (mV)	=				Barometric Pressure (mm/Hg)	=		1000	=	
														Measurement	=				
End of Day Check			4.00	=		1413	=		Temperature (ºC)	=		=		Temperature (ºC)	=		0.02	=	
			7.00	=										Tap Water Source	=		10.0	=	
			10.00	=					Standard (mV)	=				Barometric Pressure (mm/Hg)	=		1000	=	
														Measurement	=				

Notes: The Multi-Probe Field Meter measures Temperature, Specific Conductance, Dissolved Oxygen, pH, and Oxidation Reduction Potential.

The HF scientific, inc. Micro TPI Field Portable Turbidimeter measures Turbidity.

Dissolved oxygen is calibrated via % saturation method; however, field measurements are recorded as mg/L.

I certify that the aforementioned meters were calibrated within the manufacturers specifications.

Date: ____________________ By: ______________________________________

ORP Interpolation Reference Table

Temperture °C	ORP mV	Temperture °C	ORP mV	Temperture °C	ORP mV	Temperture °C	ORP mV	Temperture °C	ORP mV	Temperture °C	ORP mV	Temperture °C	ORP mV
0.0	237.0	6.6	231.4	13.2	228.1	19.7	223.2	26.3	219.0	32.7	214.4	39.3	209.6
0.1	236.9	6.7	231.3	13.3	228.0	19.8	223.2	26.4	218.9	32.8	214.3	39.4	209.5
0.2	236.8	6.8	231.3	13.4	228.0	19.9	223.1	26.5	218.8	32.9	214.3	39.5	209.4
0.3	236.7	6.9	231.2	13.4	228.0	20.0	223.0	26.6	218.7	33.0	214.2	39.6	209.3
0.4	236.6	7.0	231.2	13.5	227.9	20.1	222.9	26.7	218.6	33.1	214.1	39.7	209.2
0.5	236.5	7.1	231.2	13.6	227.8	20.2	222.9	26.8	218.6	33.2	214.1	39.8	209.2
0.6	236.4	7.2	231.1	13.7	227.8	20.3	222.8	26.9	218.5	33.3	214.0	39.9	209.1
0.7	236.3	7.3	231.1	13.8	227.7	20.4	222.8	27.0	218.4	33.4	214.0	40.0	209.0
0.8	236.2	7.4	231.0	13.9	227.7	20.5	222.7	27.1	218.3	33.5	213.9	40.1	208.9
0.9	236.1	7.5	231.0	14.0	227.6	20.6	222.6	27.2	218.2	33.6	213.8	40.2	208.8
1.0	236.0	7.6	231.0	14.1	227.5	20.7	222.6	27.3	218.2	33.7	213.8	40.3	208.8
1.1	235.9	7.7	230.9	14.2	227.5	20.8	222.5	27.4	218.1	33.8	213.7	40.4	208.7
1.2	235.8	7.8	230.9	14.3	227.4	20.9	222.5	27.5	218.0	33.9	213.7	40.5	208.6
1.3	235.7	7.9	230.8	14.4	227.4	21.0	222.4	27.6	217.9	34.0	213.6	40.6	208.5
1.4	235.6	8.0	230.8	14.5	227.3	21.1	222.3	27.7	217.8	34.1	213.5	40.7	208.4
1.5	235.5	8.1	230.8	14.6	227.2	21.2	222.3	27.8	217.8	34.2	213.5	40.8	208.4
1.6	235.4	8.2	230.7	14.7	227.2	21.3	222.2	27.9	217.7	34.3	213.4	40.9	208.3
1.7	235.3	8.3	230.7	14.8	227.1	21.4	222.2	28.0	217.6	34.4	213.4	41.0	208.2
1.8	235.2	8.4	230.6	14.9	227.1	21.5	222.1	28.1	217.5	34.5	213.3	41.1	208.1
1.9	235.1	8.5	230.6	15.0	227.0	21.6	222.0	28.2	217.4	34.6	213.2	41.2	208.0
2.0	235.0	8.6	230.6	15.1	226.9	21.7	222.0	28.3	217.4	34.7	213.2	41.3	208.0
2.1	234.9	8.7	230.5	15.2	226.8	21.8	221.9	28.4	217.3	34.8	213.1	41.4	207.9
2.2	234.8	8.8	230.5	15.3	226.8	21.9	221.9	28.5	217.2	34.9	213.1	41.5	207.8
2.3	234.7	8.9	230.4	15.4	226.7	22.0	221.8	28.6	217.1	35.0	213.0	41.6	207.7
2.4	234.6	9.0	230.4	15.5	226.6	22.1	221.7	28.7	217.0	35.1	212.9	41.7	207.6
2.5	234.5	9.1	230.4	15.6	226.5	22.2	221.7	28.8	217.0	35.2	212.8	41.8	207.6
2.6	234.4	9.2	230.3	15.7	226.4	22.3	221.6	28.9	216.9	35.3	212.8	41.9	207.5
2.7	234.3	9.3	230.3	15.8	226.4	22.4	221.6	29.0	216.8	35.4	212.7	42.0	207.4
2.8	234.2	9.4	230.2	15.9	226.3	22.5	221.5	29.1	216.7	35.5	212.6	42.1	207.3
2.9	234.1	9.5	230.2	16.0	226.2	22.6	221.4	29.2	216.6	35.6	212.5	42.2	207.2
3.0	234.0	9.6	230.2	16.1	226.1	22.7	221.4	29.3	216.6	35.7	212.4	42.3	207.2
3.1	233.9	9.7	230.1	16.2	226.0	22.8	221.3	29.4	216.5	35.8	212.4	42.4	207.1
3.2	233.8	9.8	230.1	16.3	226.0	22.9	221.3	29.3	216.6	35.9	212.3	42.5	207.0
3.3	233.7	9.9	230.0	16.4	225.9	23.0	221.2	29.4	216.5	36.0	212.2	42.6	206.9
3.4	233.6	10.0	230.0	16.5	225.8	23.1	221.1	29.5	216.4	36.1	212.1	42.7	206.8
3.5	233.5	10.1	229.9	16.6	225.7	23.2	221.1	29.6	216.3	36.2	212.0	42.8	206.8
3.6	233.4	10.2	229.9	16.7	225.6	23.3	221.0	29.7	216.2	36.3	212.0	42.9	206.7
3.7	233.3	10.3	229.8	16.8	225.6	23.4	221.0	29.8	216.2	36.4	211.9	43.0	206.6
3.8	233.2	10.4	229.8	16.9	225.5	23.5	220.9	29.9	216.1	36.5	211.8	43.1	206.5
3.9	233.1	10.5	229.7	17.0	225.4	23.6	220.8	30.0	216.0	36.6	211.7	43.2	206.4
4.0	233.0	10.6	229.6	17.1	225.3	23.7	220.8	30.1	215.9	36.7	211.6	43.3	206.4
4.1	232.9	10.7	229.6	17.2	225.2	23.8	220.7	30.2	215.9	36.8	211.6	43.4	206.3
4.2	232.8	10.8	229.5	17.3	225.2	23.9	220.7	30.3	215.8	36.9	211.5	43.5	206.2
4.3	232.7	10.9	229.5	17.4	225.1	24.0	220.6	30.4	215.8	37.0	211.4	43.6	206.1
4.4	232.6	11.0	229.4	17.5	225.0	24.1	220.5	30.5	215.7	37.1	211.3	43.7	206.0
4.5	232.5	11.1	229.3	17.6	224.9	24.2	220.5	30.6	215.6	37.2	211.2	43.8	206.0
4.6	232.4	11.2	229.3	17.7	224.8	24.3	220.4	30.7	215.6	37.3	211.2	43.9	205.9
4.7	232.3	11.3	229.2	17.8	224.8	24.4	220.4	30.8	215.5	37.4	211.1	44.0	205.8
4.8	232.2	11.4	229.2	17.9	224.7	24.5	220.3	30.9	215.5	37.5	211.0	44.1	205.7
4.9	232.1	11.5	229.1	18.0	224.6	24.6	220.2	31.0	215.4	37.6	210.9	44.2	205.6
5.0	232.0	11.6	229.0	18.1	224.5	24.7	220.2	31.1	215.3	37.7	210.8	44.3	205.6
5.1	232.0	11.7	229.0	18.2	224.4	24.8	220.1	31.2	215.3	37.8	210.8	44.4	205.5
5.2	231.9	11.8	228.9	18.3	224.4	24.9	220.1	31.3	215.2	37.9	210.7	44.5	205.4
5.3	231.9	11.9	228.9	18.4	224.3	25.0	220.0	31.4	215.2	38.0	210.6	44.6	205.3
5.4	231.8	12.0	228.8	18.5	224.2	25.1	219.9	31.5	215.1	38.1	210.5	44.7	205.2
5.5	231.8	12.1	228.7	18.6	224.1	25.2	219.8	31.6	215.0	38.2	210.4	44.8	205.2
5.6	231.8	12.2	228.7	18.7	224.0	25.3	219.8	31.7	215.0	38.3	210.4	44.9	205.1
5.7	231.7	12.3	228.6	18.8	224.0	25.4	219.7	31.8	214.9	38.4	210.3	45.0	205.0
5.8	231.7	12.4	228.6	18.9	223.9	25.5	219.6	31.9	214.9	38.5	210.2		
5.9	231.6	12.5	228.5	19.0	223.8	25.6	219.5	32.0	214.8	38.6	210.1		
6.0	231.6	12.6	228.4	19.1	223.7	25.7	219.4	32.1	214.7	38.7	210.0		
6.1	231.6	12.7	228.4	19.2	223.6	25.8	219.4	32.2	214.7	38.8	210.0		
6.2	231.5	12.8	228.3	19.3	223.6	25.9	219.3	32.3	214.6	38.9	209.9		
6.3	231.5	12.9	228.3	19.4	223.5	26.0	219.2	32.4	214.6	39.0	209.8		
6.4	231.4	13.0	228.2	19.5	223.4	26.1	219.1	32.5	214.5	39.1	209.7		
6.5	231.4	13.1	228.1	19.6	223.3	26.2	219.0	32.6	214.4	39.2	209.6		

Note: Standard ORP measurements 0, 5, 10, 15, 20, 25, 30, 35, and 40 were provided by Geotech Environmental Equipment, Inc.
The rest of the standard ORP measurements were interpolated from Geotech Standard ORP measurements.

Prepared by: GREDELL Engineering Resources, Inc. September 2017

Appendix 4

Sample Container and Preservation Guidelines
and
Groundwater Sampling Bottle Inventory Form

Groundwater Monitoring and Sampling Plan
Sikeston Power Station
Sikeston, Missouri

Sample Container and Preservation Guidelines

Constituent	Volume Required (mL)	Container [1]	Preservative	Maximum Holding Times (Days)
Field Measurements				
pH	100	P, G	None	Field Measured
Specific Conductance [2]	100	P, G	None	Field Measured
Inorganics, Non-metallics				
Chloride	100	P	None	28
Fluoride	100	P	HNO_3	28
Sulfate	100	P	None	28
Total Dissolved Solids	150	P	None	7
Metals				
Total Recoverable	250	P	HNO_3	180
Mercury	250	P	HNO_3	28
Radionuclides				
Radium 226 and 228 Combined	2,000	P	None	None

NOTES:

1. Plastic (P) or Glass (G). For metals, polyethylene with an all polypropylene cap is preferred.
2. Prior to the collection of a representative groundwater sample, constituent is field measured for stabilization purposes during monitoring well purging, and is not a requirement of 40 CFR 257.90 through 257.95.

REFERENCES:

- Methods for Chemical Analysis of Water and Wastes, March, 1983, USEPA, 600/4-79-020 and additions thereto.
- Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA publication SW-846, Third Edition, November 1986, or applicable updates.
- HF scientific, inc., Owner's Manual MicroTPI & MicroTPW Field Portable Turbidimeters, May 2010, Revision 1.9.
- In-Situ Inc., Operator's Manual, smarTroll MP Handheld Instrument, November 2013, Revision 003.
- In-Situ Inc., Instruction Sheet, Low-Flow Kits and Accessories, November 2015, Revision 002.

SBMU Sikeston Power Station - Groundwater Monitoring and Sampling Plan - Groundwater Sampling Bottle Inventory					
		Bottles Received			
Well ID	**Date Received**	**Chloride, Sulfate, Fluoride, and TDS 500 mL (pl - none)**	**Metals 250 mL (pl - HNO_3)**	**Radium 226 & 228 2,000 mL (pl - none)**	**Broken, Damaged, or Acid Stained/Leaking Bottles**
Extra # 1					
Duplicate # 1					
Field Blank					
DI Water (4 L)					
Chain-of-Custody					

Bottles delivered by: ___________________________ Bottles inventoried by: ___________________________

HNO_3 = Nitric Acid

mL = milliliter L = liter pl = plastic DI = Deionized

Appendix 5

Monitoring Well Field Inspection Form

Monitoring Well Field Inspection

Facility: SBMU SPS – Groundwater Monitoring
Monitoring Well ID: ______________________
Name (Field Staff): ____

Date: _____________

Access:

Accessibility: Good ___ Fair ___ Poor ____

Well clear of weeds and/or debris?: Yes ___ No ____

Well identification clearly visible?: Yes ___ No ____

Remarks:

Concrete Pad:

Condition of Concrete Pad: Good ___ Inadequate ____

Depressions or standing water around well?: Yes ___ No ____

Remarks:

Protective Outer Casing: Material = 4" x 4" Steel Hinged Casing with Hasp

Condition of Protective Casing: Good ___ Damaged ____

Condition of Locking Cap: Good ___ Damaged ____

Condition of Lock: Good ___ Damaged ____

Condition of Weep Hole: Good ___ Damaged ____

Remarks:

Well Riser: Material = 2" Diameter, Schedule 40 PVC, Flush Threaded

Condition of Riser: Good ___ Damaged ____

Condition of Riser Cap: Good ___ Damaged ____

Measurement Reference Point: Yes ___ No ____

Remarks:

Dedicated Purging/Sampling Device: Type = ¼ " ID Semi-Rigid Polyethylene & 0.170" ID Flexible Silicone Tubing

Condition: Good ___ Damaged ___ Missing ___

Remarks:

Monitoring Well Locked/Secured Post Sampling?: Yes ___ No ___

Remarks:

Field Certification

____

Signed Title Date

Appendix 6

Field Sampling Log

Field Sampling Log

Facility: SBMU Sikeston Power Station - Groundwater Monitoring ______________ Monitoring Well ID: ______________

Date: ______________________________

PURGE STABILIZATION DATA CONTINUED

Time	Purge Rate (mL/min)	Cumulative Volume (mL)	Temp (°C)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH (S.U.)	Oxidation Reduction Potential (mV)	Turbidity (NTU)	Water Level (feet btoc)	Notes (e.g., opacity, color, odor)

btoc - below top of casing

Volume Tracking Log

Facility Name: SBMU Sikeston Power Station - CCR Monitoring Wells

Well ID	Tally notes	Total Volume (mL)

Note: Each Tick mark is equal to 1000 mL or 1L.
Total volume based on a 1L graduated cylinder.

Appendix 7

Example Chain-of-Custody Field Record Form

Chain of Custody Record

Date: ____________________ Page: _____ of _____

Results Engineer/Plant Chemist 573-475-3131 573-471-5003 Contact Name Phone Number Fax Number									Analysis Request						Preservation Code
SBMU Sikeston Power Station Company Name															1 = 4°C 2 = HNO_3 3 = HCl 4 = H_2SO_4 5 = NaOH 6 = Other
1551 West Wakefield Avenue Street Address															
Sikeston, MO 63801 City, State, Zip															
Monitoring Wells Surface Impoundment Project Name Site Location															
Sample ID	Date Collected	Time	Matrix	Lab ID	Preservation Code	Number of Containers	Rush	Container Size							Comments

Special Instructions / Comments	(1) Relinquished By	(2) Relinquished By	Sampler Initials:
	(1) Date / Time	(2) Date / Time	Method of Shipment HAND CARRY USPS FEDX UPS
	(1) Company	(2) Company	
	(1) Received By	(2) Received By	CoC
Route Results Through: Circle: Fax Email	(1) Date / Time	(2) Date / Time	Seal Intact?
Email address:	(1) Company	(2) Company	Yes No

ATTACHMENT D5 – STATISTICAL EVALUATIONS

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

GREDELL Engineering Resources, Inc.

Sikeston Power Station

Bottom Ash Pond Baseline Statistical Evaluation

Scott County, Missouri

Prepared for:

Board of Municipal Utilities

Mr. Mark McGill
Sikeston Power Station
1551 West Wakefield Avenue
Sikeston, Missouri 63801

October 13, 2017

Sikeston Power Station

Bottom Ash Pond Baseline Groundwater Statistical Evaluation

Scott County, Missouri

Prepared for:

Sikeston Board of Municipal Utilities
1551 West Wakefield Avenue
Sikeston, Missouri 63801

October 13, 2017

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Sikeston Power Station

Bottom Ash Pond Baseline Groundwater Statistical Evaluation

Scott County, Missouri

October 13, 2017

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1.0 INTRODUCTION

Since November 2016, the Sikeston Power Station (SPS) collected groundwater samples from the bottom ash pond groundwater monitoring network. This network was developed during the Site Characterization (Gredell, 2017a) and described in the Groundwater Monitoring and Sampling Plan (GMSAP) dated September 2017 (Gredell, 2017b). The groundwater samples were collected to establish baseline conditions prior to conducting detection monitoring in accordance with 40 CFR 257.94. The data is evaluated to determine baseline conditions using appropriate statistical analysis methodology. All field sampling activities, sample transport, laboratory analytical testing, and reporting of background sample results are consistent with the GMSAP. This Baseline Groundwater Statistical Evaluation report has been prepared in accordance with 40 CFR 257.93(f) and the 2009 *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance: EPA 530/R-09-007*, hereinafter referred to as the *Unified Guidance*.

The background water quality data (background data) was analyzed in accordance with the GMSAP and in general accordance with the Unified Guidance (2009). The background data analyses conducted for this report were evaluated using the groundwater statistical software program Sanitas Technologies, Version v.9.5.32 (Sanitas). The method detection limits (MDL), practical quantitation limits (PQL), reporting limits (RL) and detected concentrations (quantified values) of the (non-Radium) background data received from the contract analytical laboratory's electronic data deliverable (EDD) files for each background sampling event were imported into Sanitas. The PQL and RL values for each constituent in the background data are identical except for Radium 226 and 228 (combined). Radium results are combined additively (Ra226 + Ra228) and compared to the sum of the respective Minimum Detectable Concentrations (MDCs) to assess detection. Upon importing the EDD files into Sanitas, the MDL for each (non-Radium) constituent is assigned as the concentration data reported as less than the PQL/RL. Radium 226 and 228 (combined) values lower than the sum of MDCs are treated as qualified data, which are used in the background data analyses as qualified concentrations.

2.0 GROUNDWATER DETECTION MONITORING NETWORK

The bottom ash pond groundwater detection monitoring network consists of five permanent wells (Figure 1). All five wells are relatively shallow (approximately 35 feet) in depth and include MW-3, MW-4, MW-5, MW-6 and MW-8 (Table 1). All wells constituting the bottom ash pond detection monitoring network are screened within and obtain groundwater from the alluvial (uppermost) aquifer that underlies the ash pond site. Based on an overall west-southwestward groundwater flow direction, wells considered hydraulically downgradient of bottom ash pond include MW-4, MW-5, and MW-8. Similarly, wells considered hydraulically upgradient of bottom ash pond include MW-3 and MW-6. The bottom ash pond groundwater detection monitoring well network summary provided as Table 1 contains additional details concerning the location and construction aspects of the five-well network.

Four of the monitoring wells (MW-3 through MW-6) were installed in April 2016 and have been sampled eight times (beginning in late-November, 2016, and ending in mid-July 2017). The remaining well (MW-8) was installed in April 2017 and has been sampled eight times (beginning in mid-May 2017 and ending in late-September 2017).

Statistical independence of groundwater samples is most likely when samples are collected at time intervals sufficiently large to prevent sampling the same volume of groundwater. Accordingly, time intervals separating monitoring events were sufficient to ensure physical independence of samples. A minimum interval was calculated with hydraulic gradient, hydraulic conductivity and effective porosity based on Unified Guidance. The calculated interval is based on the time required for groundwater to travel the distance of the well bore (maximum diameter of the well and surrounding filter pack). Groundwater sampling was then conducted at intervals greater than this calculated interval.

A summary of background analytical data results for the bottom ash pond groundwater detection monitoring network is presented in Table 2.

3.0 EXPLORATORY DATA ANALYSIS

Exploratory Data Analysis (EDA) of the background data refers to a collection of descriptive and graphical statistical tools used to explore and understand a data set (ITRC, 2013). Generally, EDA includes a numerical summary and graphical displays such as Time Series Plots, Box and Whisker Plots, Histograms and Probability Plots. EDA methods were selected to generate outputs using the aforementioned Sanitas software. The seven constituents for detection monitoring listed in 40 CFR 257 - Appendix III and the 14 constituents for assessment monitoring listed in 40 CFR 257 - Appendix IV (note Fluoride is included in detection and assessment monitoring) (Table 3) were evaluated by EDA methods per each of the monitoring wells located at the SPS bottom ash pond site. As of the date of this report complete data sets for four wells are available (MW-4 through MW-6) for a total of 84 well/constituent pairs (21 constituents x 4 wells), and a total of 672 individual background data points. When all data becomes available for MW-8 additional EDA will be performed consistent with the methods documented below. Ultimately, five monitoring wells are located at the SPS bottom ash pond site for a total of 105 well/constituent pairs (21 constituents x 5 wells), and a total of 840 individual background data points. Table 3 lists the required constituents for detection and assessment monitoring, as shown in 40 CSR 257 - Appendix III and IV, respectively. This table also specifies the analytical method used by the contract laboratory for each constituent, units of measurement, PQL/RL and range of MDL.

3.1 Time Series Plots

A Time Series Plot of concentration data versus time allows for the observation and assessment of the lack of randomness, changes in location, change in scale, small scale trends, or large-scale trends over time (Unified Guidance, 2009). Possible outliers may also be apparent in Time Series Plots. Time Series Plots (Appendix A) were generated for each well/constituent pair from the sets of background data.

Trends are visually suggested in the data for some constituents; however, many of these trends are decreasing and may be attributed to initial data spikes that are data ‘artifacts’ following installation of the wells. Notable examples of these artifacts were observed in multiple well/constituent pairs (e.g., Fluoride).

3.2 Box and Whisker Plots

Box and Whisker Plots graphically illustrate the range and extreme values found in a set of data. Box and Whisker Plots (Appendix B) were developed for each well/constituent pair from the sets of background data. The Box and Whisker Plots in Appendix B are preceded by a data summary table, which is generated by Sanitas.

The 25th and 75th percentiles show the typical concentration range or the interquartile range (IQR) of each constituent. The median value (50th percentile), which is represented in the

Sanitas Box and Whisker Plots as a solid line between the 25th and 75th percentiles, is an estimate of the typical value found for the concentration of the constituent in the well. The "Whiskers" indicate the extreme values of the data set. The mean (average) value is denoted by a "+". If a value is not plotted for a well/constituent pair, all values were reported less than the PQL/RL. Sample population means (averages) for constituents that show variation among a set of compared wells may indicate spatial variation, which is defined as statistically identifiable differences in mean and/or variance levels across the well field (Unified Guidance, 2009).

Each of the wells include several well/constituent pairs suggestive of spatial variation and the possibility of multiple target populations. This observation is based on the variation in mean values and IQR as demonstrated by an assessment of the Box and Whisker Plots. Multiple target populations are apparent on Box and Whisker Plots in Appendix B for Arsenic, Barium, Boron, Calcium, Chloride, Cobalt, Fluoride, pH, Sulfate, and Total Dissolved Solids (TDS).

3.3 Histograms

"*A histogram is a visual representation of the data collected into groups. This graphical technique provides a visual method of identifying the underlying distribution of the data. The data range is divided into several bins or classes and the data is sorted into the bins. A histogram is a bar graph conveying the bins and the frequency of data points in each bin*" (Unified Guidance, 2009).

The 'frequency' of the background data values is represented on the y-axis versus the range of constituent concentrations (data values) within the 'bins' along the x-axis. The Histograms provide a visual method to evaluate the skewness, kurtosis and symmetry (the overall location, shape and spread) of the background data, and are useful in showing how the background data may not be normally distributed (Unified Guidance, 2009).

Histograms (Appendix C) were generated for the well/constituent pairs from the background data and provide an additional EDA method for observation and assessment. As an example, the well/constituent pairs of TDS and Sulfate from the background data set for MW-4 show the data is left-skewed (positive value) due to the prevalence of relatively low concentrations, whereas the values for Barium from the background data set for MW-3 show a right-skewed (negative value) due to the low frequency relatively low concentrations in this data set. A symmetrical, bell-shaped curve (normal distribution) is apparent in the Histogram for the constituent Calcium for the MW-4 background data set.

3.4 Probability Plots

"*Probability plots are particularly useful for spotting irregularities within the data when compared to a specific distributional model (usually, but not always, the normal). It is easy to determine whether departures from normality are occurring more or less in the middle* *ranges of the data or in the extreme tails. Probability plots can also indicate the presence of possible outlier values that do not follow the basic pattern of the data and can show the presence of significant positive or negative skewness*" (Unified Guidance, 2009).

Probability Plots (Appendix D) were generated for the well/constituent pairs from the background data and provide an additional EDA method for observation and assessment. The Probability Plots aid in determining if there are multiple possible outliers or a single possible outlier within a well/constituent pair and are used, with Time Series Plots and Box and Whisker Plots, to justify possible outliers. Possible outliers are data points on the Probability Plots that visually appear out of alignment with the rest of the data.

As an example, possible outliers for Barium, Boron, and Calcium are apparent on Time Series Plots for monitoring well MW-5 for the May 17, 2017 background sampling event. The Probability Plots for these constituents support the argument of possible outliers as the data points are out of alignment with the rest of the sample population. Additionally, the Box and Whisker Plots provide further support for possible outliers as the sample population data show extended upper 'whiskers' that exceed three times the IQR (described in Section 3.2).

4.0 RESULTS SUMMARY

The evaluation of the SPS bottom ash pond site background data was completed using a series of four statistical evaluation techniques generated by Sanitas software. These include Exploratory Data Analysis (EDA), Outlier Analysis, Trend Testing, and Analysis of Variance (ANOVA). The EDA technique is discussed in Section 3.0 and the remaining background data statistical evaluation techniques are discussed below.

4.1 Outlier Analysis

"*Outliers or observations not derived from the same population as the rest of the sample violate the basic statistical assumption of identically-distributed measurements. The Unified Guidance recommends that testing of outliers be performed on background data, but they generally not be removed unless some basis for a likely error or discrepancy can be identified. Such possible errors or discrepancies could include data recording errors, unusual sampling and laboratory procedures or conditions, inconsistent sample turbidity, and values significantly outside the historical ranges of background data*" (Unified Guidance, 2009).

"*If an outlier value with much higher concentration than other background observations is not removed from background prior to statistical testing, it will tend to increase both the background sample mean and standard deviation…It may be advisable at times to remove high-magnitude outliers in background even if the reasons for these apparently extreme observations are not known. The overall impact of removal will tend to improve the power of prediction limits and control charts, and thus result in a more environmentally protective program*" (Unified Guidance, 2009).

The background data was initially evaluated for possible outliers using the EDA outputs, which included Time Series Plots, Box and Whisker Plots, Histograms and Probability Plots. The following procedure provides the basis for the 'statistical' evaluation of possible outliers:

1. The background data well/constituent pairs sample populations were analyzed for outliers using the Sanitas program by initially screening for possible outliers with the EPA 1989 Outlier Test (Grubb's Test).
2. The data points within the sample populations were normality tested using the Shapiro-Wilk Test. The purpose of normality testing is to determine whether the sample populations are normally distributed.
3. Data that is normally distributed or can be normalized through transformation by the Ladder of Powers methods were then further analyzed for possible outliers using Dixon's Test, which is a parametric statistical outlier identification test. If the sample populations cannot be normalized by the Shapiro-Wilk test or through Ladder of Powers transformation, Dixon's Test method is halted.
4. Some possible outliers selected during the EDA evaluation were not identified by the above procedures due to the sample population being not normalizable. These

possible outliers were further tested (continued even if the distribution remained not normalizable) to determine if they could be confirmed. Several of these possible outliers were confirmed as a result of the additional testing. However, it is noted that these additional outliers are not recognized as 'statistical' outliers since the sample population distribution was not normalizable.

5. Possible outliers selected during the EDA evaluation that were not identified by the above procedures were reanalyzed using Tukey's method for outlier analysis, which indicates possible 'extreme' low or high outliers (Tukey, 1977; Unified Guidance, 2009), if the outlier concentrations exceed three times the interquartile range (IQR) on the Box and Whisker Plots, as described in Section 3.2. Additional outliers were confirmed as a result of Tukey's method analysis.

Using the above-mentioned outlier analysis procedures, seven outliers (Appendix E) were identified out of 672 background data points, or approximately one percent. The confirmed outlier plots located in Appendix E are preceded by a data summary table of confirmed outliers, as generated by Sanitas.

4.2 Trend Analysis

"*A key implication of the independent and identically distributed assumption is that a series of sample measurements should be stationary over time (i.e., stable in mean level and variance). Data that are trending upward or downward violate this assumption since the mean level is changing. Seasonal fluctuations also violate this assumption since both the mean and variance will likely oscillate…With interwell tests and a common (upgradient) background, a trend can signify several possibilities: Contaminated background; A 'break-in' period following new well installation; Site-wide changes in the aquifer; and Seasonal fluctuations, perhaps on the order of several months to a few years"* (Unified Guidance, 2009).

The confirmed outliers were excluded from the background data prior to trend testing. The Sen's Slope/Mann-Kendall (non-parametric) trend test within Sanitas was selected to identify statistically significant downward or upward trends (Appendix F) in the background data. The trend analysis plots located in Appendix F are preceded with a data summary table of significant trends, as generated by Sanitas. Trend testing of monitoring wells and their respective results are as follows:

- The upgradient wells (MW-3 and MW-6) display apparent increasing and decreasing trends among the 42 well/constituent pairs (2 wells x 21 constituents). However, only Chloride and Sulfate were identified in the MW-6 background data set as having significant trends by Sanitas. Both identified significant trends were decreasing.

- The downgradient wells (MW-4 and MW-5) display apparent increasing and decreasing trends among the 42 well/constituent pairs (2 wells x 21 constituents). However, none of these apparent trends are identified by Sanitas as significant.

4.3 Analysis of Variance

Analysis of Variance (ANOVA) is defined as a statistical method for identifying differences among several population means or medians. "*If a one-way ANOVA on the set of background wells finds significant differences in the mean levels for some constituents, and hence, evidence of spatial variability, the guidance recommends using intrawell tests...The method is particularly useful for a group of multiple upgradient wells, to determine whether or not there are large average concentration differences from one location to the next due to natural groundwater fluctuations and/or differences in geochemistry* (Unified Guidance, 2009).

In accordance with the Unified Guidance (2009), natural or man-made differences in mean levels, referred to as spatial variability, impact how background is established and evidence of spatial variation supports the selection of an intrawell statistical approach. The confirmed outliers were excluded from the background data prior to ANOVA testing. The following procedure provides the basis for ANOVA testing within Sanitas.

1. The background data were analyzed via one-way ANOVA using the Shapiro-Wilk ($n \leq 50$) or the Shapiro-Francia ($n > 50$) parametric methods to test residuals for normality.
2. If the distributions were determined to be non-normal as a result of the Shapiro-Wilk and Shapiro-Francia parametric methods, they were analyzed by the Ladder of Powers transformation.
3. Levene's Equality of Variance was then performed on the residuals of the data. "*Levene's test is a formal procedure for testing homogeneity of variance that is fairly robust (i.e., not overly sensitive) to non-normality in the data"* (Unified Guidance, 2009).
4. Background data that could not be normalized by transformation, or that did not pass Levene's test after transformation, were then analyzed using the Kruskal-Wallis non-parametric method by testing the differences among average population ranks equivalent to the medians to assess spatial variability.

One-way ANOVA (Appendix G) for normal distribution (parametric) and non-normal distribution (non-parametric) was performed on the background data from the upgradient wells (MW-3 and MW-6) to assess spatial variability. The ANOVA data summary sheets provided in Appendix G are preceded by a data summary table of significant ANOVA results, as generated by Sanitas. Overall, the ANOVA tests (parametric and non-parametric) indicated five of seven Appendix III constituents and two of five Appendix IV constituents (7 of 12 total) were significantly different in the comparison among the upgradient wells. However, two of the Appendix IV constituents (Mercury and Molybdenum) had reported concentrations in only one sample each and variance is not apparent. The five Appendix III and two Appendix IV constituents identified by ANOVA as being statistically significant and having spatial variation are generally apparent on the Box and Whisker Plots (after outlier removal) for the same upgradient wells. The constituents Antimony, Beryllium, Cadmium, Chromium, Cobalt, Lead, and Lithium were not analyzed by ANOVA because 100 percent of the sample population values are less than the PQL/RL.

ANOVA testing by comparing the 'pooled' upgradient wells (MW-3 and MW-6) to the downgradient wells was not performed because spatial variation is present among the upgradient wells. According to the Unified Guidance (2009), "*If the spatial variation is ignored and data are pooled across wells with differing mean levels (and perhaps variances) to run an interwell parametric prediction limit or control chart test, the pooled standard deviation will tend to be substantially larger than expected. This will result in a higher critical limit for the test. Using pooled data with spatial variation will also tends to increase observed maximum values in background, leading to higher and less powerful non-parametric prediction limit tests. In either application, there will be a loss of statistical power for detecting concentration changes at individual compliance wells. Compliance wells with naturally higher mean levels will also be more frequently determined to exceed the limit than expected, while real increases at compliance wells with naturally lower means will go undetected more often*". Due to spatial variation among the upgradient wells, a Wilcoxon Rank Sum analysis of the shallow alluvial well set was not justified.

5.0 CONCLUSIONS

This Baseline Groundwater Statistical Evaluation report provides record of baseline concentrations of 40 CFR 257 – Appendix III and IV constituents for detection and assessment monitoring (Table 3) around the SPS bottom ash pond site. The concentrations reflect the quality of the groundwater over eight physically independent rounds of background sampling. Measured constituents appear to display a consistent range progressing from the initial round of sampling. As additional analytical results from future semi-annual groundwater detection sampling events are added to the data set, the sample population for each well/constituent pair will be refined.

The comparison of values among the detection monitoring well network indicates that the wells at the SPS bottom ash pond site should not be compared in the context of upgradient to downgradient using interwell analysis for the following reasons:

- Box and Whisker Plots indicate the presence of spatial variation among the upgradient wells;
- As verified by ANOVA testing, there is spatial variation among the upgradient wells, and;
- Evidence of decreasing data trends among an upgradient well (Chloride and Sulfate in MW-6)

Overall, the bullet items provided above support the conclusion that there is more than one statistically different target population within the groundwater detection monitoring well network. The different target populations are attributable to the natural spatial variation inherent in an alluvial setting, where groundwater flow conditions are variable and alluvial sediments are a heterogeneous mixture of sands, silts, and clays. The dissimilarity in water quality data among wells during the background monitoring period indicates that intrawell analysis is the most appropriate statistical method to evaluate possible changes in groundwater quality during semi-annual detection monitoring events. The background data set will be reviewed and updated every two to three years as additional data are acquired. In addition, the statistical analysis methodology of such future events may be updated and modified as appropriate.

6.0 REFERENCES

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FIGURES

N

SCALE: 1" = 400'

0 200 400

LEGEND

PROPERTY LINE	PL
PROPOSED 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 & UNDERGROUND CULVERT ELEVATIONS SURVEYED BY BOWEN ENGINEERING & SURVEYING.

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FIGURE 1
GROUNDWATER MONITORING WELL LOCATION MAP

PROJECT NAME	FILE NAME	SHEET #
SIKESTON/GWMASP	SAP FIGS	1 OF 1

SIKESTON POWER STATION BOTTOM ASH POND BASELINE GROUNDWATER STATISTICAL EVALUATION

SURVEYED	DESIGNED	DRAWN	CHECKED	APPROVED	DATE	SCALE
NA	NA	AJK	KE	MCC	10/2017	AS NOTED

GREDELL Engineering Resources, Inc.
ENVIRONMENTAL ENGINEERING LAND - AIR - WATER
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MO CORP. ENGINEERING LICENSE NO. E-2001001669-D

M:\Shared\CADD\Files\SIKESTON\CCR\BASELINE GW STAT EVAL.dwg, FIGURE 2, 10/6/2017 9:59:25 AM

TABLES

Sikeston Power Station

Bottom Ash Pond Baseline Groundwater Statistical Evaluation

Scott County, Missouri

Table 1
Groundwater Monitoring Network Summary

Monitoring Well ID[1,2]	Northing Location[3]	Easting Location[3]	Ground Surface Elevation[3] (feet)	Top of Riser Elevation[3] (feet)	Well Depth[4] (feet)	Base of Well Elevation (feet)	Screen Length[5] (feet)	Top of Screen Elevation (feet)
MW-3 (UG)	381130.00	1079946.62	306.11	308.55	37.21	271.34	10	281.5
MW-4 (DG)	380804.62	1077766.95	303.26	305.61	37.55	268.06	10	278.3
MW-5 (DG)	379858.94	1078477.85	303.57	305.91	37.17	268.74	10	278.9
MW-6 (UG)	379874.77	1079384.36	305.37	307.72	38.03	269.69	10	279.9
MW-8 (DG)	380311.20	1077940.08	302.37	304.77	37.41	267.36	10	277.4

NOTES:

1. MW-3 through MW-6 were formerly termed TPZ-3 through TPZ-6 in Site Characterization Report (May 2017).
2. Refer to Figure 1 for monitoring well locations.
3. Refer to GMSAP for well construction diagrams.
4. Monitoring well survey data provided by Bowen Engineering & Surveying, Inc.
5. Horizontal Datum: Missouri State Plane Coordinates - NAD 83 (Feet), Vertical Datum: NAVD 88 (Feet).
6. Depth measurements relative to surveyed point on top of well casing.
7. Actual screen length (9.7 feet) is the machine-slotted section of the 10-foot length of Schedule 40 PVC pipe.

Sikeston Power Station
Bottom Ash Pond Baseline Groundwater Statistical Evaluation
Scott County, Missouri

Table 2
Background Water Quality Summary

		40 CFR 257 - Appendix III Constituents for Detection Monitoring							40 CFR 257 - Appendix IV Constituents for Assessment Monitoring															
Well	Date	pH	Chloride	Fluoride	Sulfate	TDS	Boron	Calcium	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium III	Cobalt	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium	Radium 226 and 228 (Combined)[2]	Radium "Detected"[2]	Radium (Combined) MDC
ID		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		pCi/L
MW-3 (UG)	11/30/2016	7.08	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	1.140
	1/24/2017	6.88	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	1.390
	2/22/2017	6.93	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	1.248
	3/20/2017	6.68	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	1.375
	4/27/2017	6.68	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	1.740
	5/17/2017	6.59	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	1.241
	6/8/2017	6.66	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	1.877
	7/13/2017	6.71	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	1.292
MW-4 (DG)	11/30/2016	7.46	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	1.562
	1/24/2017	7.45	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	0.703	ND	1.276
	2/22/2017	7.49	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	1.317
	3/20/2017	7.37	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	0.863
	4/27/2017	7.38	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	1.782
	5/17/2017	7.38	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	1.286
	6/8/2017	7.38	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	1.326
	7/13/2017	7.37	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	1.660
MW-5 (DG)	11/30/2016	6.97	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	yes	0.997
	1/24/2017	6.90	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	1.500
	2/22/2017	6.97	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	1.588
	3/20/2017	6.85	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	1.272
	4/27/2017	6.80	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	yes	1.544
	5/17/2017	6.81	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	yes	1.163
	6/8/2017	6.82	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	1.511
	7/13/2017	6.98	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	1.302
MW-6 (UG)	11/30/2016	6.92	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	yes	1.293
	1/24/2017	6.87	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	1.188
	2/22/2017	6.89	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	1.468
	3/20/2017	6.73	2.1	<0.250	31	240	37	39	<3.0	5.0	160	<1.0	<1.0	<4.0	<2.0	<1.0	<10	<0.20	<1.0	<1.0	<1.0	0.577	ND	1.655
	4/27/2017	6.72	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	1.396
	5/17/2017	6.76	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	1.391
	6/8/2017	6.73	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	1.388
	7/13/2017	6.98	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	1.000
MW-8 (DG)	5/18/2017	7.16	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	yes	0.779
	6/9/2017	7.16	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	1.135
	7/13/2017	7.25	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	1.045
	8/3/2017	7.15	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	0.684	ND	1.185
	8/15/2017	7.16	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	1.218
	8/30/2017	7.15	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	1.214
	9/14/2017	7.13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	9/27/2017	7.05	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
1. Less than (<) symbol indicates constituent not detected above reporting limit.
2. Radium 226 and 228 (combined) values are assessed as qualified values if less than associated MDC and denoted with "ND".
3. NA = Data not available at time of this report.
4. 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.

Sikeston Power Station

Bottom Ash Pond Baseline Groundwater Statistical Evaluation

Scott County, Missouri

Table 3
Groundwater Monitoring Constituents

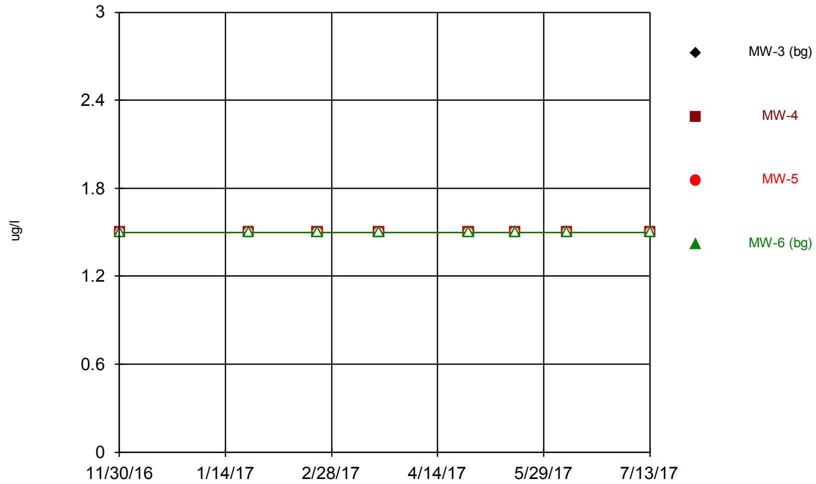
40 CFR 257			
Appendix III - Constituents for Detection Monitoring		**Appendix IV - Monitoring Constituents for Assessment Monitoring**	
Chemical Constituent	**Method**	**Chemical Constituent**	**Method**
pH (S.U.)	Field	Antimony (µg/L)	SW 6020
Boron (µg/L)	SW 6020	Arsenic (µg/L)	SW 6020
Calcium (mg/L)	SW 6020	Barium (µg/L)	SW 6020
Chloride (mg/L)	EPA 300.0	Beryllium (µg/L)	SW 6020
Fluoride (mg/L)	EPA 300.0	Cadmium (µg/L)	SW 6020
Sulfate (mg/L)	EPA 300.0	Chromium (µg/L)	SW 6020
Total Dissolved Solids (mg/L)	SM 2540C	Cobalt (µg/L)	SW 6020
		Fluoride (mg/L)	EPA 300
		Lead (µg/L)	SW 6020
		Lithium (µg/L)	SW 6020
		Mercury (µg/L)	SW 6020
		Molybdenum (µg/L)	SW 6020
		Selenium (µg/L)	SW 6020
		Thallium (µg/L)	SW 6020
		Radium 226 and 228 combined (pCi/L)	EPA 903.1 & 904.0

APPENDICES

Appendix A
Time Series Plots

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.

Antimony

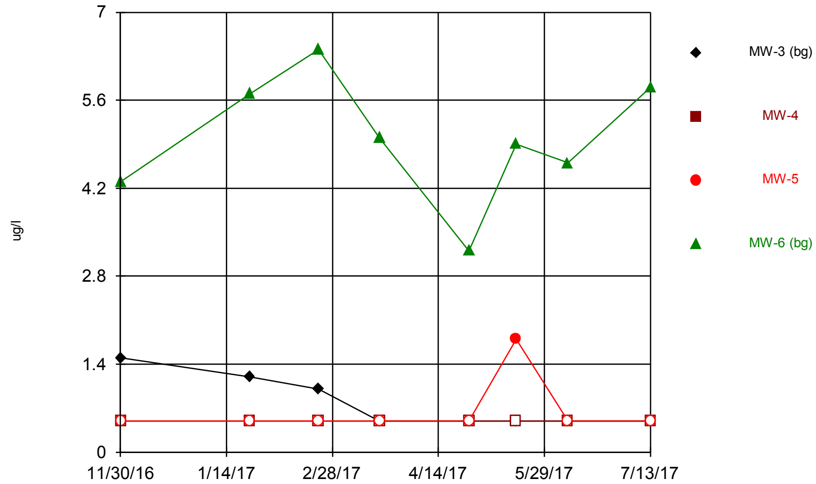


Time Series Analysis Run 10/3/2017 10:53 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.

Arsenic

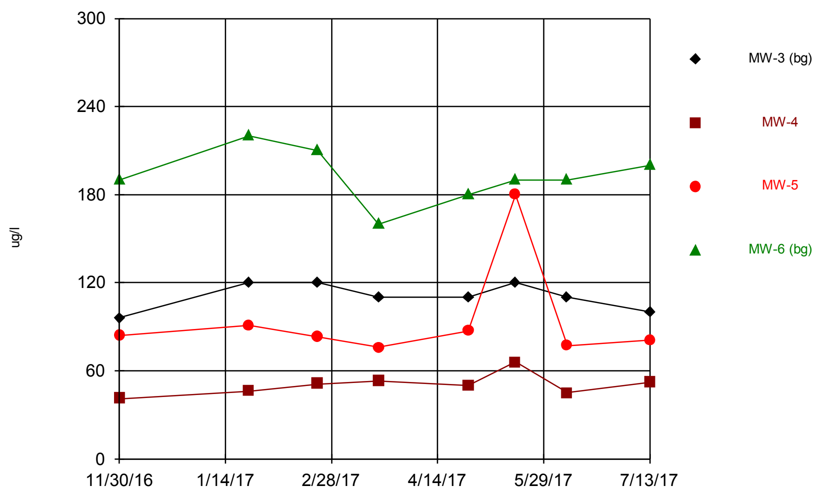


Time Series Analysis Run 10/3/2017 10:53 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Barium

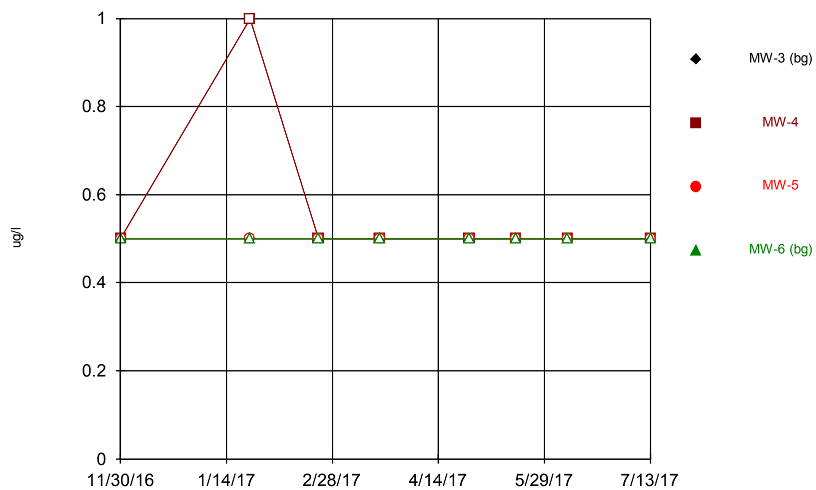


Time Series Analysis Run 10/3/2017 10:53 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

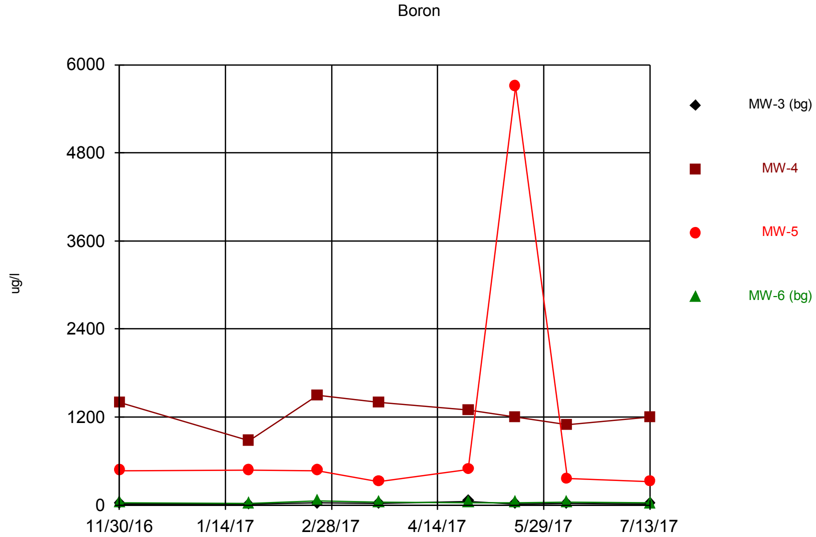
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.

Beryllium



Time Series Analysis Run 10/3/2017 10:53 AM

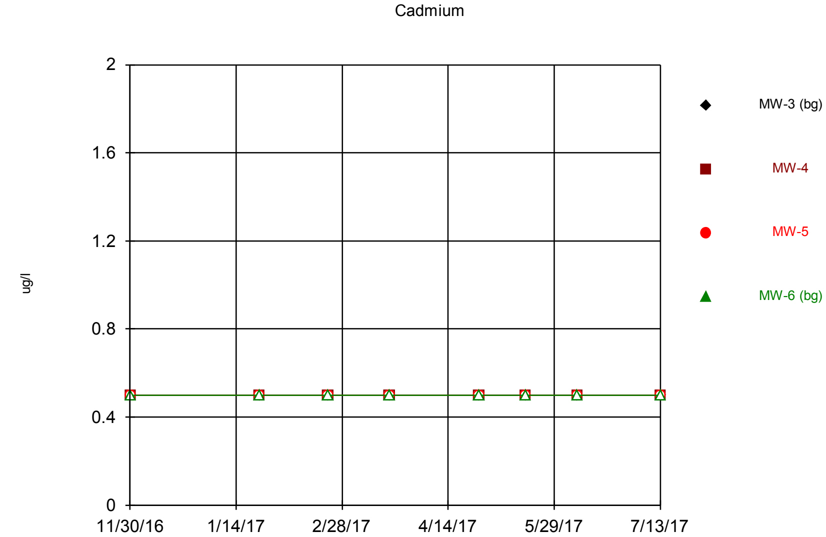
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17



Time Series Analysis Run 10/3/2017 10:53 AM

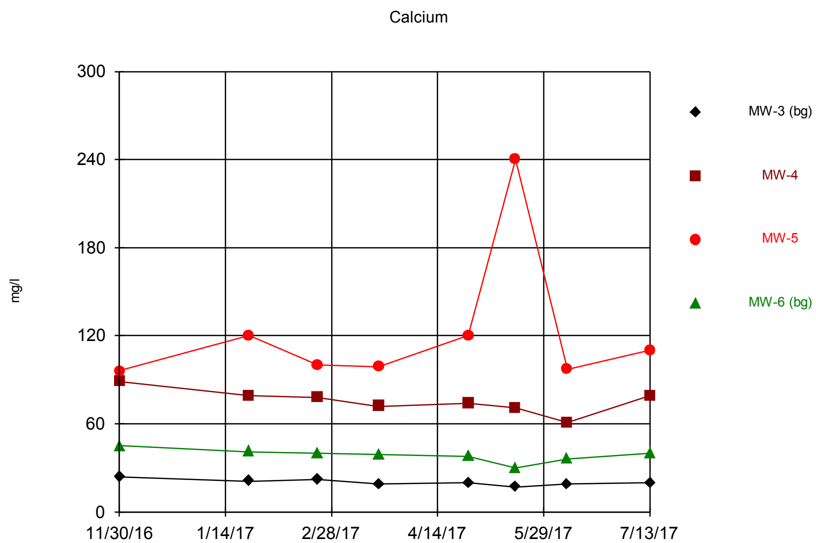
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Hollow symbols indicate censored values.



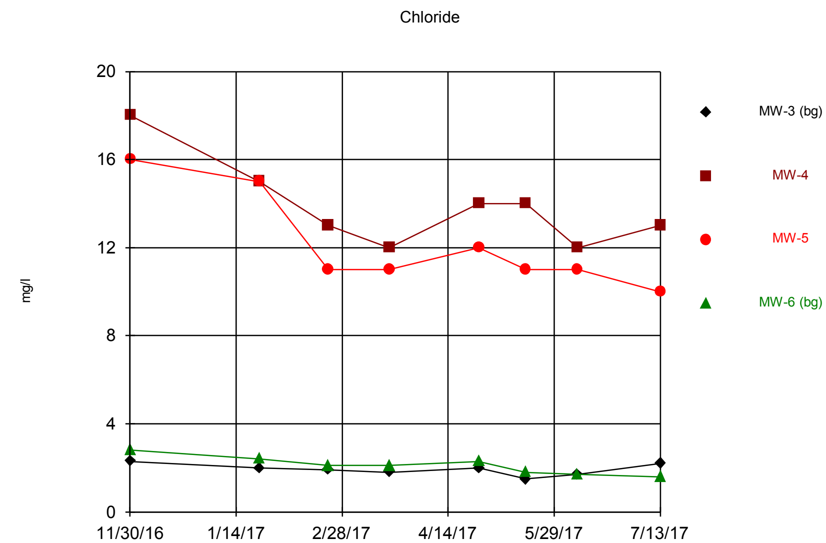
Time Series Analysis Run 10/3/2017 10:53 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17



Time Series Analysis Run 10/3/2017 10:53 AM

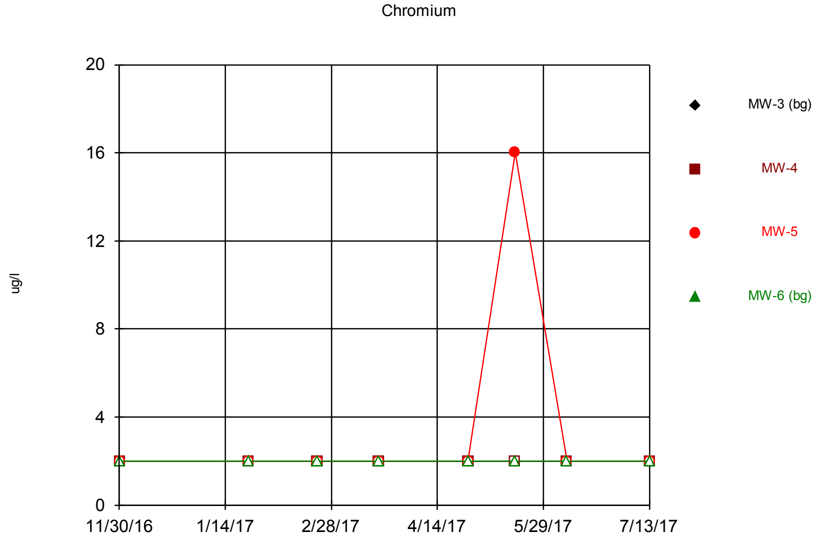
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17



Time Series Analysis Run 10/3/2017 10:53 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Hollow symbols indicate censored values.



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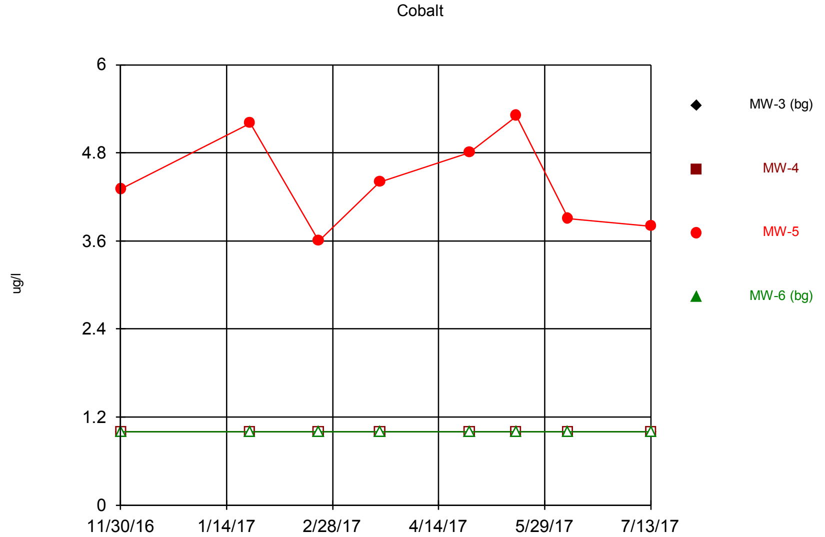

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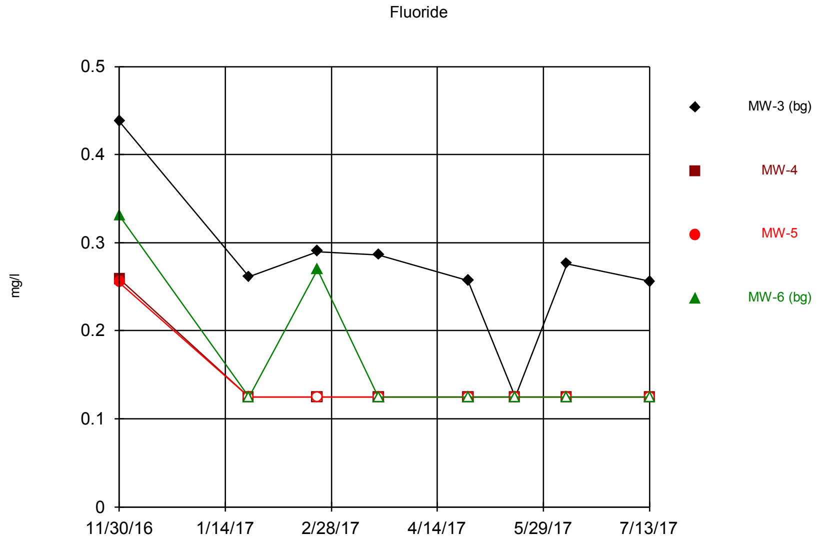

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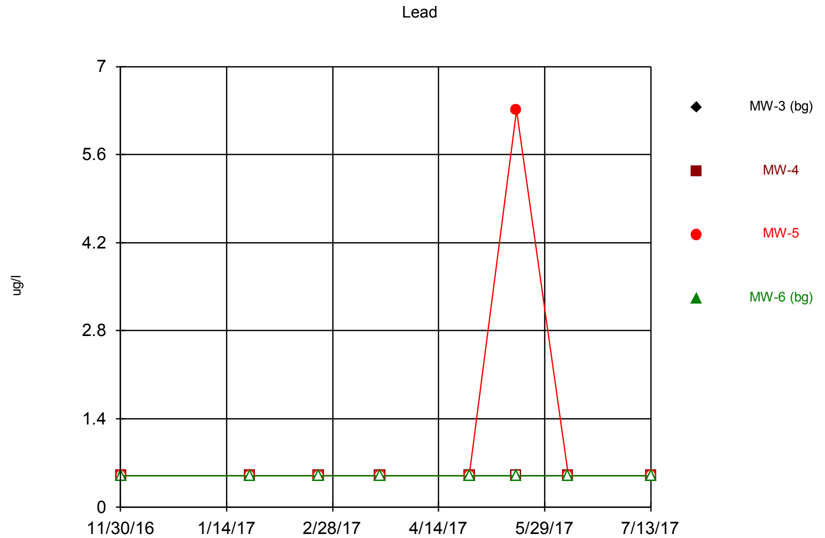

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SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

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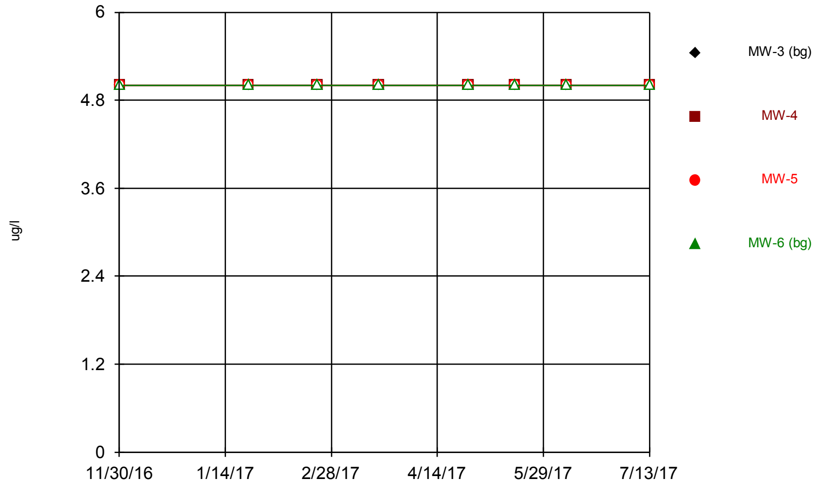
Lithium



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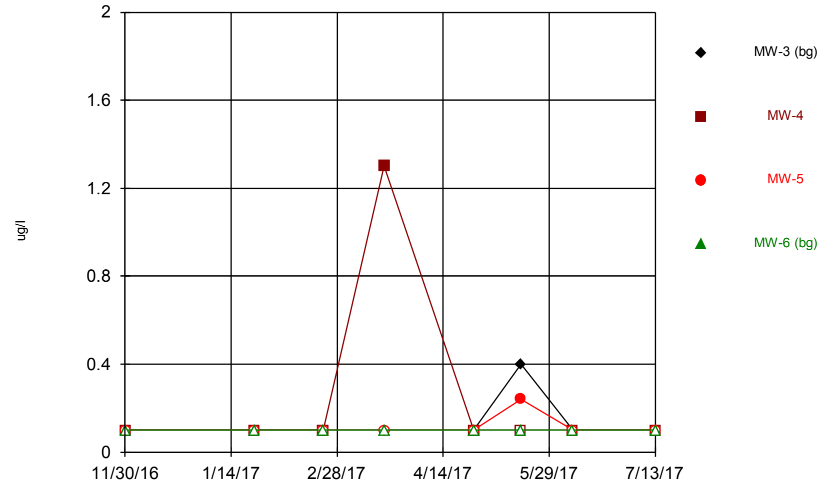
Hollow symbols indicate censored values.

Mercury



Time Series Analysis Run 10/3/2017 10:53 AM

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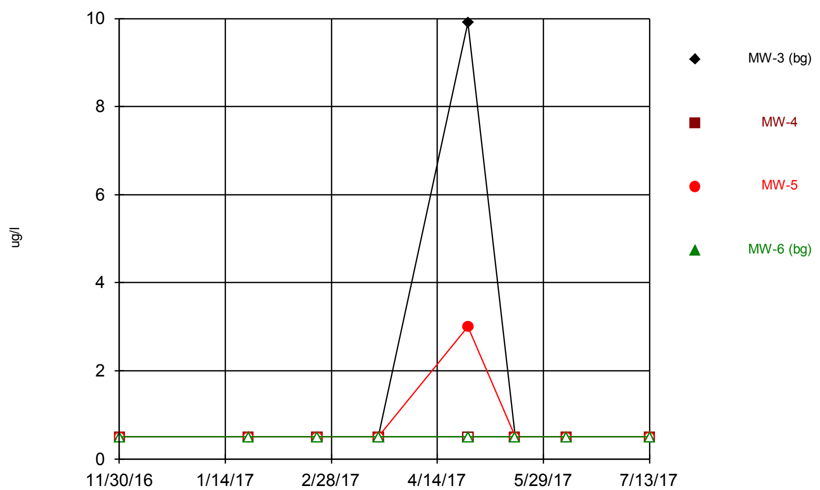
Hollow symbols indicate censored values.

Molybdenum



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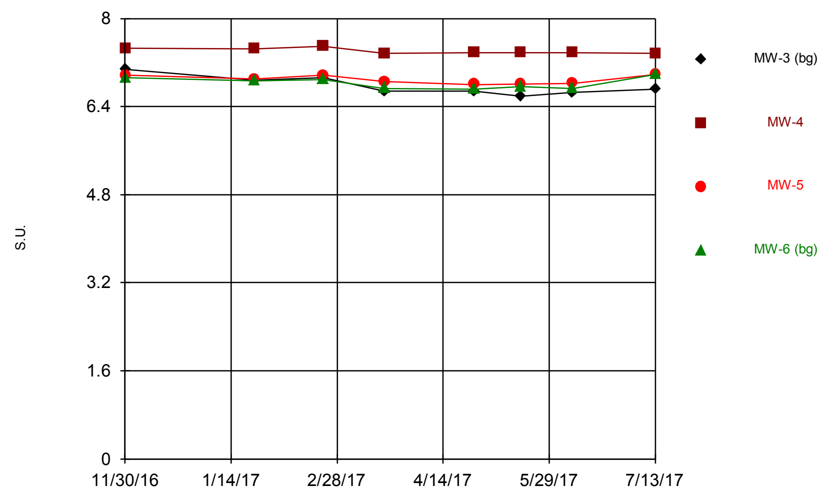
pH



Time Series Analysis Run 10/3/2017 10:53 AM

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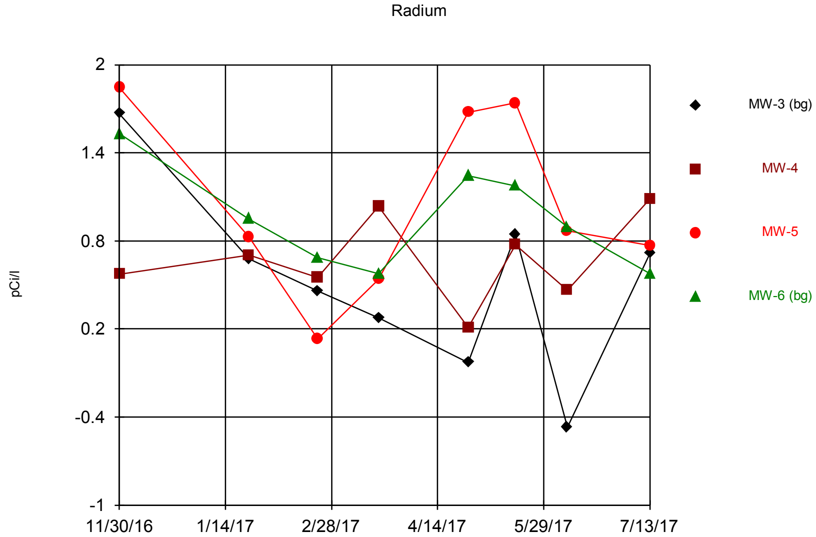

Time Series Analysis Run 10/3/2017 10:53 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

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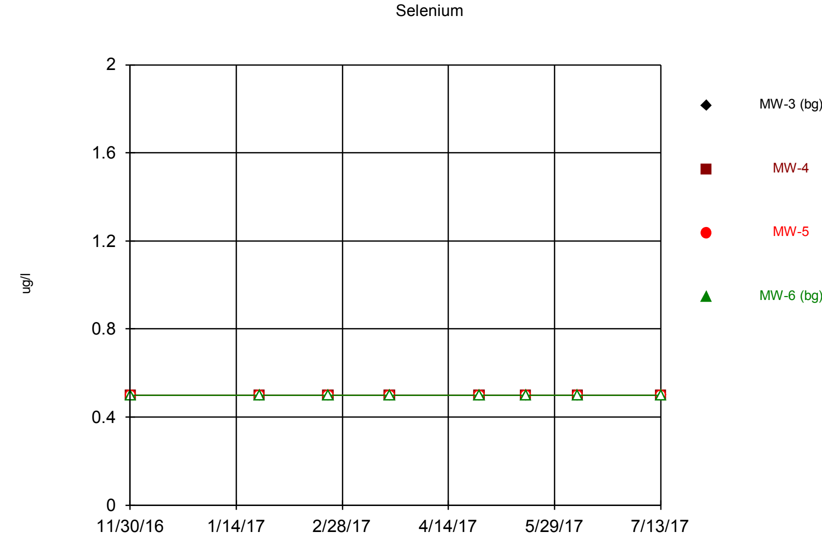
Hollow symbols indicate censored values.



Time Series Analysis Run 10/3/2017 10:53 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

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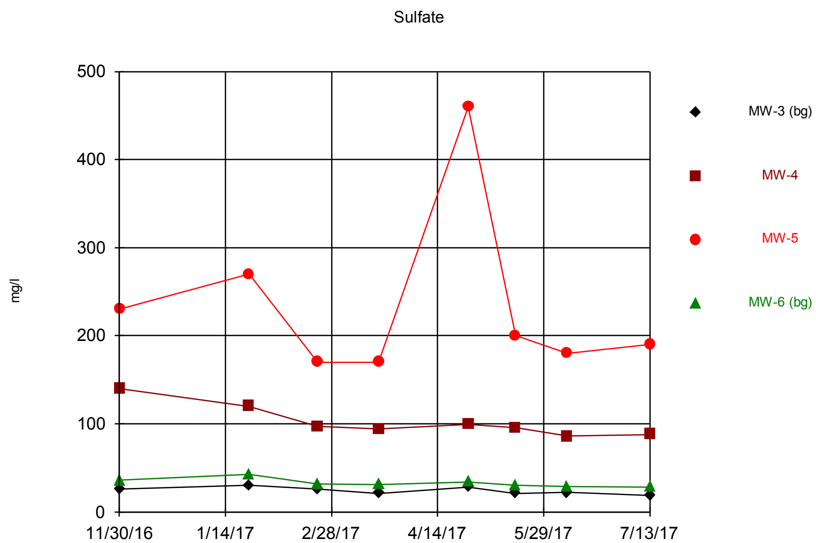

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SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

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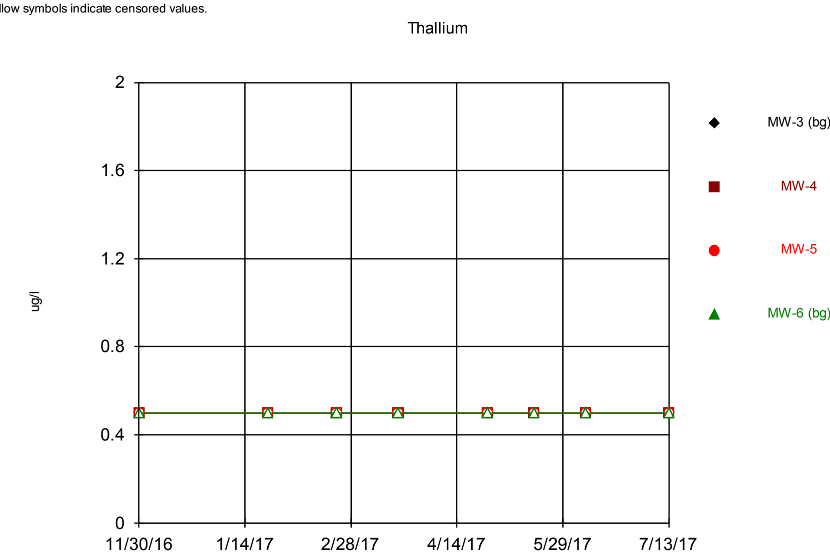
Hollow symbols indicate censored values.



Time Series Analysis Run 10/3/2017 10:53 AM

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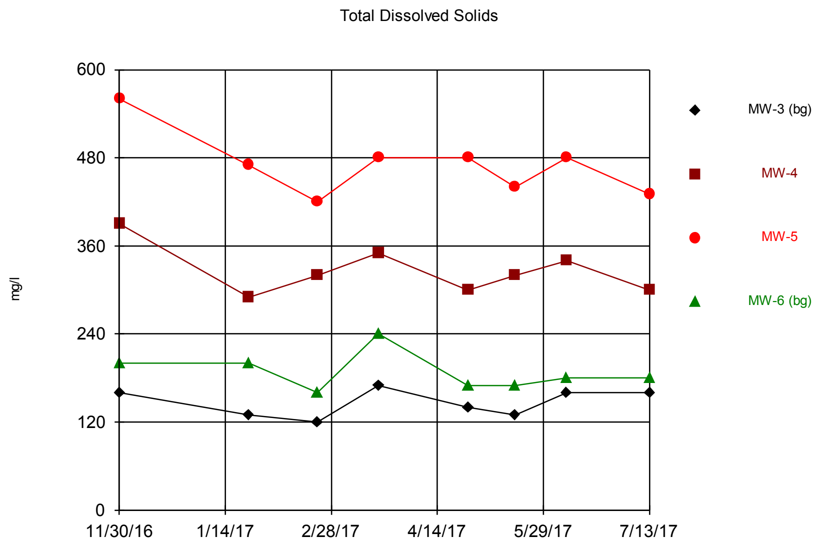

Time Series Analysis Run 10/3/2017 10:53 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Appendix B

Box and Whisker Plots

Box & Whiskers Plot

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17 Printed 10/3/2017, 11:02 AM

Constituent	Well	N	Mean	Median	Lower Q.	Upper Q.	Min.	Max.	%NDs
Antimony (ug/l)	MW-3 (bg)	8	1.5	1.5	1.5	1.5	1.5	1.5	100
Antimony (ug/l)	MW-4	8	1.5	1.5	1.5	1.5	1.5	1.5	100
Antimony (ug/l)	MW-5	8	1.5	1.5	1.5	1.5	1.5	1.5	100
Antimony (ug/l)	MW-6 (bg)	8	1.5	1.5	1.5	1.5	1.5	1.5	100
Arsenic (ug/l)	MW-3 (bg)	8	0.775	0.5	0.5	1.1	0.5	1.5	62.5
Arsenic (ug/l)	MW-4	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Arsenic (ug/l)	MW-5	8	0.6625	0.5	0.5	0.5	0.5	1.8	87.5
Arsenic (ug/l)	MW-6 (bg)	8	4.988	4.95	4.45	5.75	3.2	6.4	0
Barium (ug/l)	MW-3 (bg)	8	110.8	110	105	120	96	120	0
Barium (ug/l)	MW-4	8	50.5	50.5	45.5	52.5	41	66	0
Barium (ug/l)	MW-5	8	94.88	83.5	79	89	76	180	0
Barium (ug/l)	MW-6 (bg)	8	192.5	190	185	205	160	220	0
Beryllium (ug/l)	MW-3 (bg)	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Beryllium (ug/l)	MW-4	8	0.5625	0.5	0.5	0.5	0.5	1	100
Beryllium (ug/l)	MW-5	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Beryllium (ug/l)	MW-6 (bg)	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Boron (ug/l)	MW-3 (bg)	8	24.5	19.5	18	27.5	12	54	0
Boron (ug/l)	MW-4	8	1248	1250	1150	1400	880	1500	0
Boron (ug/l)	MW-5	8	1076	470	340	485	320	5700	0
Boron (ug/l)	MW-6 (bg)	8	37.38	36	33	37.5	27	59	0
Cadmium (ug/l)	MW-3 (bg)	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Cadmium (ug/l)	MW-4	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Cadmium (ug/l)	MW-5	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Cadmium (ug/l)	MW-6 (bg)	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Calcium (mg/l)	MW-3 (bg)	8	20.25	20	19	21.5	17	24	0
Calcium (mg/l)	MW-4	8	75.38	76	71.5	79	61	89	0
Calcium (mg/l)	MW-5	8	122.8	105	98	120	96	240	0
Calcium (mg/l)	MW-6 (bg)	8	38.63	39.5	37	40.5	30	45	0
Chloride (mg/l)	MW-3 (bg)	8	1.925	1.95	1.75	2.1	1.5	2.3	0
Chloride (mg/l)	MW-4	8	13.88	13.5	12.5	14.5	12	18	0
Chloride (mg/l)	MW-5	8	12.13	11	11	13.5	10	16	0
Chloride (mg/l)	MW-6 (bg)	8	2.1	2.1	1.75	2.35	1.6	2.8	0
Chromium (ug/l)	MW-3 (bg)	8	2	2	2	2	2	2	100
Chromium (ug/l)	MW-4	8	2	2	2	2	2	2	100
Chromium (ug/l)	MW-5	8	3.75	2	2	2	2	16	87.5
Chromium (ug/l)	MW-6 (bg)	8	2	2	2	2	2	2	100
Cobalt (ug/l)	MW-3 (bg)	8	1	1	1	1	1	1	100
Cobalt (ug/l)	MW-4	8	1	1	1	1	1	1	100
Cobalt (ug/l)	MW-5	8	4.413	4.35	3.85	5	3.6	5.3	0
Cobalt (ug/l)	MW-6 (bg)	8	1	1	1	1	1	1	100
Fluoride (mg/l)	MW-3 (bg)	8	0.2736	0.2685	0.2565	0.288	0.125	0.438	12.5
Fluoride (mg/l)	MW-4	8	0.1418	0.125	0.125	0.125	0.125	0.259	87.5
Fluoride (mg/l)	MW-5	8	0.1413	0.125	0.125	0.125	0.125	0.255	87.5
Fluoride (mg/l)	MW-6 (bg)	8	0.1688	0.125	0.125	0.197	0.125	0.331	75
Lead (ug/l)	MW-3 (bg)	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Lead (ug/l)	MW-4	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Lead (ug/l)	MW-5	8	1.225	0.5	0.5	0.5	0.5	6.3	87.5
Lead (ug/l)	MW-6 (bg)	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Lithium (ug/l)	MW-3 (bg)	8	5	5	5	5	5	5	100
Lithium (ug/l)	MW-4	8	5	5	5	5	5	5	100

Box & Whiskers Plot

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17 Printed 10/3/2017, 11:02 AM

Constituent	Well	N	Mean	Median	Lower Q.	Upper Q.	Min.	Max.	%NDs
Lithium (ug/l)	MW-5	8	5	5	5	5	5	5	100
Lithium (ug/l)	MW-6 (bg)	8	5	5	5	5	5	5	100
Mercury (ug/l)	MW-3 (bg)	8	0.1375	0.1	0.1	0.1	0.1	0.4	87.5
Mercury (ug/l)	MW-4	8	0.25	0.1	0.1	0.1	0.1	1.3	87.5
Mercury (ug/l)	MW-5	8	0.1175	0.1	0.1	0.1	0.1	0.24	87.5
Mercury (ug/l)	MW-6 (bg)	8	0.1	0.1	0.1	0.1	0.1	0.1	100
Molybdenum (ug/l)	MW-3 (bg)	8	1.675	0.5	0.5	0.5	0.5	9.9	87.5
Molybdenum (ug/l)	MW-4	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Molybdenum (ug/l)	MW-5	8	0.8125	0.5	0.5	0.5	0.5	3	87.5
Molybdenum (ug/l)	MW-6 (bg)	8	0.5	0.5	0.5	0.5	0.5	0.5	100
pH (S.U.)	MW-3 (bg)	8	6.776	6.695	6.67	6.905	6.59	7.08	0
pH (S.U.)	MW-4	8	7.41	7.38	7.375	7.455	7.37	7.49	0
pH (S.U.)	MW-5	8	6.888	6.875	6.815	6.97	6.8	6.98	0
pH (S.U.)	MW-6 (bg)	8	6.825	6.815	6.73	6.905	6.72	6.98	0
Radium (pCi/l)	MW-3 (bg)	8	0.5178	0.5685	0.1235	0.7795	-0.469	1.668	0
Radium (pCi/l)	MW-4	8	0.6744	0.6375	0.507	0.905	0.21	1.086	0
Radium (pCi/l)	MW-5	8	1.049	0.848	0.6525	1.708	0.13	1.844	0
Radium (pCi/l)	MW-6 (bg)	8	0.9533	0.9205	0.631	1.208	0.575	1.532	0
Selenium (ug/l)	MW-3 (bg)	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Selenium (ug/l)	MW-4	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Selenium (ug/l)	MW-5	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Selenium (ug/l)	MW-6 (bg)	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Sulfate (mg/l)	MW-3 (bg)	8	24.13	24	21	27	19	30	0
Sulfate (mg/l)	MW-4	8	102.5	96.5	91	109.5	86	140	0
Sulfate (mg/l)	MW-5	8	233.8	195	175	250	170	460	0
Sulfate (mg/l)	MW-6 (bg)	8	32.88	31.5	29.5	35	28	43	0
Thallium (ug/l)	MW-3 (bg)	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Thallium (ug/l)	MW-4	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Thallium (ug/l)	MW-5	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Thallium (ug/l)	MW-6 (bg)	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Total Dissolved Solids (mg/l)	MW-3 (bg)	8	146.3	150	130	160	120	170	0
Total Dissolved Solids (mg/l)	MW-4	8	326.3	320	300	345	290	390	0
Total Dissolved Solids (mg/l)	MW-5	8	470	475	435	480	420	560	0
Total Dissolved Solids (mg/l)	MW-6 (bg)	8	187.5	180	170	200	160	240	0

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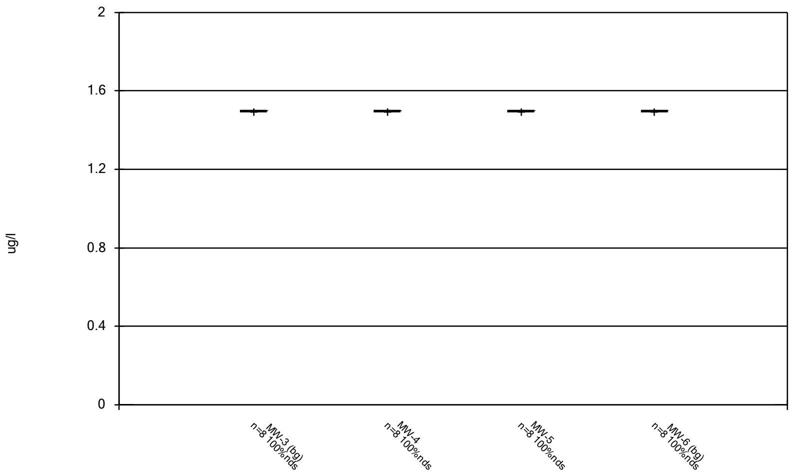
Antimony



Box & Whiskers Plot   Analysis Run 10/3/2017 11:00 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

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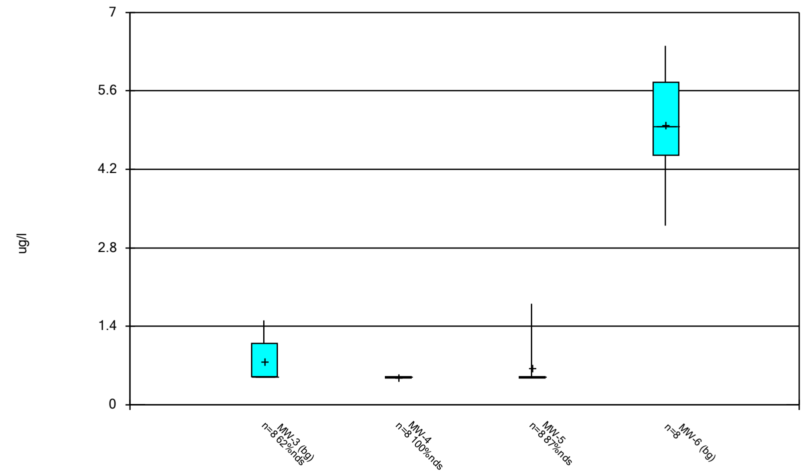
Arsenic



Box & Whiskers Plot   Analysis Run 10/3/2017 11:00 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

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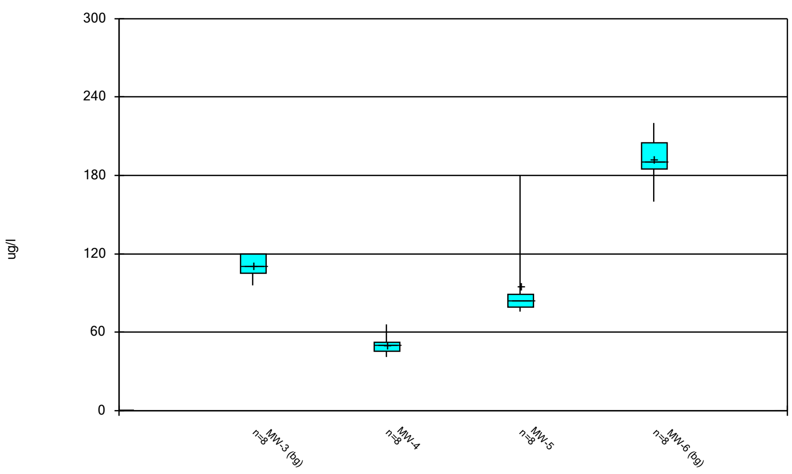
Barium



Box & Whiskers Plot   Analysis Run 10/3/2017 11:00 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

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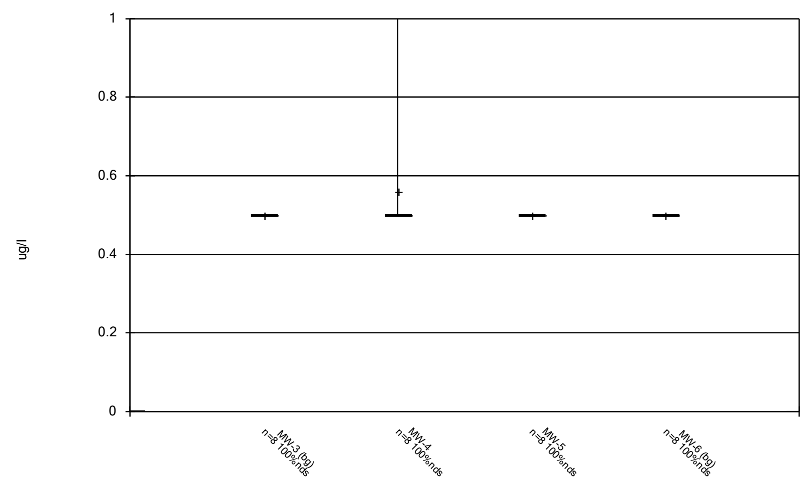
Beryllium



Box & Whiskers Plot   Analysis Run 10/3/2017 11:00 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

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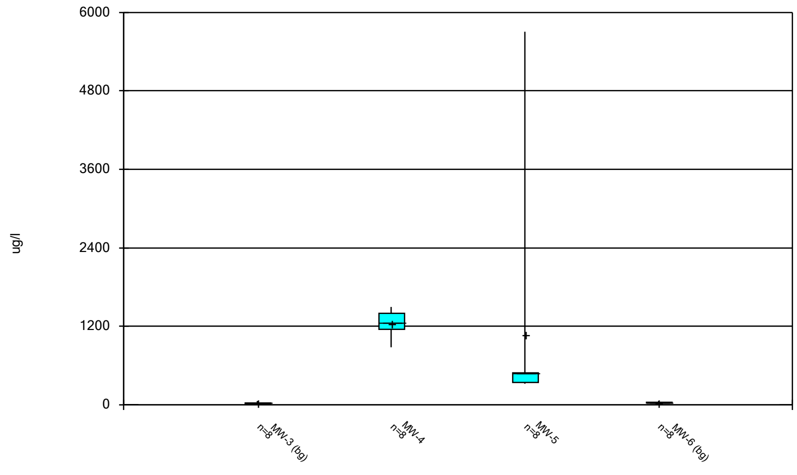
Boron



Box & Whiskers Plot   Analysis Run 10/3/2017 11:00 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

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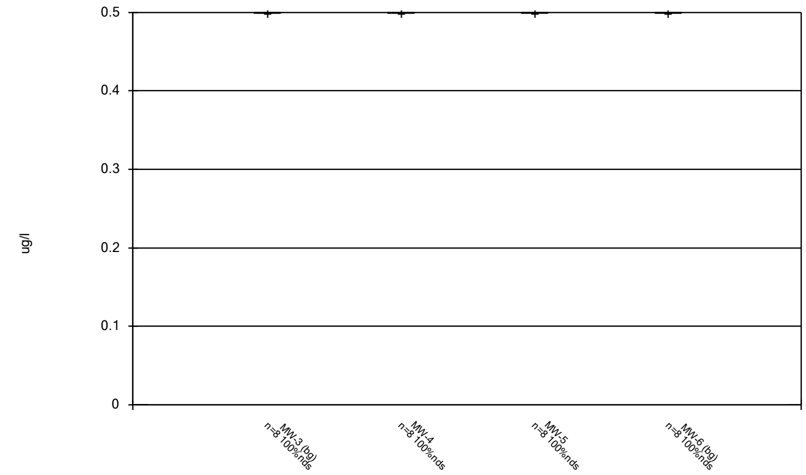
Cadmium



Box & Whiskers Plot   Analysis Run 10/3/2017 11:00 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

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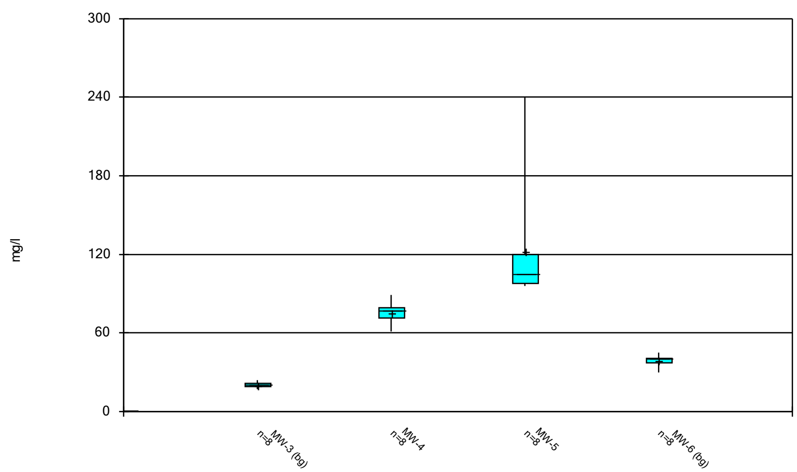
Calcium



Box & Whiskers Plot   Analysis Run 10/3/2017 11:00 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

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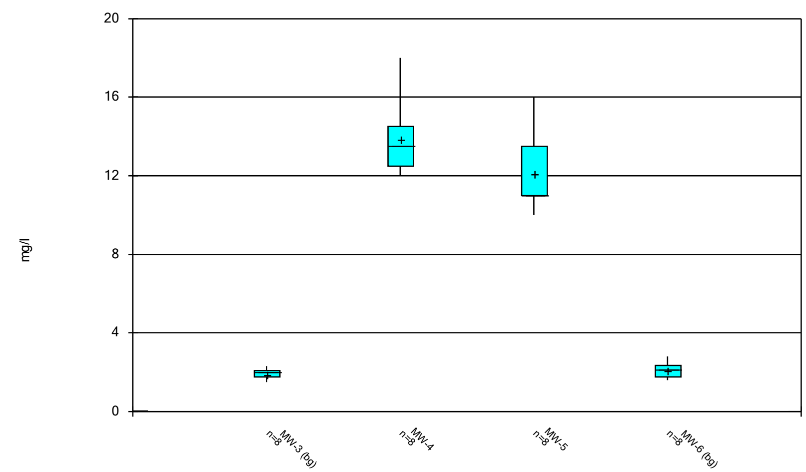
Chloride



Box & Whiskers Plot   Analysis Run 10/3/2017 11:00 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

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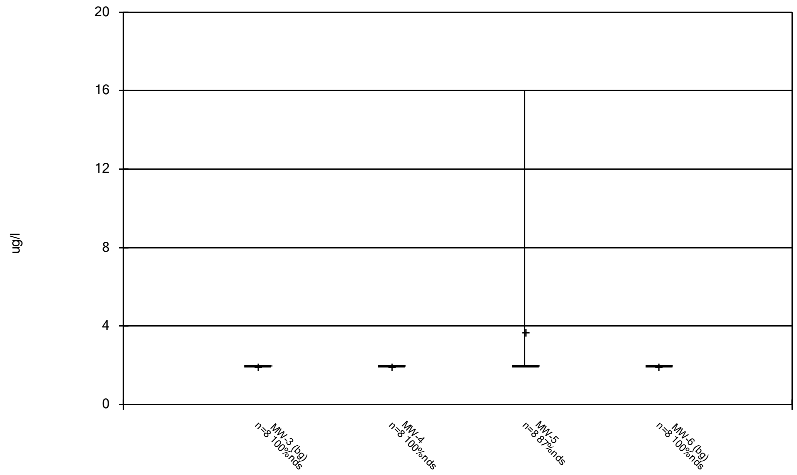
Chromium



Box & Whiskers Plot   Analysis Run 10/3/2017 11:00 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

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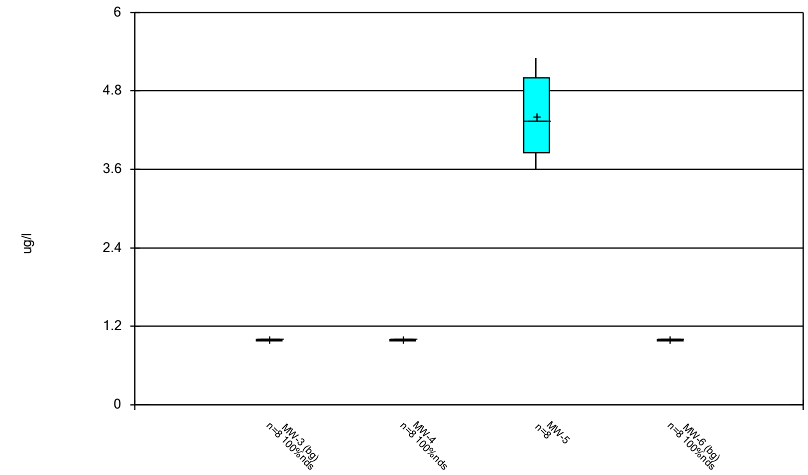
Cobalt



Box & Whiskers Plot   Analysis Run 10/3/2017 11:00 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

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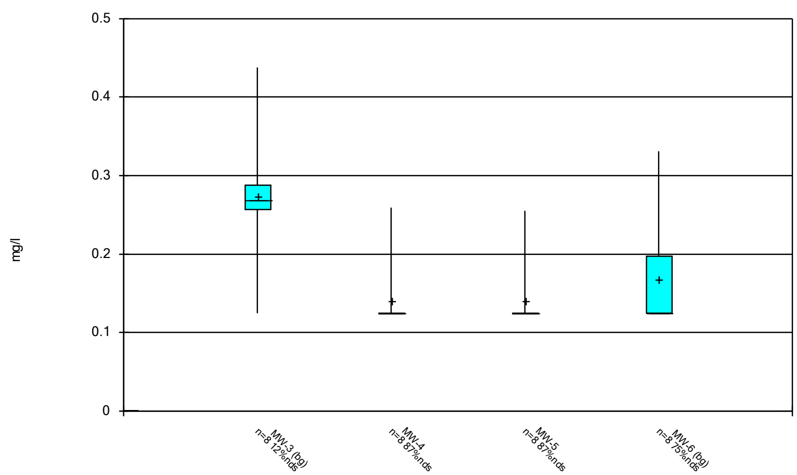
Fluoride



Box & Whiskers Plot   Analysis Run 10/3/2017 11:00 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

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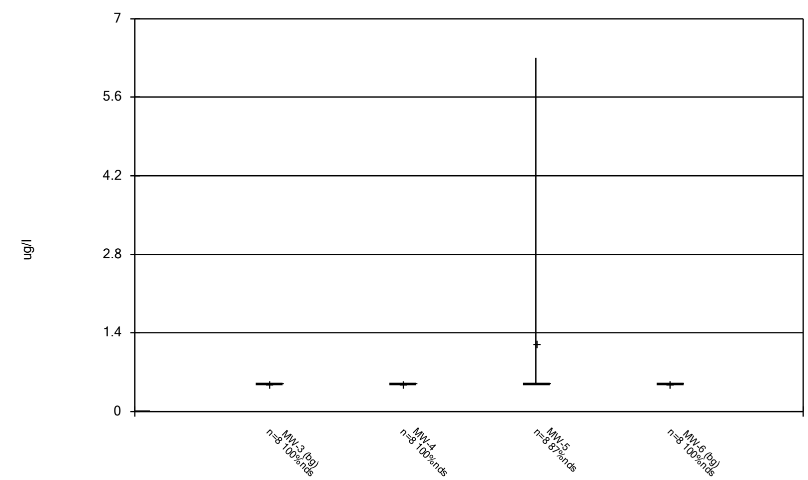
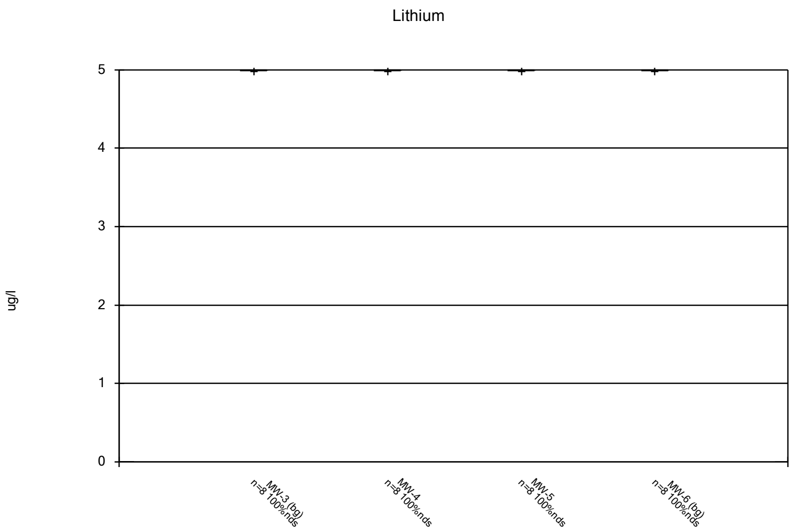
Lead



Box & Whiskers Plot   Analysis Run 10/3/2017 11:00 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

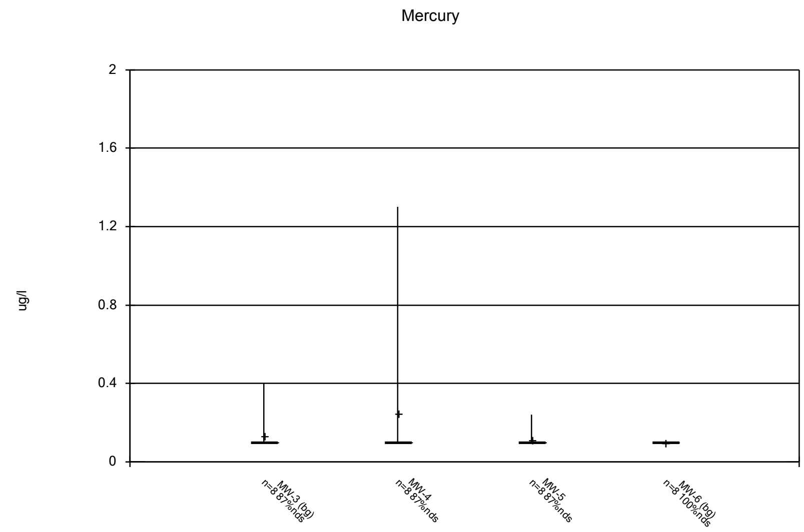
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



Box & Whiskers Plot   Analysis Run 10/3/2017 11:00 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

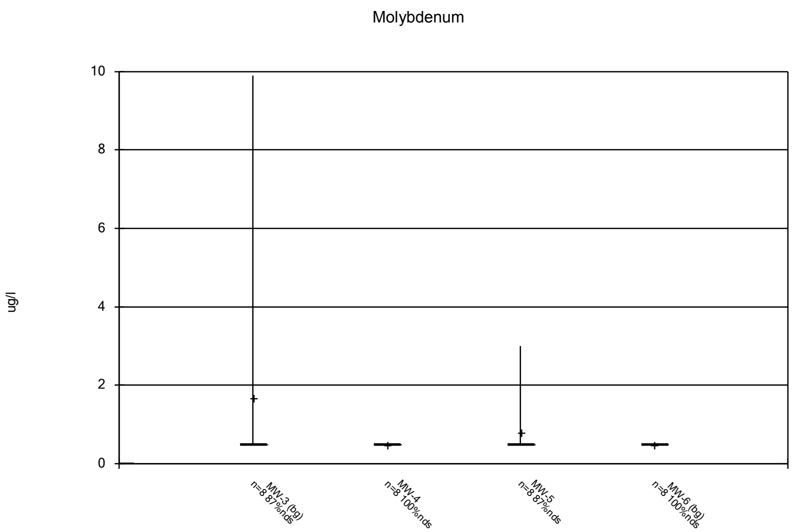
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



Box & Whiskers Plot   Analysis Run 10/3/2017 11:00 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

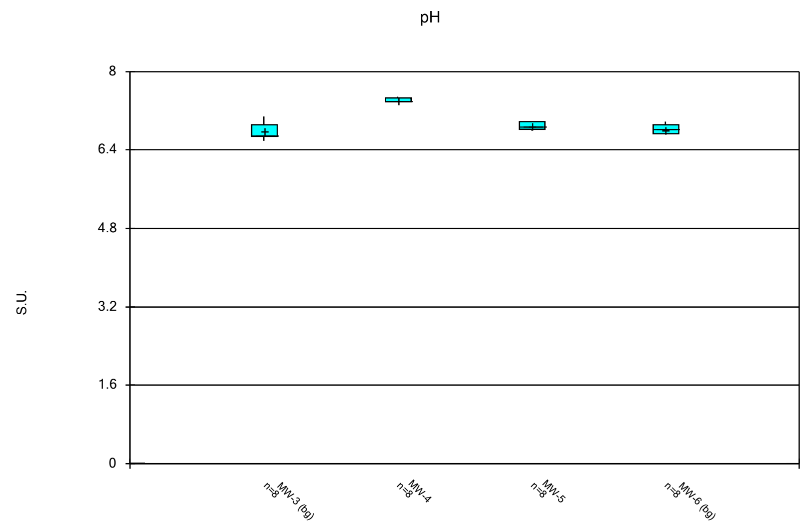
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



Box & Whiskers Plot   Analysis Run 10/3/2017 11:00 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

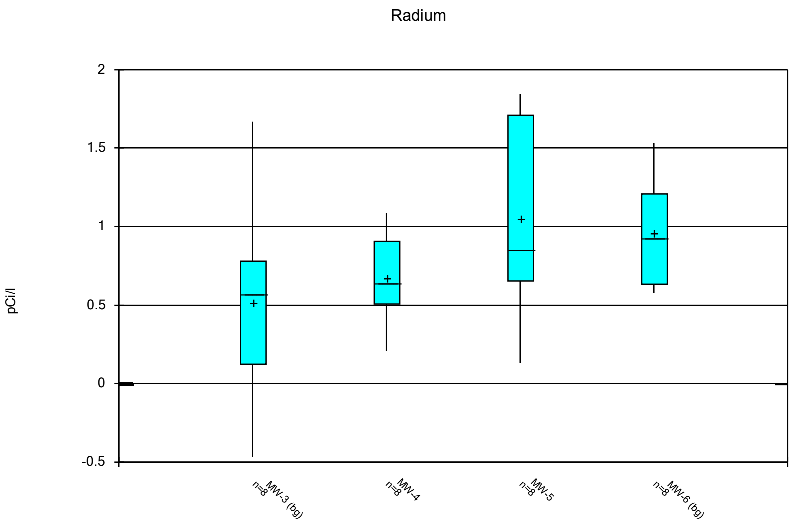
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



Box & Whiskers Plot   Analysis Run 10/3/2017 11:00 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

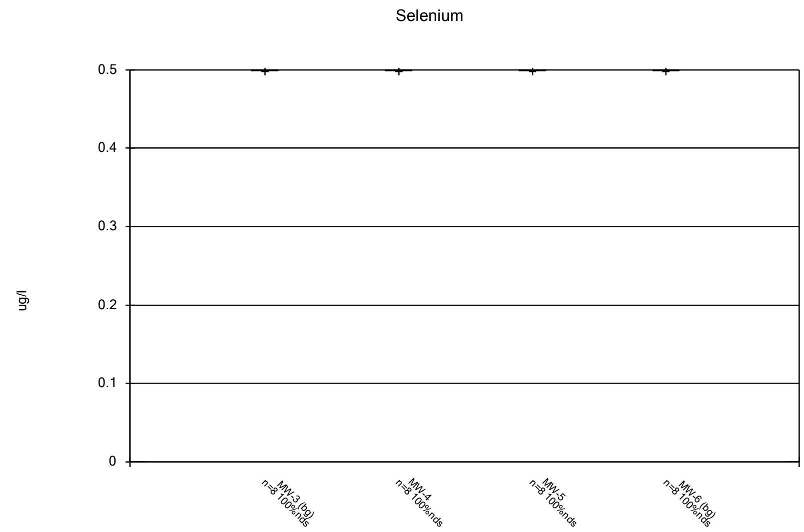
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



Box & Whiskers Plot   Analysis Run 10/3/2017 11:00 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

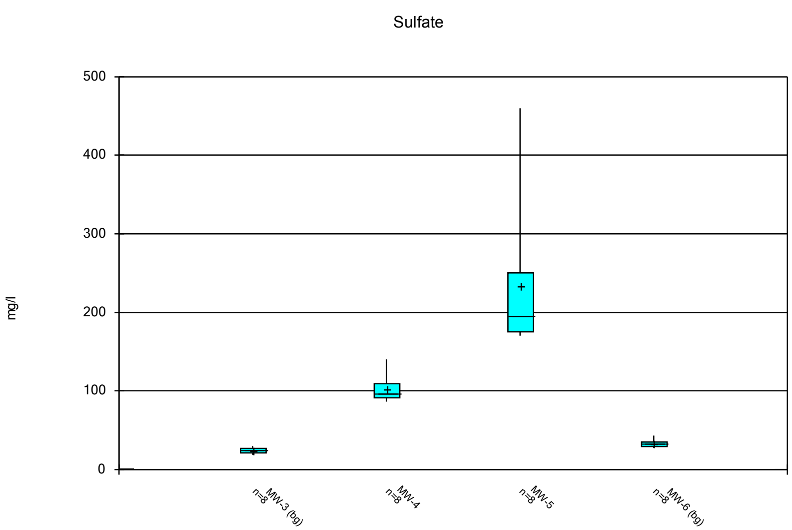
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



Box & Whiskers Plot   Analysis Run 10/3/2017 11:00 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

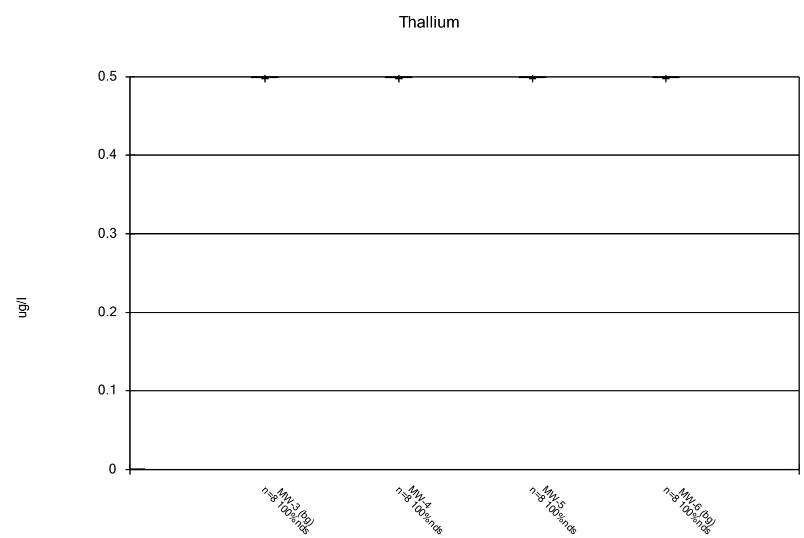
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



Box & Whiskers Plot   Analysis Run 10/3/2017 11:00 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

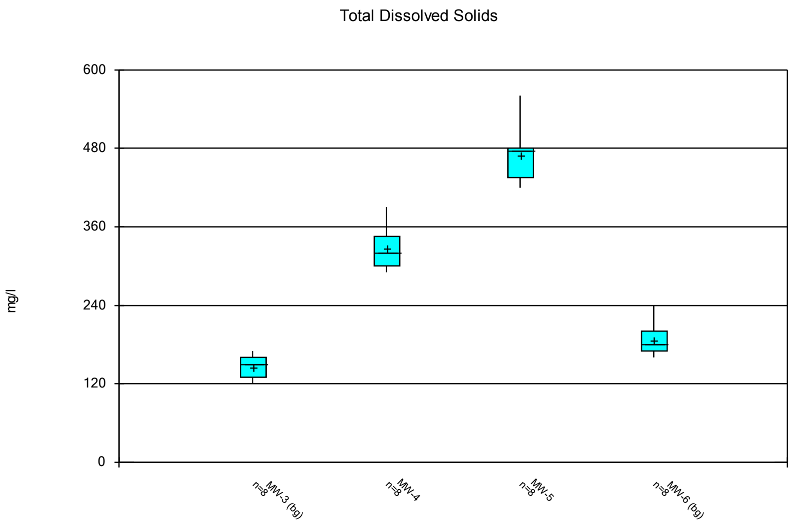
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



Box & Whiskers Plot   Analysis Run 10/3/2017 11:00 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



Box & Whiskers Plot   Analysis Run 10/3/2017 11:00 AM

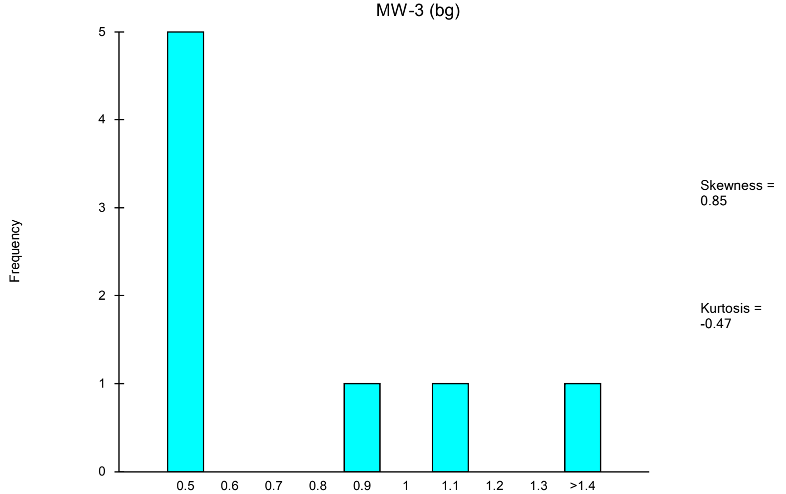
SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

Appendix C

Histograms

Arsenic

MW-3 (bg)

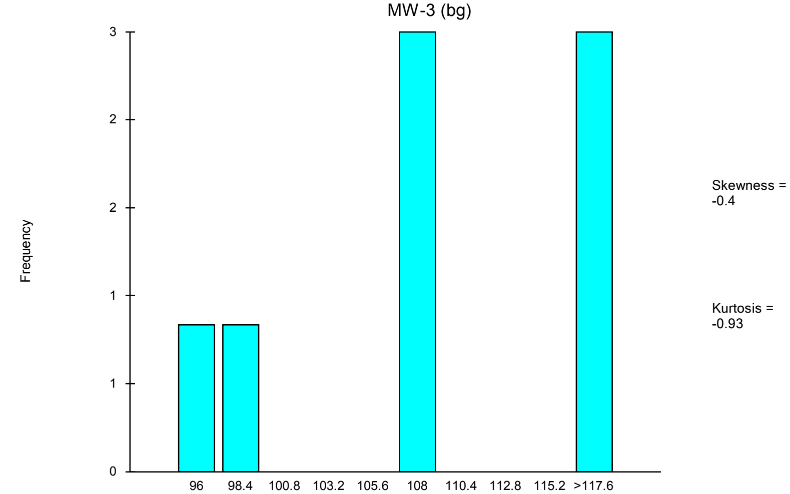


Histogram Analysis Run 10/3/2017 10:55 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Barium

MW-3 (bg)

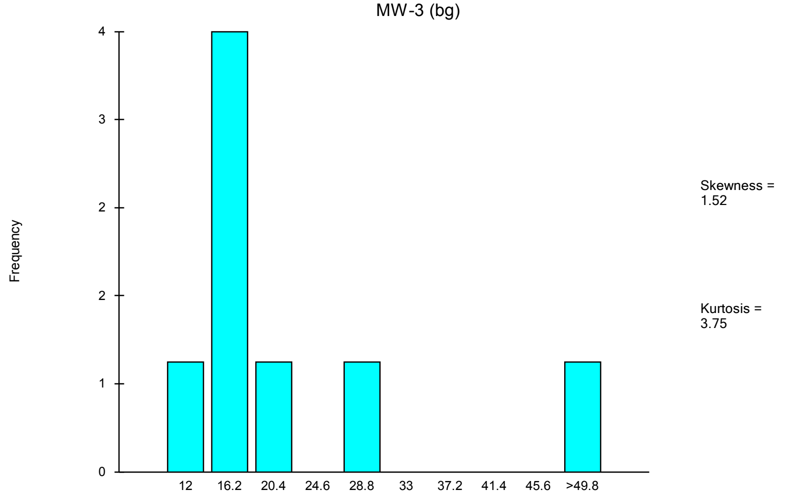


Histogram Analysis Run 10/3/2017 10:55 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Boron

MW-3 (bg)

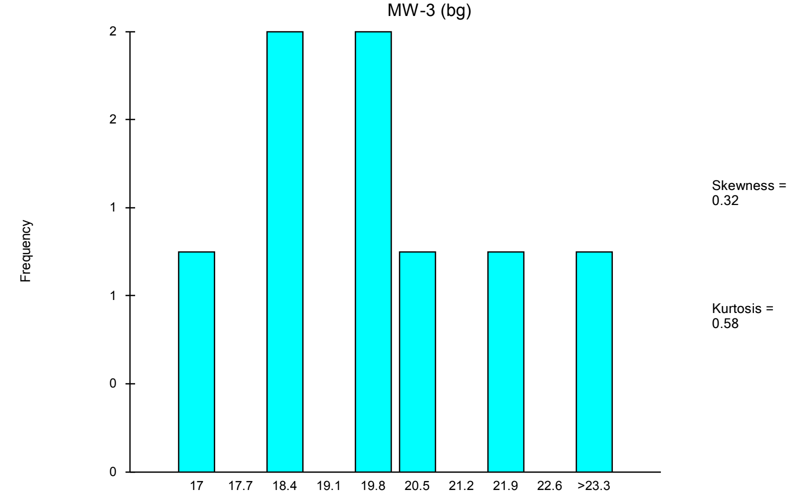


Histogram Analysis Run 10/3/2017 10:55 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

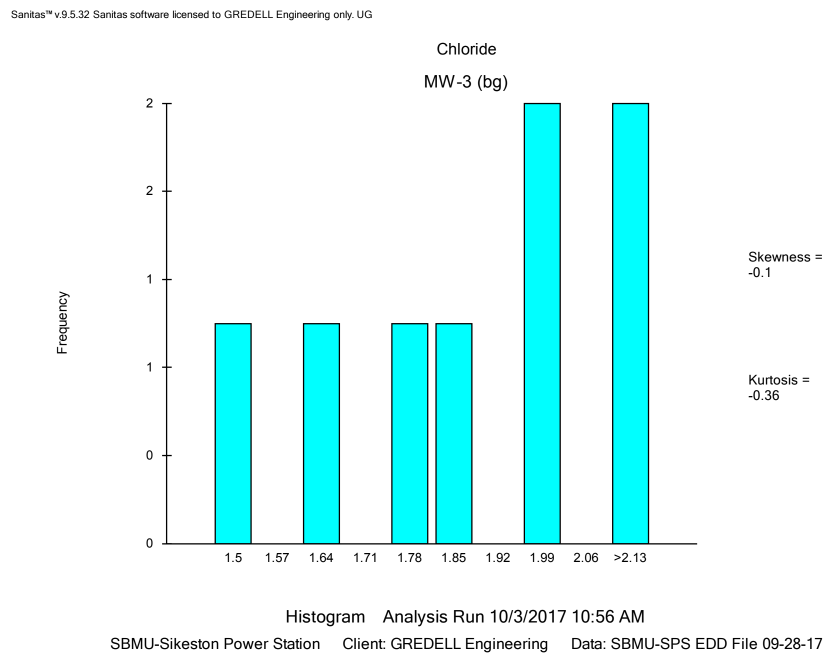
Calcium

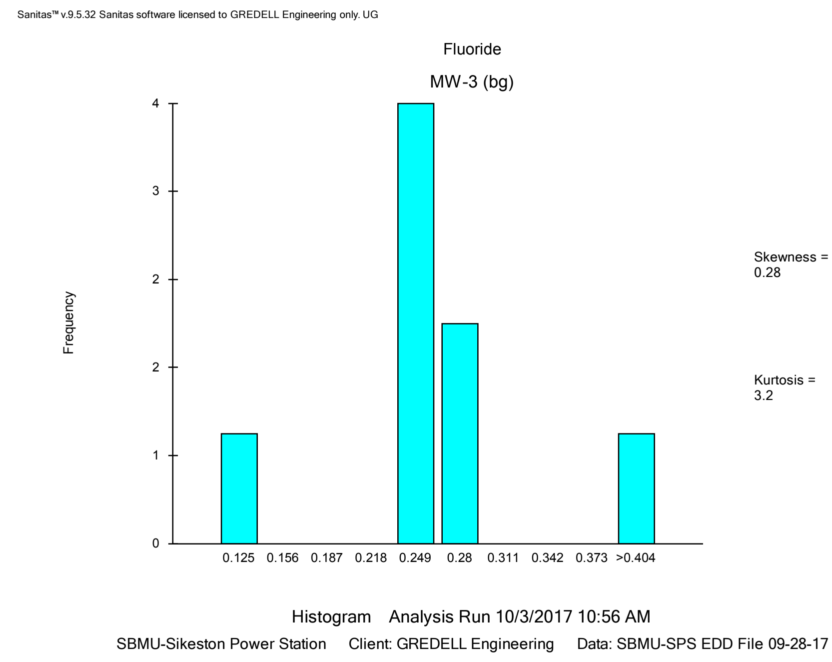
MW-3 (bg)

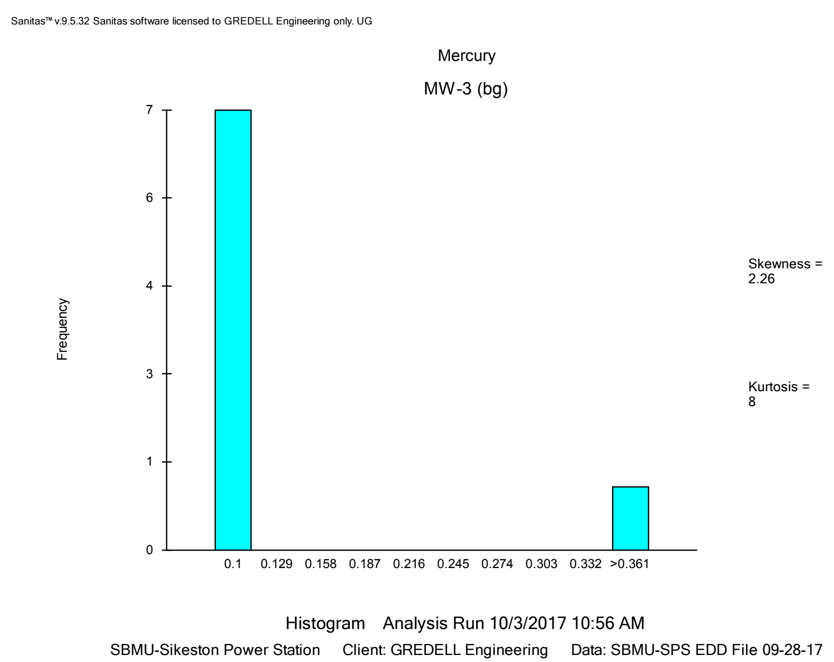


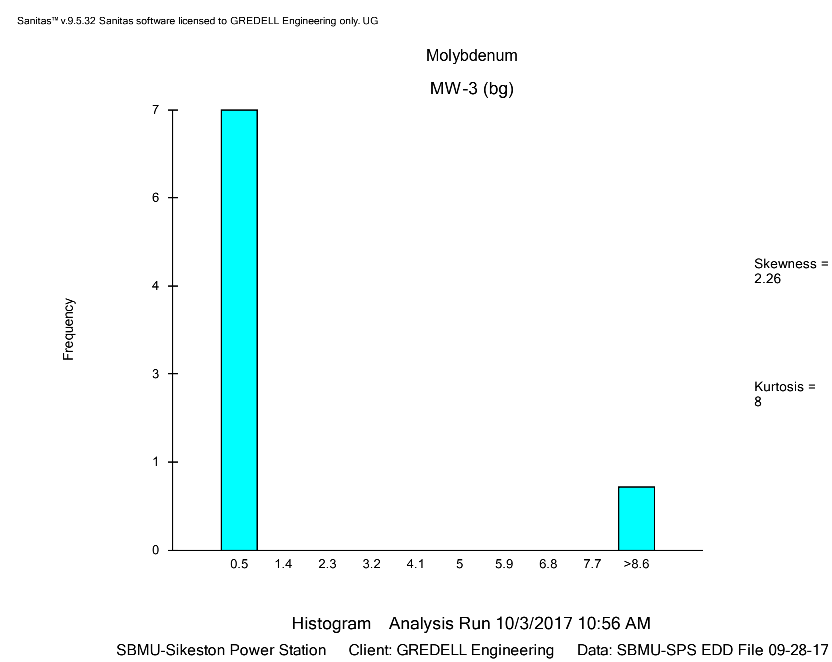
Histogram Analysis Run 10/3/2017 10:56 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17


Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Chloride
MW-3 (bg)
Frequency
2
2
1
1
0
0
1.5
1.57
1.64
1.71
1.78
1.85
1.92
1.99
2.06
>2.13
Skewness =
-0.1
Kurtosis =
-0.36
Histogram Analysis Run 10/3/2017 10:56 AM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17


Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Fluoride
MW-3 (bg)
Frequency
4
3
2
2
1
0
0.125
0.156
0.187
0.218
0.249
0.28
0.311
0.342
0.373
>0.404
Skewness =
0.28
Kurtosis =
3.2
Histogram Analysis Run 10/3/2017 10:56 AM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

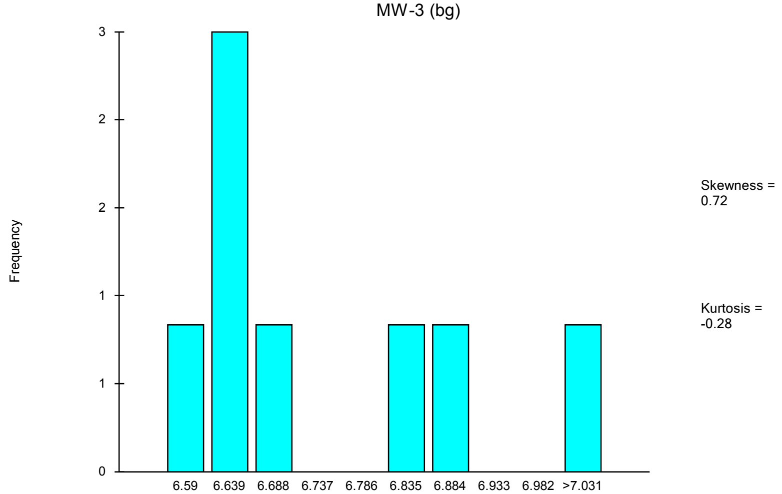

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Mercury
MW-3 (bg)
Frequency
7
6
4
3
1
0
0.1
0.129
0.158
0.187
0.216
0.245
0.274
0.303
0.332
>0.361
Skewness =
2.26
Kurtosis =
8
Histogram Analysis Run 10/3/2017 10:56 AM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17


Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Molybdenum
MW-3 (bg)
Frequency
7
6
4
3
1
0
0.5
1.4
2.3
3.2
4.1
5
5.9
6.8
7.7
>8.6
Skewness =
2.26
Kurtosis =
8
Histogram Analysis Run 10/3/2017 10:56 AM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

pH

MW-3 (bg)



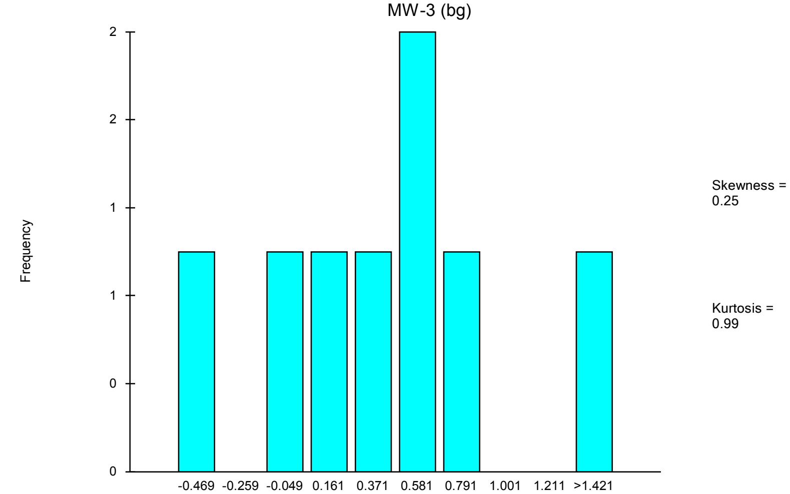
Histogram Analysis Run 10/3/2017 10:56 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Radium

MW-3 (bg)



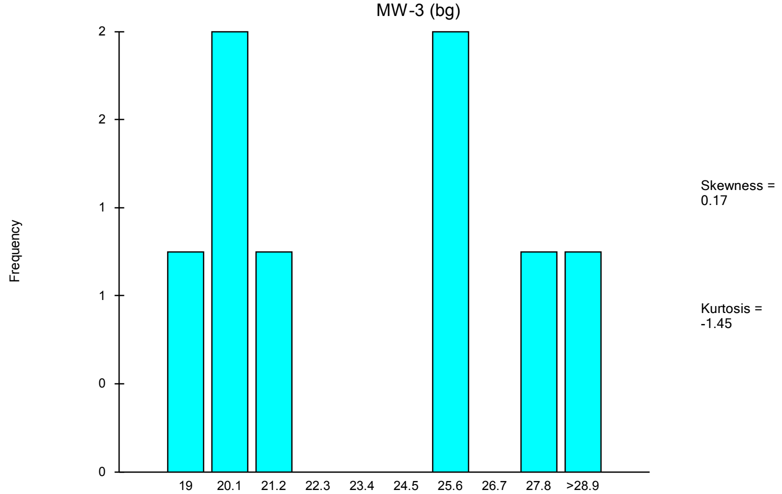
Histogram Analysis Run 10/3/2017 10:56 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Sulfate

MW-3 (bg)



Histogram Analysis Run 10/3/2017 10:56 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

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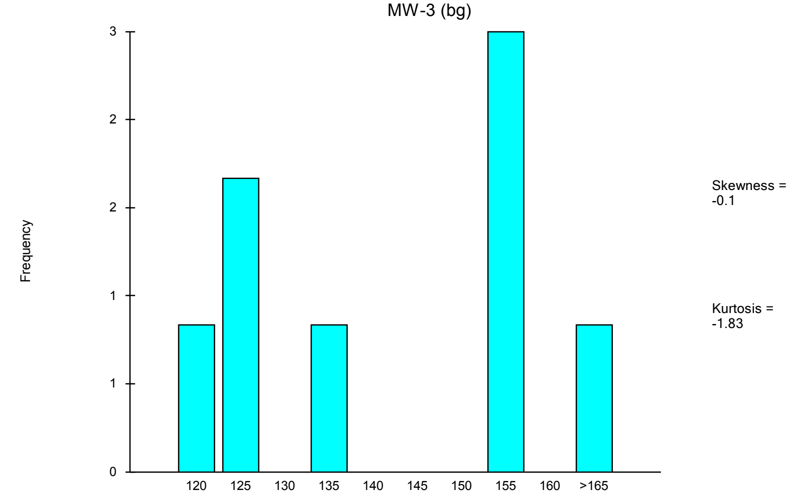
Total Dissolved Solids

MW-3 (bg)



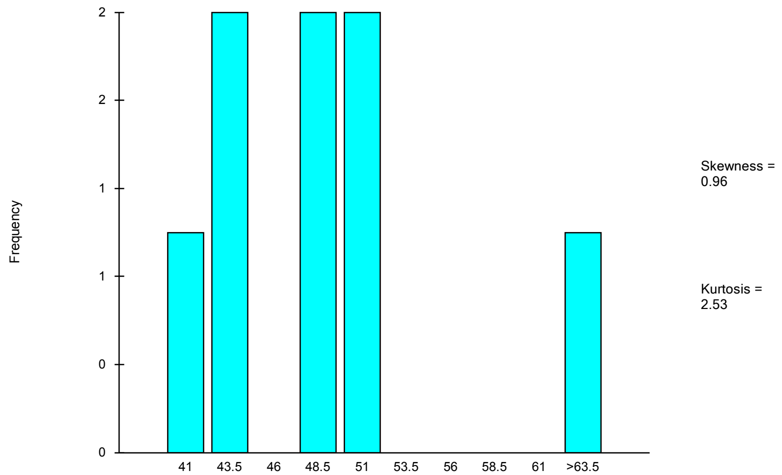
Histogram Analysis Run 10/3/2017 10:56 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Barium

MW-4



Histogram Analysis Run 10/3/2017 10:56 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

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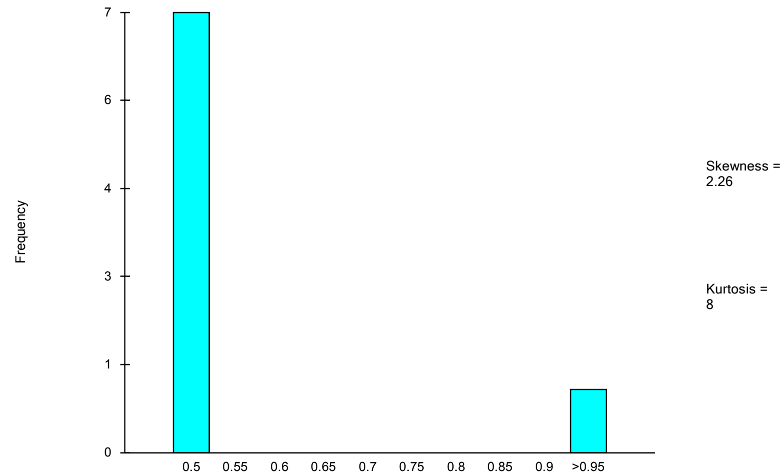
Beryllium

MW-4



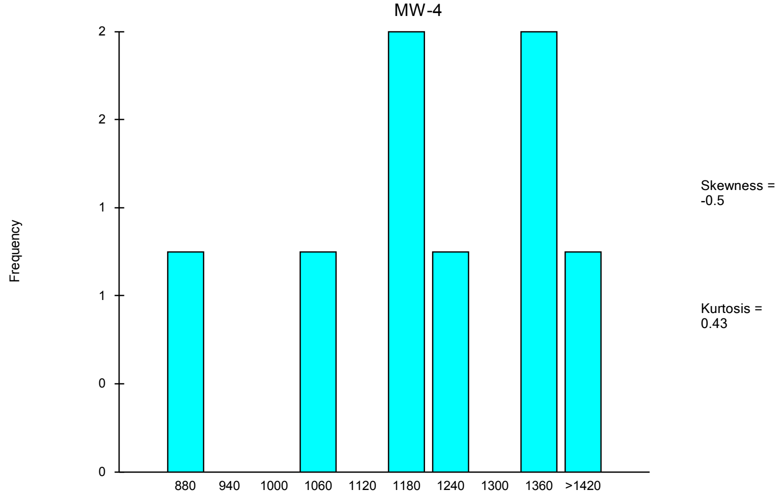
Histogram Analysis Run 10/3/2017 10:56 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Boron

MW-4



Histogram Analysis Run 10/3/2017 10:56 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

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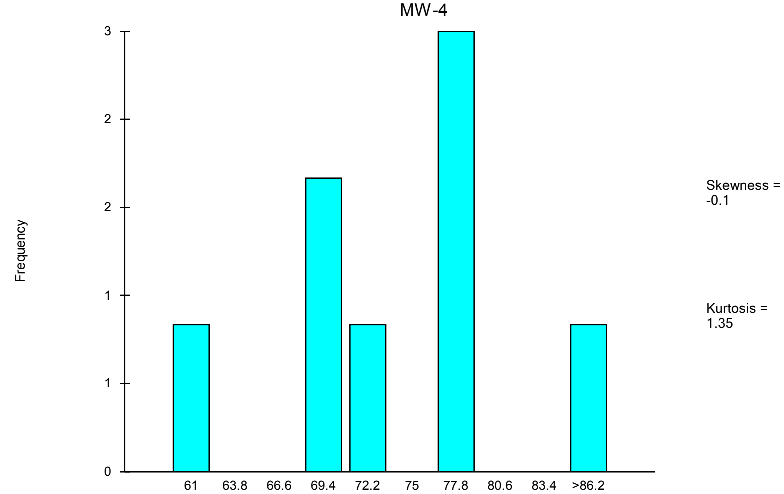
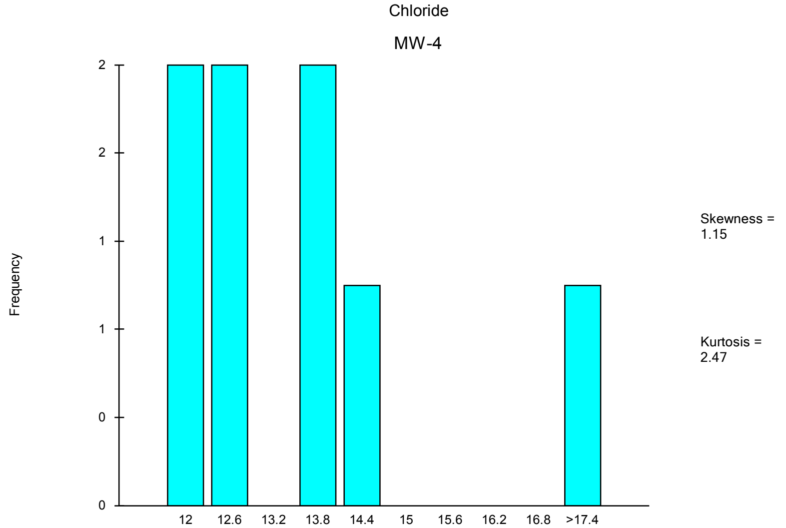
Calcium

MW-4



Histogram Analysis Run 10/3/2017 10:56 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17



Histogram Analysis Run 10/3/2017 10:56 AM
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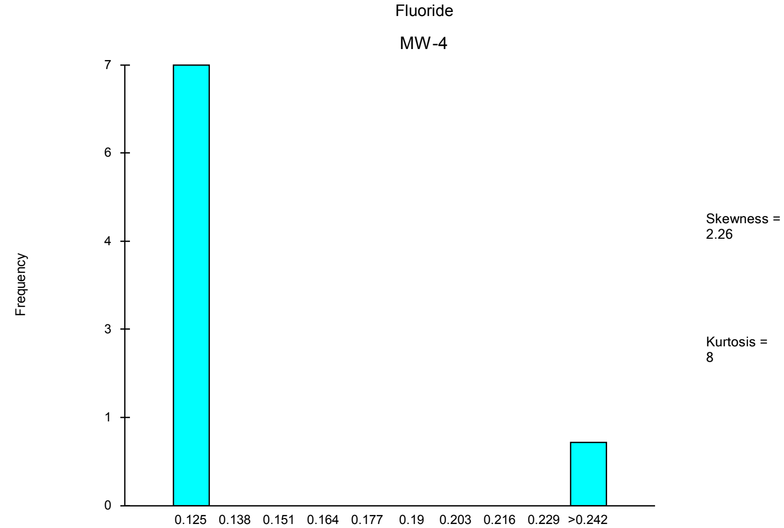

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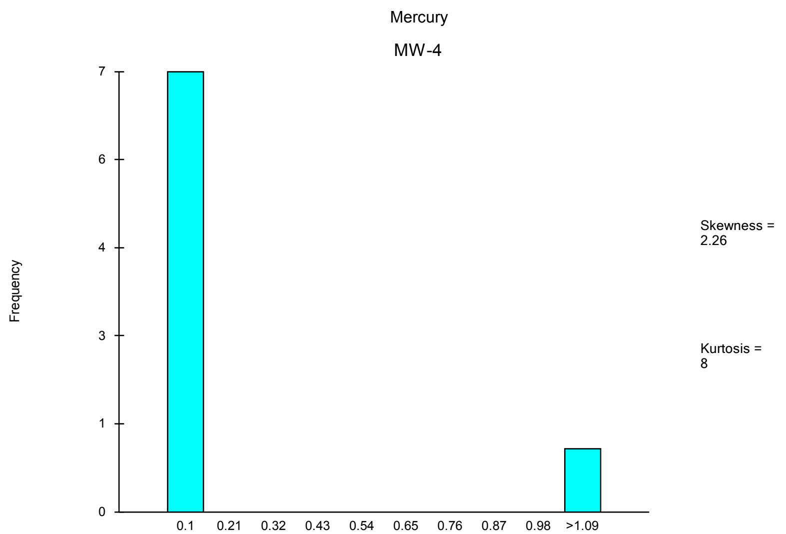

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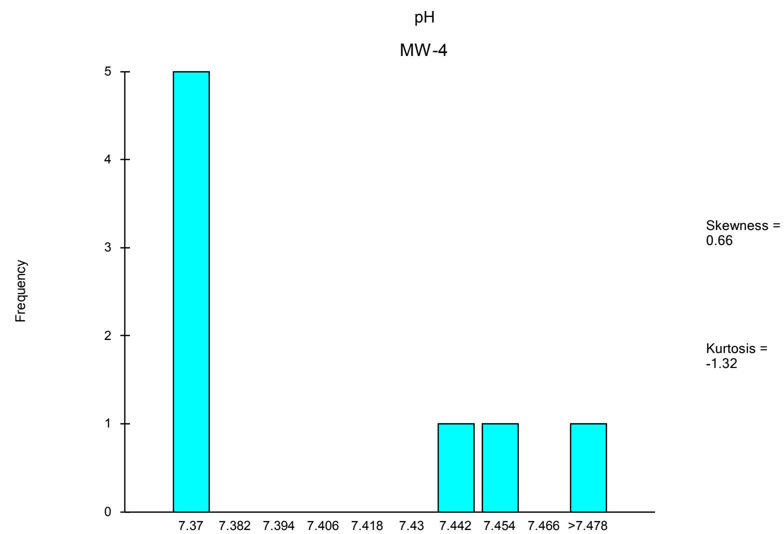

Histogram Analysis Run 10/3/2017 10:56 AM
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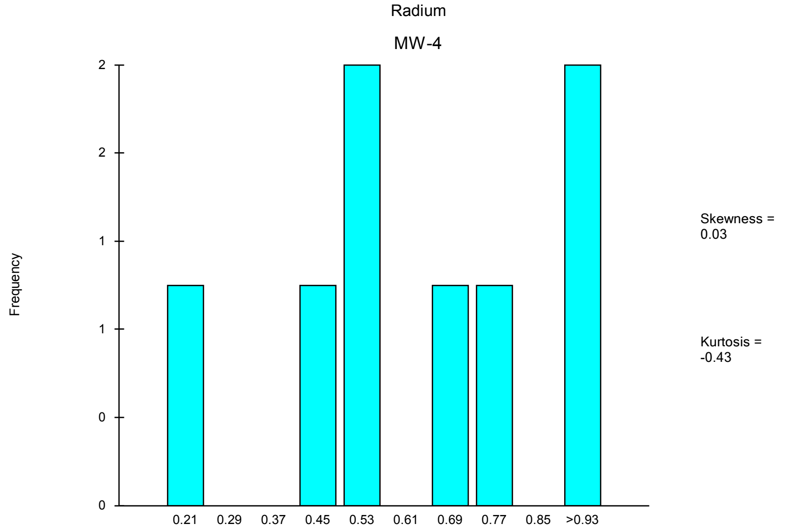

Histogram Analysis Run 10/3/2017 10:56 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

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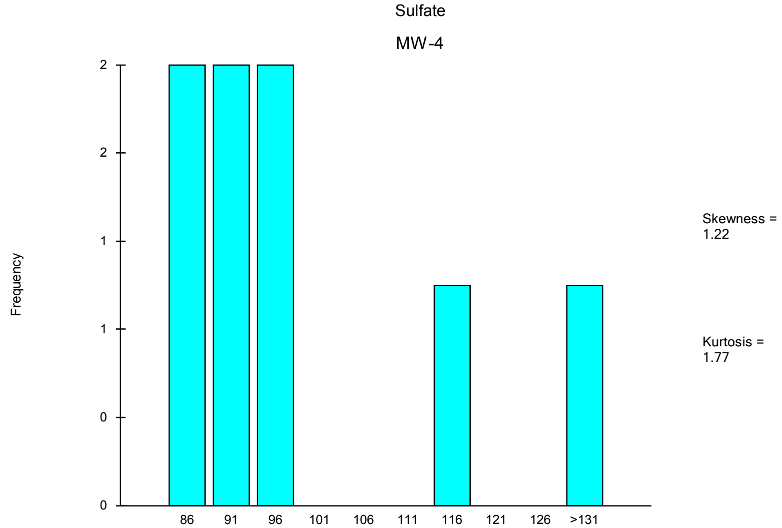

Histogram Analysis Run 10/3/2017 10:57 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

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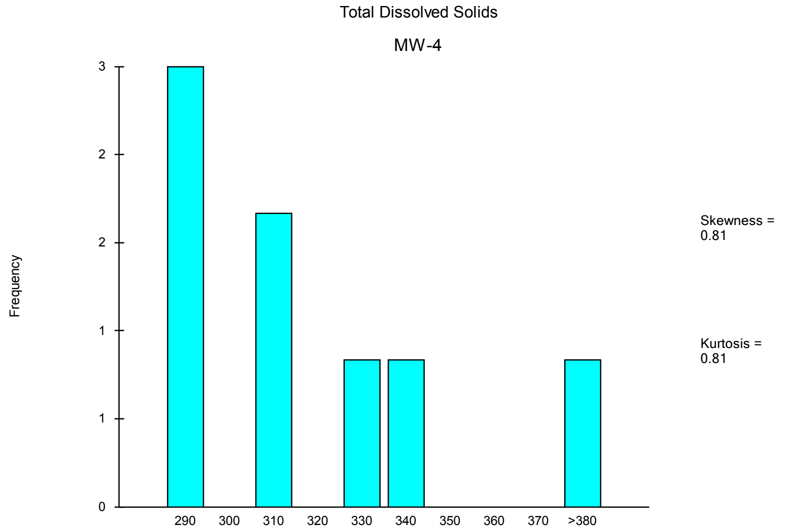

Histogram Analysis Run 10/3/2017 10:57 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

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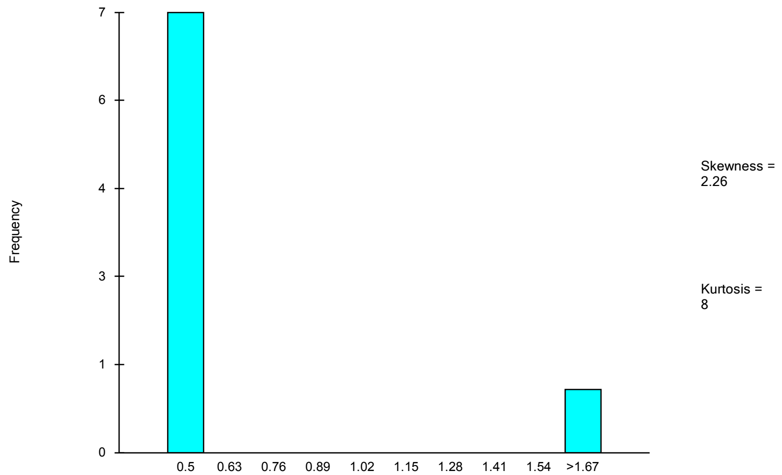
Arsenic

MW-5



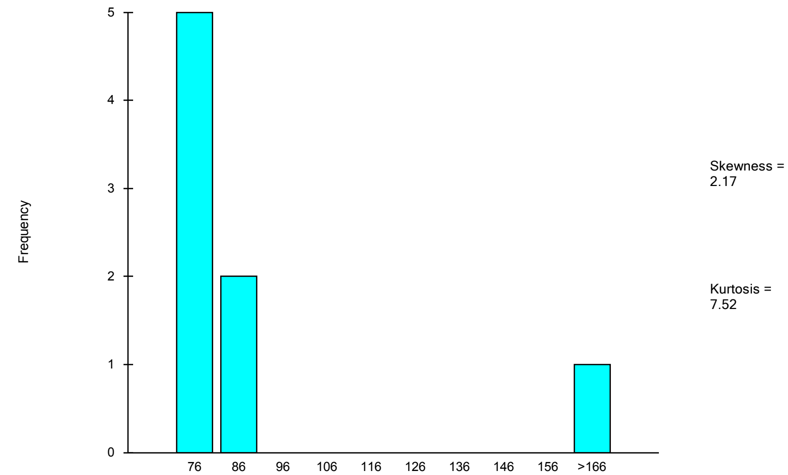
Histogram Analysis Run 10/3/2017 10:57 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Barium

MW-5



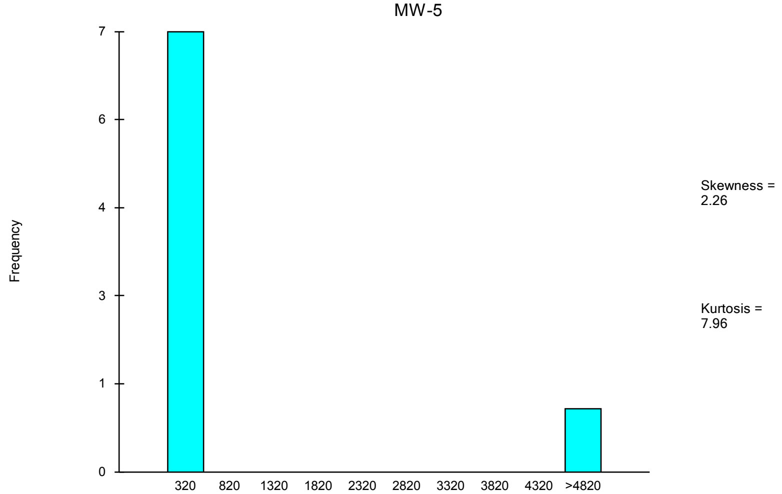
Histogram Analysis Run 10/3/2017 10:57 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Boron

MW-5



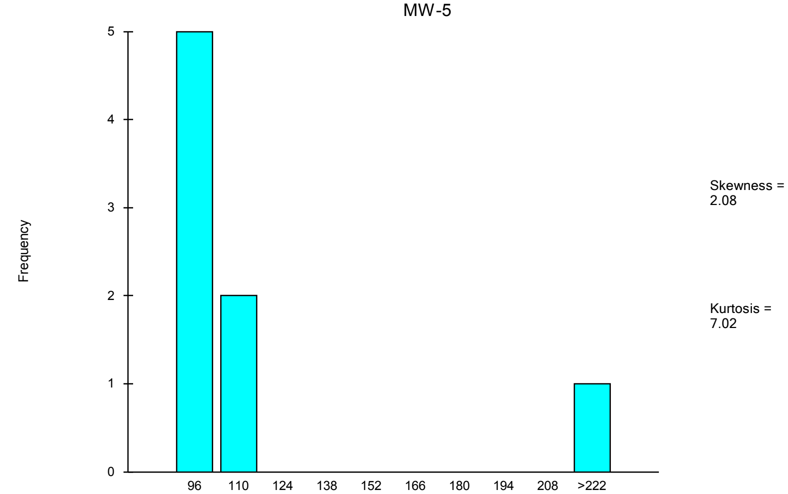
Histogram Analysis Run 10/3/2017 10:57 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Calcium

MW-5



Histogram Analysis Run 10/3/2017 10:57 AM

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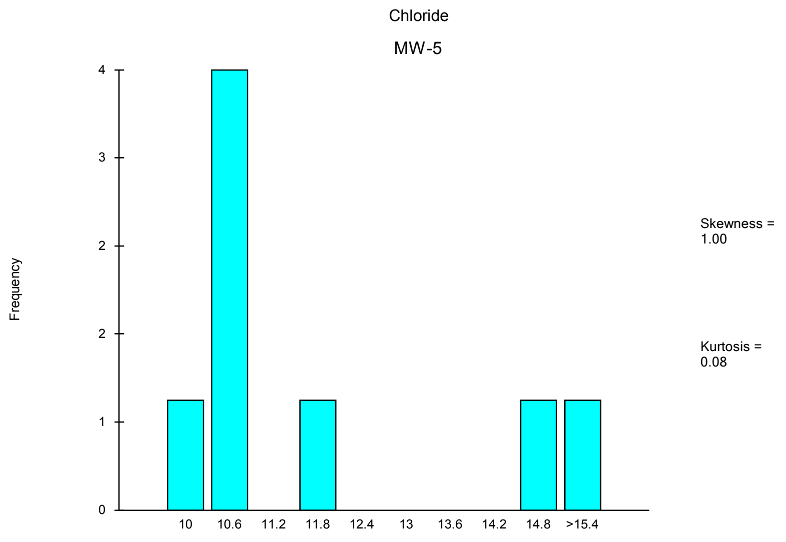

Histogram Analysis Run 10/3/2017 10:57 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

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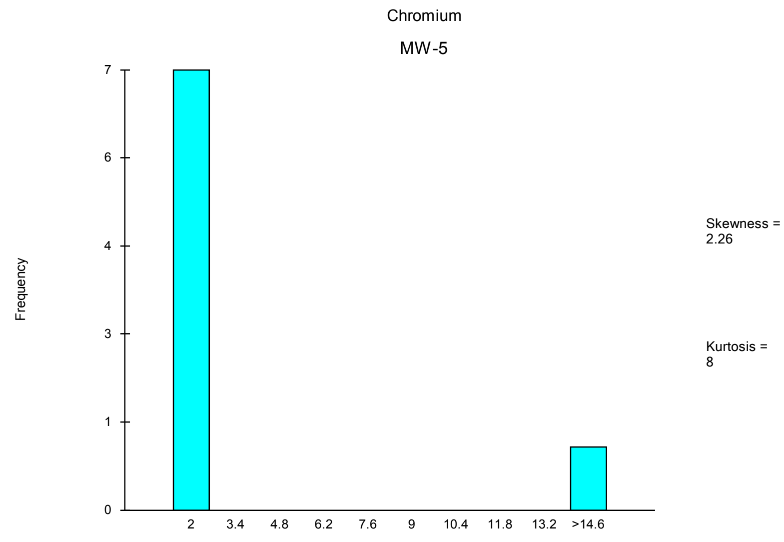

Histogram Analysis Run 10/3/2017 10:57 AM

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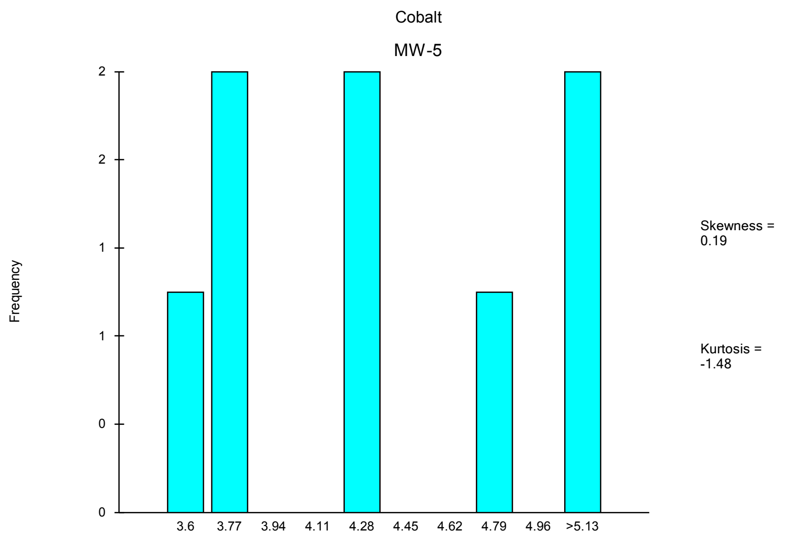
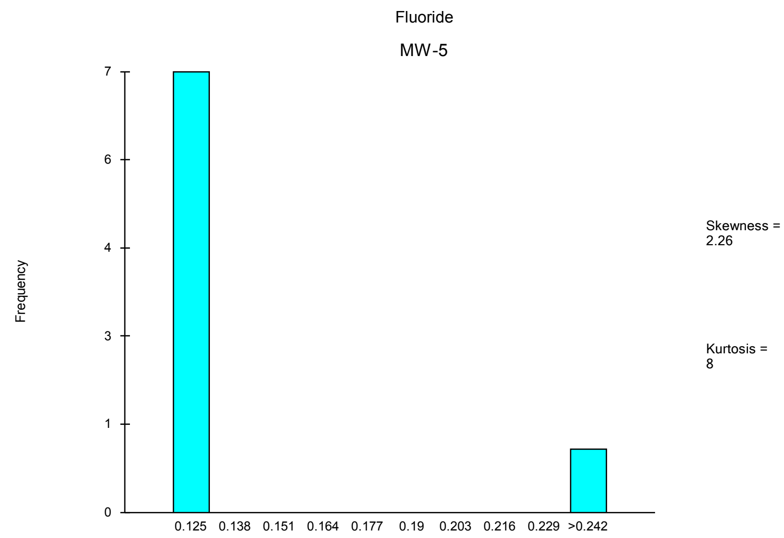
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



Histogram Analysis Run 10/3/2017 10:57 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



Histogram Analysis Run 10/3/2017 10:57 AM

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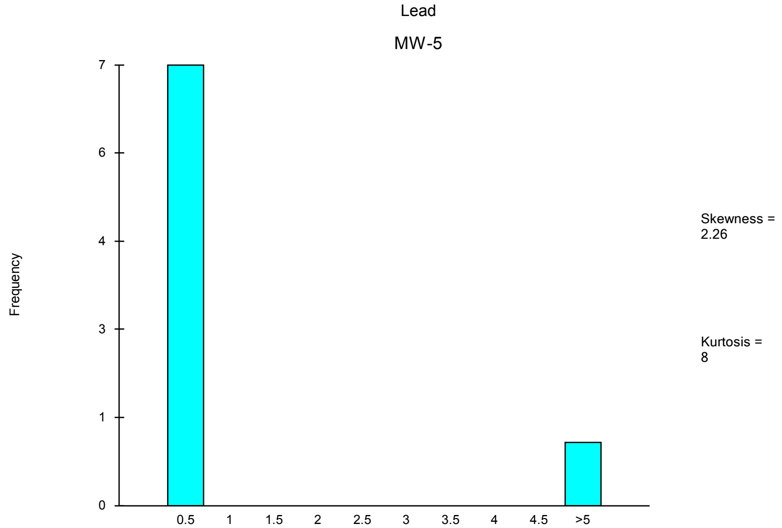
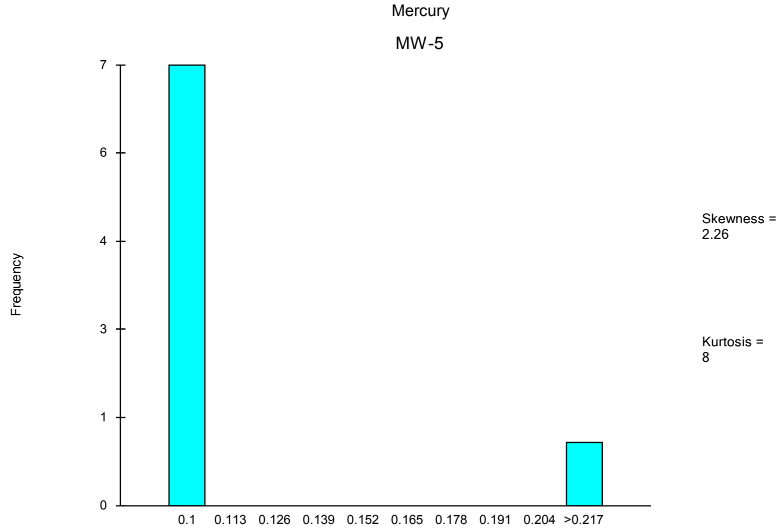


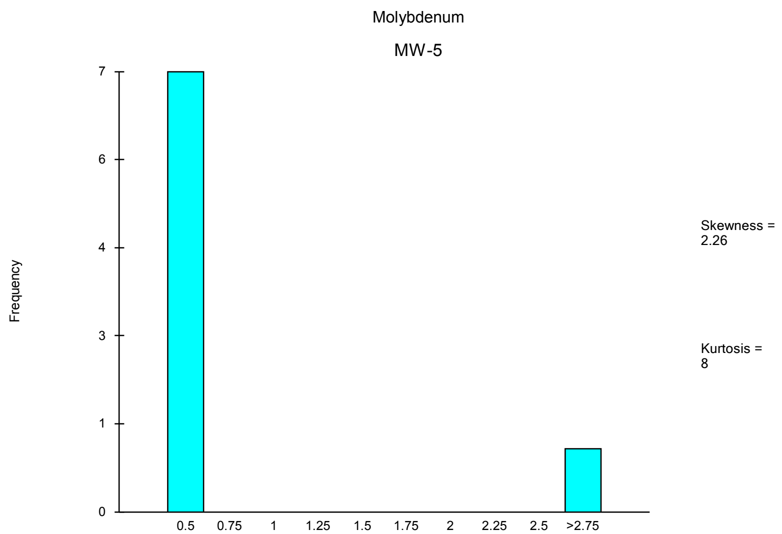
Histogram Analysis Run 10/3/2017 10:57 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17



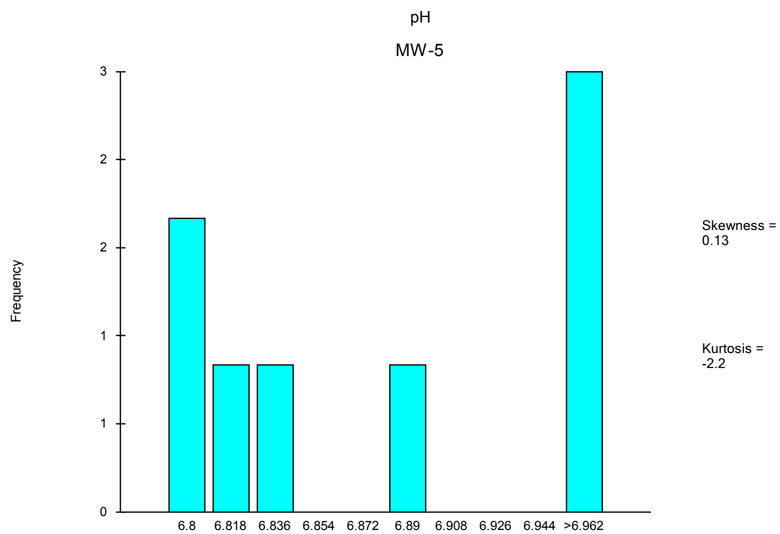
Histogram Analysis Run 10/3/2017 10:57 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17



Histogram Analysis Run 10/3/2017 10:57 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17



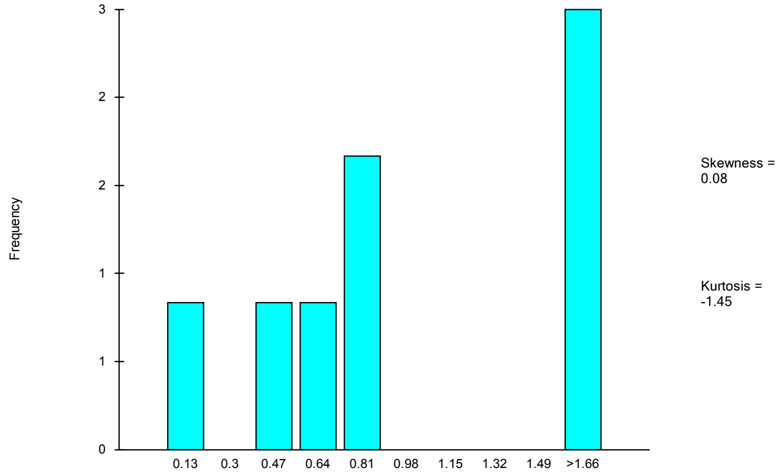
Histogram Analysis Run 10/3/2017 10:57 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Radium

MW-5



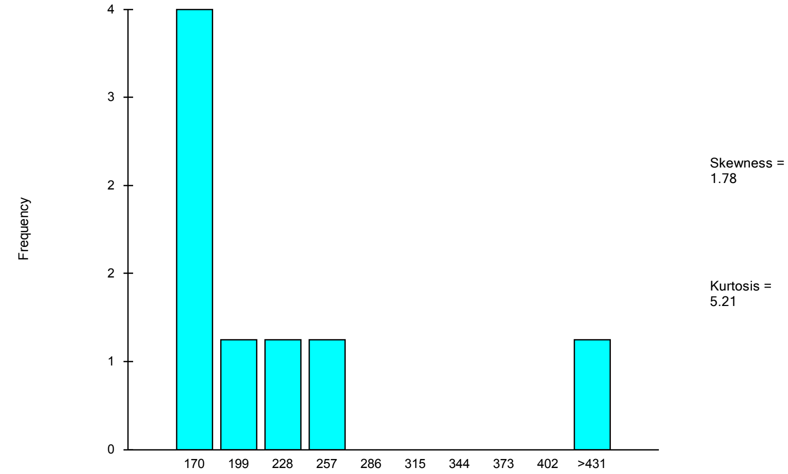
Histogram Analysis Run 10/3/2017 10:57 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Sulfate

MW-5



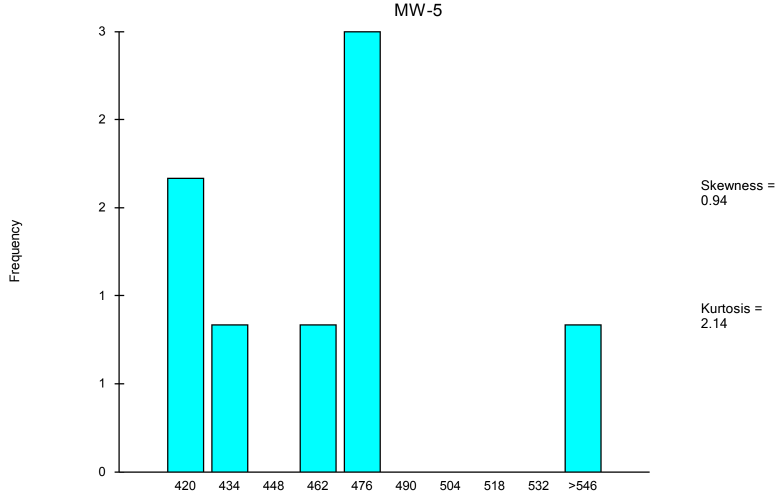
Histogram Analysis Run 10/3/2017 10:57 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Total Dissolved Solids

MW-5



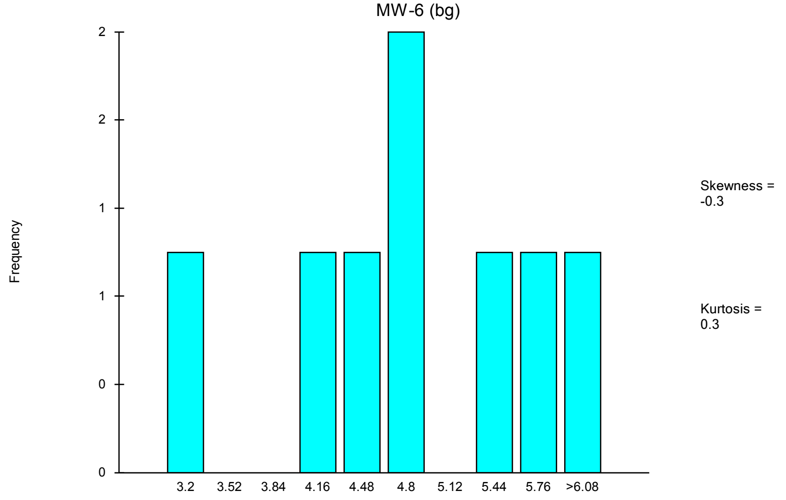
Histogram Analysis Run 10/3/2017 10:57 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Arsenic

MW-6 (bg)



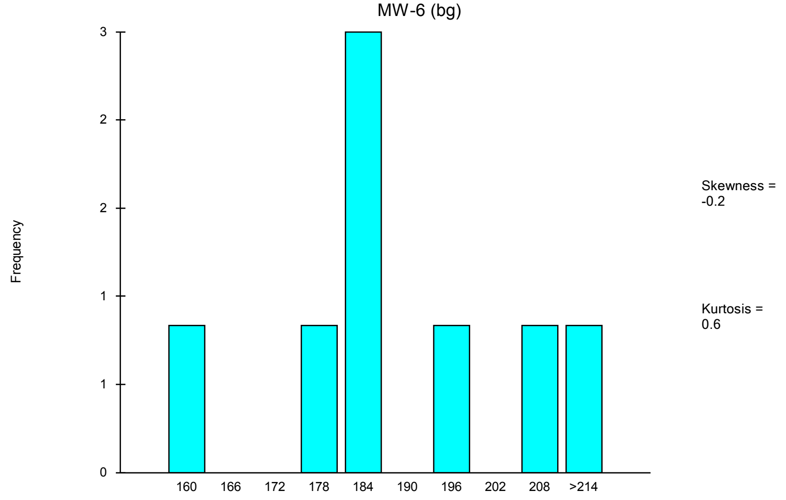
Histogram   Analysis Run 10/3/2017 10:58 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Barium

MW-6 (bg)



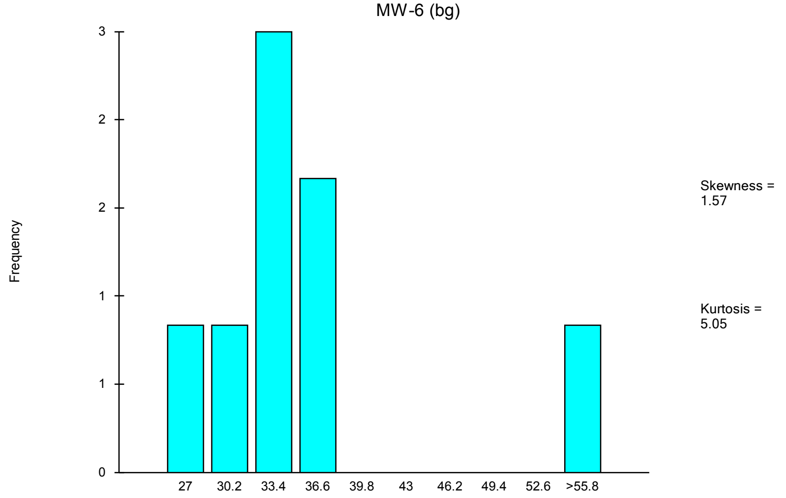
Histogram   Analysis Run 10/3/2017 10:58 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Boron

MW-6 (bg)



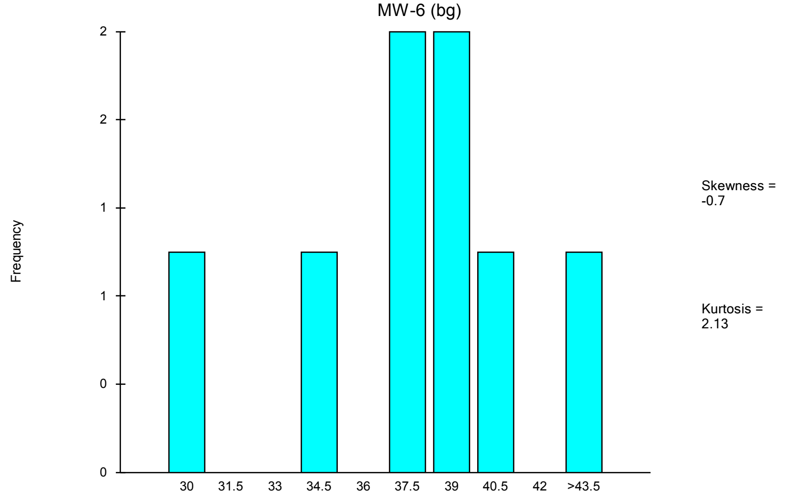
Histogram   Analysis Run 10/3/2017 10:58 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

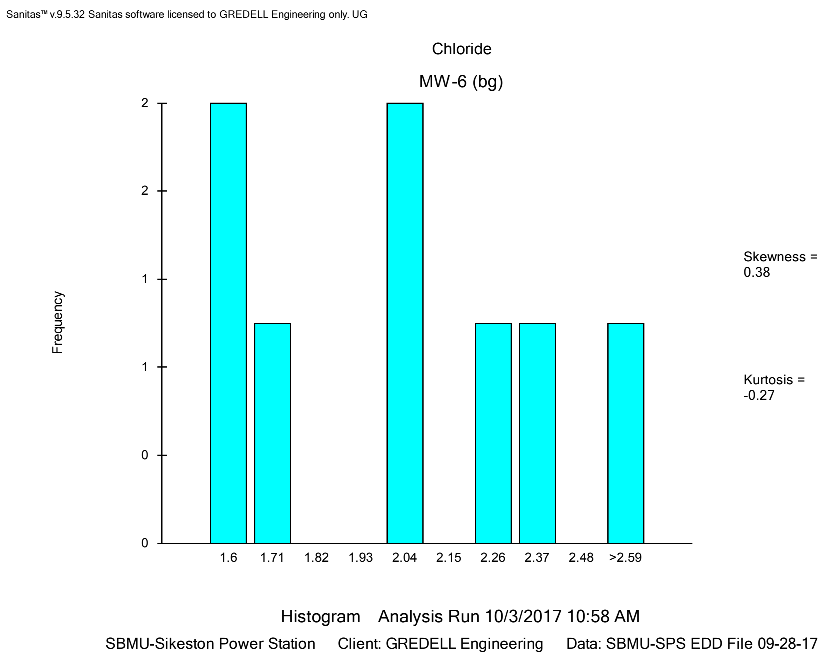
Calcium

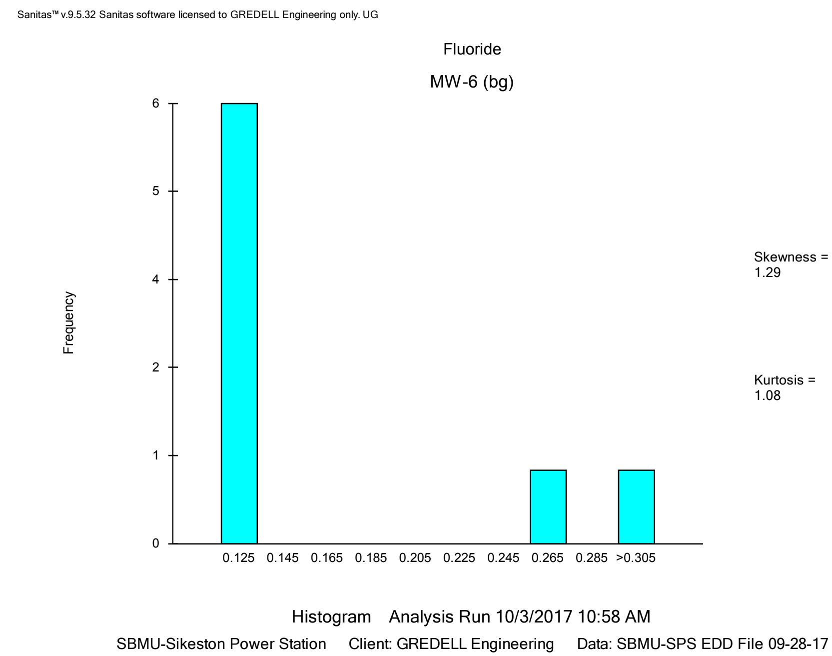
MW-6 (bg)

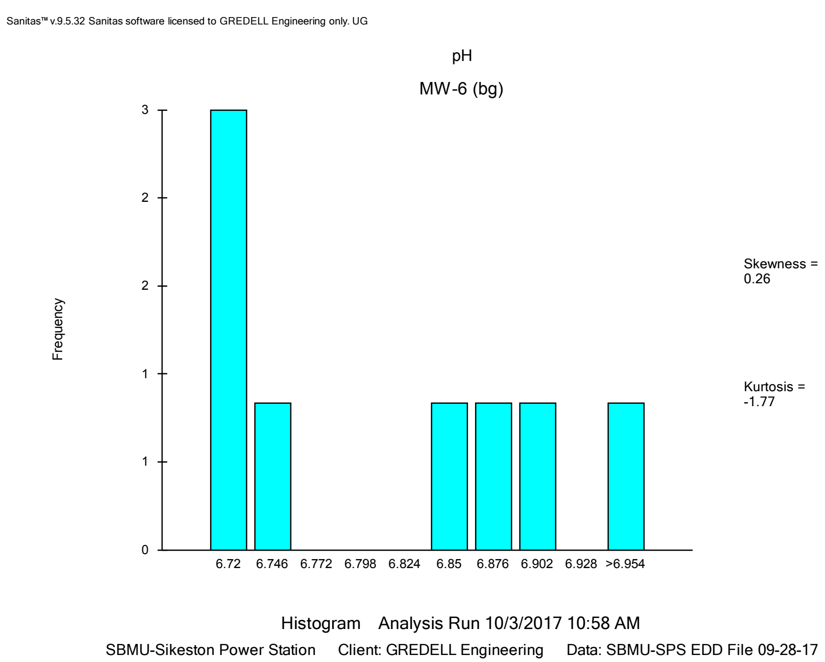


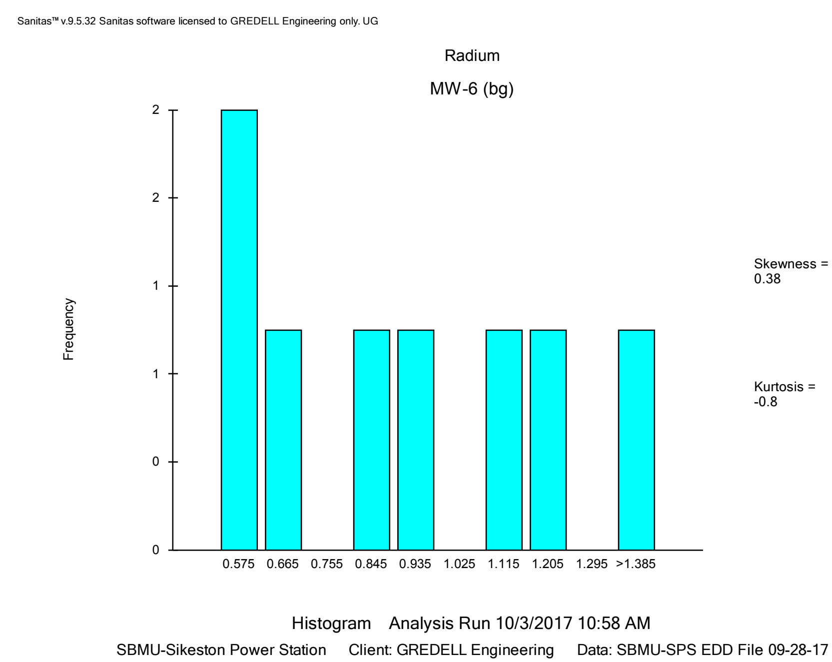
Histogram   Analysis Run 10/3/2017 10:58 AM

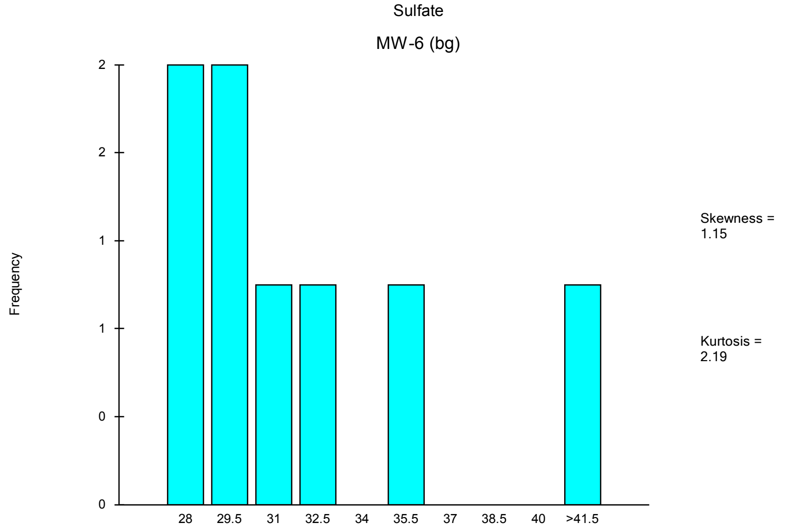
SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17


Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Chloride
MW-6 (bg)
Frequency
2
2
1
1
0
0
1.6
1.71
1.82
1.93
2.04
2.15
2.26
2.37
2.48
>2.59
Skewness =
0.38
Kurtosis =
-0.27
Histogram Analysis Run 10/3/2017 10:58 AM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17


Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Fluoride
MW-6 (bg)
Frequency
6
5
4
2
1
0
0.125
0.145
0.165
0.185
0.205
0.225
0.245
0.265
0.285
>0.305
Skewness =
1.29
Kurtosis =
1.08
Histogram Analysis Run 10/3/2017 10:58 AM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17


Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
pH
MW-6 (bg)
Frequency
3
2
2
1
1
0
6.72
6.746
6.772
6.798
6.824
6.85
6.876
6.902
6.928
>6.954
Skewness =
0.26
Kurtosis =
-1.77
Histogram Analysis Run 10/3/2017 10:58 AM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

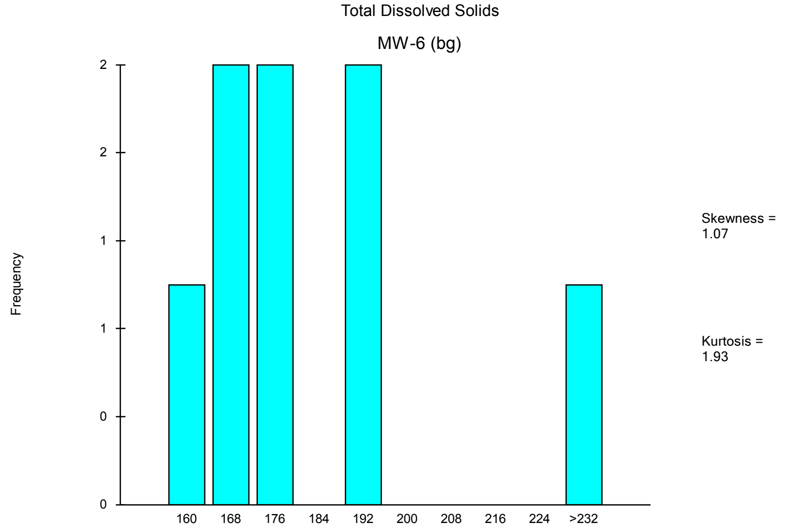

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Radium
MW-6 (bg)
Frequency
2
2
1
1
0
0
0.575
0.665
0.755
0.845
0.935
1.025
1.115
1.205
1.295
>1.385
Skewness =
0.38
Kurtosis =
-0.8
Histogram Analysis Run 10/3/2017 10:58 AM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17



Histogram Analysis Run 10/3/2017 10:58 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

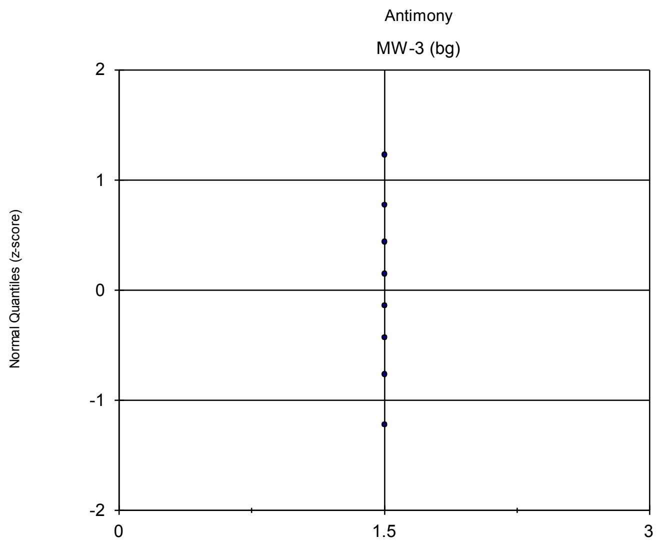


Histogram Analysis Run 10/3/2017 10:58 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

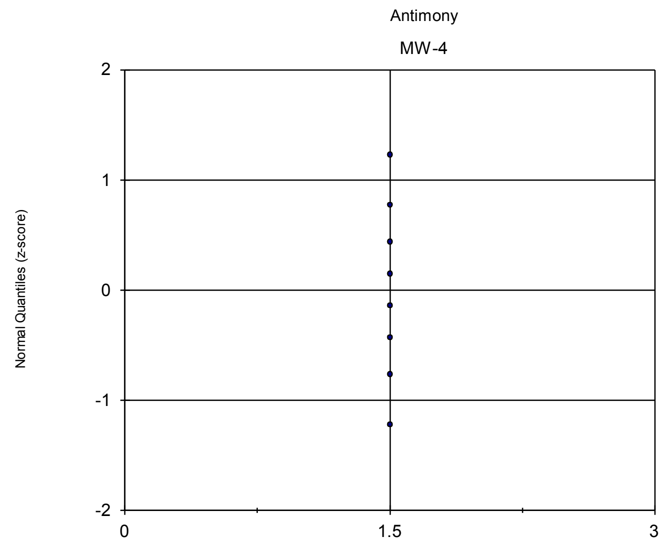
Appendix D

Probability Plots



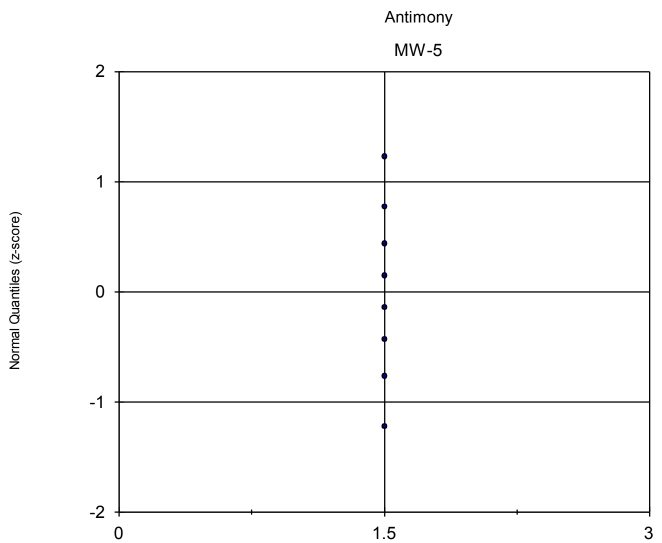
Probability Plot Analysis Run 10/3/2017 11:03 AM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



Probability Plot Analysis Run 10/3/2017 11:03 AM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



Probability Plot Analysis Run 10/3/2017 11:03 AM
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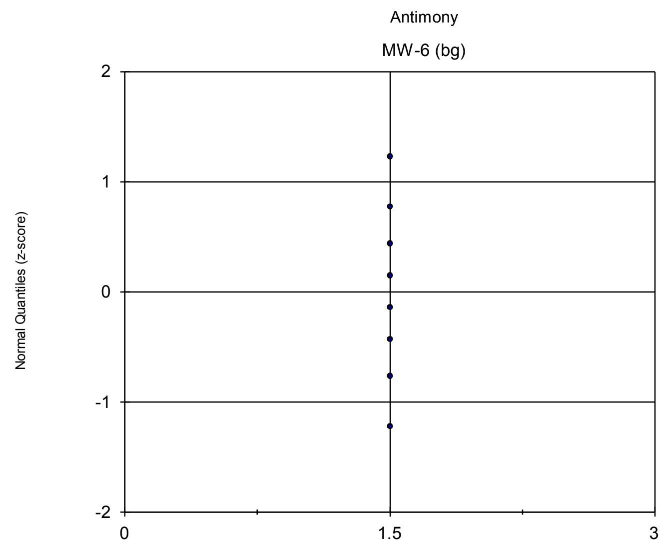
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

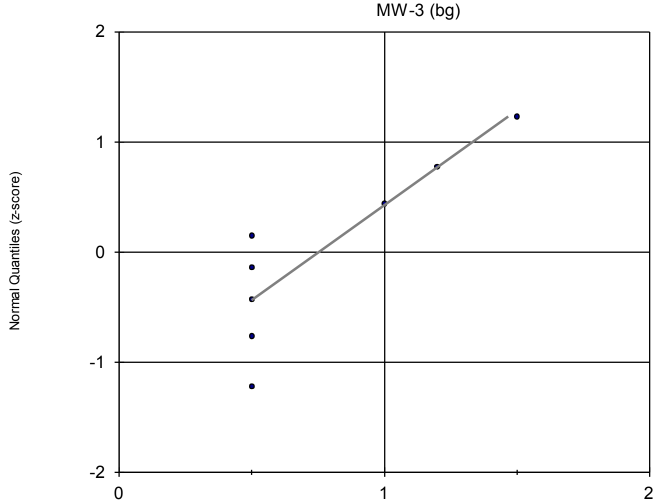


Probability Plot Analysis Run 10/3/2017 11:03 AM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Arsenic

MW-3 (bg)



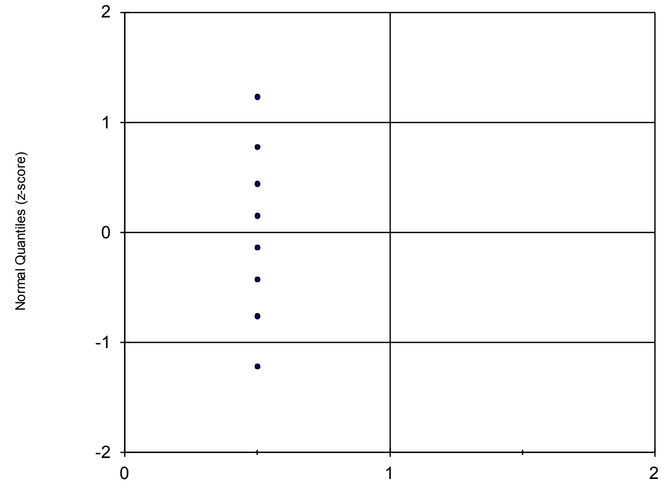
Probability Plot   Analysis Run 10/3/2017 11:03 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Arsenic

MW-4



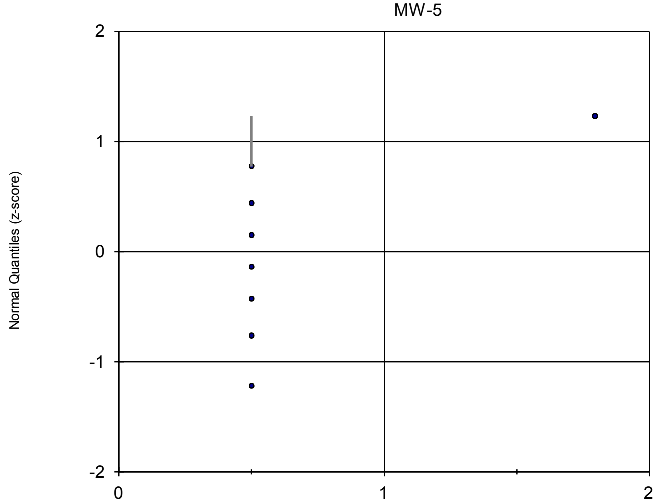
Probability Plot   Analysis Run 10/3/2017 11:03 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Arsenic

MW-5



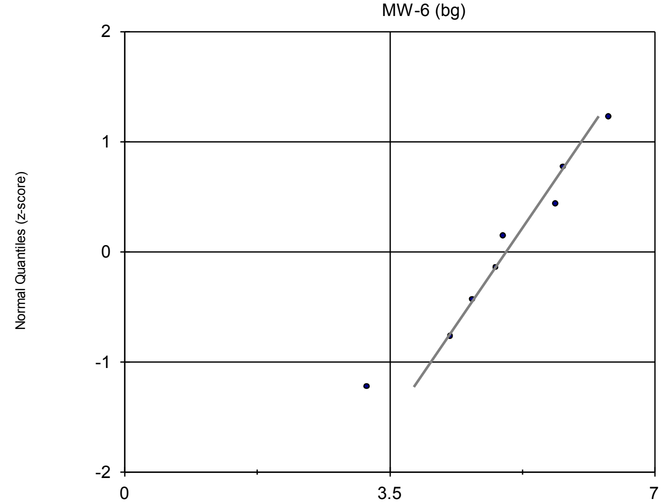
Probability Plot   Analysis Run 10/3/2017 11:03 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Arsenic

MW-6 (bg)



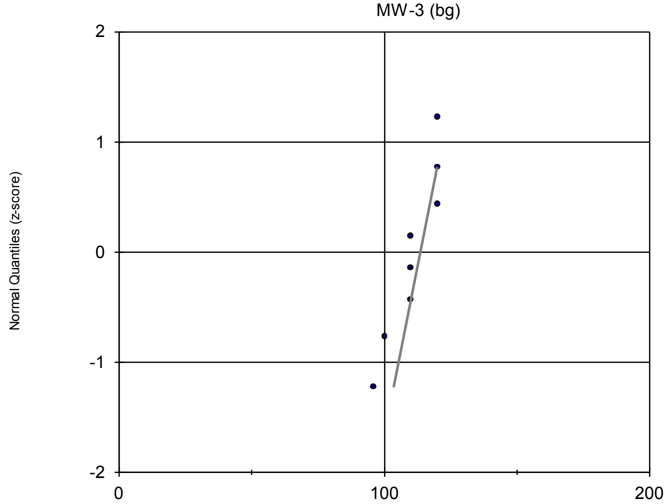
Probability Plot   Analysis Run 10/3/2017 11:03 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Barium

MW-3 (bg)



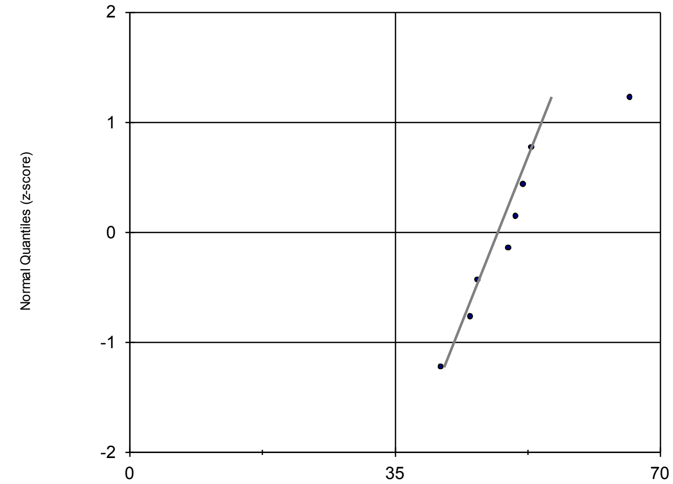
Probability Plot Analysis Run 10/3/2017 11:03 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Barium

MW-4



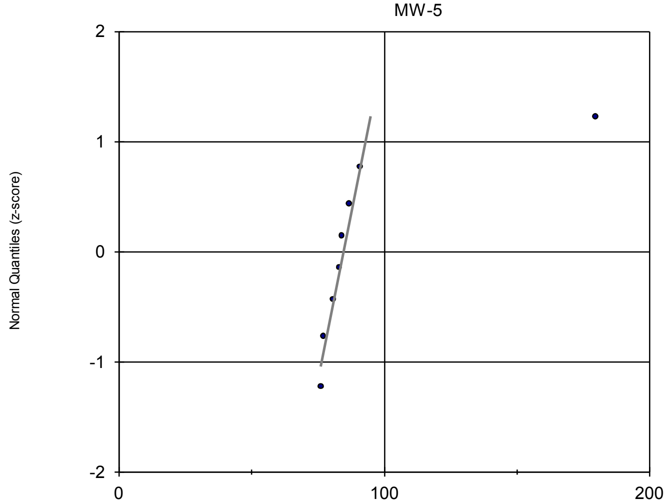
Probability Plot Analysis Run 10/3/2017 11:03 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Barium

MW-5



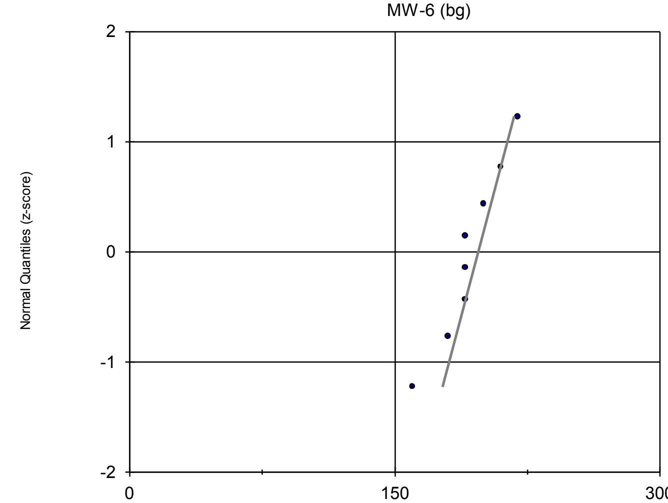
Probability Plot Analysis Run 10/3/2017 11:03 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Barium

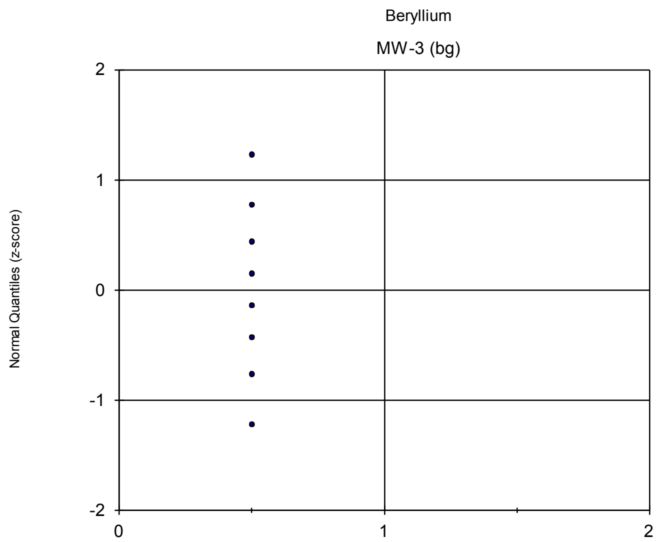
MW-6 (bg)



Probability Plot Analysis Run 10/3/2017 11:03 AM

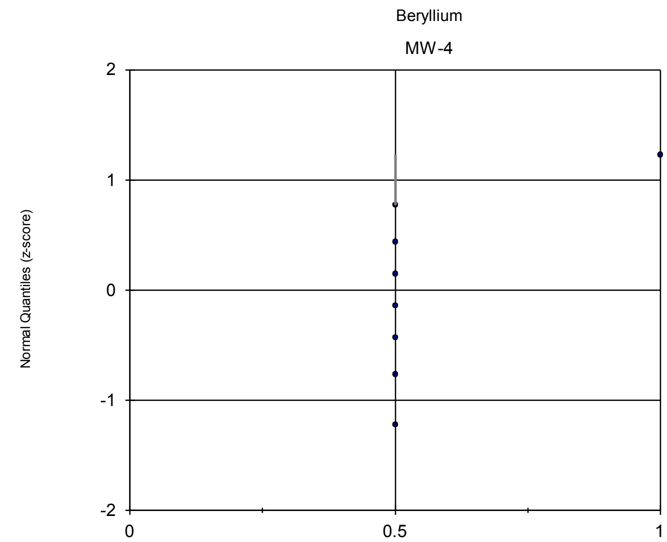
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



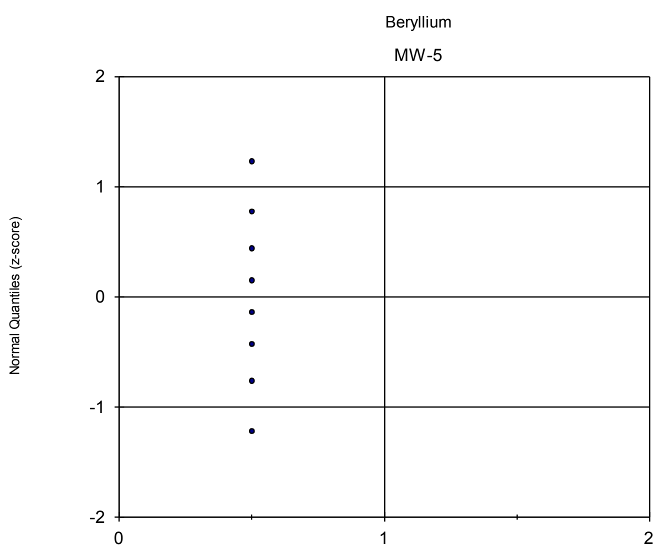
Probability Plot   Analysis Run 10/3/2017 11:04 AM
SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



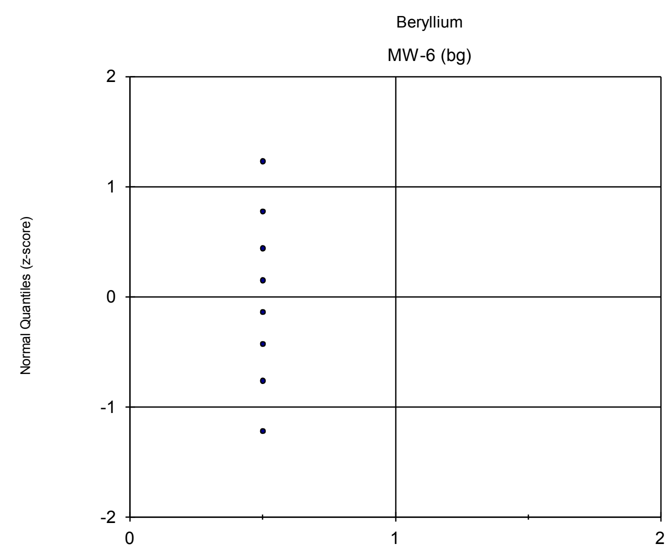
Probability Plot   Analysis Run 10/3/2017 11:04 AM
SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



Probability Plot   Analysis Run 10/3/2017 11:04 AM
SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

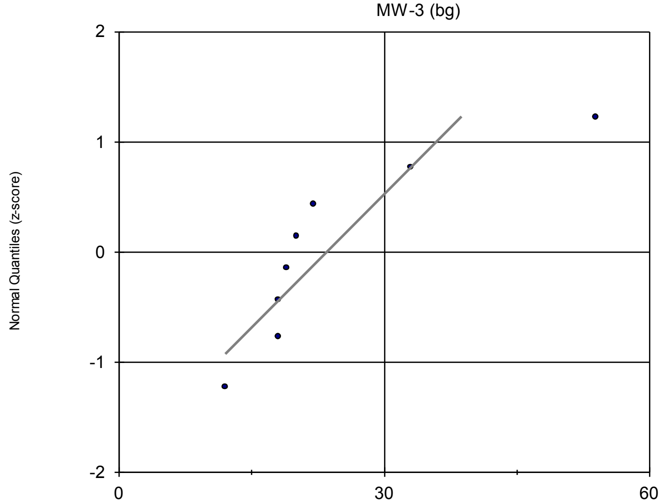


Probability Plot   Analysis Run 10/3/2017 11:04 AM
SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Boron

MW-3 (bg)



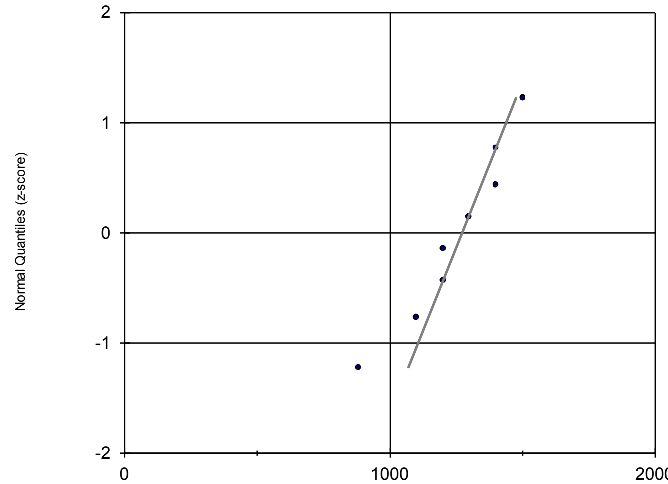
Probability Plot Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Boron

MW-4



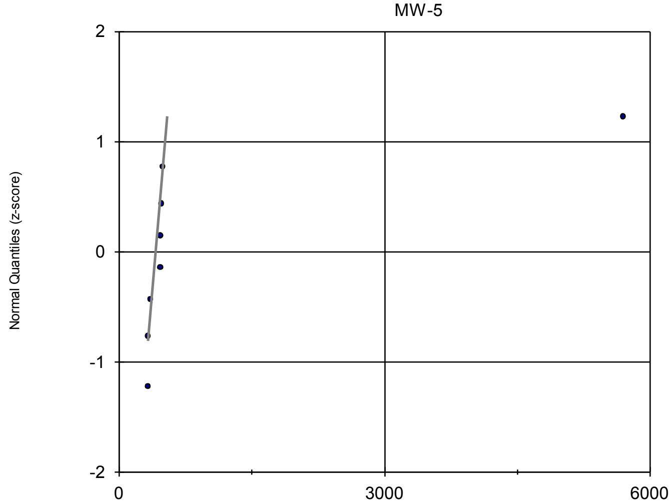
Probability Plot Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Boron

MW-5



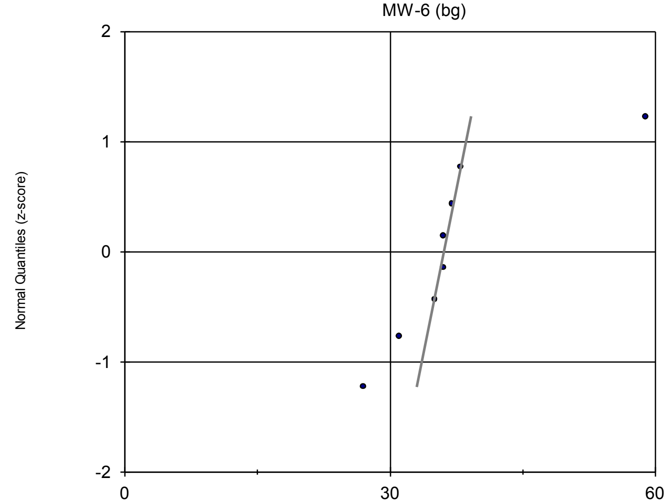
Probability Plot Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Boron

MW-6 (bg)

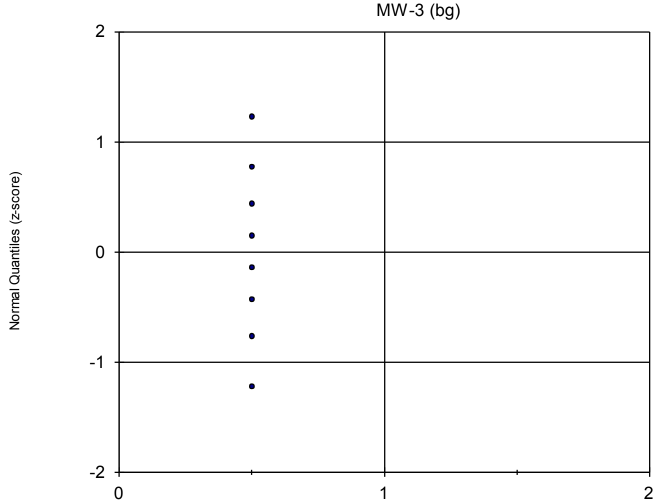


Probability Plot Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Cadmium

MW-3 (bg)



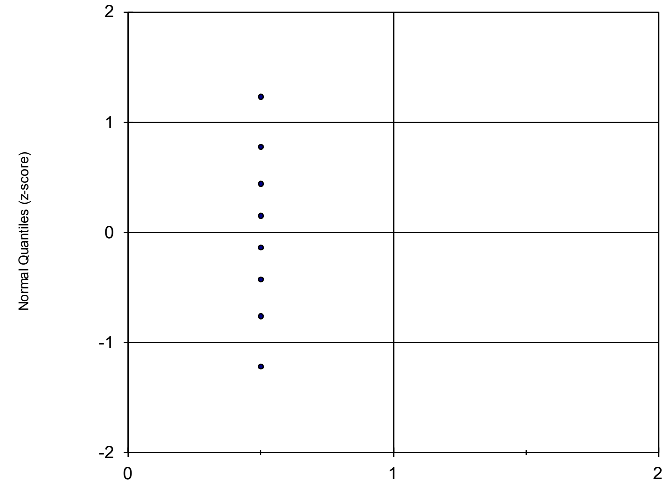
Probability Plot   Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Cadmium

MW-4



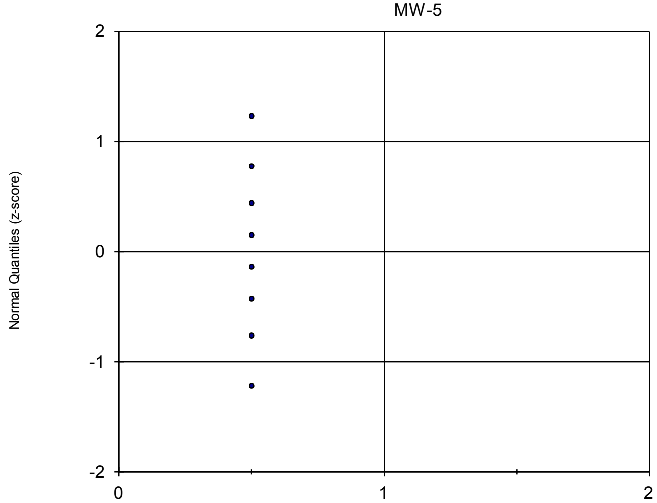
Probability Plot   Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Cadmium

MW-5



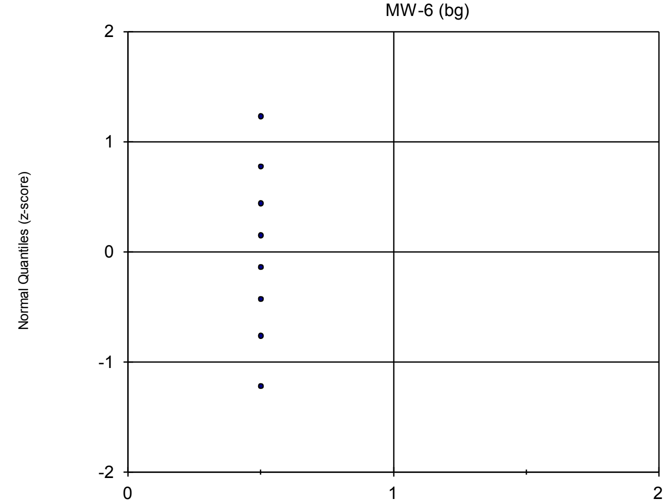
Probability Plot   Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Cadmium

MW-6 (bg)



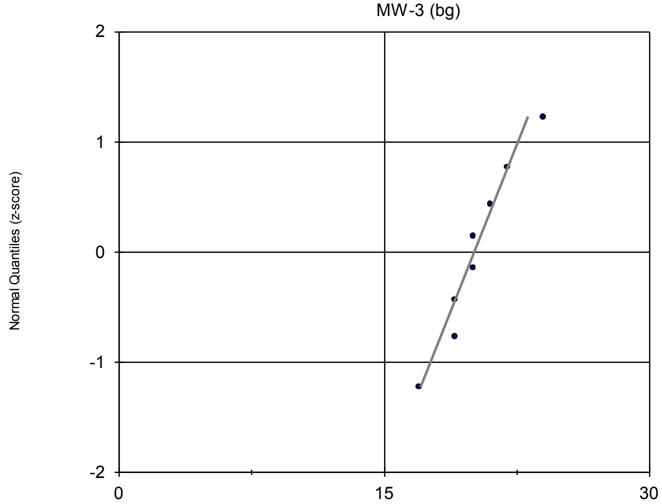
Probability Plot   Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Calcium

MW-3 (bg)



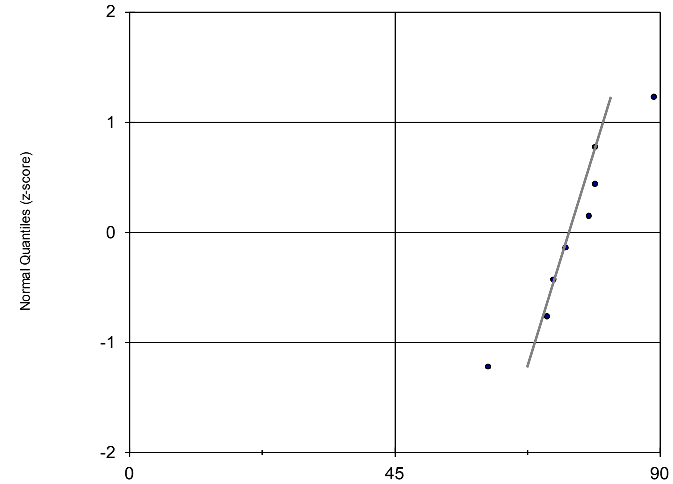
Probability Plot Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Calcium

MW-4



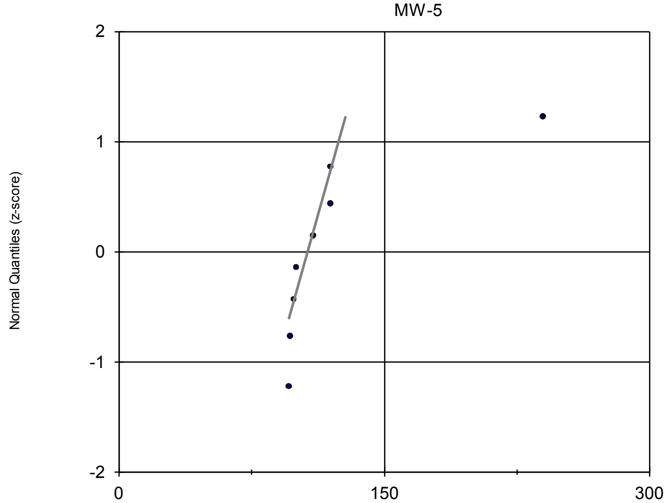
Probability Plot Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Calcium

MW-5



Probability Plot Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

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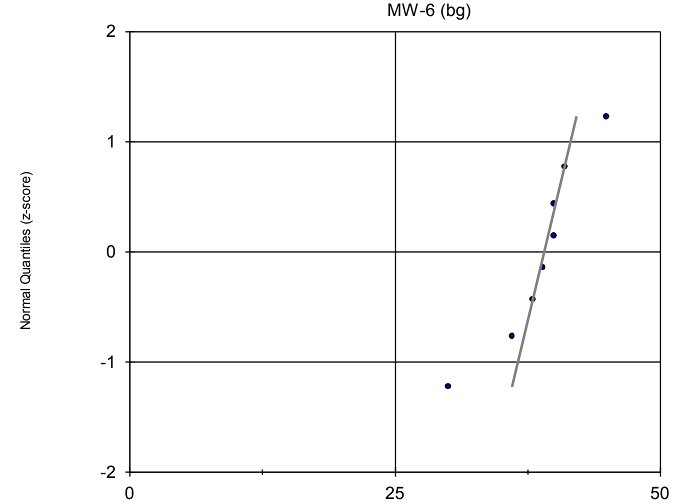
Calcium

MW-6 (bg)



Probability Plot Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

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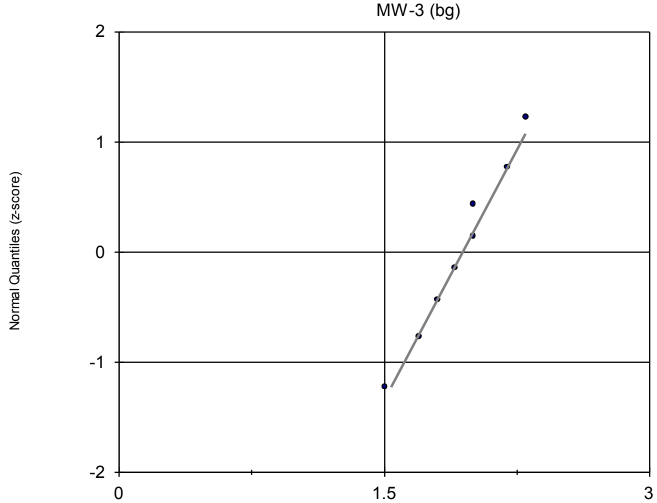
Chloride

MW-3 (bg)



Probability Plot Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

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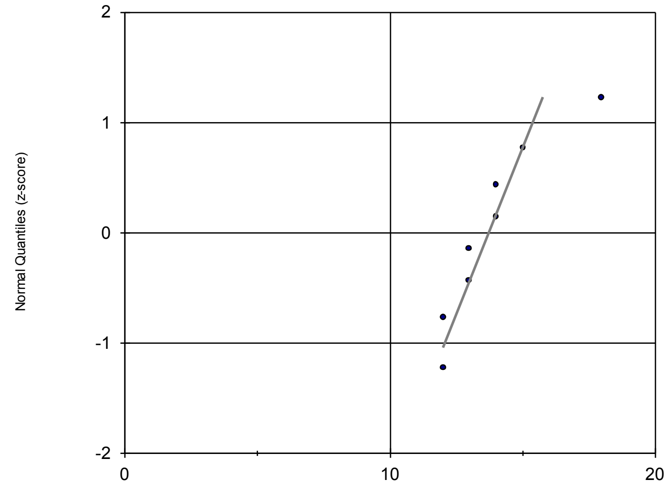
Chloride

MW-4



Probability Plot Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

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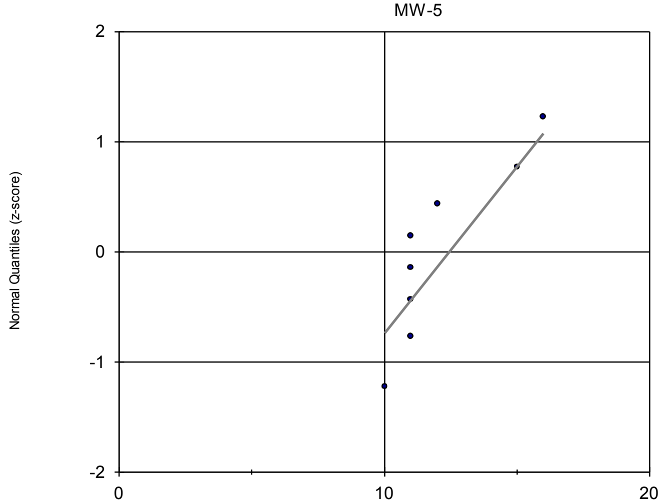
Chloride

MW-5



Probability Plot Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

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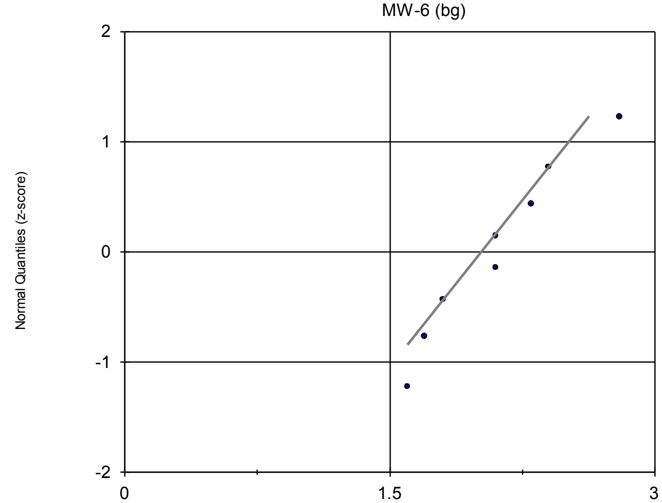
Chloride

MW-6 (bg)



Probability Plot Analysis Run 10/3/2017 11:04 AM

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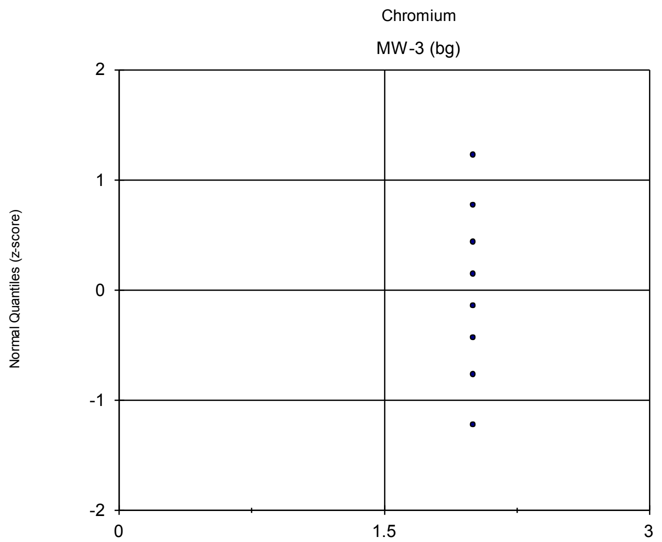

Probability Plot Analysis Run 10/3/2017 11:04 AM
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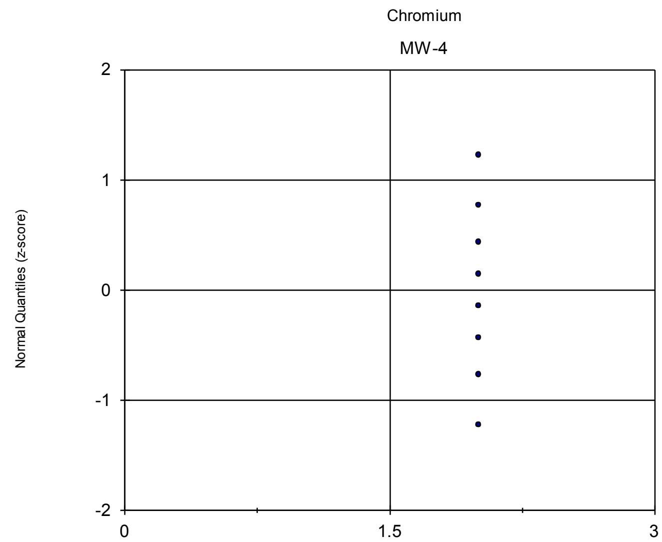

Probability Plot Analysis Run 10/3/2017 11:04 AM
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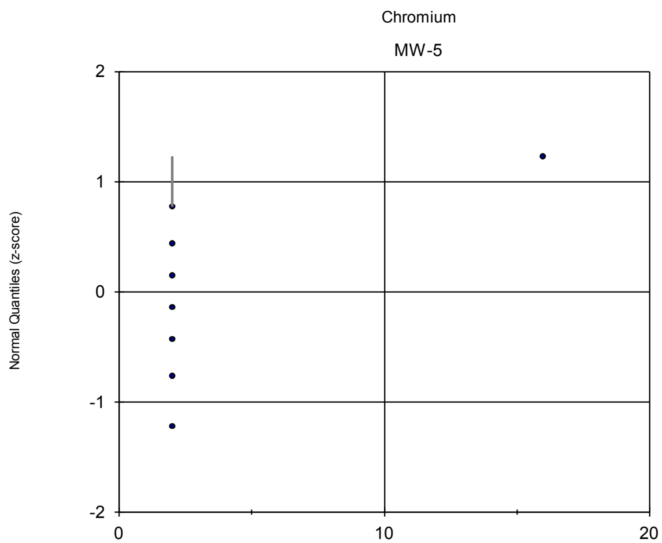
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



Probability Plot Analysis Run 10/3/2017 11:04 AM
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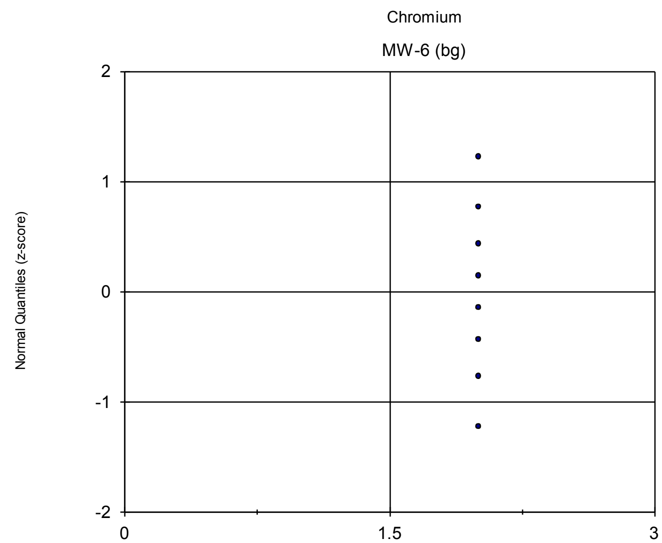

Probability Plot Analysis Run 10/3/2017 11:04 AM
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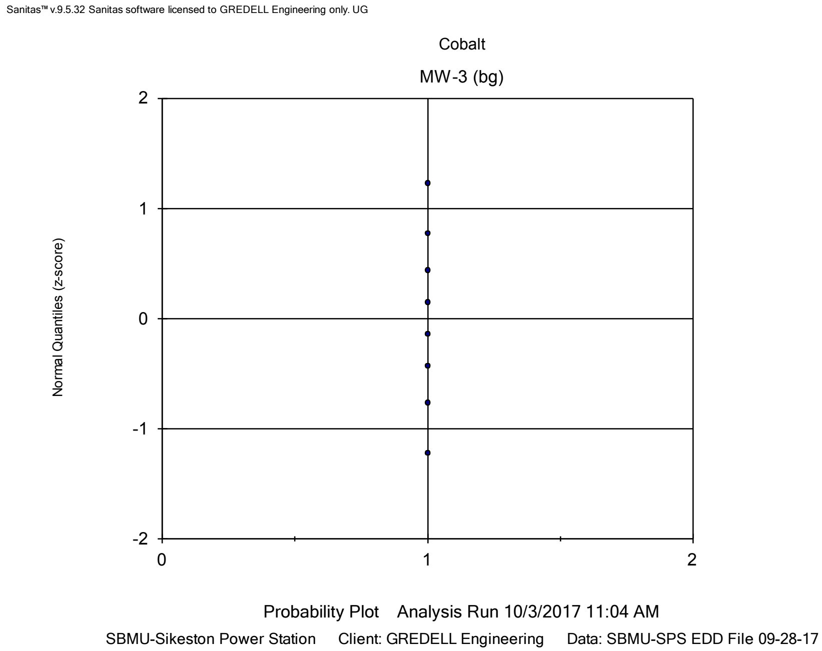

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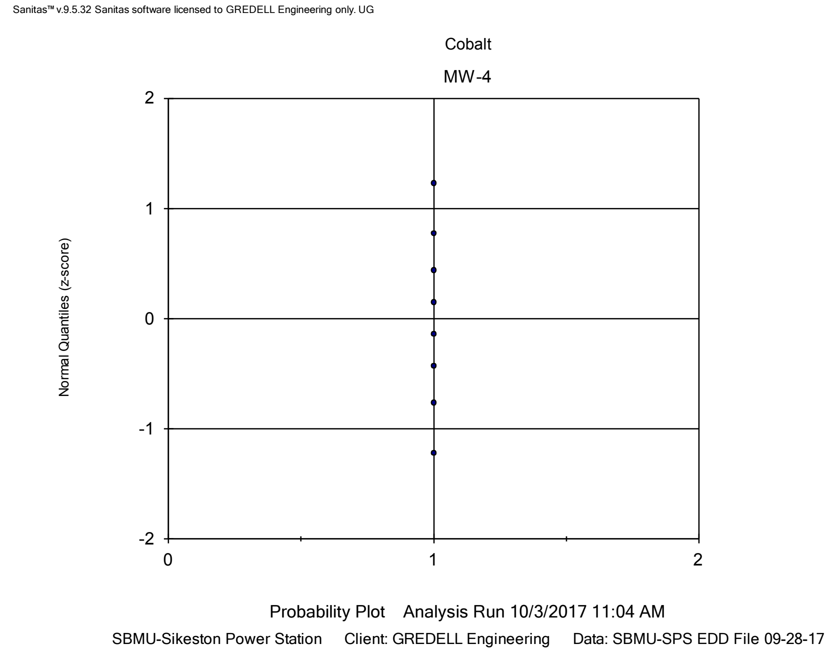
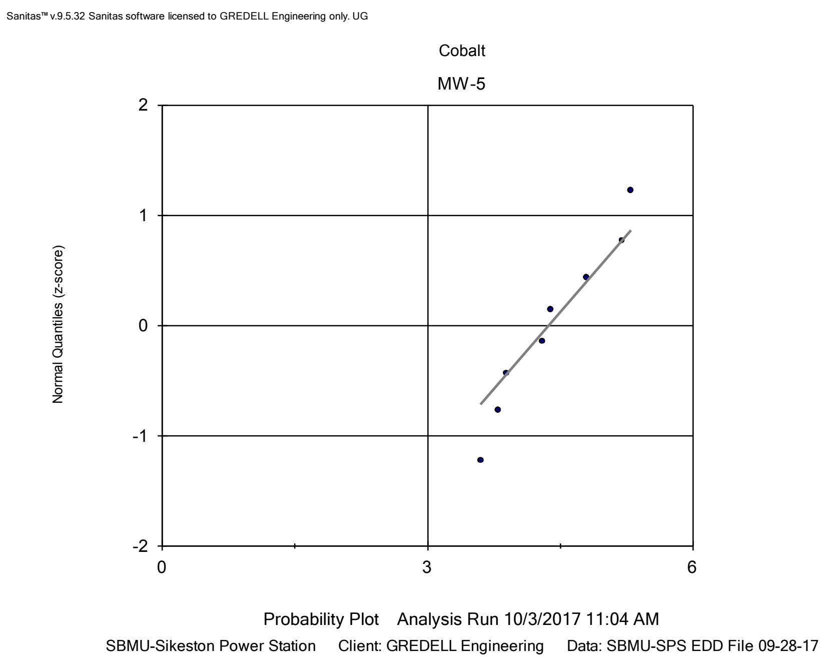
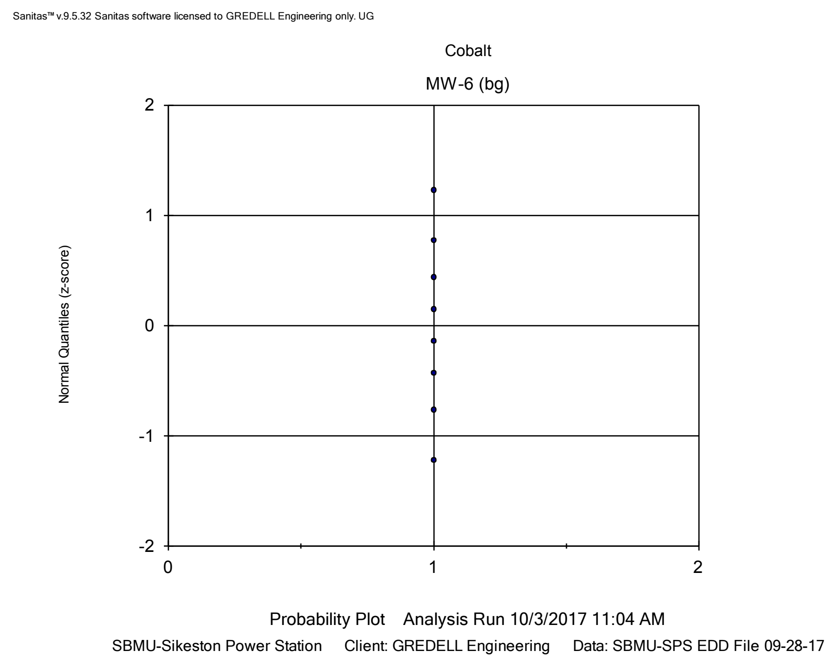
Cobalt
MW-3 (bg)
Normal Quantiles (z-score)
2
1
0
-1
-2
0
1
2
Probability Plot Analysis Run 10/3/2017 11:04 AM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17



Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Cobalt
MW-4
Normal Quantiles (z-score)
2
1
0
-1
-2
0
1
2
Probability Plot Analysis Run 10/3/2017 11:04 AM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17



Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Cobalt
MW-5
Normal Quantiles (z-score)
2
1
0
-1
-2
0
3
6
Probability Plot Analysis Run 10/3/2017 11:04 AM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17



Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Cobalt
MW-6 (bg)
Normal Quantiles (z-score)
2
1
0
-1
-2
0
1
2
Probability Plot Analysis Run 10/3/2017 11:04 AM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

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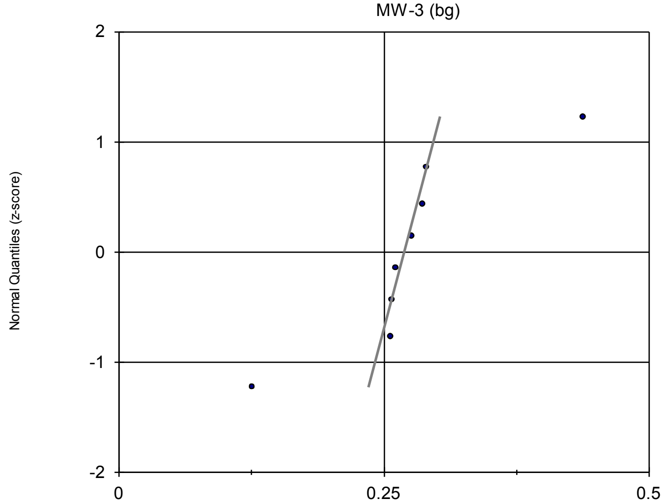
Fluoride

MW-3 (bg)



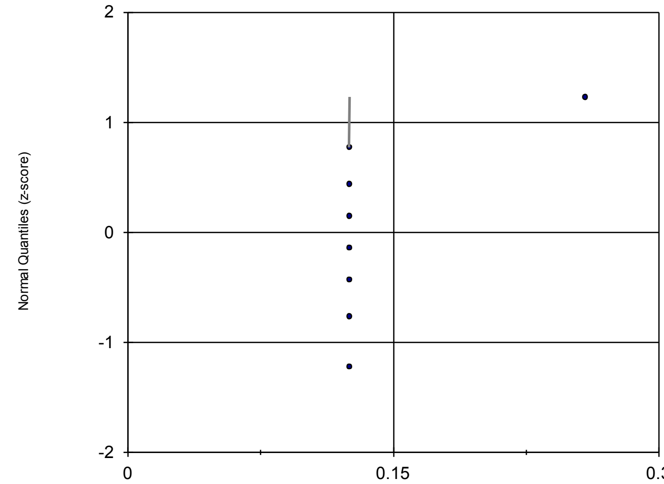
Probability Plot   Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Fluoride

MW-4



Probability Plot   Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

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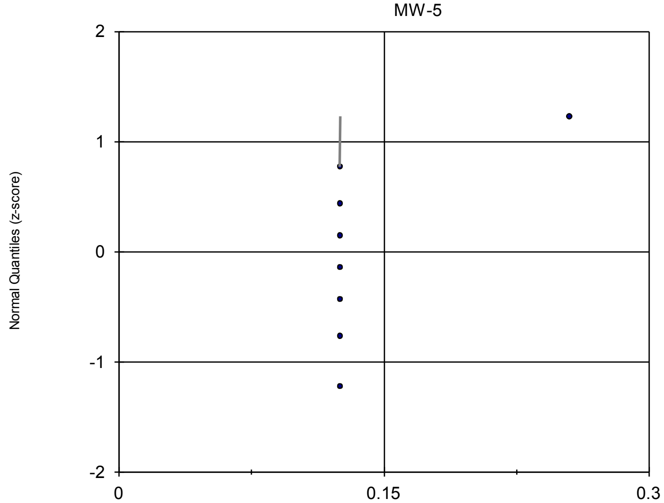
Fluoride

MW-5



Probability Plot   Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

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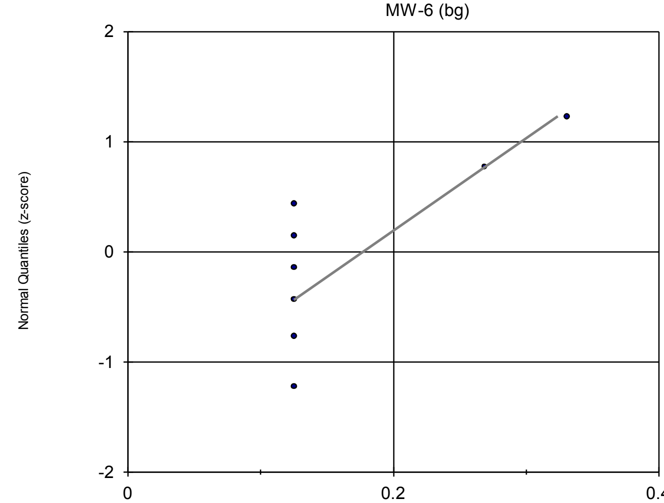
Fluoride

MW-6 (bg)



Probability Plot   Analysis Run 10/3/2017 11:04 AM

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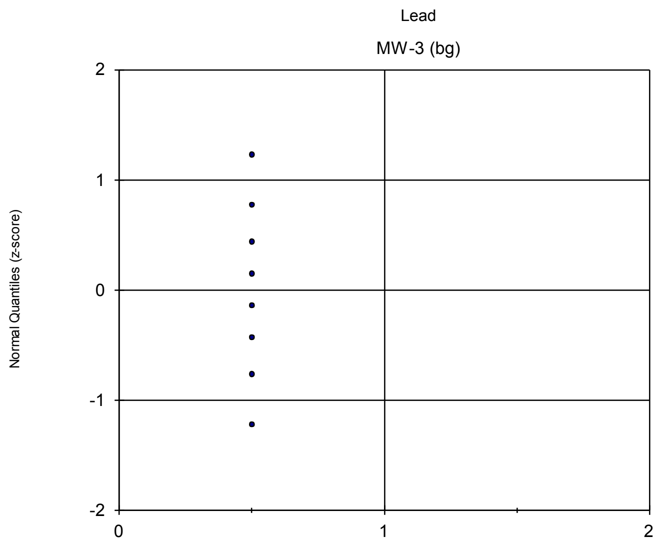

Probability Plot Analysis Run 10/3/2017 11:04 AM

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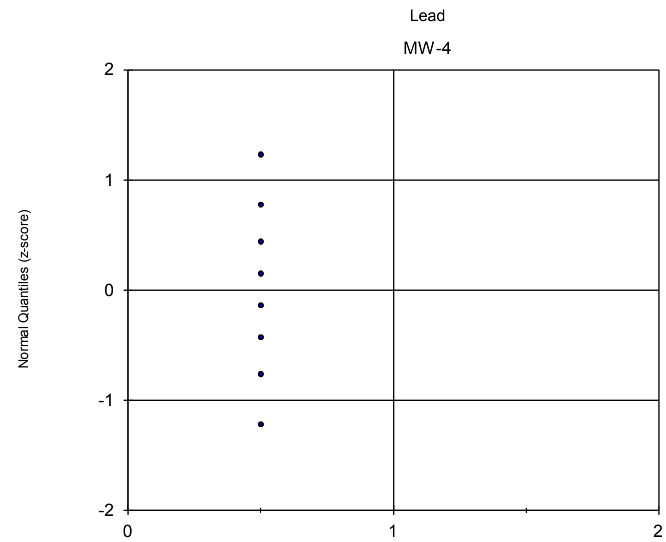

Probability Plot Analysis Run 10/3/2017 11:04 AM

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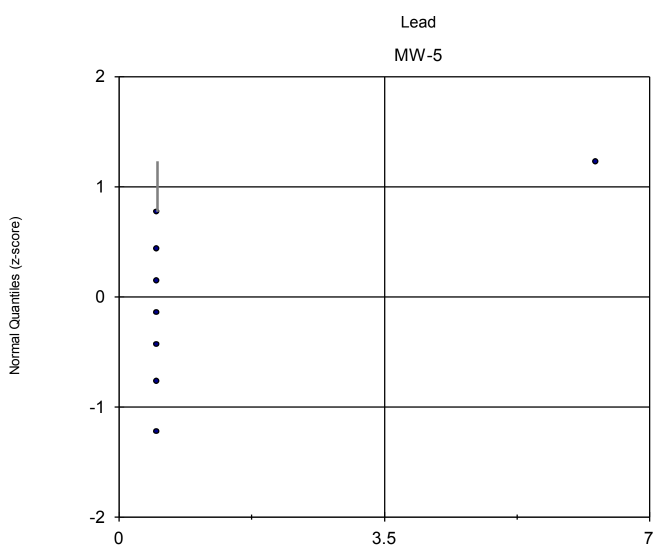

Probability Plot Analysis Run 10/3/2017 11:04 AM

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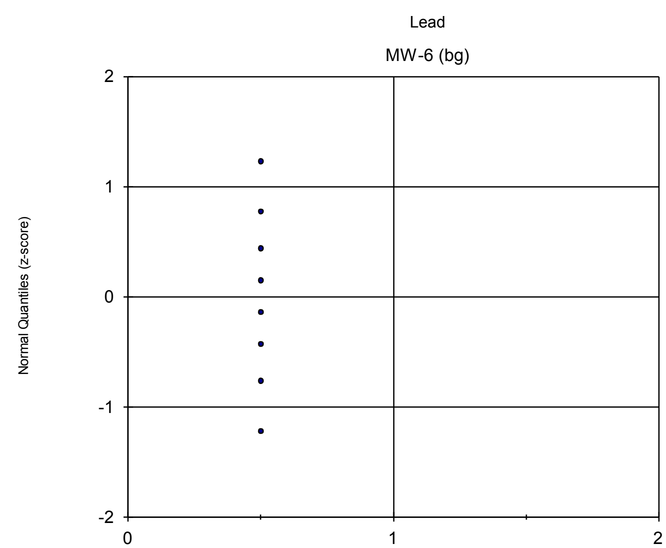

Probability Plot Analysis Run 10/3/2017 11:04 AM

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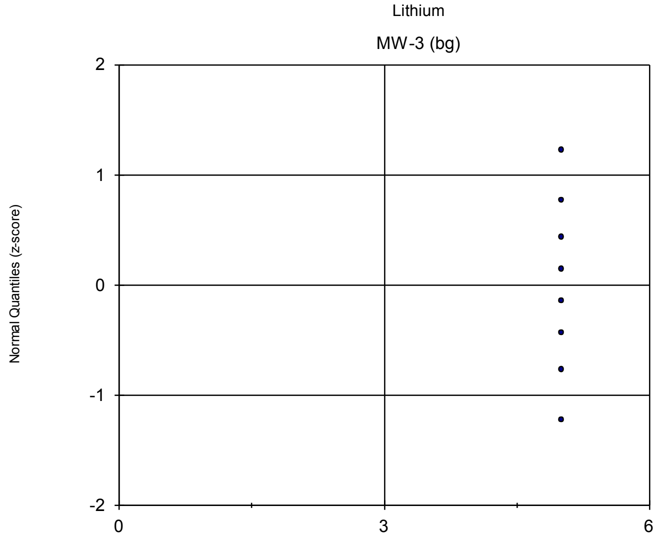

Probability Plot Analysis Run 10/3/2017 11:04 AM
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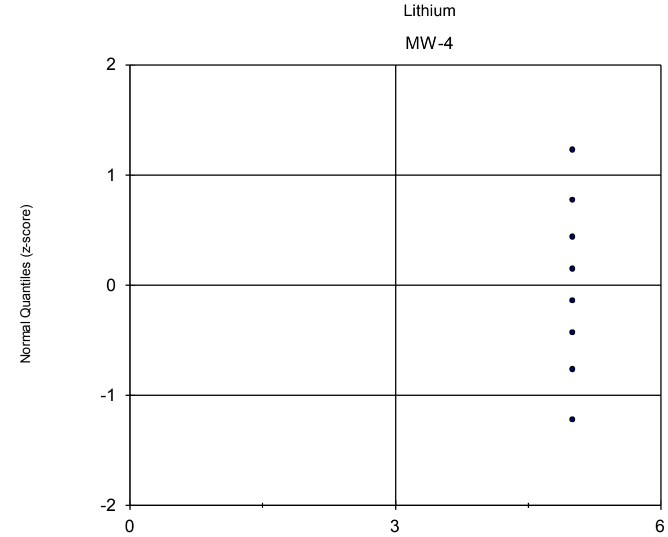

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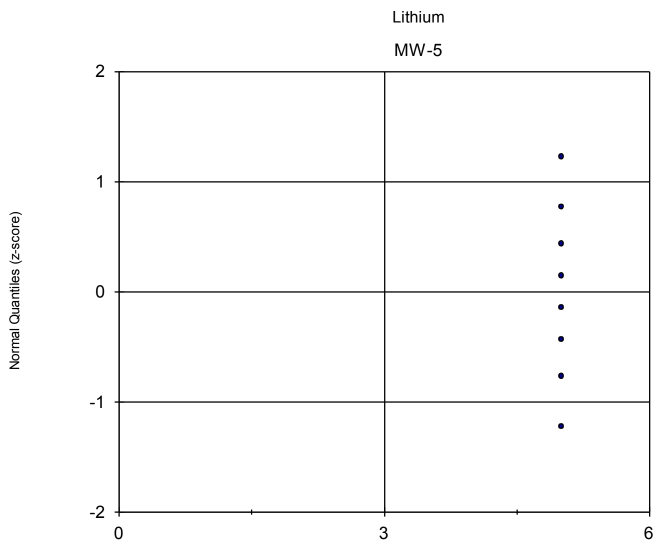

Probability Plot Analysis Run 10/3/2017 11:04 AM
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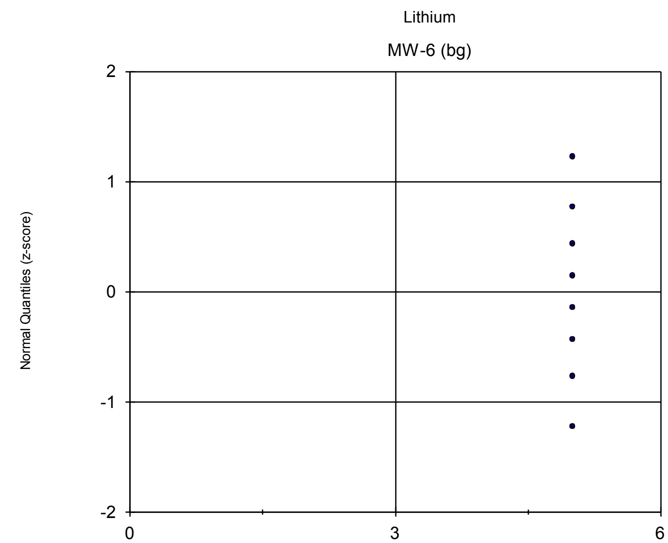
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



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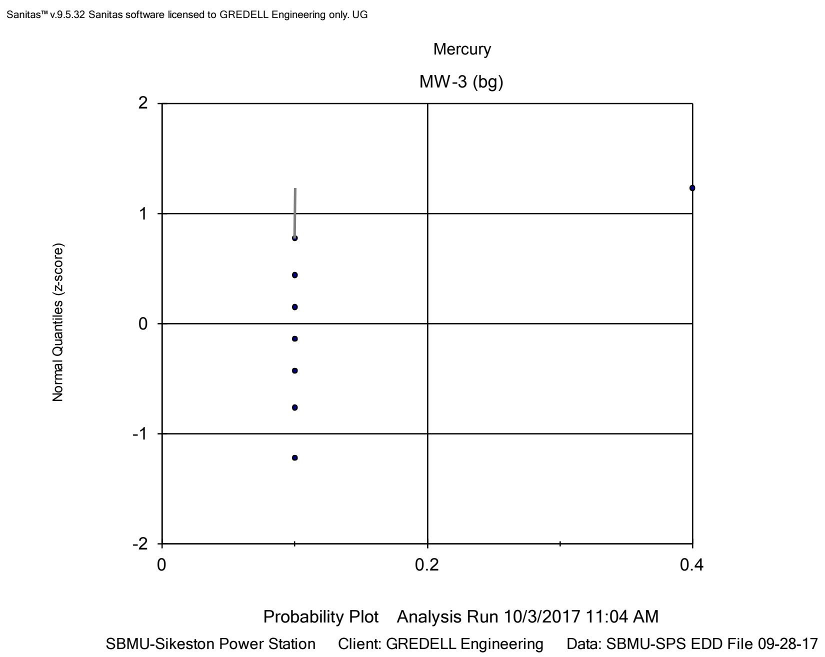
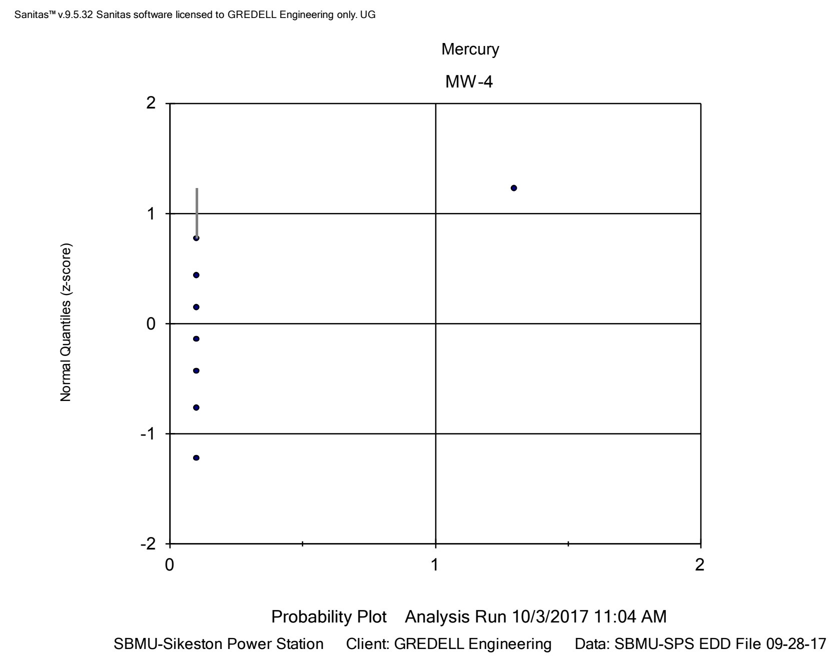
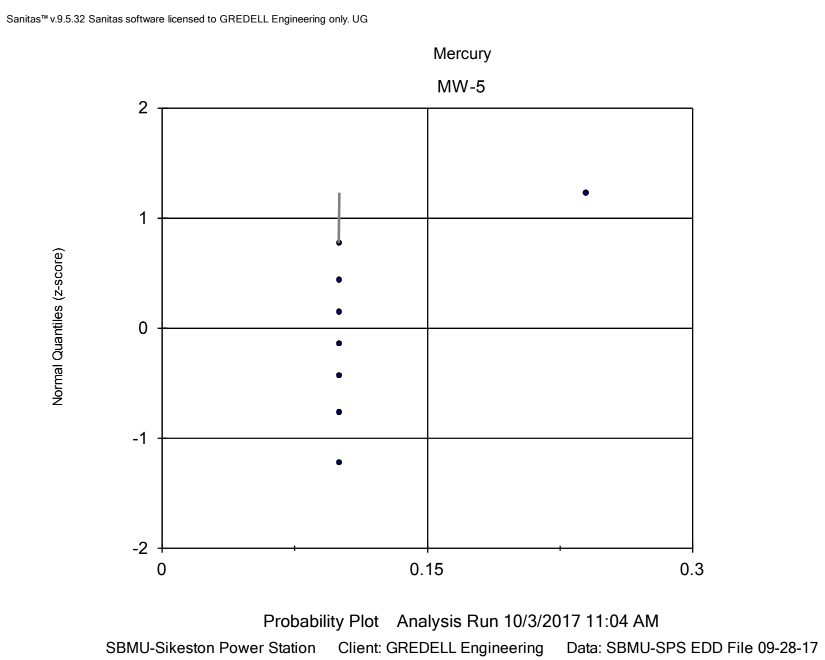


Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Mercury
MW-3 (bg)
Normal Quantiles (z-score)
2
1
0
-1
-2
0
0.2
0.4
Probability Plot Analysis Run 10/3/2017 11:04 AM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17



Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Mercury
MW-4
Normal Quantiles (z-score)
2
1
0
-1
-2
0
1
2
Probability Plot Analysis Run 10/3/2017 11:04 AM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17



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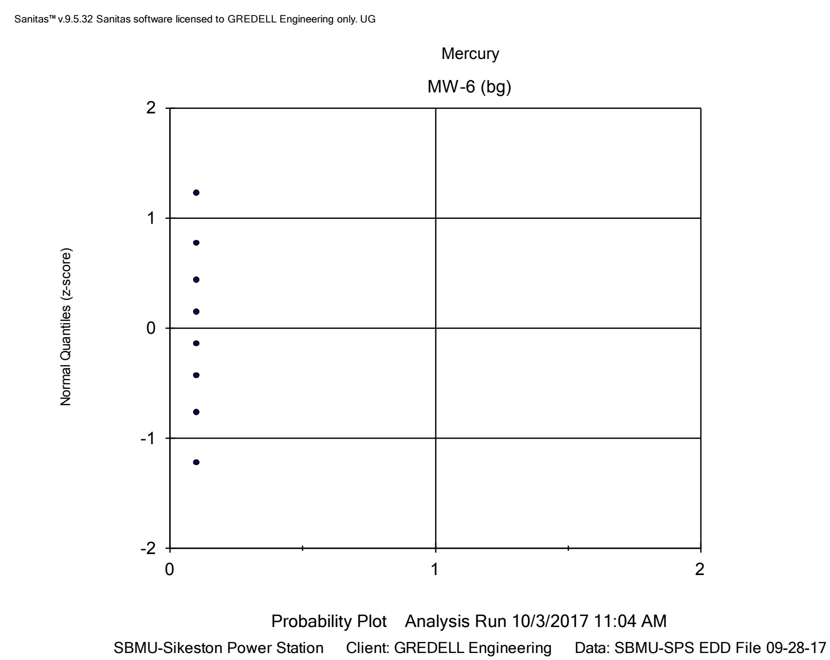
Mercury
MW-5
Normal Quantiles (z-score)
2
1
0
-1
-2
0
0.15
0.3
Probability Plot Analysis Run 10/3/2017 11:04 AM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17



Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Mercury
MW-6 (bg)
Normal Quantiles (z-score)
2
1
0
-1
-2
0
1
2
Probability Plot Analysis Run 10/3/2017 11:04 AM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

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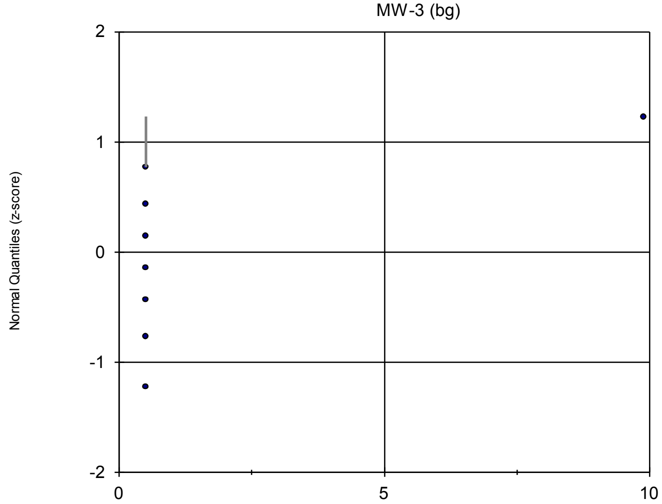
Molybdenum

MW-3 (bg)



Probability Plot   Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

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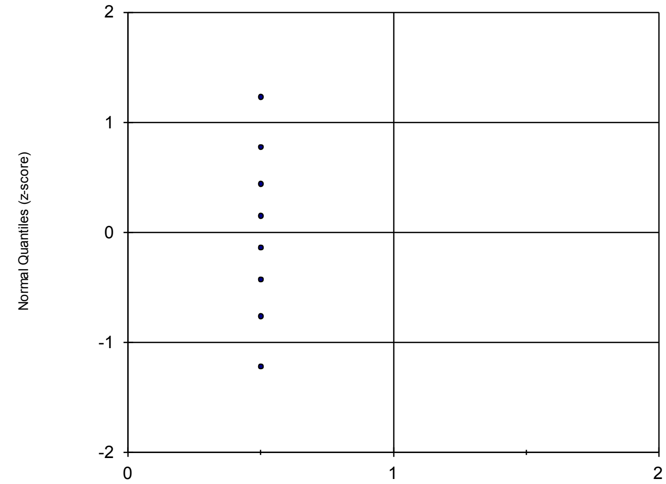
Molybdenum

MW-4



Probability Plot   Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

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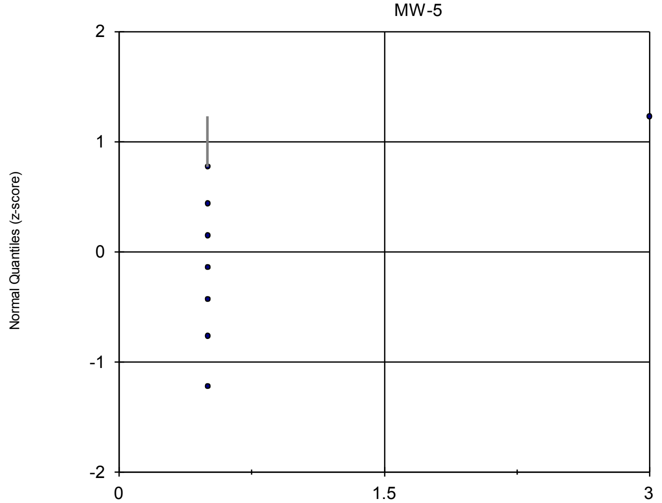
Molybdenum

MW-5



Probability Plot   Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

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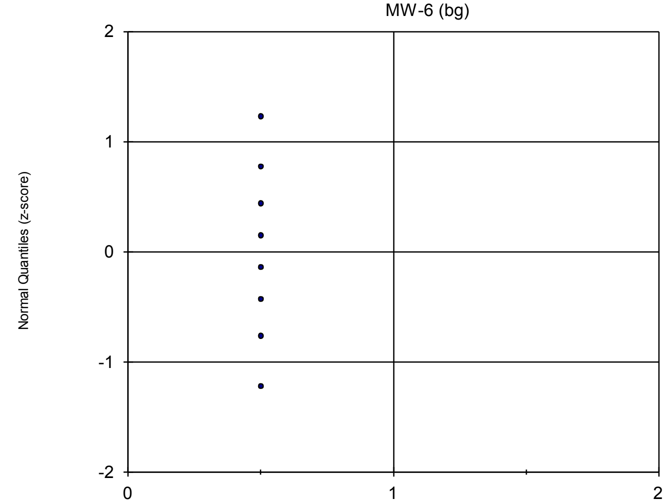
Molybdenum

MW-6 (bg)



Probability Plot   Analysis Run 10/3/2017 11:04 AM

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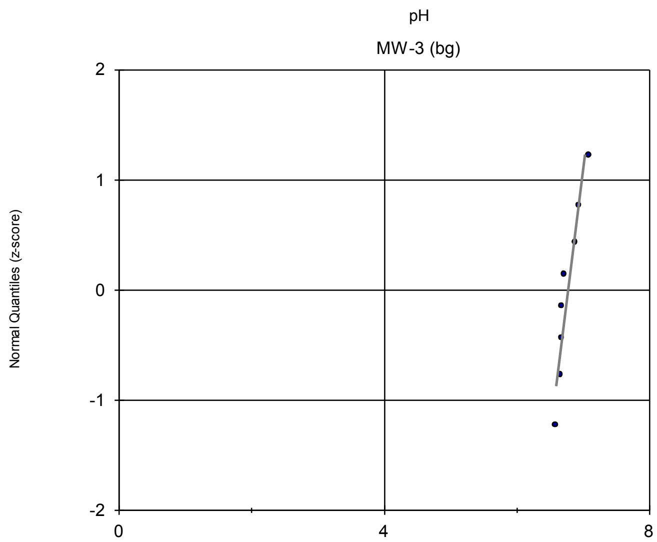

Probability Plot Analysis Run 10/3/2017 11:04 AM

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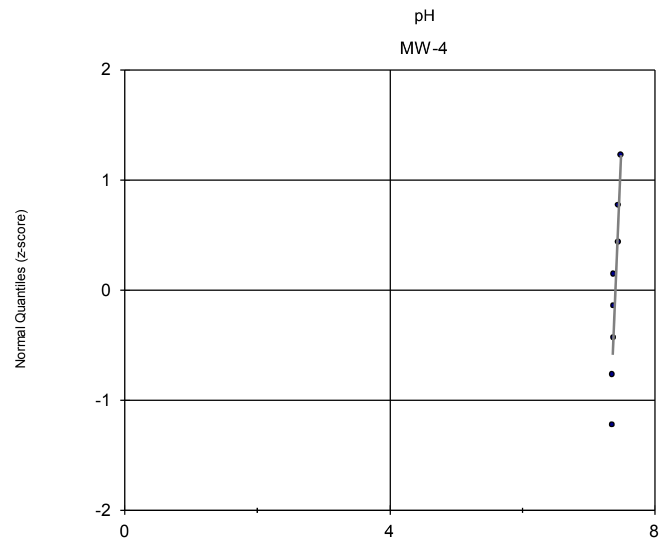

Probability Plot Analysis Run 10/3/2017 11:04 AM

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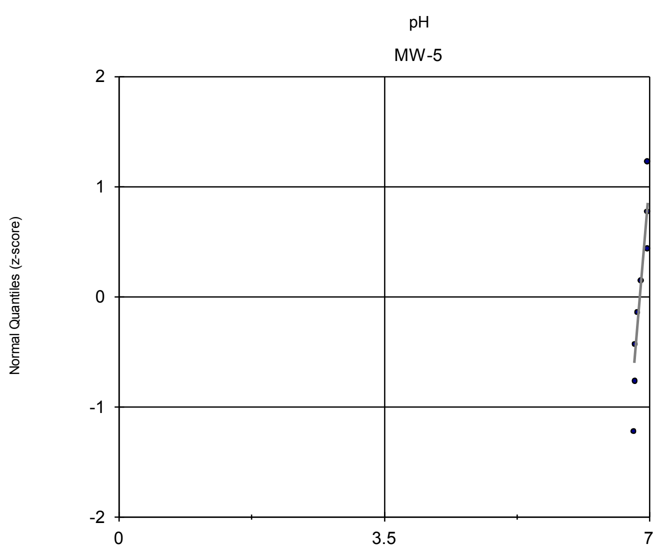
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



Probability Plot Analysis Run 10/3/2017 11:04 AM

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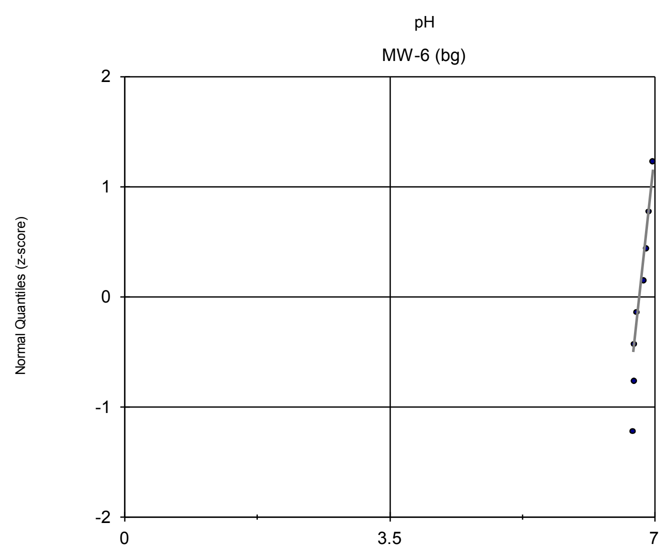
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



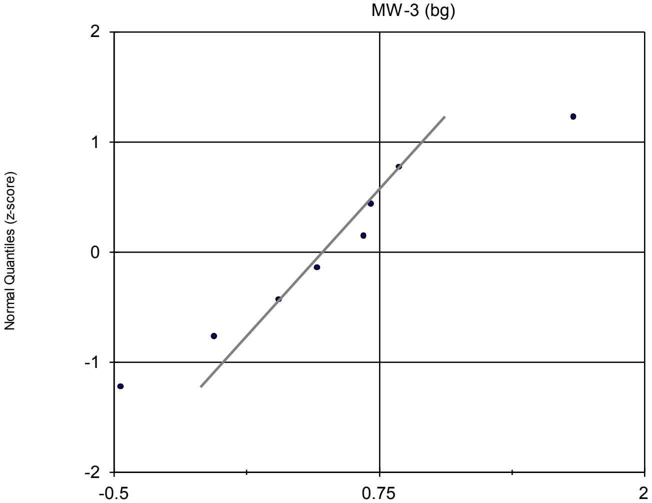
Probability Plot Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Radium

MW-3 (bg)



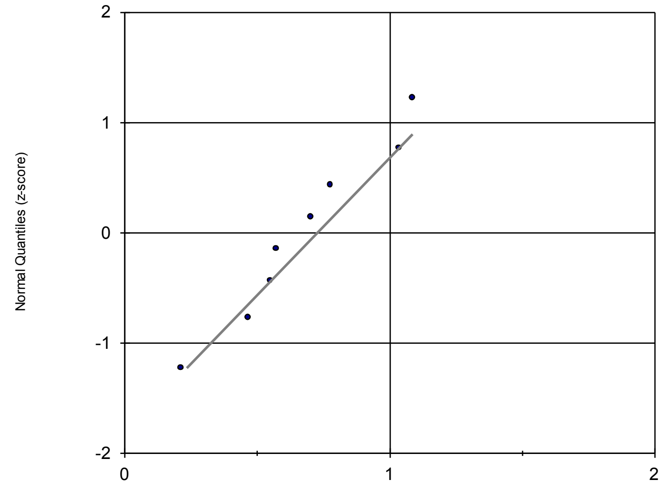
Probability Plot Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Radium

MW-4



Probability Plot Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

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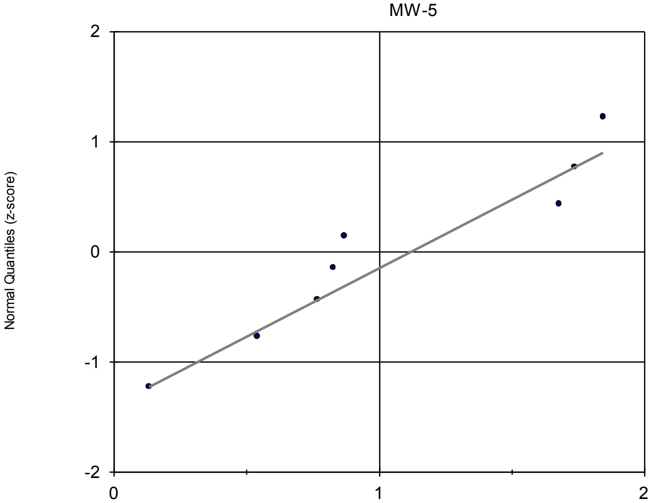
Radium

MW-5



Probability Plot Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

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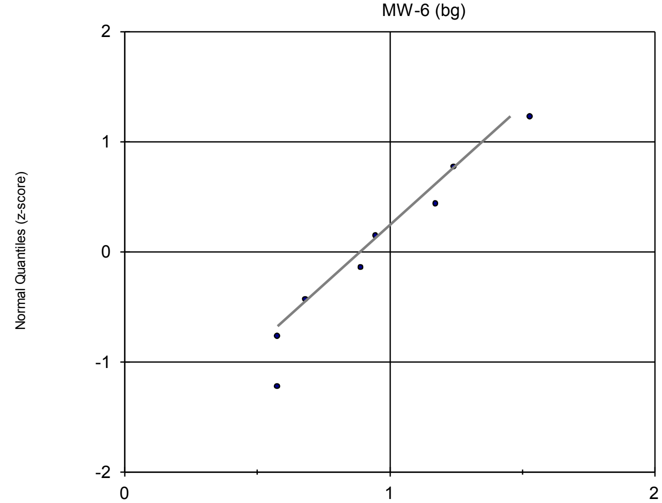
Radium

MW-6 (bg)



Probability Plot Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

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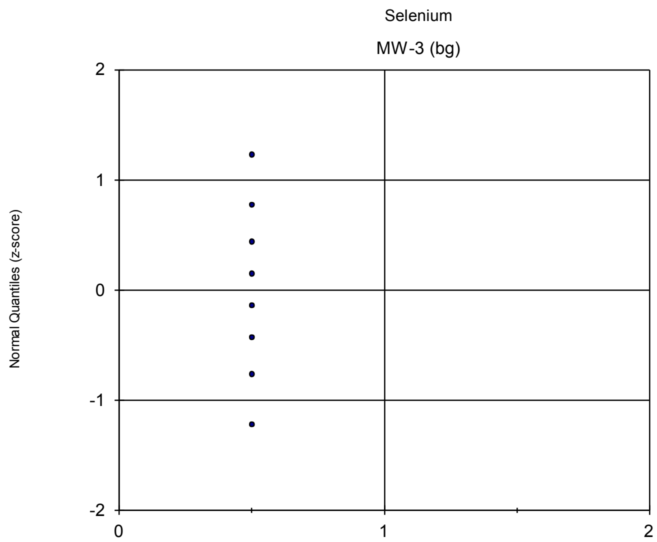
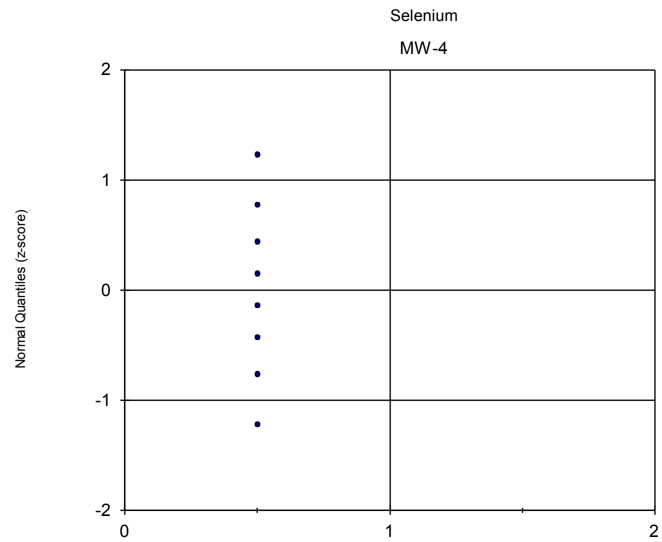


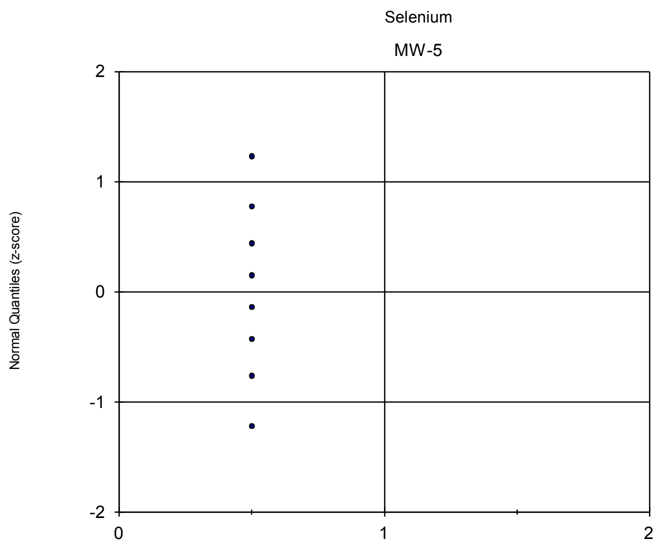
Probability Plot Analysis Run 10/3/2017 11:04 AM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



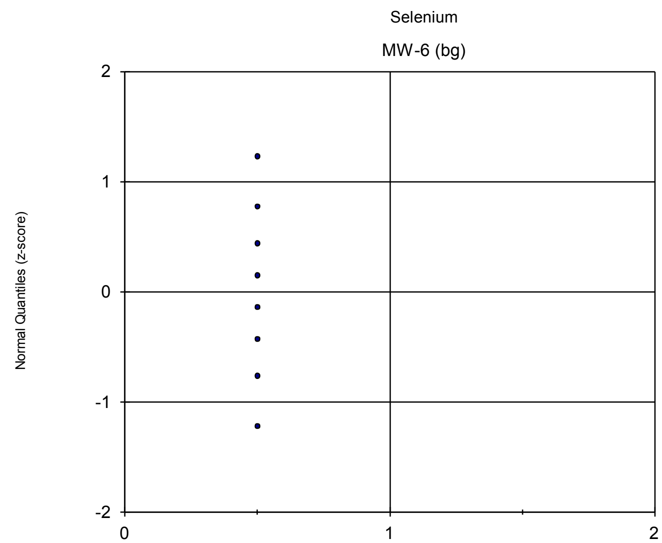
Probability Plot Analysis Run 10/3/2017 11:04 AM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



Probability Plot Analysis Run 10/3/2017 11:04 AM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



Probability Plot Analysis Run 10/3/2017 11:04 AM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

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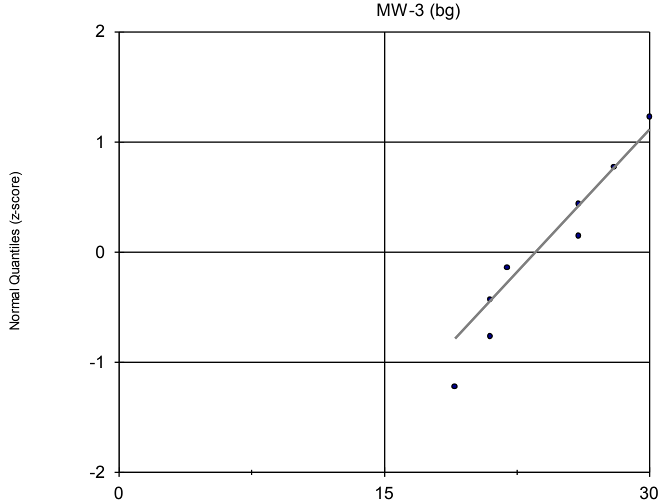
Sulfate

MW-3 (bg)



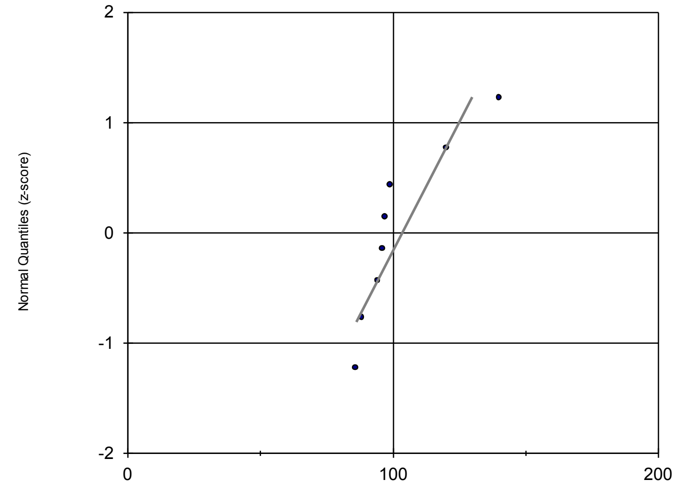
Probability Plot   Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Sulfate

MW-4



Probability Plot   Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

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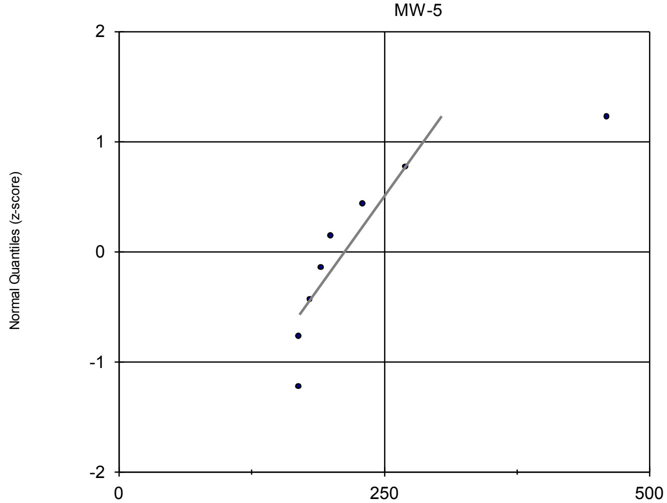
Sulfate

MW-5



Probability Plot   Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

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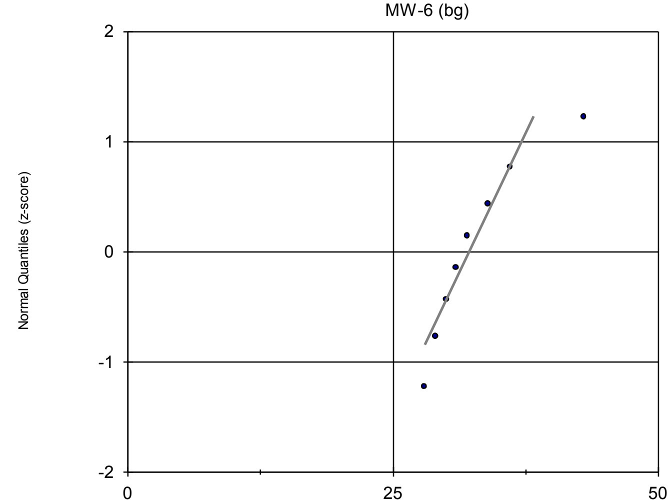
Sulfate

MW-6 (bg)



Probability Plot   Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

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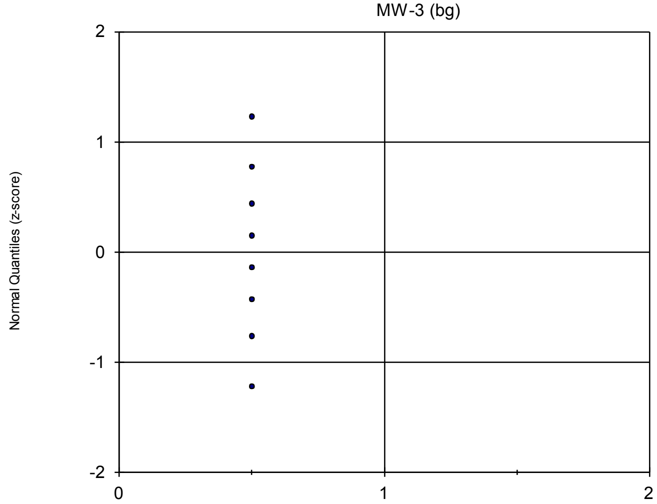
Thallium

MW-3 (bg)



Probability Plot Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

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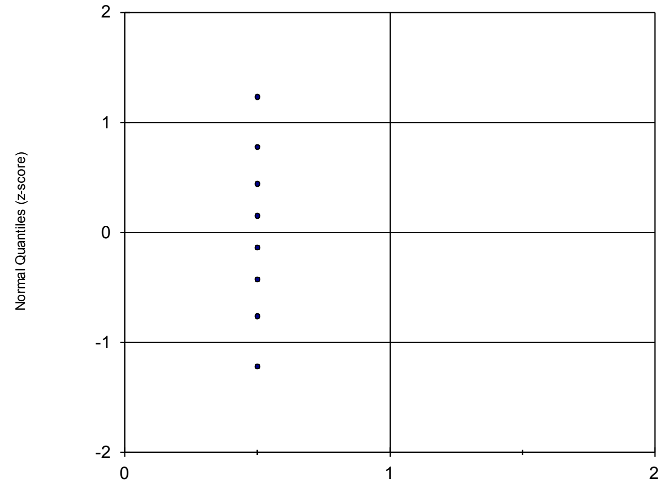
Thallium

MW-4



Probability Plot Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

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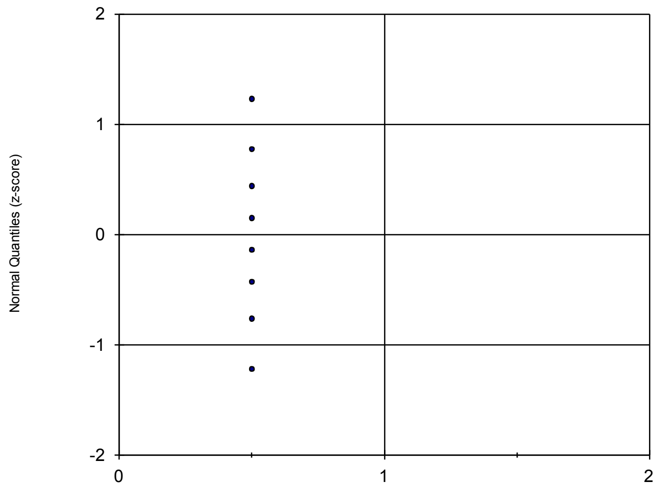
Thallium

MW-5



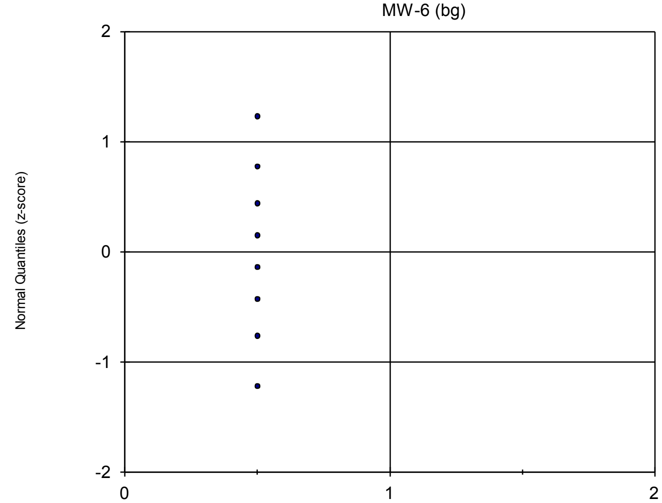
Probability Plot Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

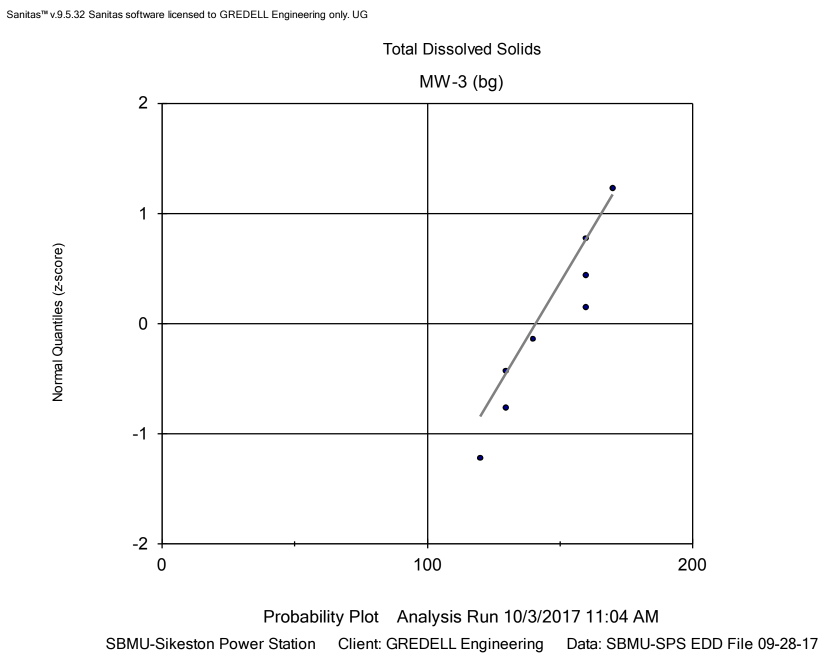
Thallium

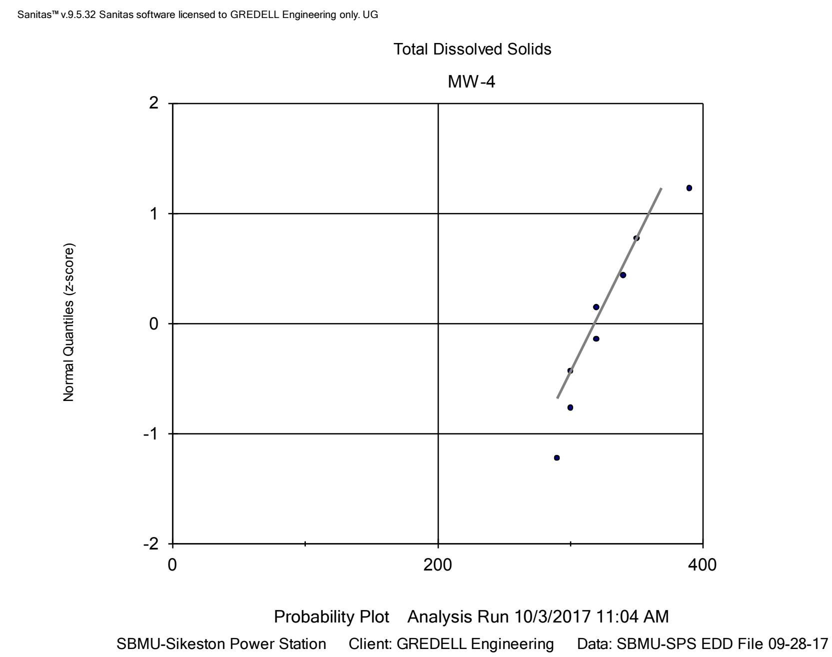
MW-6 (bg)

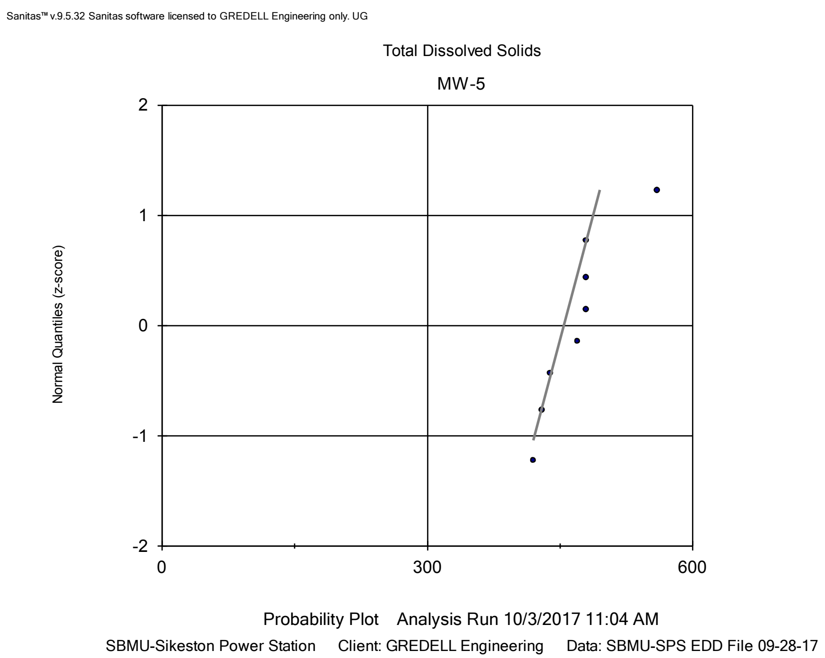


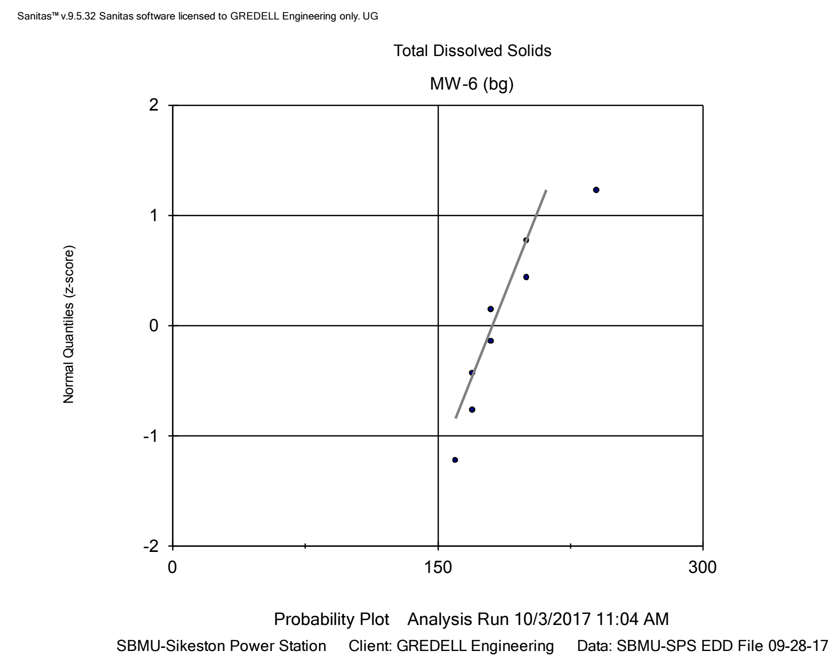
Probability Plot Analysis Run 10/3/2017 11:04 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17


Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Total Dissolved Solids
MW-3 (bg)
Normal Quantiles (z-score)
2
1
0
-1
-2
0
100
200
Probability Plot Analysis Run 10/3/2017 11:04 AM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17


Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Total Dissolved Solids
MW-4
Normal Quantiles (z-score)
2
1
0
-1
-2
0
200
400
Probability Plot Analysis Run 10/3/2017 11:04 AM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17


Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Total Dissolved Solids
MW-5
Normal Quantiles (z-score)
2
1
0
-1
-2
0
300
600
Probability Plot Analysis Run 10/3/2017 11:04 AM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17


Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Total Dissolved Solids
MW-6 (bg)
Normal Quantiles (z-score)
2
1
0
-1
-2
0
150
300
Probability Plot Analysis Run 10/3/2017 11:04 AM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Appendix E

Outlier Analysis

Outlier Analysis

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: 1stEventNov2016EDD c   Printed 9/27/2017, 11:52 AM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Barium (ug/l)	**MW-5**	**Yes**	**180**	**5/17/2017**	**Dixon`s**	**0.05**	**8**	**94.88**	**34.75**	**normal**	**ShapiroWilk**
Boron (ug/l)	**MW-5**	**Yes**	**5700**	**5/17/2017**	**NP (nrm)**	**NaN**	**8**	**1076**	**1870**	**unknown**	**ShapiroWilk**
Boron (ug/l)	**MW-6 (bg)**	**Yes**	**59**	**2/22/2017**	**Dixon`s**	**0.05**	**8**	**37.38**	**9.456**	**normal**	**ShapiroWilk**
Calcium (mg/l)	**MW-5**	**Yes**	**240**	**5/17/2017**	**Dixon`s**	**0.05**	**8**	**122.8**	**48.38**	**normal**	**ShapiroWilk**
Fluoride (mg/l)	**MW-3 (bg)**	**Yes**	**0.438,0.125**	**11/30/201...**	**Dixon`s**	**0.05**	**8**	**0.2736**	**0.08475**	**normal**	**ShapiroWilk**
Sulfate (mg/l)	**MW-5**	**Yes**	**460**	**4/27/2017**	**Dixon`s**	**0.05**	**8**	**233.8**	**97.53**	**normal**	**ShapiroWilk**

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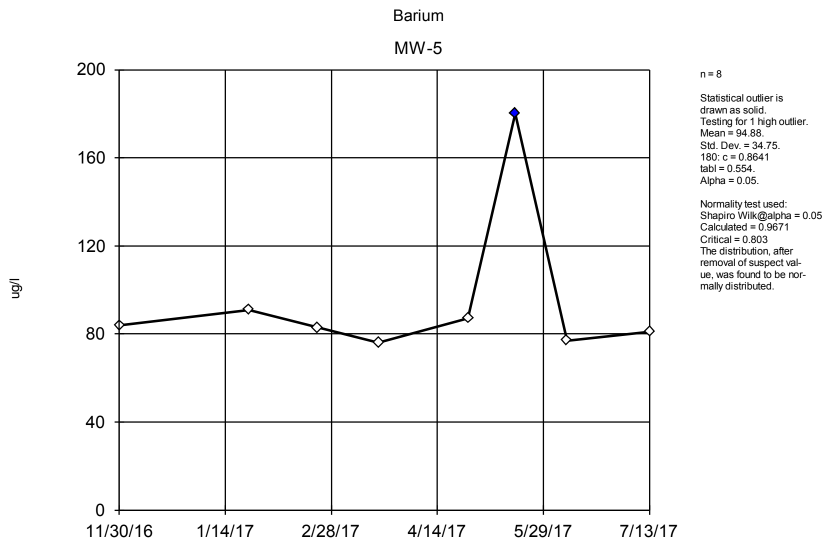
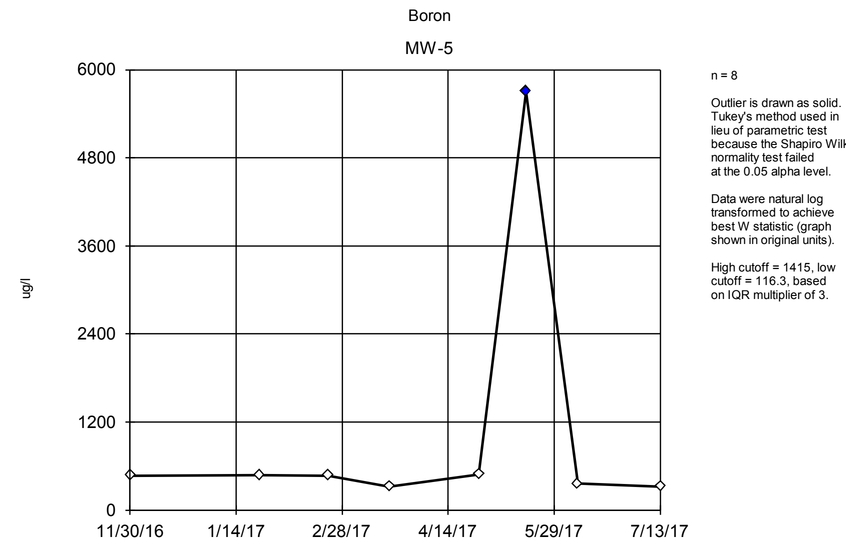


Dixon's Outlier Test   Analysis Run 9/27/2017 11:50 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: 1stEventNov2016EDD c

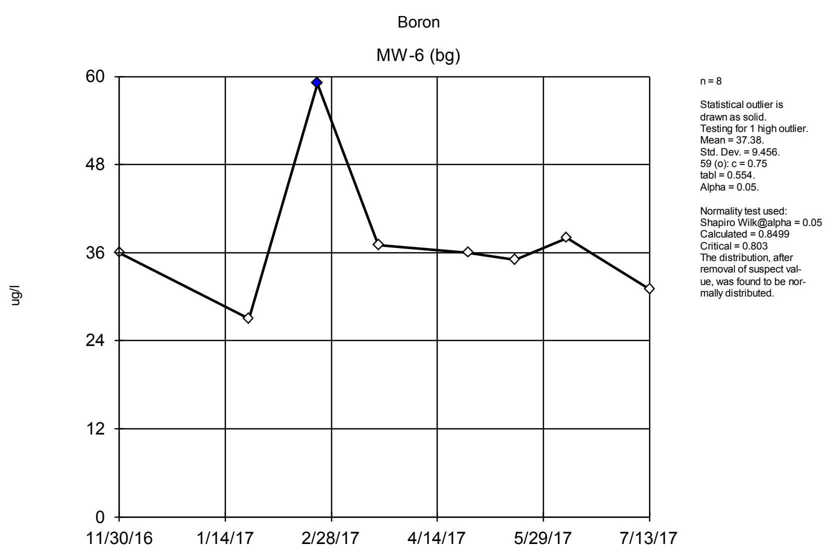
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



Tukey's Outlier Screening   Analysis Run 9/27/2017 11:50 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: 1stEventNov2016EDD c

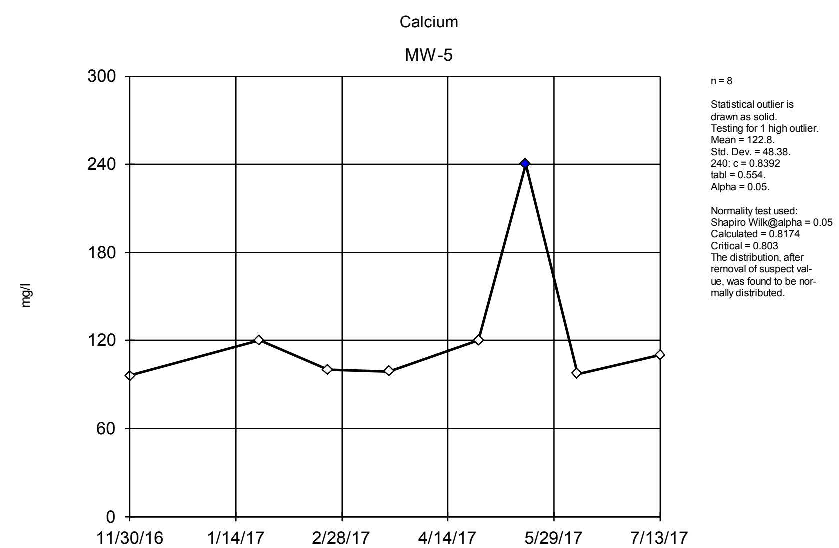
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



Dixon's Outlier Test   Analysis Run 9/27/2017 11:50 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: 1stEventNov2016EDD c

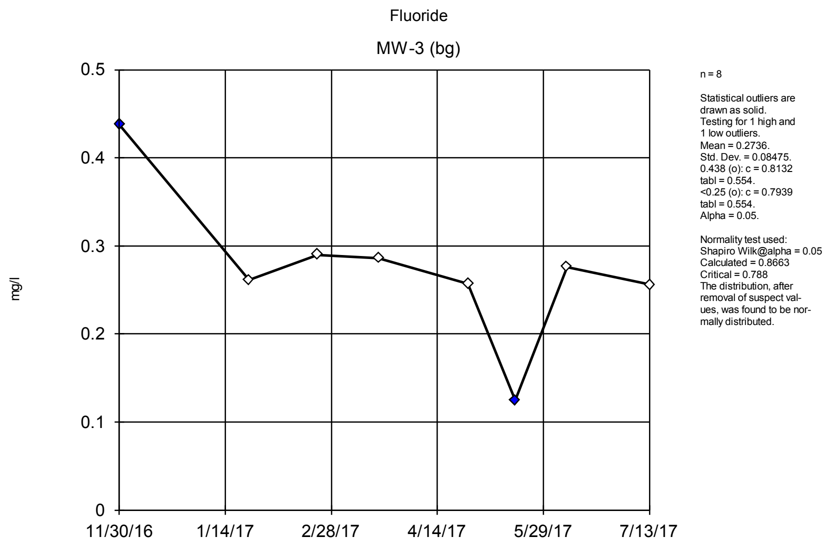
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



Dixon's Outlier Test   Analysis Run 9/27/2017 11:50 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: 1stEventNov2016EDD c

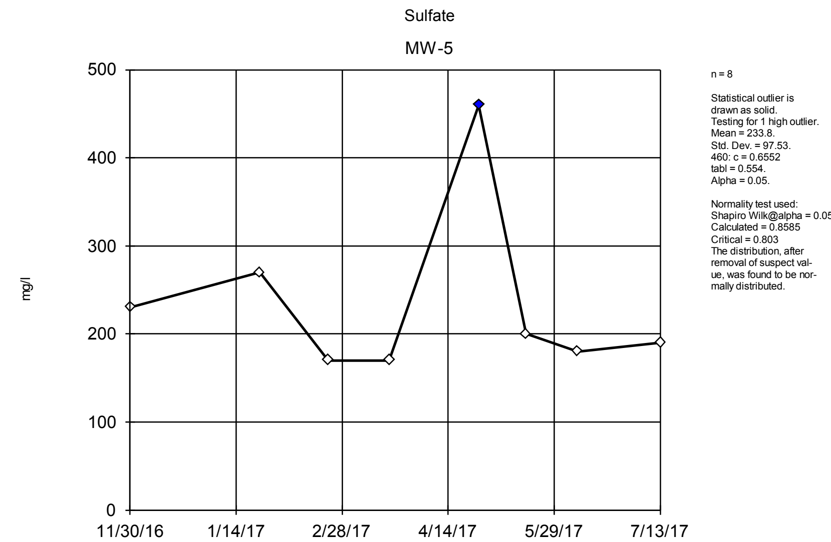
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



Dixon's Outlier Test   Analysis Run 9/27/2017 11:51 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: 1stEventNov2016EDD c

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



Dixon's Outlier Test   Analysis Run 9/27/2017 11:51 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: 1stEventNov2016EDD c

Appendix F

Trend Analysis

Sen's Slope/Mann-Kendall Trend Test

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17 Printed 9/28/2017, 1:47 PM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Antimony (ug/l)	MW-3 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Antimony (ug/l)	MW-4	0	0	20	No	8	100	n/a	n/a	0.02	NP
Antimony (ug/l)	MW-5	0	0	20	No	8	100	n/a	n/a	0.02	NP
Antimony (ug/l)	MW-6 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Arsenic (ug/l)	MW-3 (bg)	-1.807	-18	-20	No	8	62.5	n/a	n/a	0.02	NP
Arsenic (ug/l)	MW-4	0	0	20	No	8	100	n/a	n/a	0.02	NP
Arsenic (ug/l)	MW-5	0	3	20	No	8	87.5	n/a	n/a	0.02	NP
Arsenic (ug/l)	MW-6 (bg)	-0.2073	0	20	No	8	0	n/a	n/a	0.02	NP
Barium (ug/l)	MW-3 (bg)	0	-4	-20	No	8	0	n/a	n/a	0.02	NP
Barium (ug/l)	MW-4	16.77	10	20	No	8	0	n/a	n/a	0.02	NP
Barium (ug/l)	MW-5	-13.45	-7	-17	No	7	0	n/a	n/a	0.02	NP
Barium (ug/l)	MW-6 (bg)	0	-1	-20	No	8	0	n/a	n/a	0.02	NP
Beryllium (ug/l)	MW-3 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Beryllium (ug/l)	MW-4	0	-5	-20	No	8	100	n/a	n/a	0.02	NP
Beryllium (ug/l)	MW-5	0	0	20	No	8	100	n/a	n/a	0.02	NP
Beryllium (ug/l)	MW-6 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Boron (ug/l)	MW-3 (bg)	1.086	1	20	No	8	0	n/a	n/a	0.02	NP
Boron (ug/l)	MW-4	-525.2	-10	-20	No	8	0	n/a	n/a	0.02	NP
Boron (ug/l)	MW-5	-243.3	-7	-17	No	7	0	n/a	n/a	0.02	NP
Boron (ug/l)	MW-6 (bg)	0	0	17	No	7	0	n/a	n/a	0.02	NP
Cadmium (ug/l)	MW-3 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Cadmium (ug/l)	MW-4	0	0	20	No	8	100	n/a	n/a	0.02	NP
Cadmium (ug/l)	MW-5	0	0	20	No	8	100	n/a	n/a	0.02	NP
Cadmium (ug/l)	MW-6 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Calcium (mg/l)	MW-3 (bg)	-8.69	-14	-20	No	8	0	n/a	n/a	0.02	NP
Calcium (mg/l)	MW-4	-33.7	-15	-20	No	8	0	n/a	n/a	0.02	NP
Calcium (mg/l)	MW-5	1.921	2	17	No	7	0	n/a	n/a	0.02	NP
Calcium (mg/l)	MW-6 (bg)	-13.6	-17	-20	No	8	0	n/a	n/a	0.02	NP
Chloride (mg/l)	MW-3 (bg)	-0.7755	-9	-20	No	8	0	n/a	n/a	0.02	NP
Chloride (mg/l)	MW-4	-5.572	-13	-20	No	8	0	n/a	n/a	0.02	NP
Chloride (mg/l)	MW-5	-9.543	-18	-20	No	8	0	n/a	n/a	0.02	NP
Chloride (mg/l)	**MW-6 (bg)**	**-1.856**	**-23**	**-20**	**Yes**	**8**	**0**	**n/a**	**n/a**	**0.02**	**NP**
Chromium (ug/l)	MW-3 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Chromium (ug/l)	MW-4	0	0	20	No	8	100	n/a	n/a	0.02	NP
Chromium (ug/l)	MW-5	0	3	20	No	8	87.5	n/a	n/a	0.02	NP
Chromium (ug/l)	MW-6 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Cobalt (ug/l)	MW-3 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Cobalt (ug/l)	MW-4	0	0	20	No	8	100	n/a	n/a	0.02	NP
Cobalt (ug/l)	MW-5	-0.7898	-2	-20	No	8	0	n/a	n/a	0.02	NP
Cobalt (ug/l)	MW-6 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Fluoride (mg/l)	MW-3 (bg)	-0.04562	-7	-13	No	6	0	n/a	n/a	0.02	NP
Fluoride (mg/l)	MW-4	0	-7	-20	No	8	87.5	n/a	n/a	0.02	NP
Fluoride (mg/l)	MW-5	0	-7	-20	No	8	87.5	n/a	n/a	0.02	NP
Fluoride (mg/l)	MW-6 (bg)	0	-11	-20	No	8	75	n/a	n/a	0.02	NP
Lead (ug/l)	MW-3 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Lead (ug/l)	MW-4	0	0	20	No	8	100	n/a	n/a	0.02	NP
Lead (ug/l)	MW-5	0	3	20	No	8	87.5	n/a	n/a	0.02	NP
Lead (ug/l)	MW-6 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Lithium (ug/l)	MW-3 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Lithium (ug/l)	MW-4	0	0	20	No	8	100	n/a	n/a	0.02	NP

Sen's Slope/Mann-Kendall Trend Test

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17   Printed 9/28/2017, 1:47 PM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Lithium (ug/l)	MW-5	0	0	20	No	8	100	n/a	n/a	0.02	NP
Lithium (ug/l)	MW-6 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Mercury (ug/l)	MW-3 (bg)	0	3	20	No	8	87.5	n/a	n/a	0.02	NP
Mercury (ug/l)	MW-4	0	-1	-20	No	8	87.5	n/a	n/a	0.02	NP
Mercury (ug/l)	MW-5	0	3	20	No	8	87.5	n/a	n/a	0.02	NP
Mercury (ug/l)	MW-6 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Molybdenum (ug/l)	MW-3 (bg)	0	1	20	No	8	87.5	n/a	n/a	0.02	NP
Molybdenum (ug/l)	MW-4	0	0	20	No	8	100	n/a	n/a	0.02	NP
Molybdenum (ug/l)	MW-5	0	1	20	No	8	87.5	n/a	n/a	0.02	NP
Molybdenum (ug/l)	MW-6 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
pH (S.U.)	MW-3 (bg)	-0.626	-15	-20	No	8	0	n/a	n/a	0.02	NP
pH (S.U.)	MW-4	-0.1498	-14	-20	No	8	0	n/a	n/a	0.02	NP
pH (S.U.)	MW-5	-0.234	-5	-20	No	8	0	n/a	n/a	0.02	NP
pH (S.U.)	MW-6 (bg)	-0.2311	-5	-20	No	8	0	n/a	n/a	0.02	NP
Radium (pCi/l)	MW-3 (bg)	-2.693	-10	-20	No	8	0	n/a	n/a	0.02	NP
Radium (pCi/l)	MW-4	0.3341	4	20	No	8	0	n/a	n/a	0.02	NP
Radium (pCi/l)	MW-5	-0.1785	-2	-20	No	8	0	n/a	n/a	0.02	NP
Radium (pCi/l)	MW-6 (bg)	-1.014	-12	-20	No	8	0	n/a	n/a	0.02	NP
Selenium (ug/l)	MW-3 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Selenium (ug/l)	MW-4	0	0	20	No	8	100	n/a	n/a	0.02	NP
Selenium (ug/l)	MW-5	0	0	20	No	8	100	n/a	n/a	0.02	NP
Selenium (ug/l)	MW-6 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Sulfate (mg/l)	MW-3 (bg)	-13.29	-14	-20	No	8	0	n/a	n/a	0.02	NP
Sulfate (mg/l)	MW-4	-73.11	-20	-20	No	8	0	n/a	n/a	0.02	NP
Sulfate (mg/l)	MW-5	-64.89	-4	-17	No	7	0	n/a	n/a	0.02	NP
Sulfate (mg/l)	**MW-6 (bg)**	**-13.24**	**-22**	**-20**	**Yes**	**8**	**0**	**n/a**	**n/a**	**0.02**	**NP**
Thallium (ug/l)	MW-3 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Thallium (ug/l)	MW-4	0	0	20	No	8	100	n/a	n/a	0.02	NP
Thallium (ug/l)	MW-5	0	0	20	No	8	100	n/a	n/a	0.02	NP
Thallium (ug/l)	MW-6 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Total Dissolved Solids (mg/l)	MW-3 (bg)	16.59	4	20	No	8	0	n/a	n/a	0.02	NP
Total Dissolved Solids (mg/l)	MW-4	-48.7	-4	-20	No	8	0	n/a	n/a	0.02	NP
Total Dissolved Solids (mg/l)	MW-5	-91.39	-7	-20	No	8	0	n/a	n/a	0.02	NP
Total Dissolved Solids (mg/l)	MW-6 (bg)	-16.22	-3	-20	No	8	0	n/a	n/a	0.02	NP

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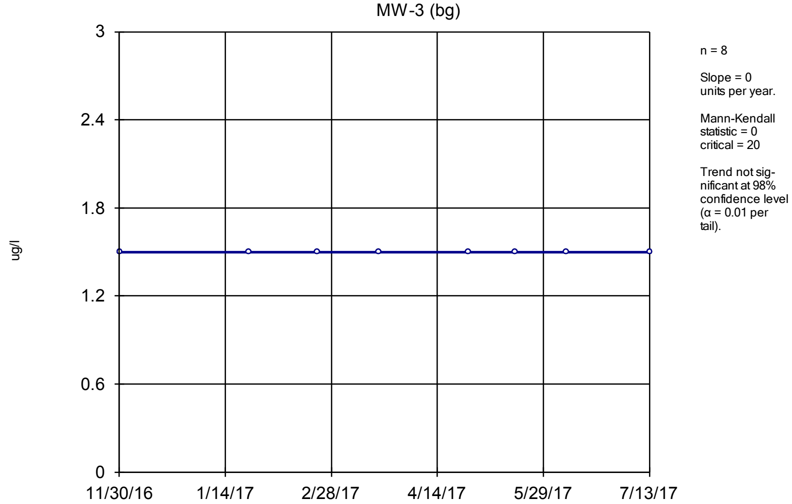
Hollow symbols indicate censored values.

Antimony

MW-3 (bg)



Sen's Slope Estimator   Analysis Run 9/28/2017 1:46 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

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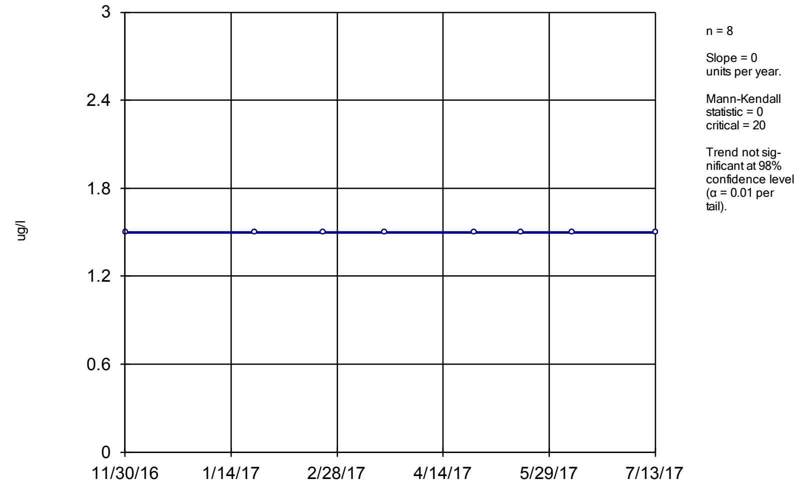
Hollow symbols indicate censored values.

Antimony

MW-4



Sen's Slope Estimator   Analysis Run 9/28/2017 1:46 PM

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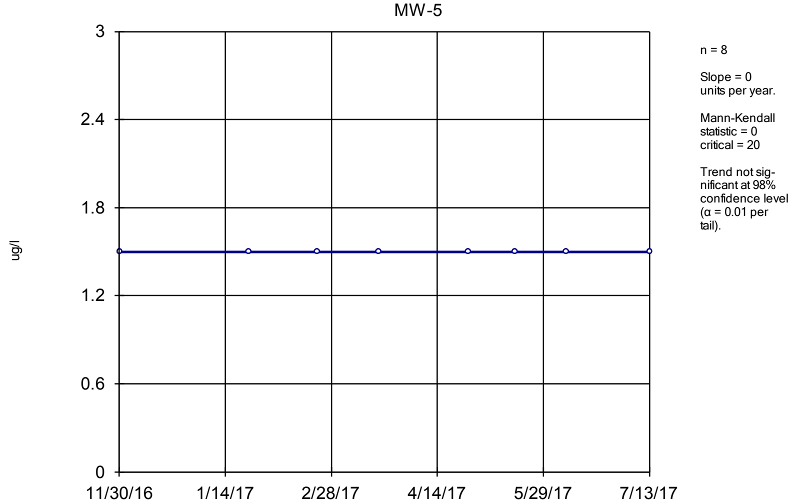
Hollow symbols indicate censored values.

Antimony

MW-5



Sen's Slope Estimator   Analysis Run 9/28/2017 1:46 PM

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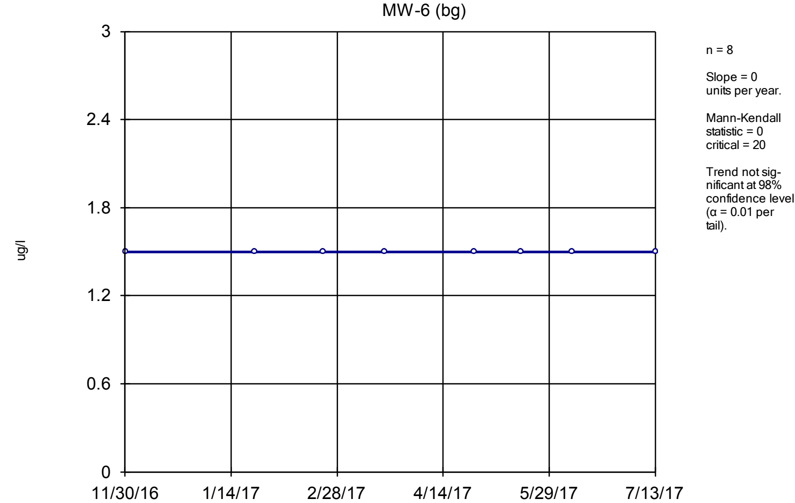
Hollow symbols indicate censored values.

Antimony

MW-6 (bg)



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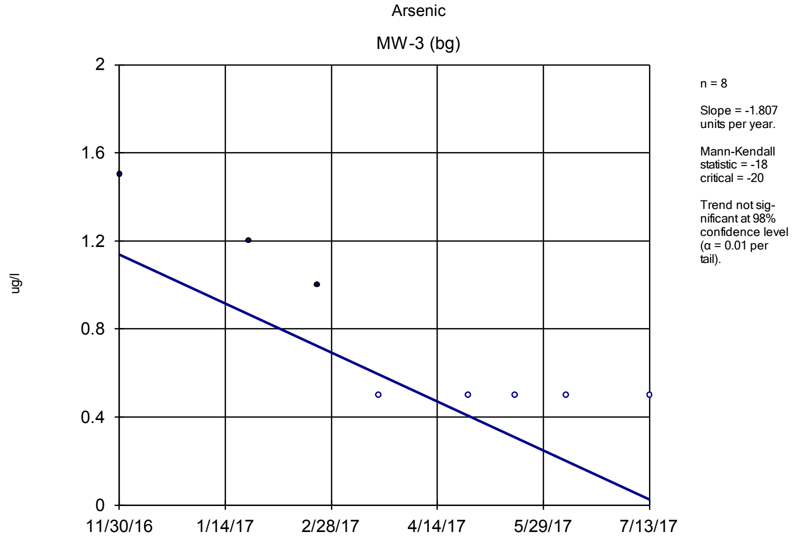

Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

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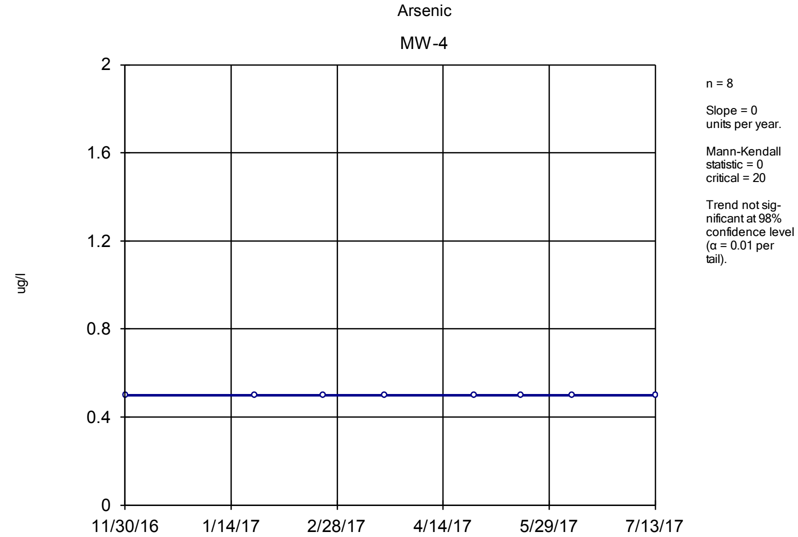
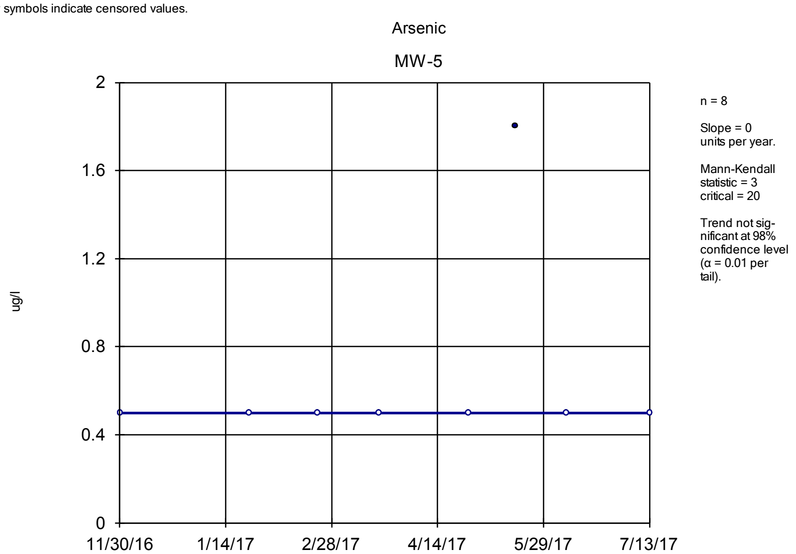
Hollow symbols indicate censored values.



Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.



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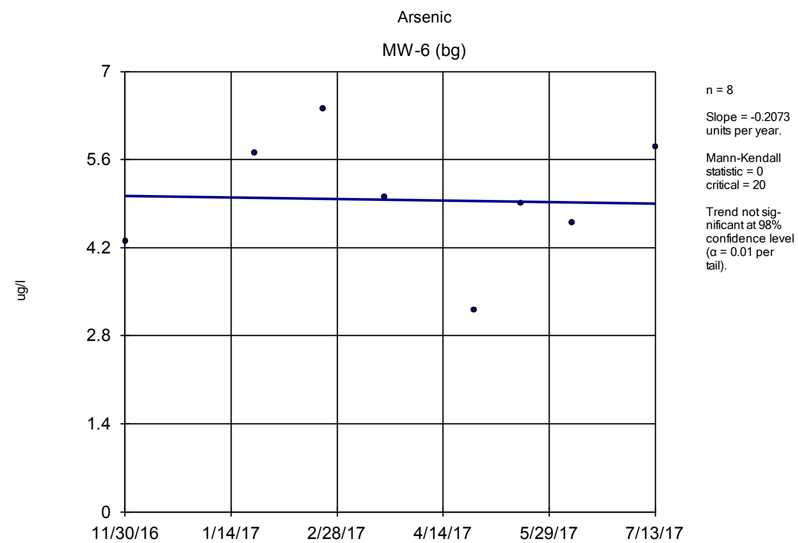

Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

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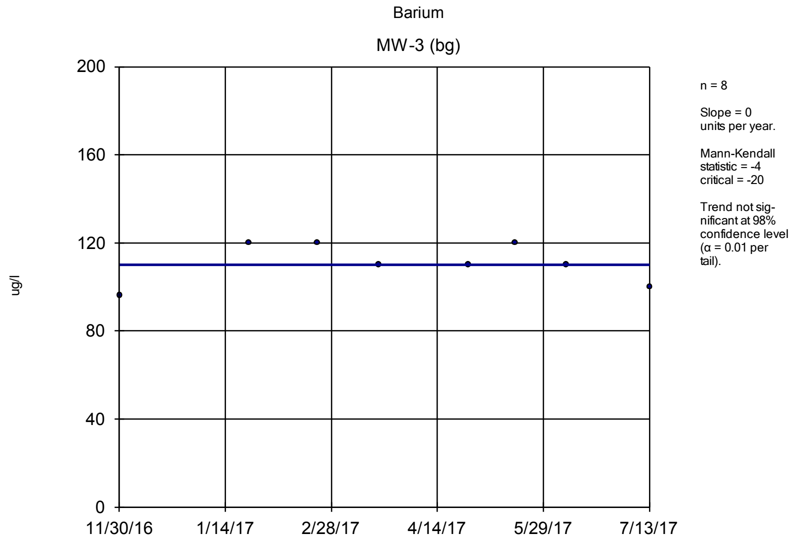

Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM

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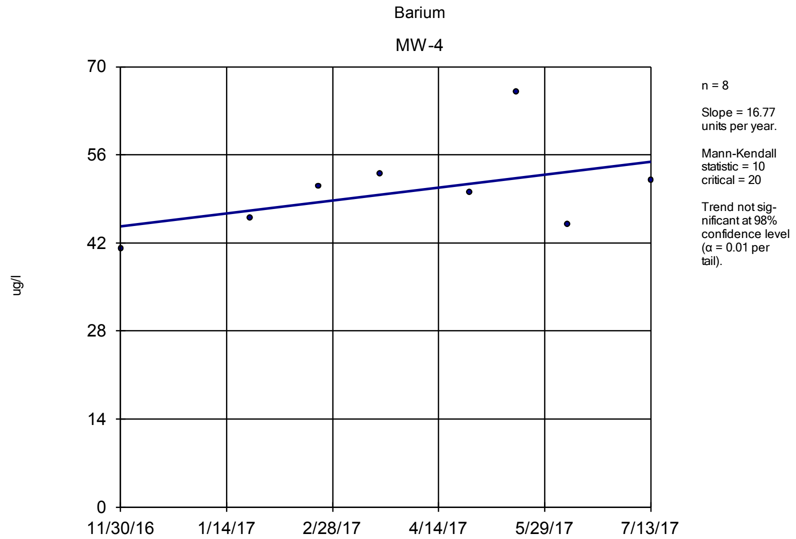

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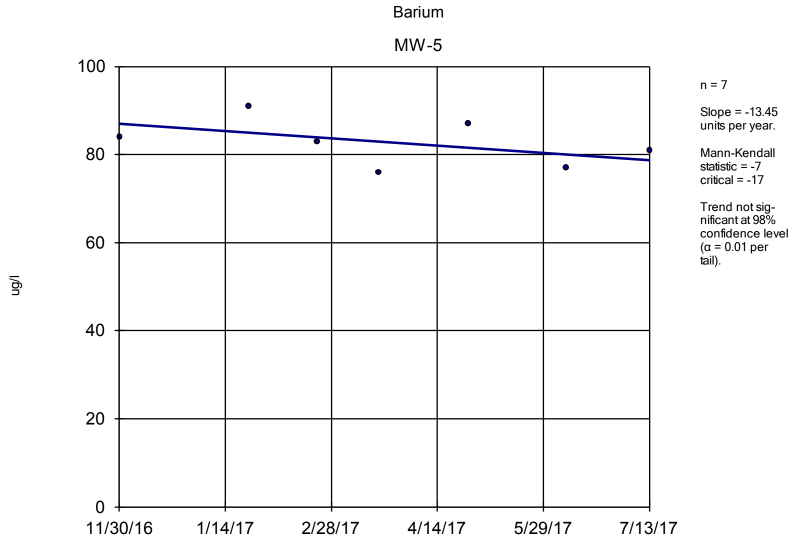

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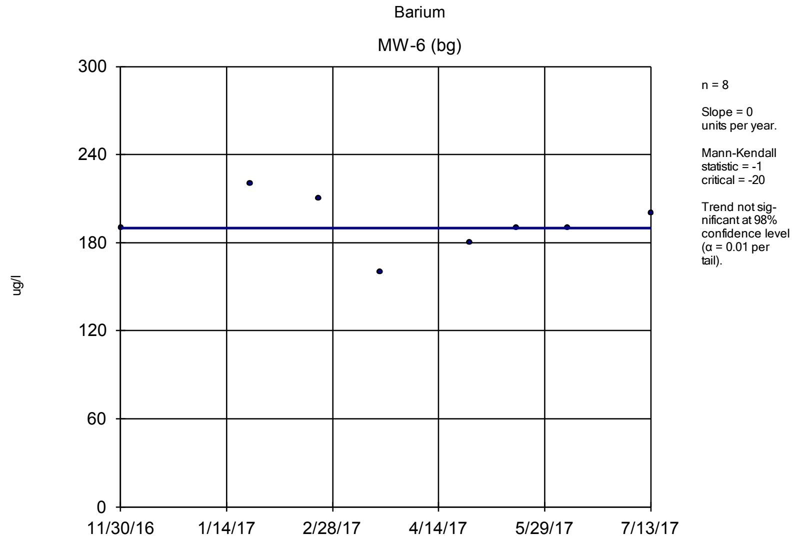

Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

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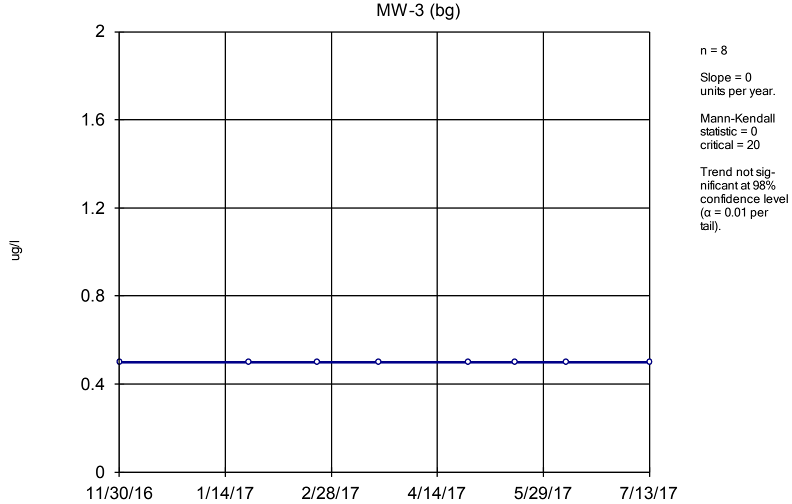
Hollow symbols indicate censored values.

Beryllium

MW-3 (bg)



Sen's Slope Estimator   Analysis Run 9/28/2017 1:46 PM

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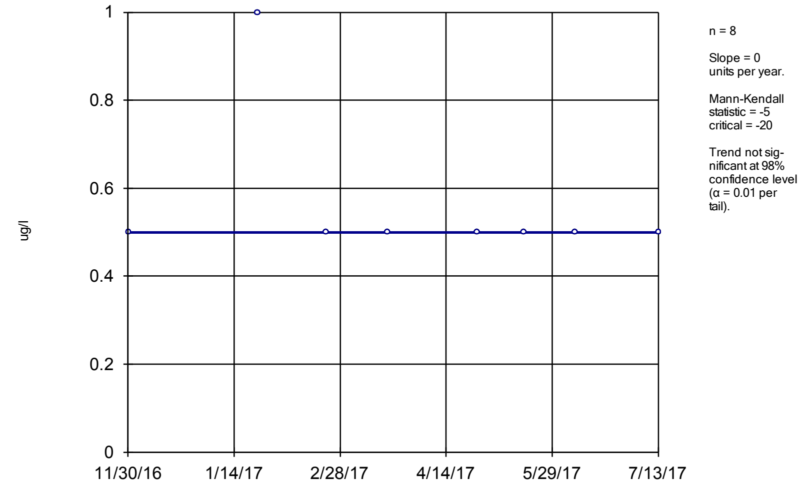
Hollow symbols indicate censored values.

Beryllium

MW-4



Sen's Slope Estimator   Analysis Run 9/28/2017 1:46 PM

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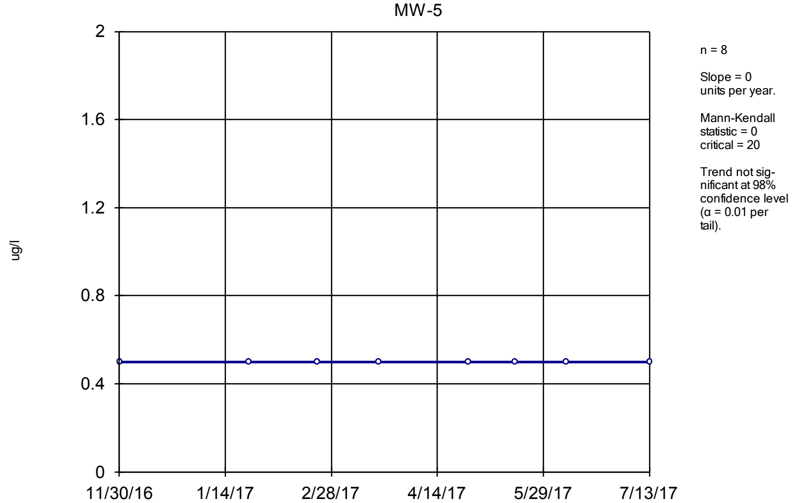
Hollow symbols indicate censored values.

Beryllium

MW-5



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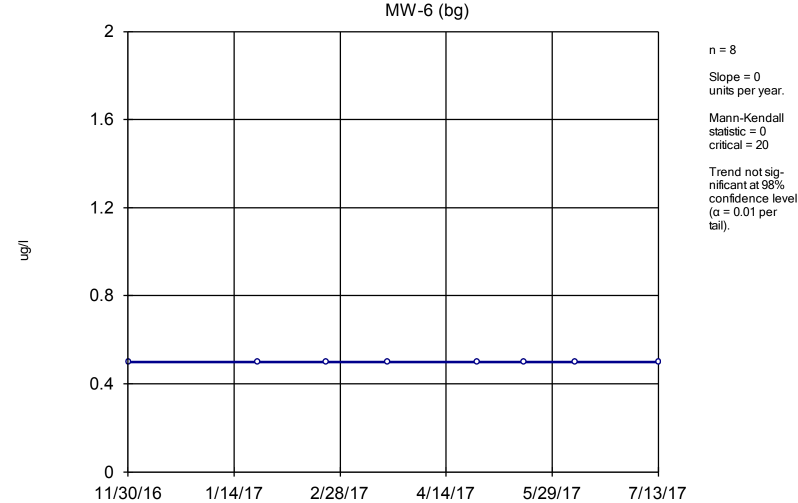
Hollow symbols indicate censored values.

Beryllium

MW-6 (bg)



Sen's Slope Estimator   Analysis Run 9/28/2017 1:46 PM

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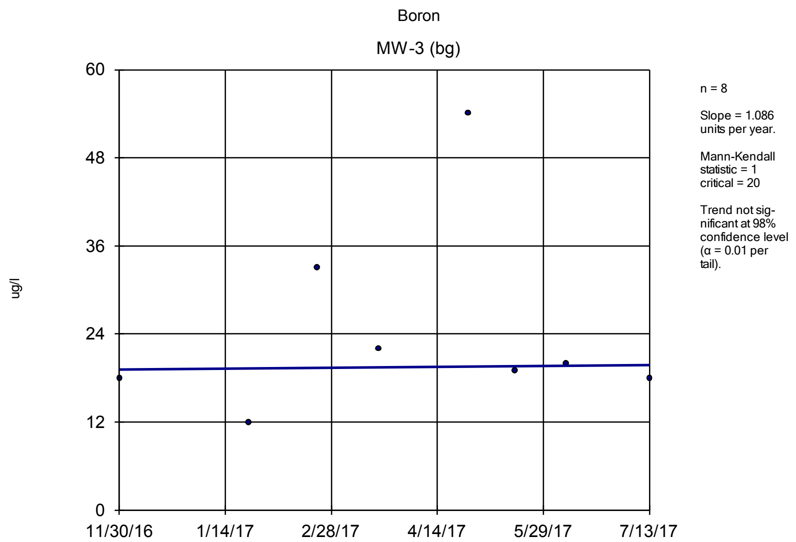

Sen's Slope Estimator   Analysis Run 9/28/2017 1:46 PM

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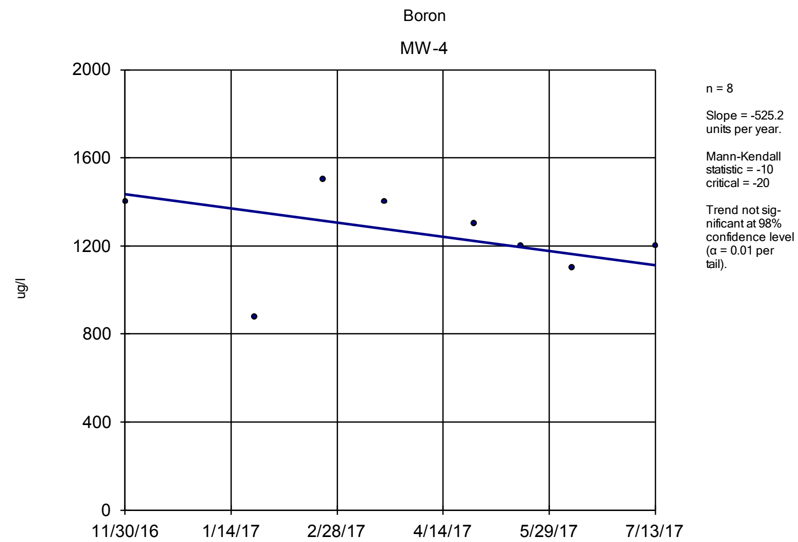

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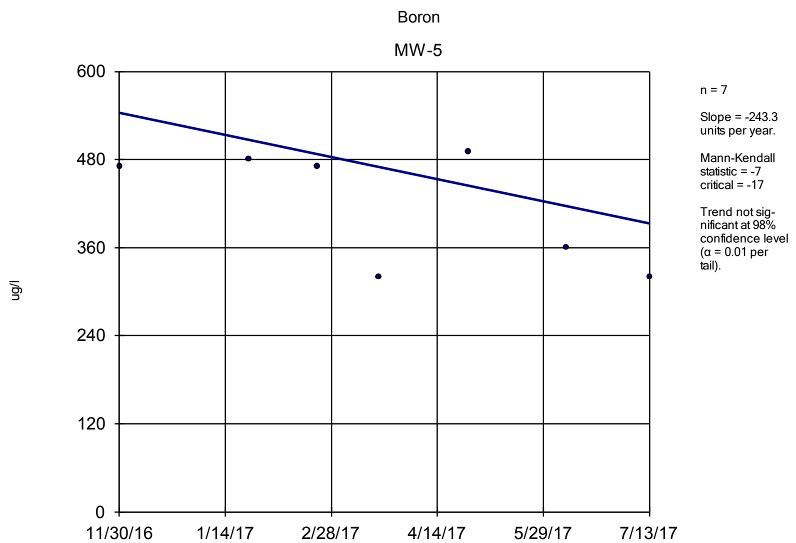

Sen's Slope Estimator   Analysis Run 9/28/2017 1:46 PM

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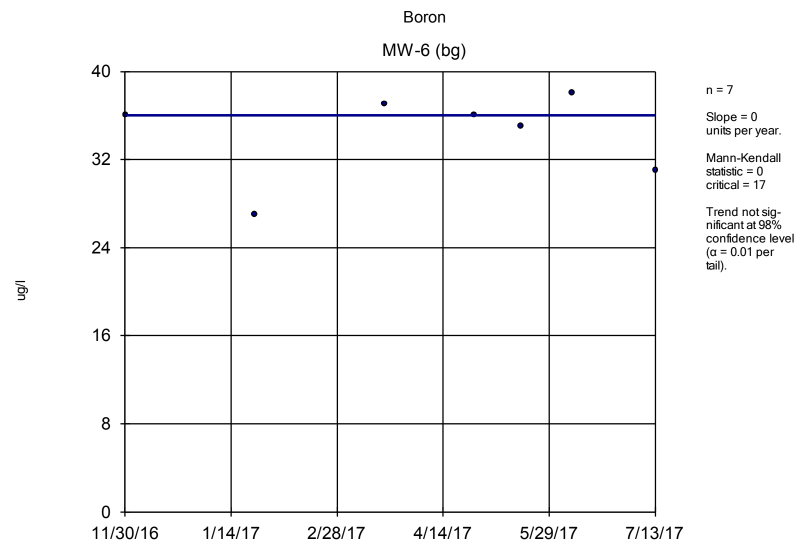

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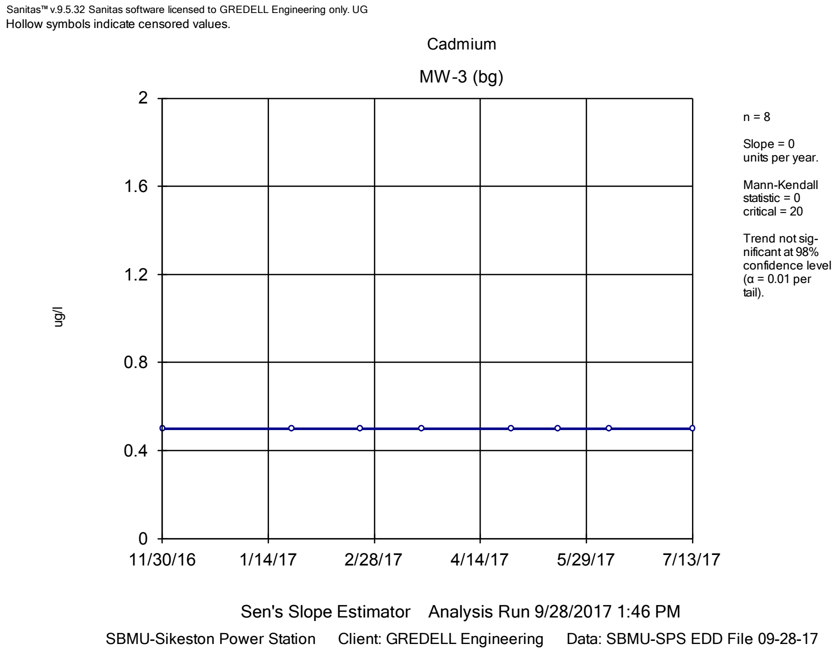
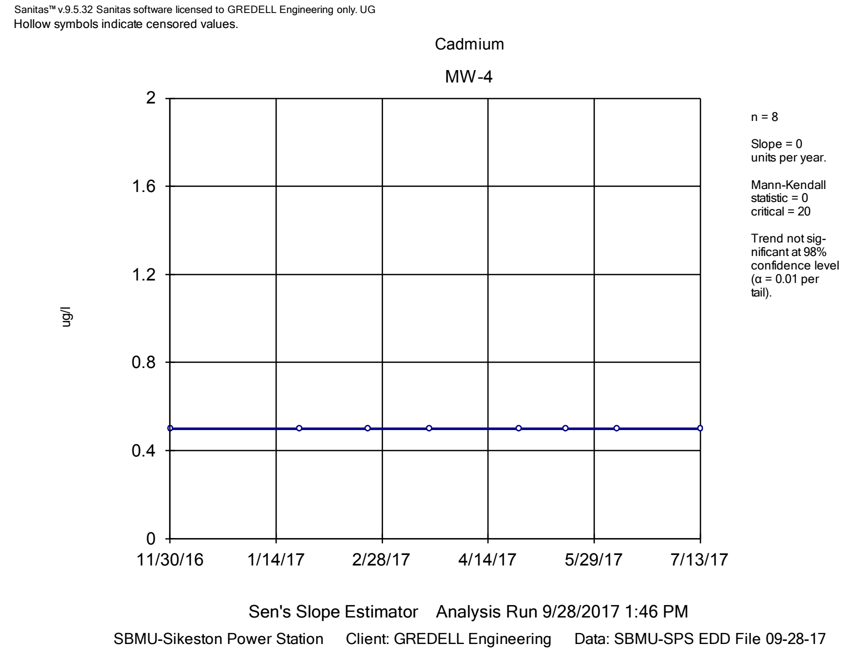


Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.
Cadmium
MW-3 (bg)
ug/l
n = 8
Slope = 0 units per year.
Mann-Kendall statistic = 0 critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
11/30/16
1/14/17
2/28/17
4/14/17
5/29/17
7/13/17
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17



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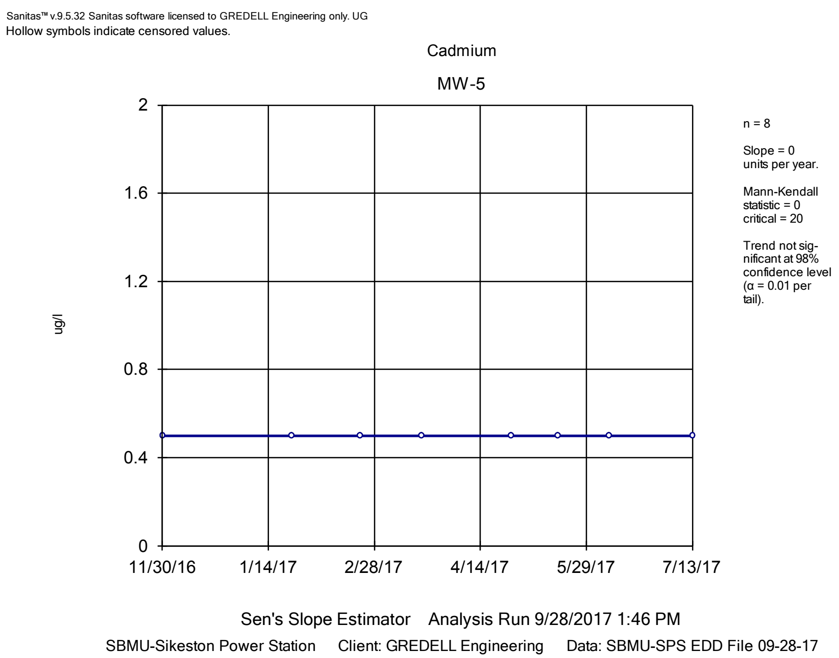
Hollow symbols indicate censored values.
Cadmium
MW-4
ug/l
n = 8
Slope = 0 units per year.
Mann-Kendall statistic = 0 critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
11/30/16
1/14/17
2/28/17
4/14/17
5/29/17
7/13/17
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17



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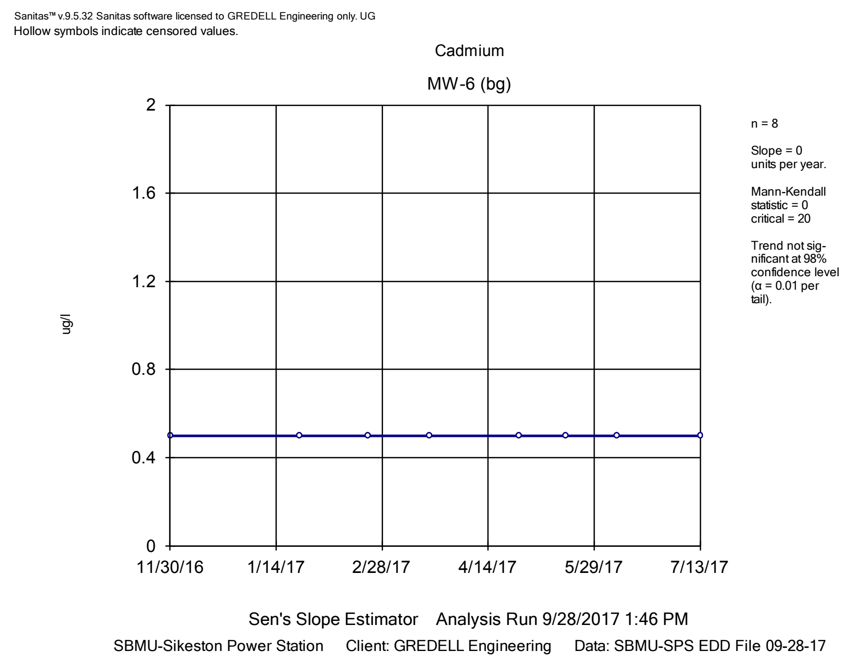
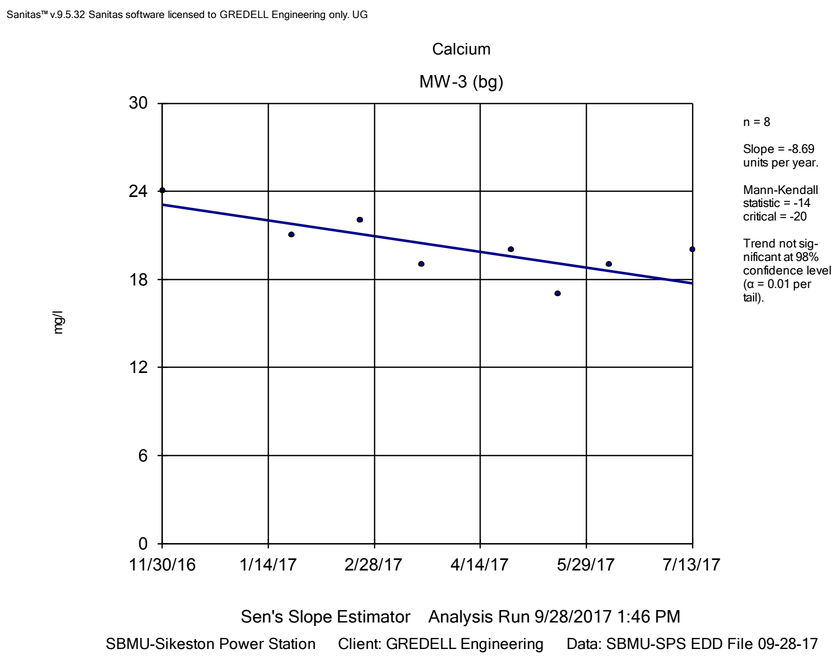
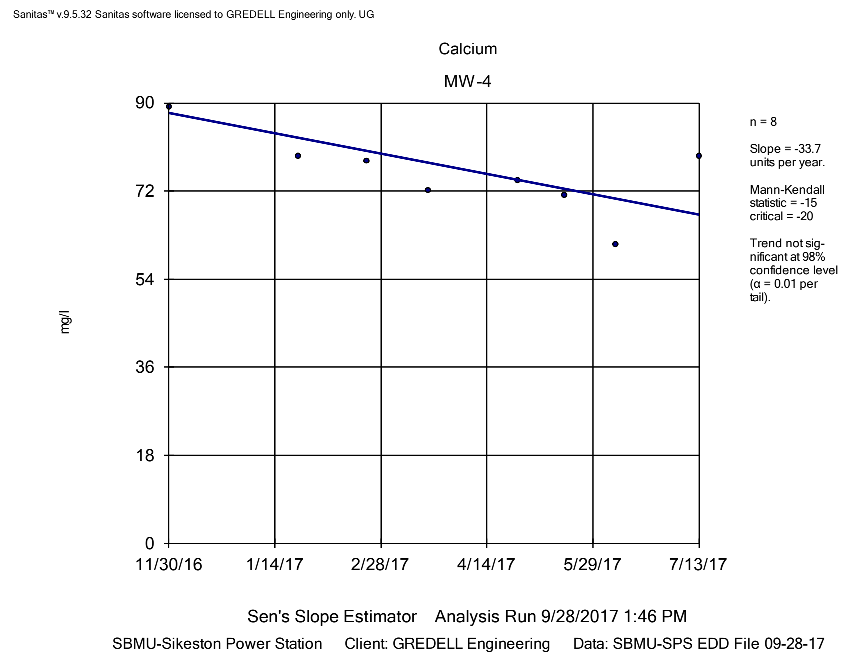
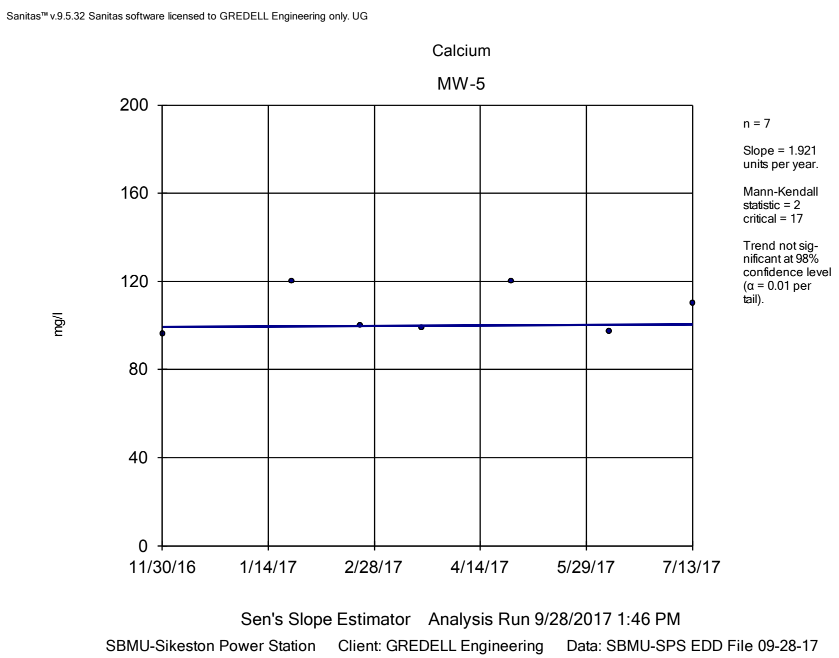
Hollow symbols indicate censored values.
Cadmium
MW-5
ug/l
n = 8
Slope = 0 units per year.
Mann-Kendall statistic = 0 critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
11/30/16
1/14/17
2/28/17
4/14/17
5/29/17
7/13/17
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

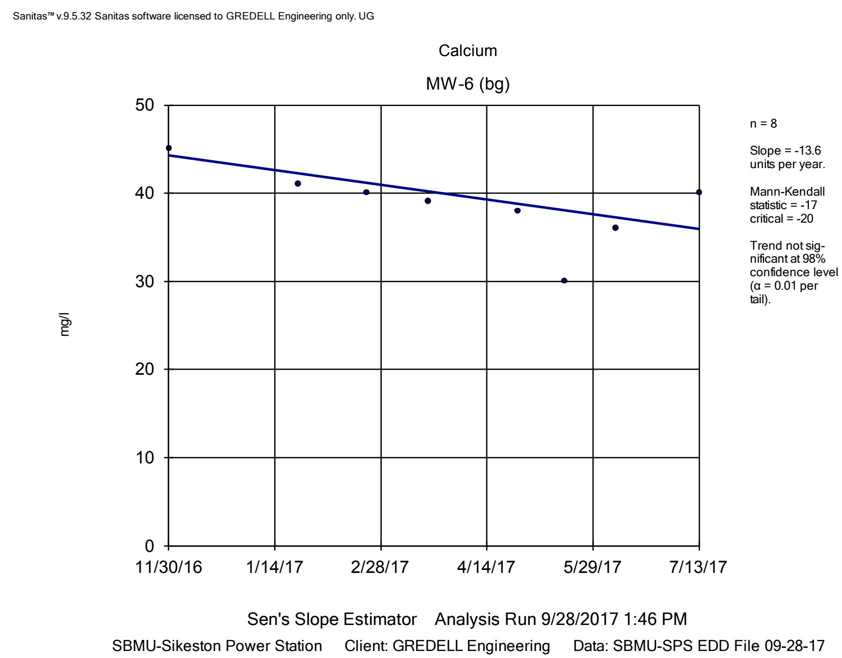


Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.
Cadmium
MW-6 (bg)
ug/l
n = 8
Slope = 0 units per year.
Mann-Kendall statistic = 0 critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
11/30/16
1/14/17
2/28/17
4/14/17
5/29/17
7/13/17
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17


Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Calcium
MW-3 (bg)
mg/l
n = 8
Slope = -8.69 units per year.
Mann-Kendall statistic = -14 critical = -20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17


Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Calcium
MW-4
mg/l
n = 8
Slope = -33.7 units per year.
Mann-Kendall statistic = -15 critical = -20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17


Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Calcium
MW-5
mg/l
n = 7
Slope = 1.921 units per year.
Mann-Kendall statistic = 2 critical = 17
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17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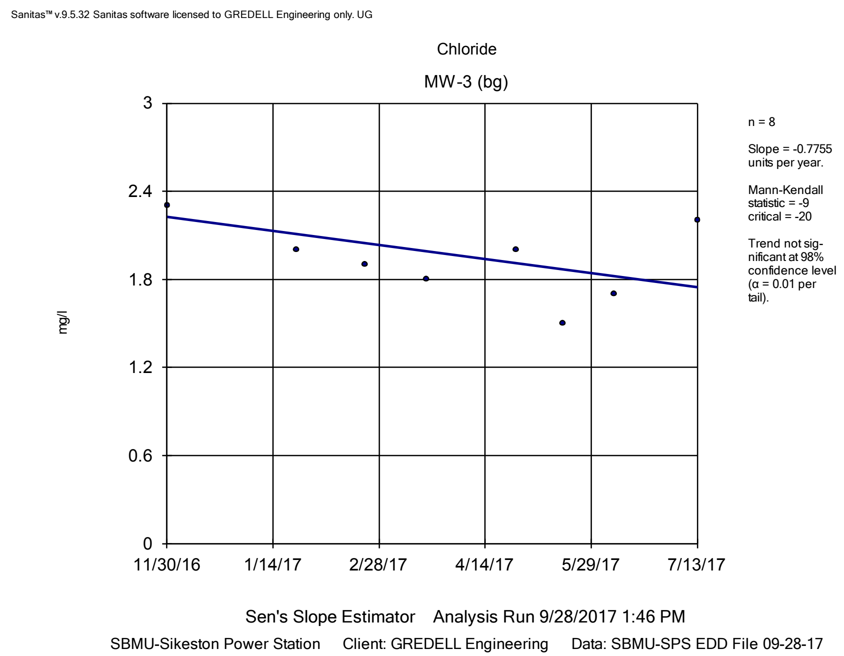
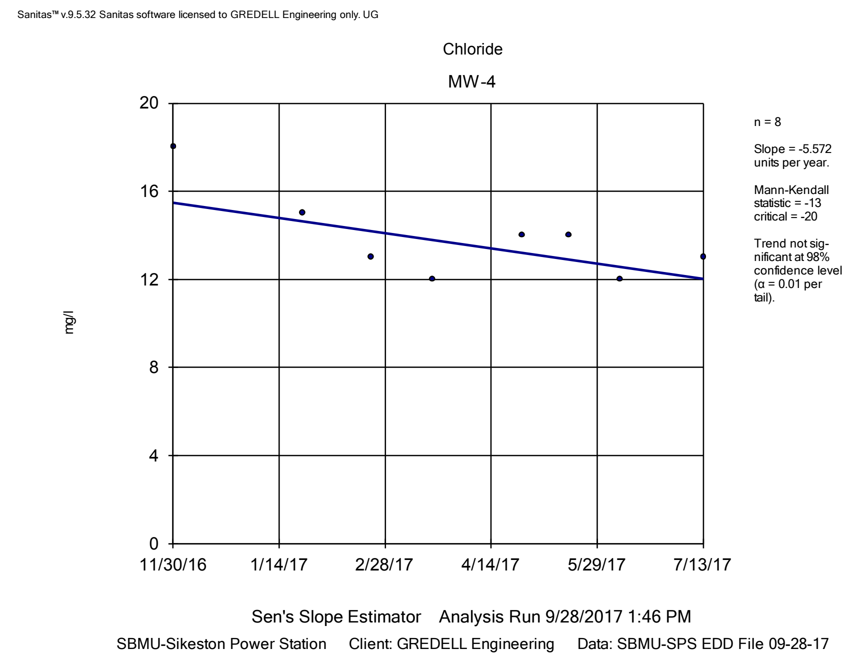
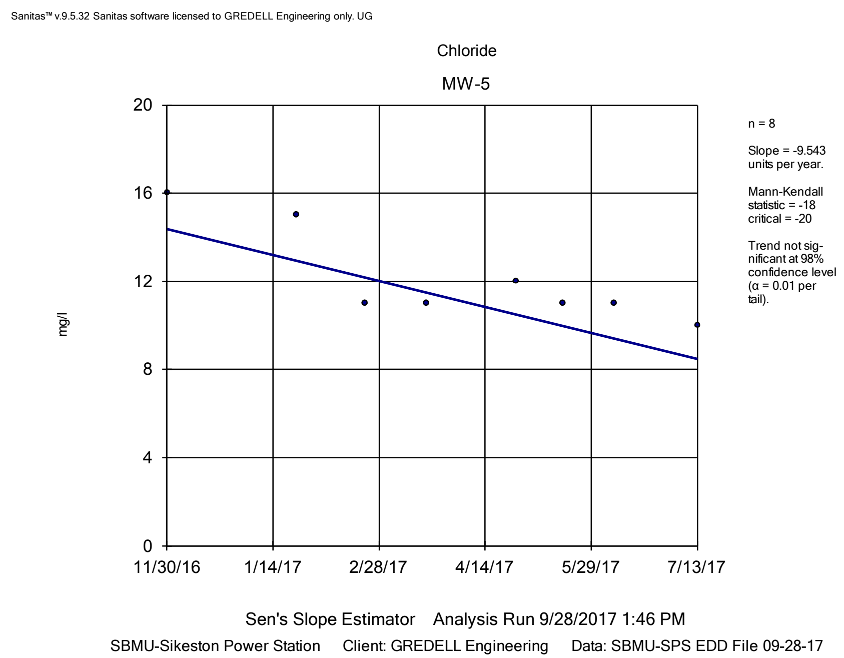
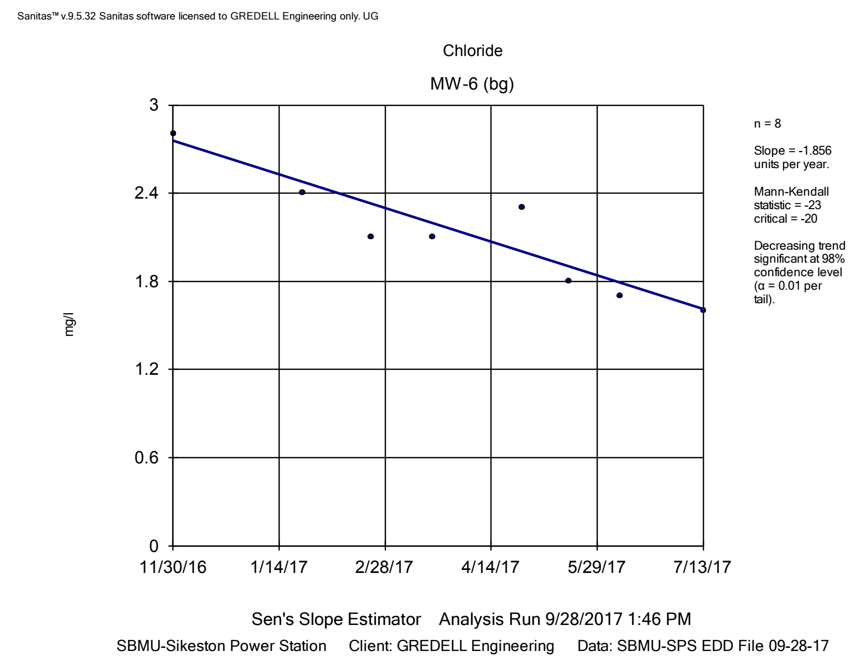
Calcium
MW-6 (bg)
mg/l
n = 8
Slope = -13.6 units per year.
Mann-Kendall statistic = -17 critical = -20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17


Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Chloride
MW-3 (bg)
mg/l
3
2.4
1.8
1.2
0.6
0
11/30/16
1/14/17
2/28/17
4/14/17
5/29/17
7/13/17
n = 8
Slope = -0.7755 units per year.
Mann-Kendall statistic = -9 critical = -20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17


Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Chloride
MW-4
mg/l
20
16
12
8
4
0
11/30/16
1/14/17
2/28/17
4/14/17
5/29/17
7/13/17
n = 8
Slope = -5.572 units per year.
Mann-Kendall statistic = -13 critical = -20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17


Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Chloride
MW-5
mg/l
20
16
12
8
4
0
11/30/16
1/14/17
2/28/17
4/14/17
5/29/17
7/13/17
n = 8
Slope = -9.543 units per year.
Mann-Kendall statistic = -18 critical = -20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17


Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Chloride
MW-6 (bg)
mg/l
3
2.4
1.8
1.2
0.6
0
11/30/16
1/14/17
2/28/17
4/14/17
5/29/17
7/13/17
n = 8
Slope = -1.856 units per year.
Mann-Kendall statistic = -23 critical = -20
Decreasing trend significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

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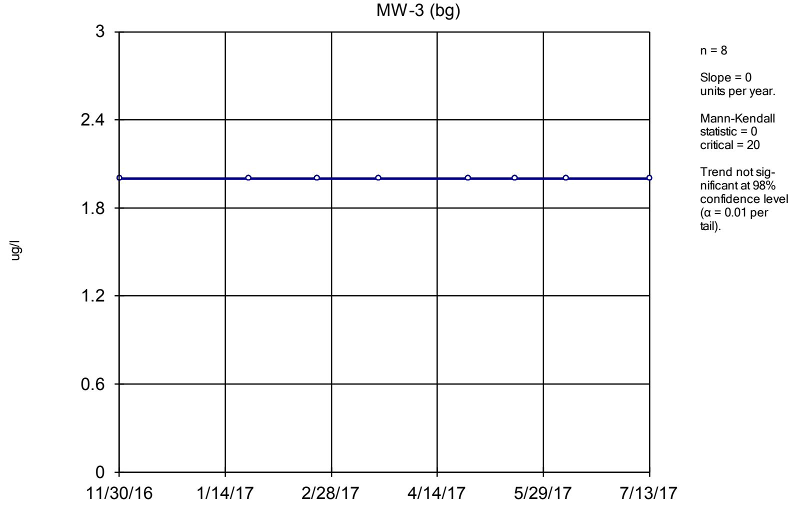
Hollow symbols indicate censored values.

Chromium

MW-3 (bg)



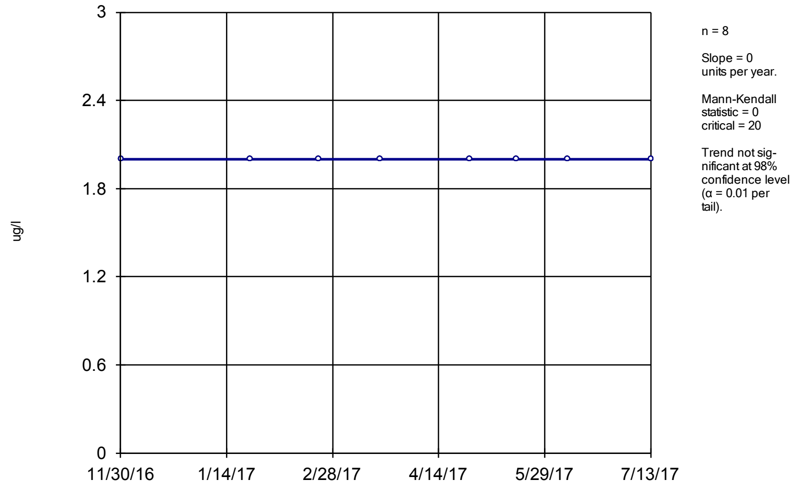
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.

Chromium

MW-4



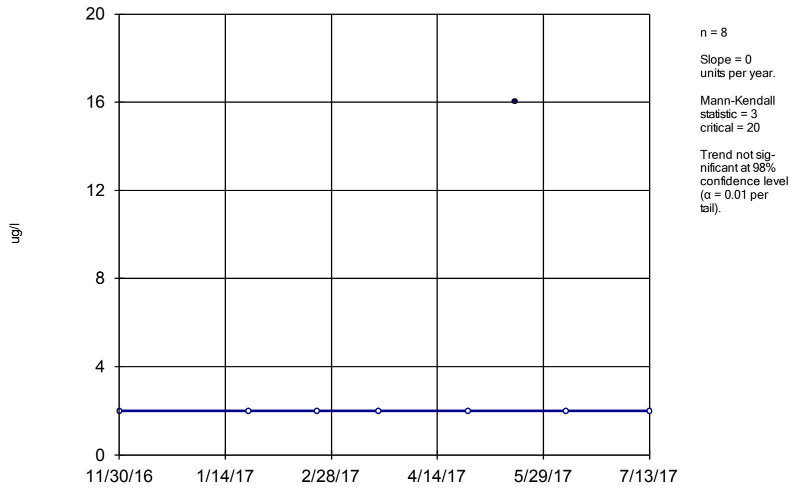
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.

Chromium

MW-5



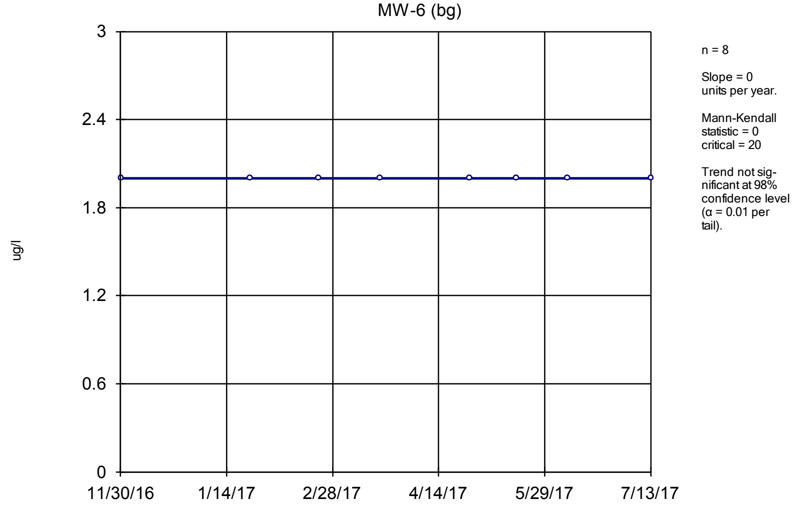
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.

Chromium

MW-6 (bg)



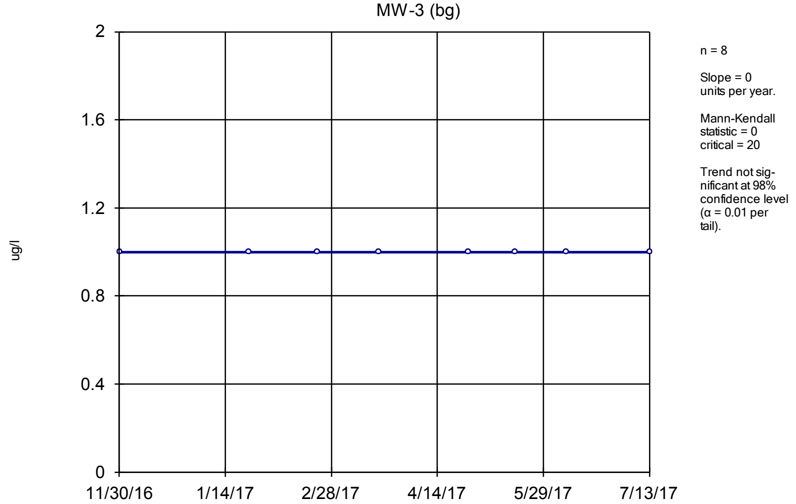
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.

Cobalt

MW-3 (bg)



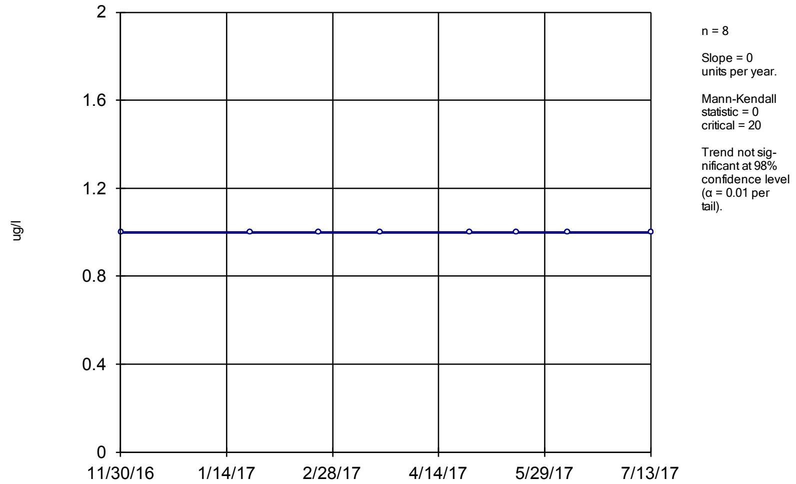
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.

Cobalt

MW-4



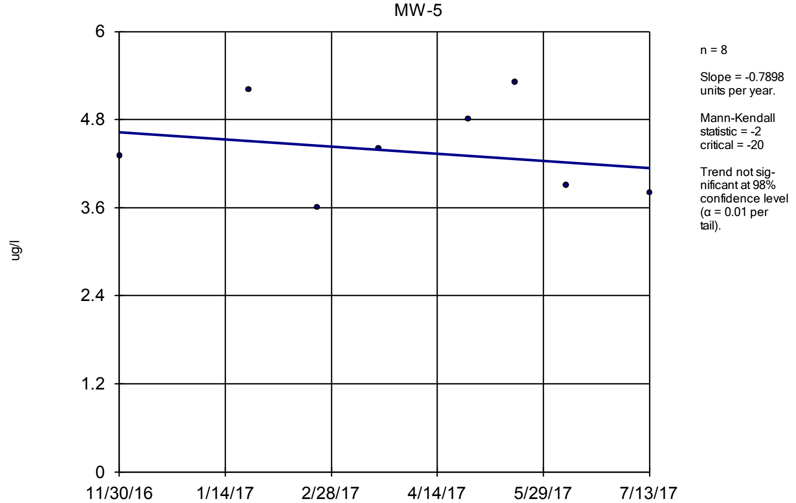
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

Cobalt

MW-5



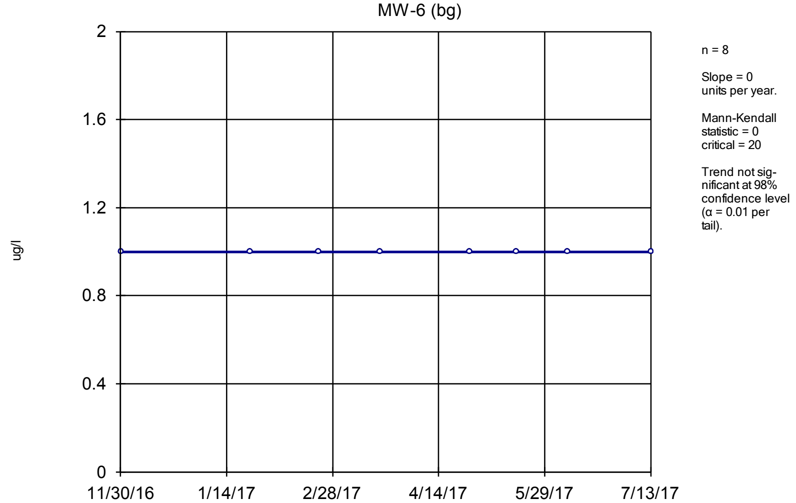
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.

Cobalt

MW-6 (bg)



Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM

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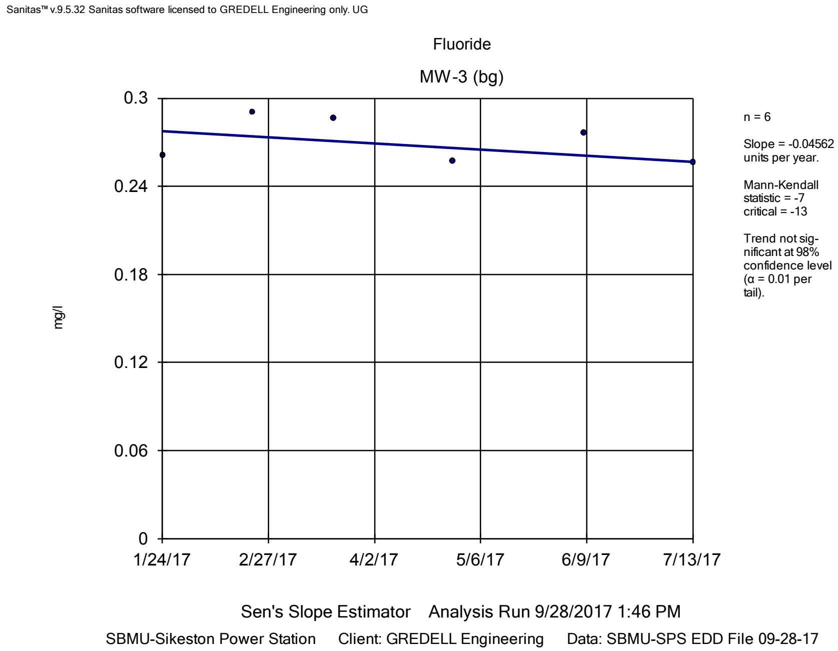
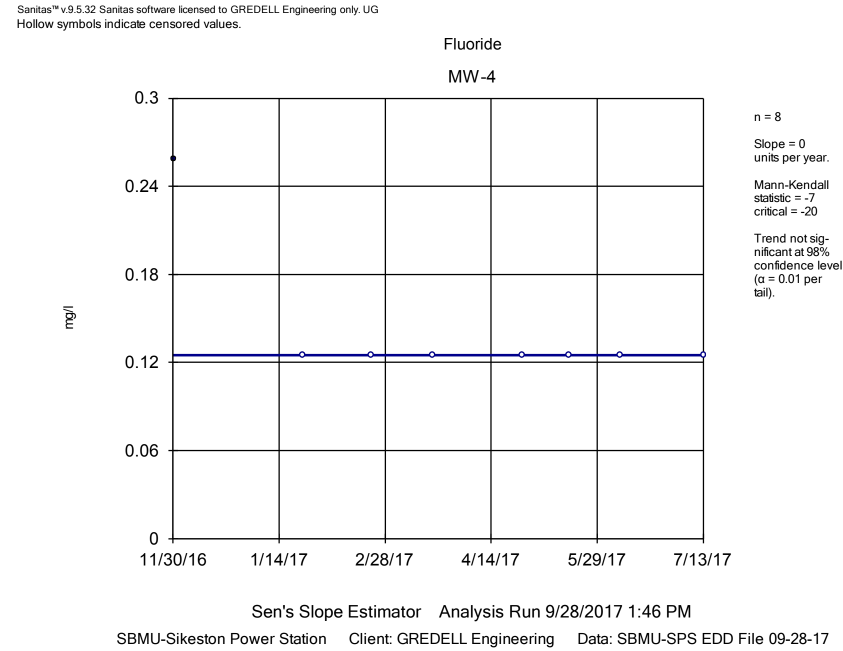
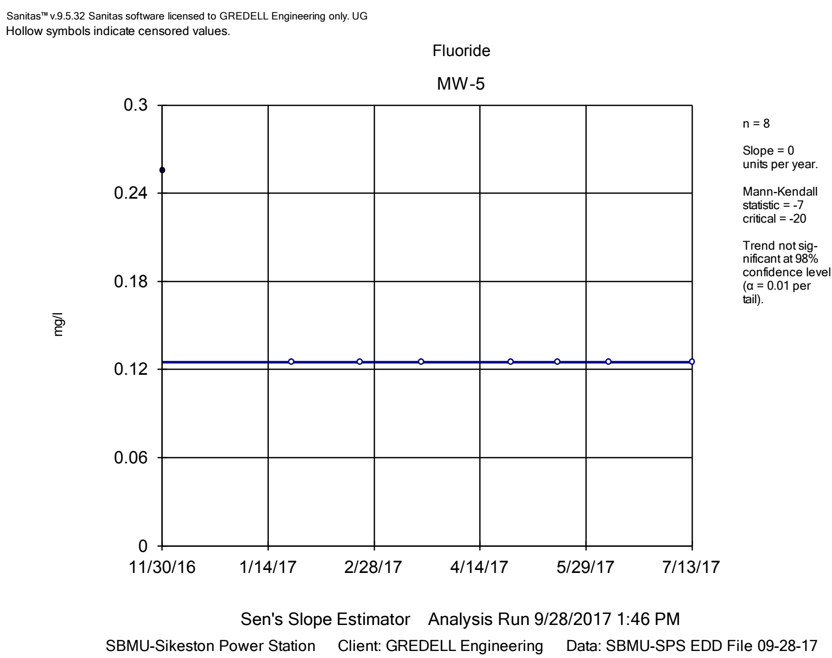


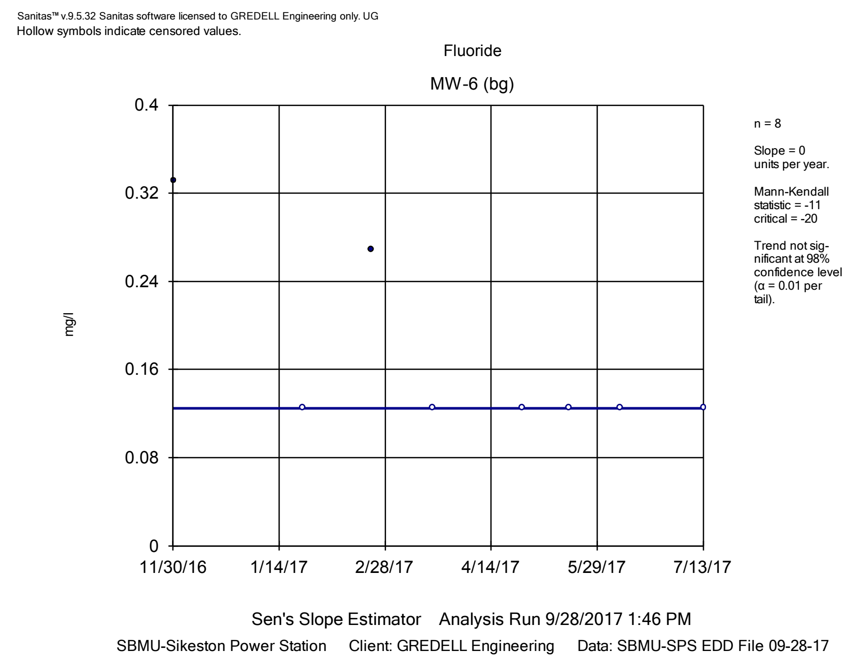
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Fluoride
MW-3 (bg)
mg/l
n = 6
Slope = -0.04562 units per year.
Mann-Kendall statistic = -7 critical = -13
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17



Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.
Fluoride
MW-4
mg/l
n = 8
Slope = 0 units per year.
Mann-Kendall statistic = -7 critical = -20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

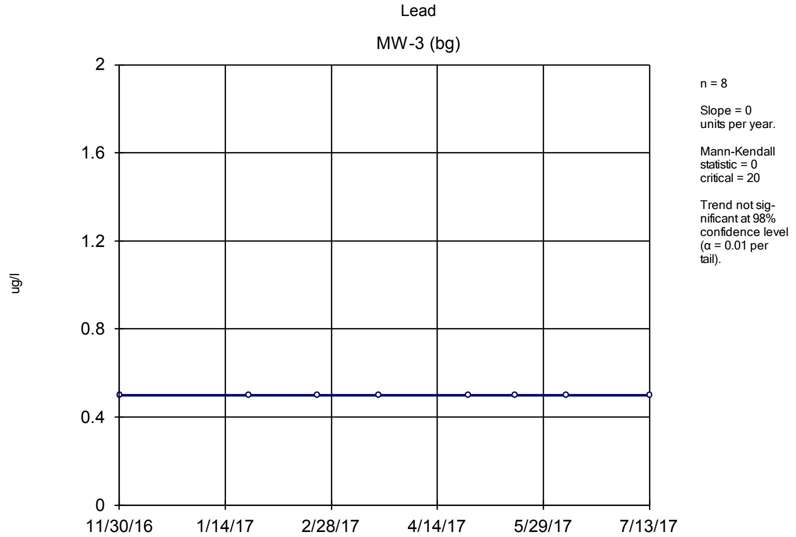


Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.
Fluoride
MW-5
mg/l
n = 8
Slope = 0 units per year.
Mann-Kendall statistic = -7 critical = -20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17



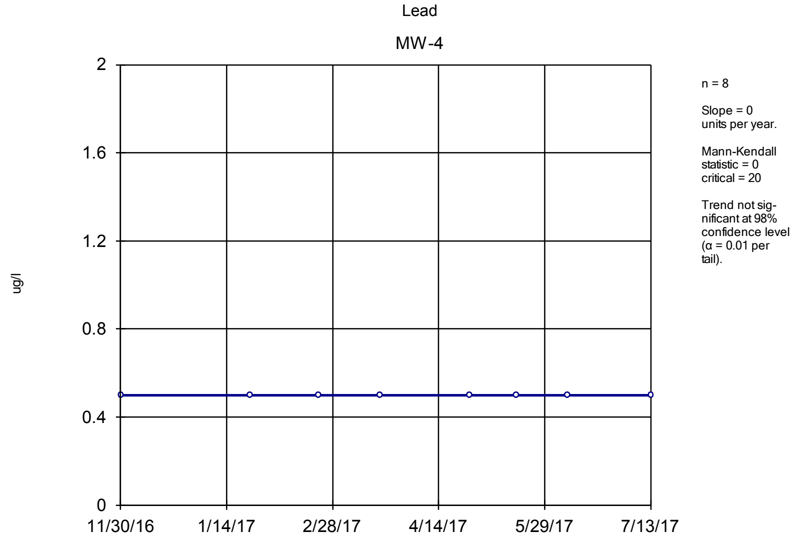
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.
Fluoride
MW-6 (bg)
mg/l
n = 8
Slope = 0 units per year.
Mann-Kendall statistic = -11 critical = -20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.



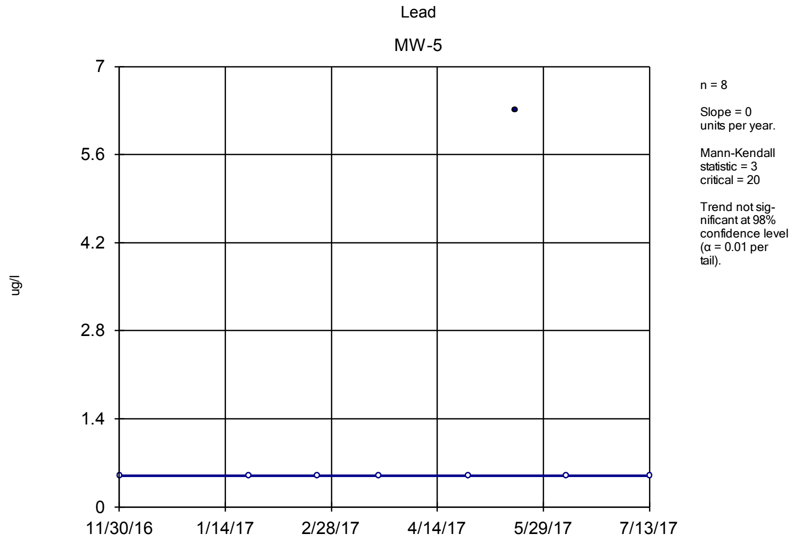
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.



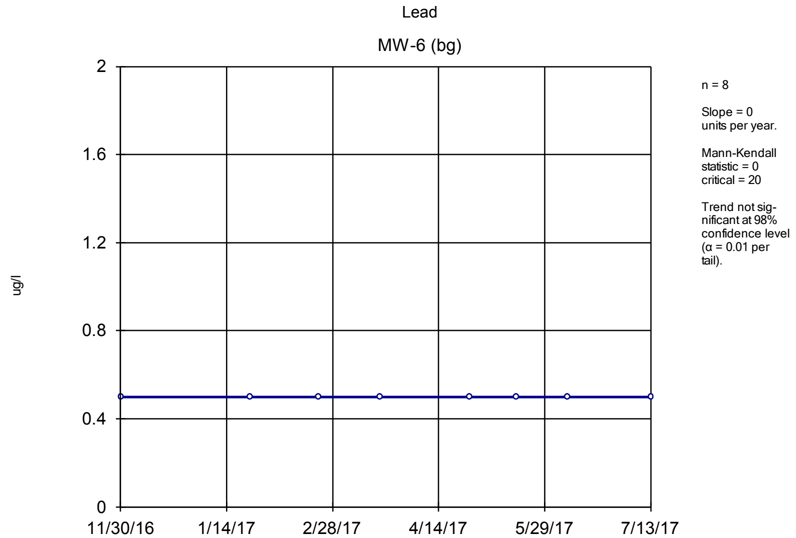
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.

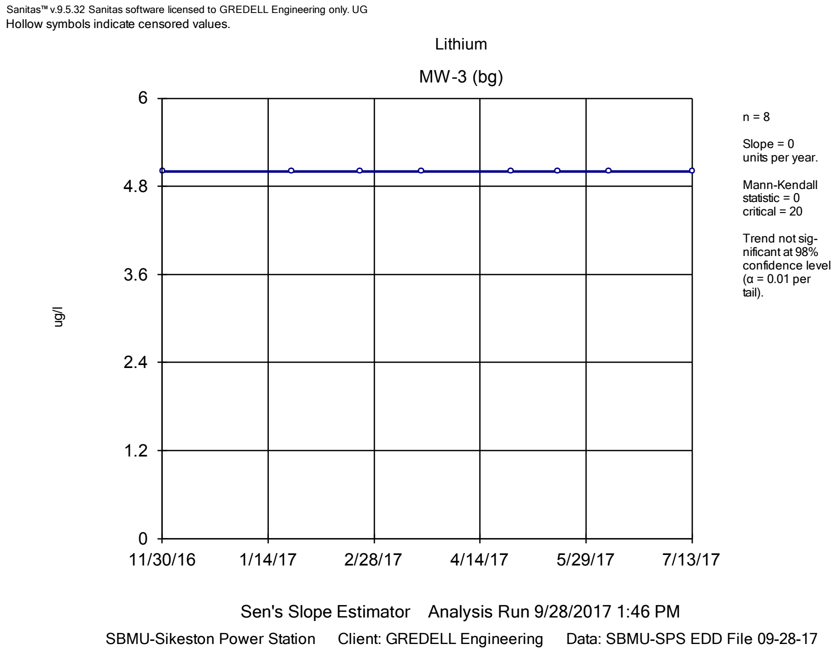


Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

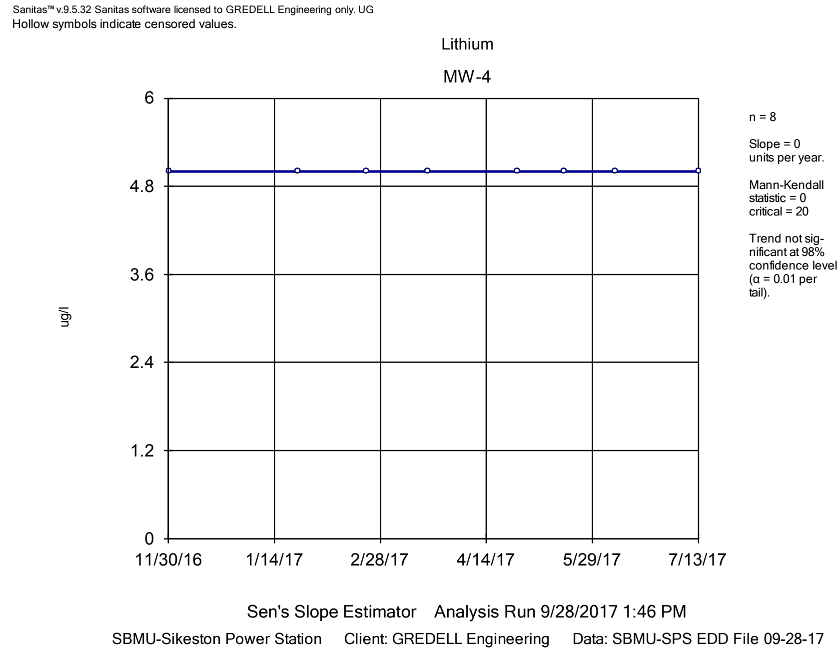
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.



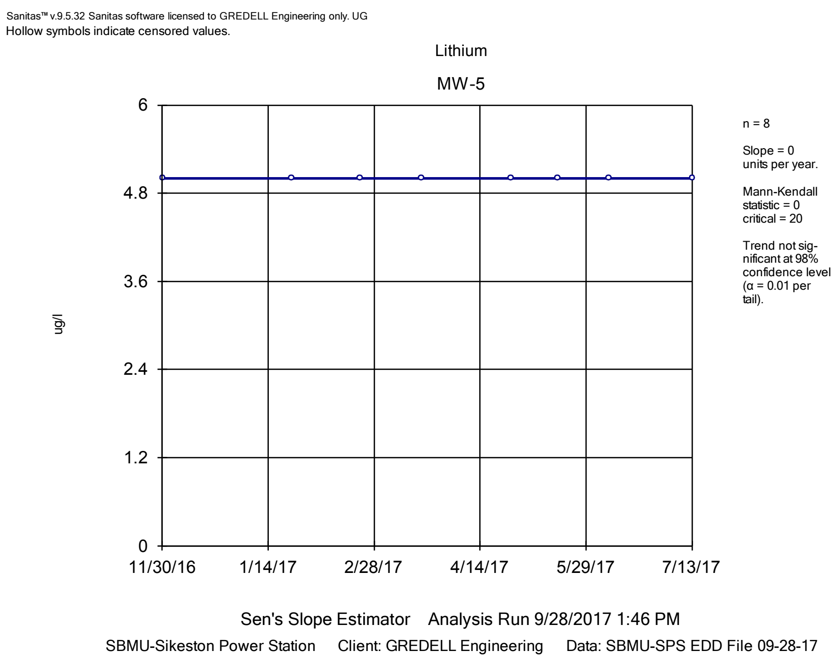
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17



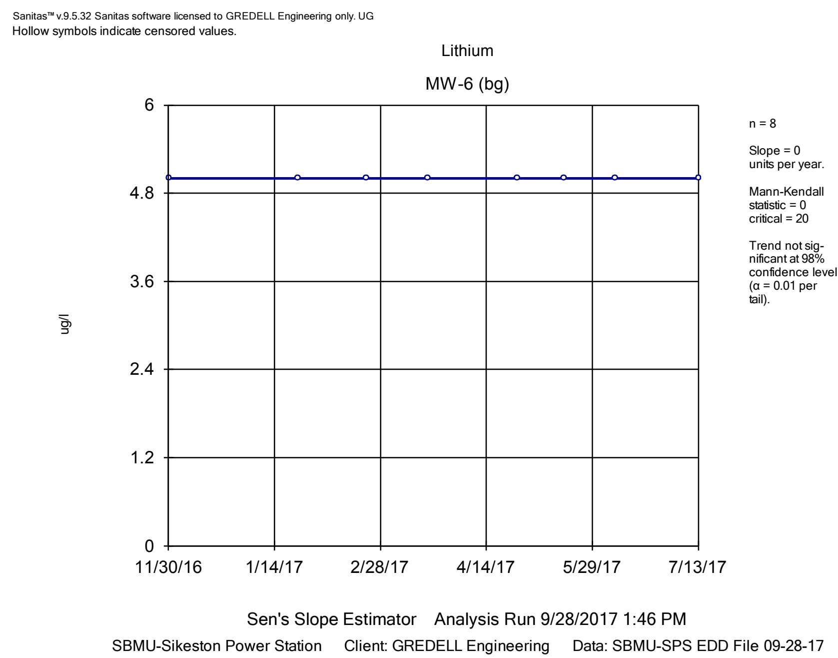
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.
Lithium
MW-3 (bg)
ug/l
6
4.8
3.6
2.4
1.2
0
11/30/16
1/14/17
2/28/17
4/14/17
5/29/17
7/13/17
n = 8
Slope = 0
units per year.
Mann-Kendall
statistic = 0
critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17



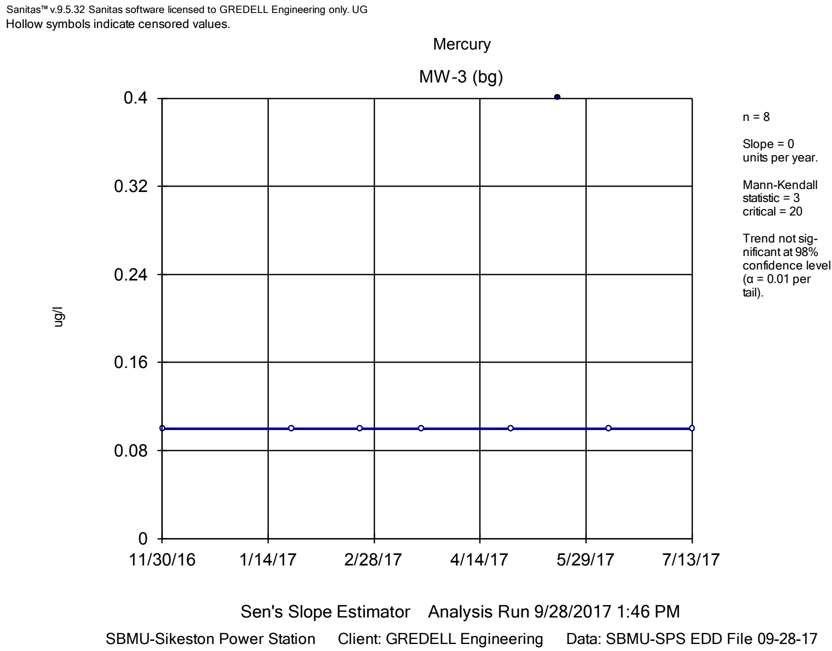
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.
Lithium
MW-4
ug/l
6
4.8
3.6
2.4
1.2
0
11/30/16
1/14/17
2/28/17
4/14/17
5/29/17
7/13/17
n = 8
Slope = 0
units per year.
Mann-Kendall
statistic = 0
critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

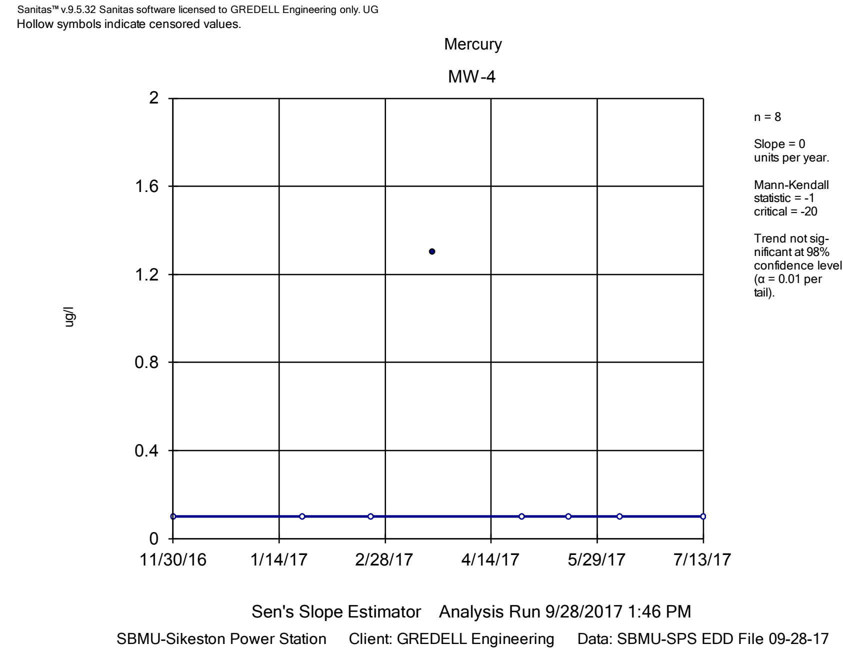


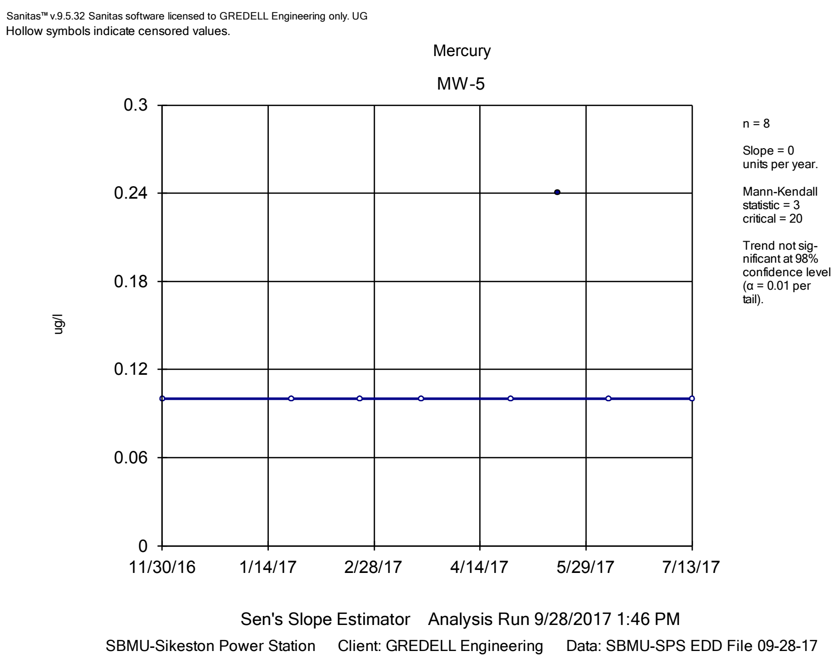
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.
Lithium
MW-5
ug/l
6
4.8
3.6
2.4
1.2
0
11/30/16
1/14/17
2/28/17
4/14/17
5/29/17
7/13/17
n = 8
Slope = 0
units per year.
Mann-Kendall
statistic = 0
critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

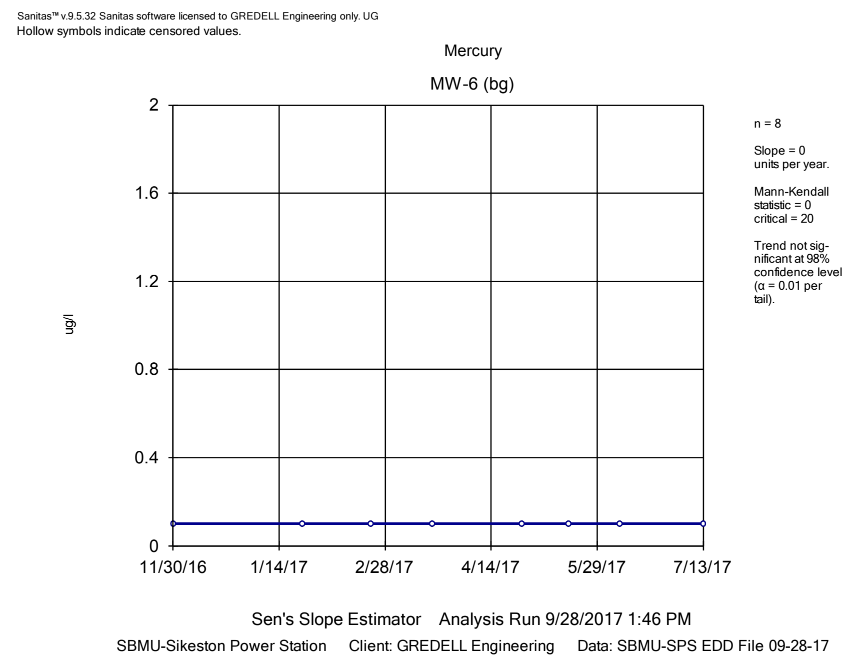


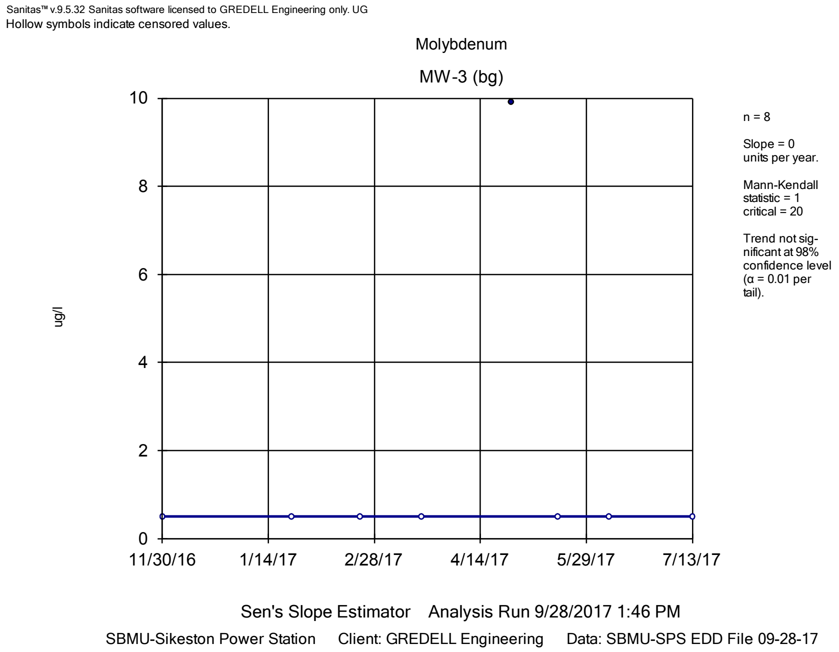
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.
Lithium
MW-6 (bg)
ug/l
6
4.8
3.6
2.4
1.2
0
11/30/16
1/14/17
2/28/17
4/14/17
5/29/17
7/13/17
n = 8
Slope = 0
units per year.
Mann-Kendall
statistic = 0
critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

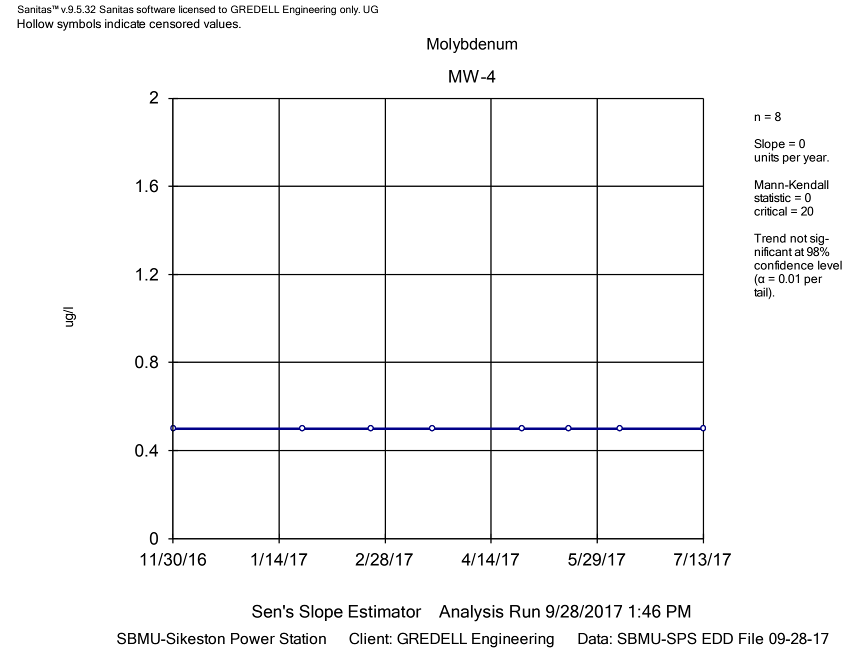

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.
Mercury
MW-3 (bg)
ug/l
0.4
0.32
0.24
0.16
0.08
0
11/30/16
1/14/17
2/28/17
4/14/17
5/29/17
7/13/17
n = 8
Slope = 0 units per year.
Mann-Kendall statistic = 3 critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

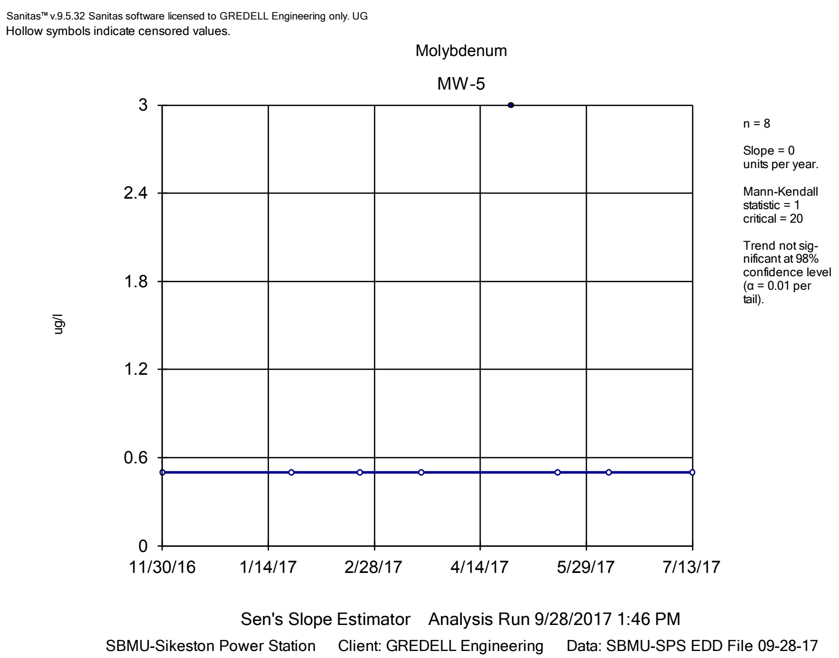

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.
Mercury
MW-4
ug/l
2
1.6
1.2
0.8
0.4
0
11/30/16
1/14/17
2/28/17
4/14/17
5/29/17
7/13/17
n = 8
Slope = 0 units per year.
Mann-Kendall statistic = -1 critical = -20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

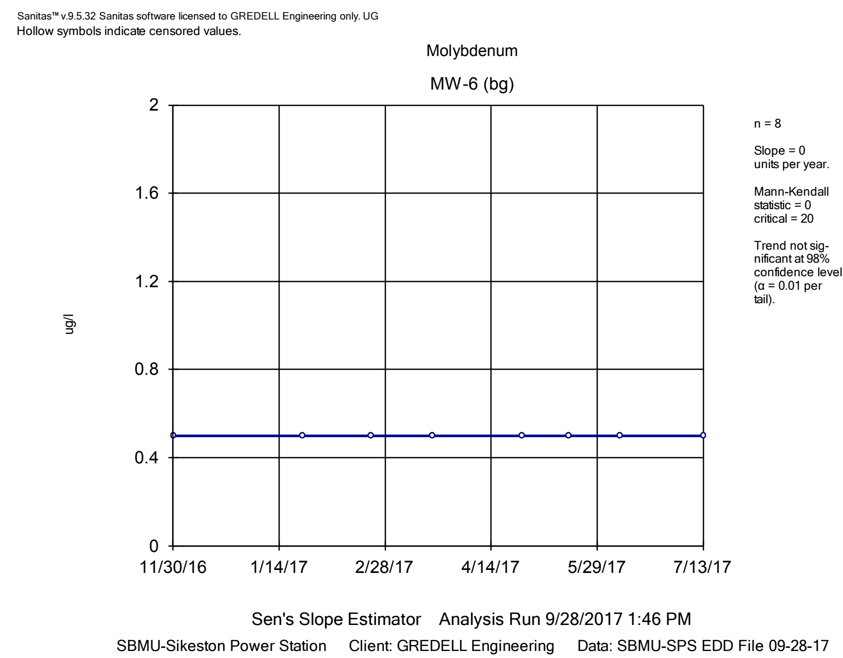

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.
Mercury
MW-5
ug/l
0.3
0.24
0.18
0.12
0.06
0
11/30/16
1/14/17
2/28/17
4/14/17
5/29/17
7/13/17
n = 8
Slope = 0 units per year.
Mann-Kendall statistic = 3 critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17


Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.
Mercury
MW-6 (bg)
ug/l
2
1.6
1.2
0.8
0.4
0
11/30/16
1/14/17
2/28/17
4/14/17
5/29/17
7/13/17
n = 8
Slope = 0 units per year.
Mann-Kendall statistic = 0 critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17


Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.
Molybdenum
MW-3 (bg)
ug/l
10
8
6
4
2
0
11/30/16
1/14/17
2/28/17
4/14/17
5/29/17
7/13/17
n = 8
Slope = 0
units per year.
Mann-Kendall
statistic = 1
critical = 20
Trend not sig-
nificant at 98%
confidence level
(α = 0.01 per
tail).
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17


Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.
Molybdenum
MW-4
ug/l
2
1.6
1.2
0.8
0.4
0
11/30/16
1/14/17
2/28/17
4/14/17
5/29/17
7/13/17
n = 8
Slope = 0
units per year.
Mann-Kendall
statistic = 0
critical = 20
Trend not sig-
nificant at 98%
confidence level
(α = 0.01 per
tail).
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

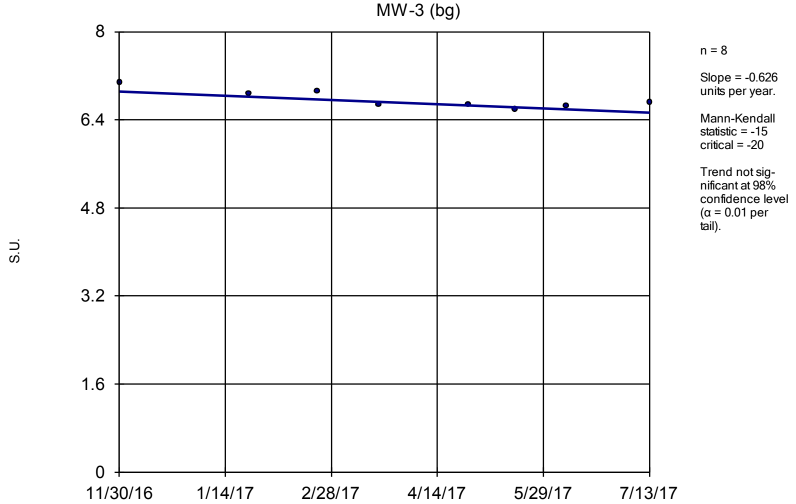

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.
Molybdenum
MW-5
ug/l
3
2.4
1.8
1.2
0.6
0
11/30/16
1/14/17
2/28/17
4/14/17
5/29/17
7/13/17
n = 8
Slope = 0
units per year.
Mann-Kendall
statistic = 1
critical = 20
Trend not sig-
nificant at 98%
confidence level
(α = 0.01 per
tail).
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17


Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.
Molybdenum
MW-6 (bg)
ug/l
2
1.6
1.2
0.8
0.4
0
11/30/16
1/14/17
2/28/17
4/14/17
5/29/17
7/13/17
n = 8
Slope = 0
units per year.
Mann-Kendall
statistic = 0
critical = 20
Trend not sig-
nificant at 98%
confidence level
(α = 0.01 per
tail).
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

pH

MW-3 (bg)



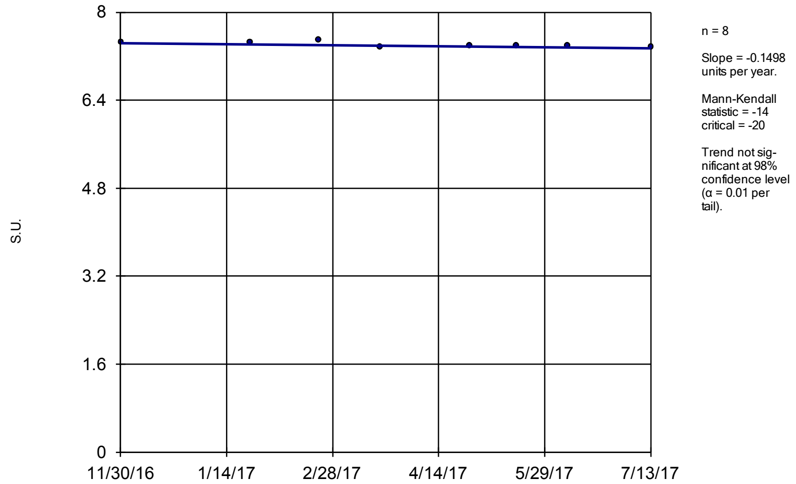
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

pH

MW-4



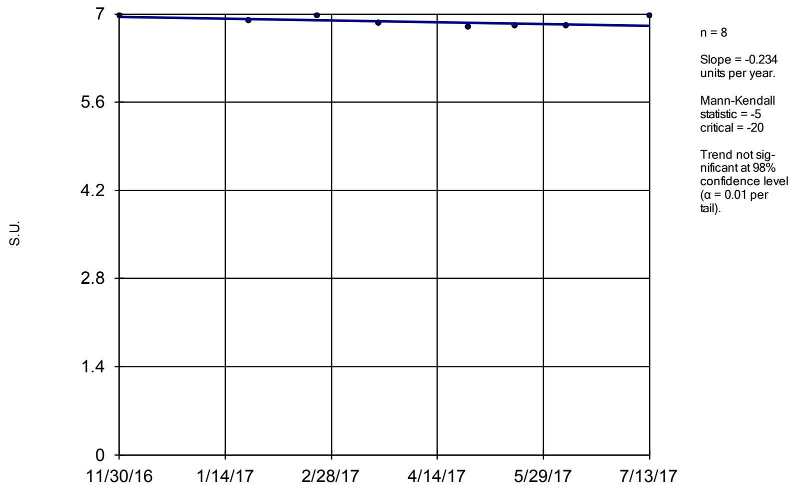
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

pH

MW-5



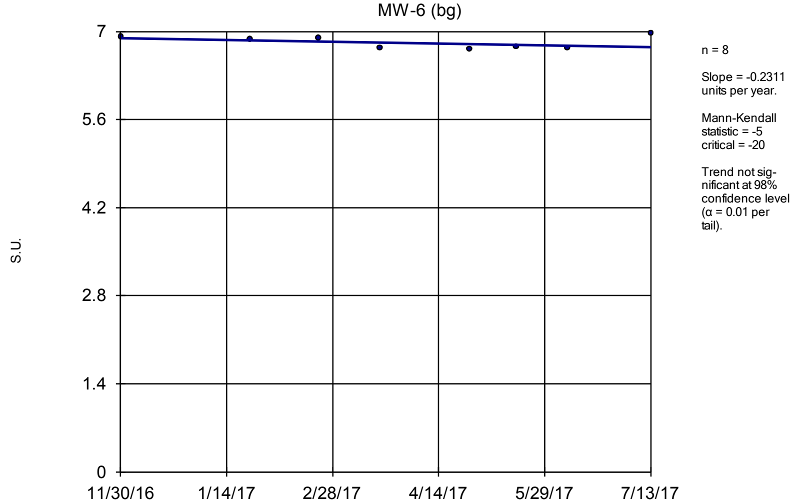
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG

pH

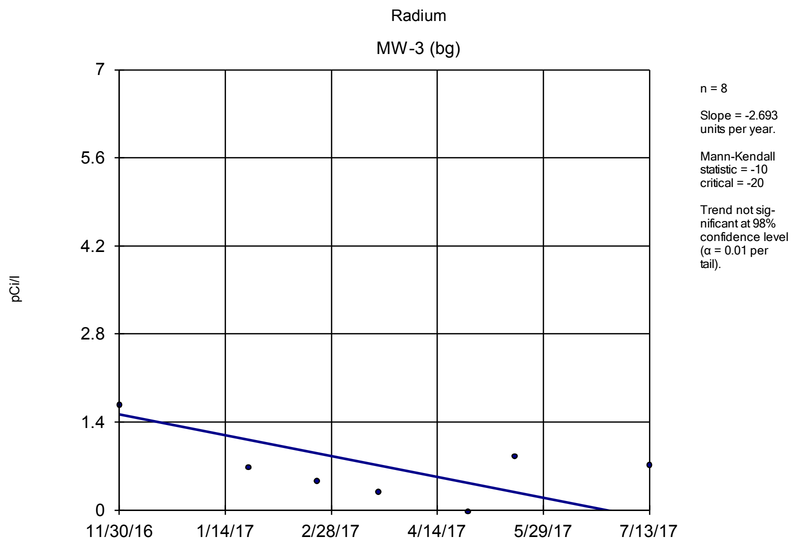
MW-6 (bg)



Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM

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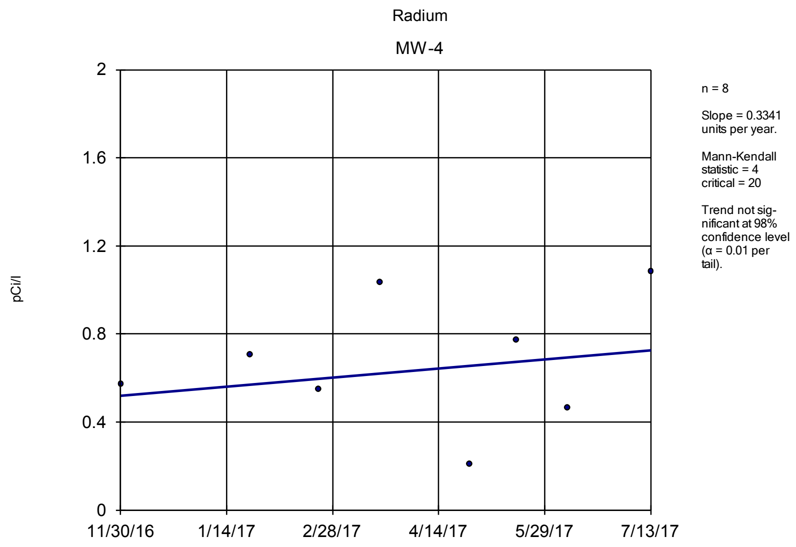
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM

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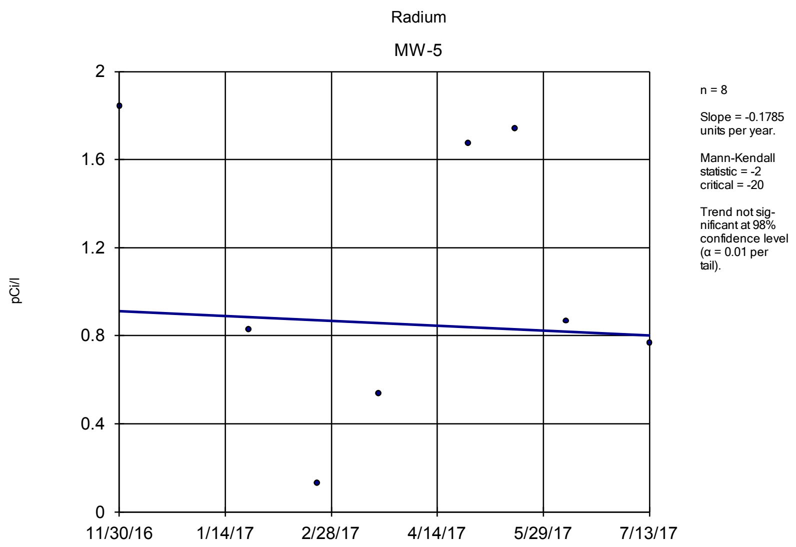
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



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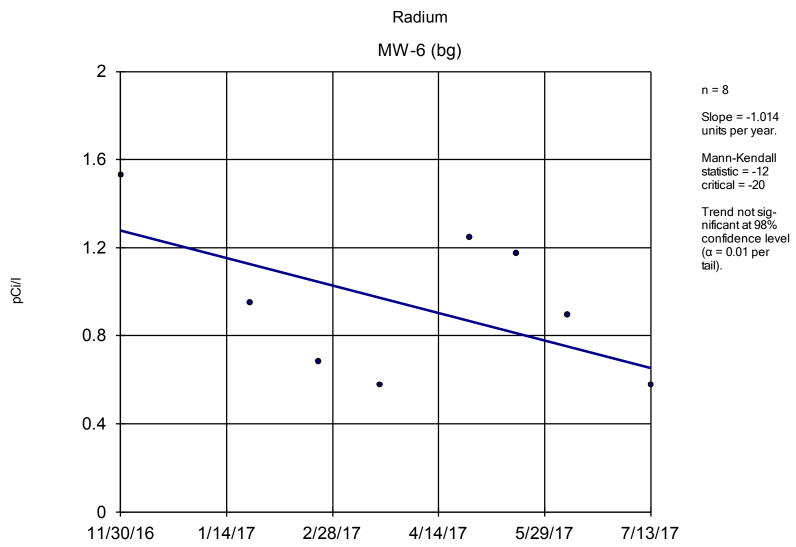
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



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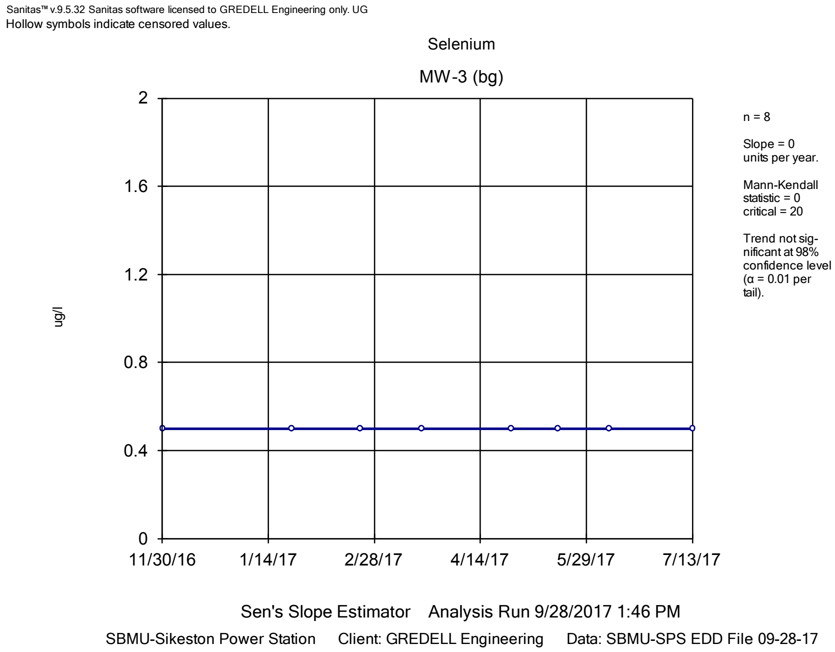
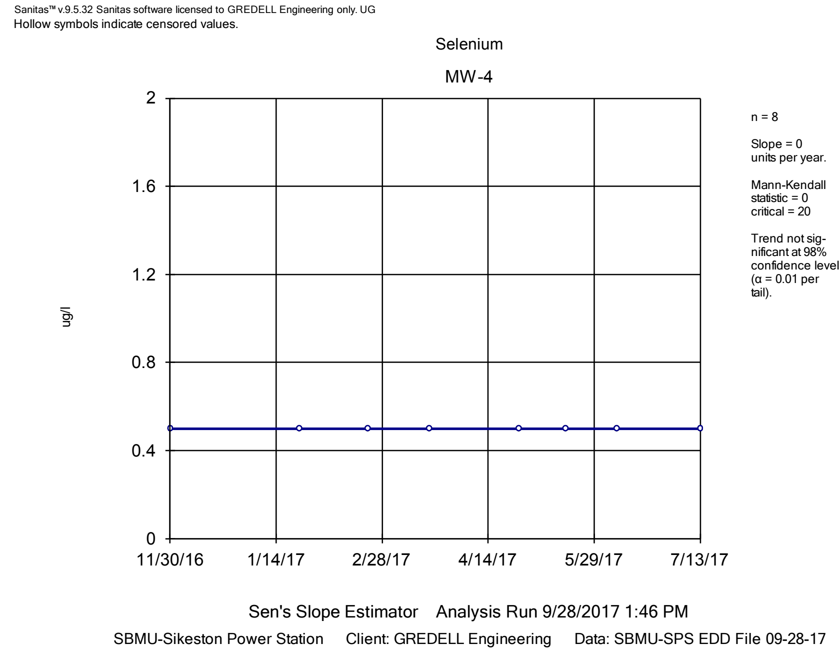

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.
Selenium
MW-3 (bg)
ug/l
n = 8
Slope = 0 units per year.
Mann-Kendall statistic = 0 critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17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Selenium
MW-4
ug/l
n = 8
Slope = 0 units per year.
Mann-Kendall statistic = 0 critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
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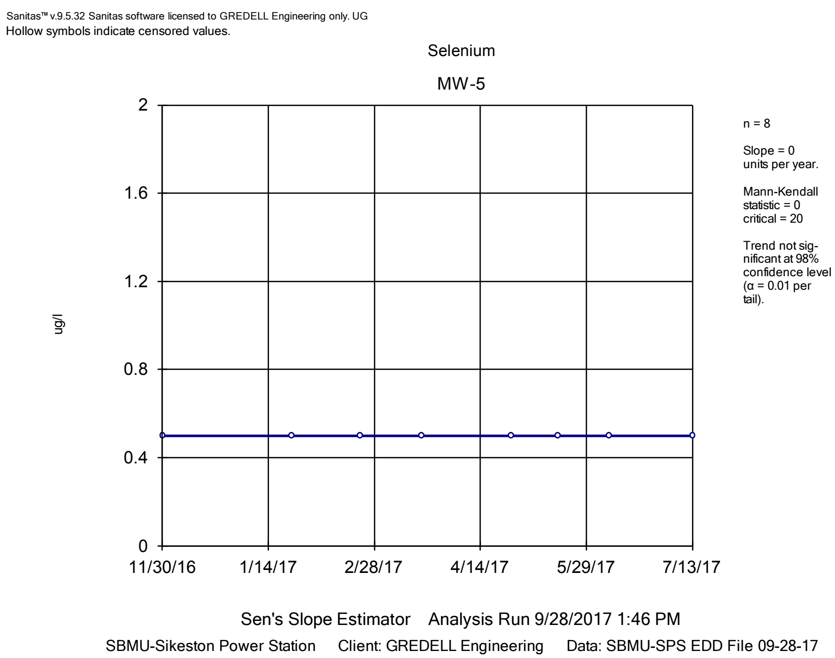
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17


Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.
Selenium
MW-5
ug/l
n = 8
Slope = 0 units per year.
Mann-Kendall statistic = 0 critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
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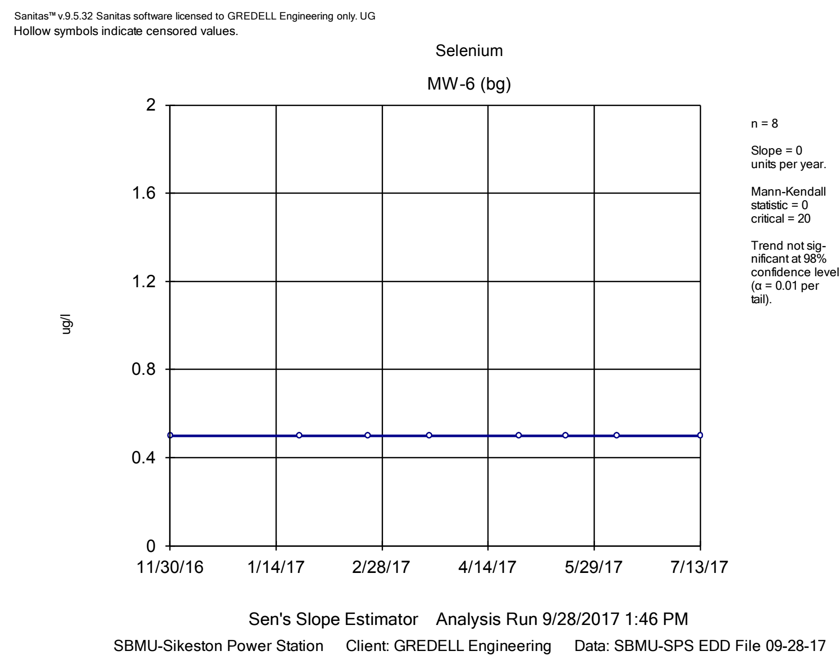
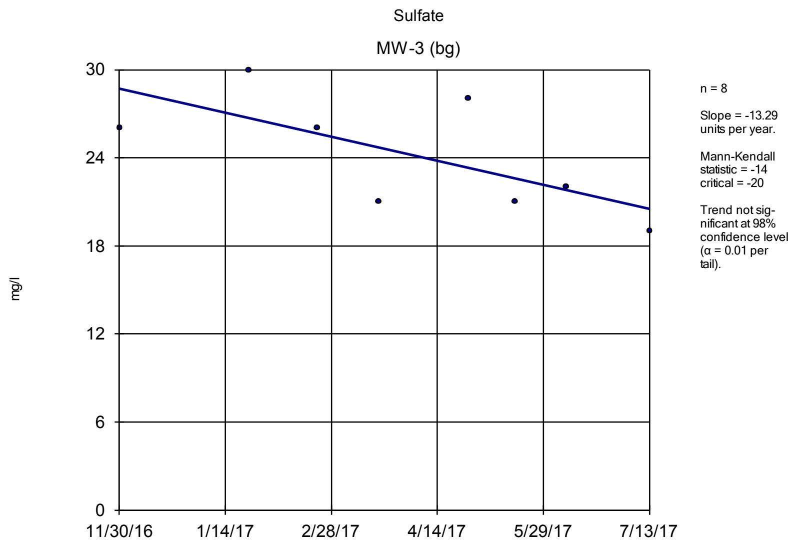
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17


Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.
Selenium
MW-6 (bg)
ug/l
n = 8
Slope = 0 units per year.
Mann-Kendall statistic = 0 critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM

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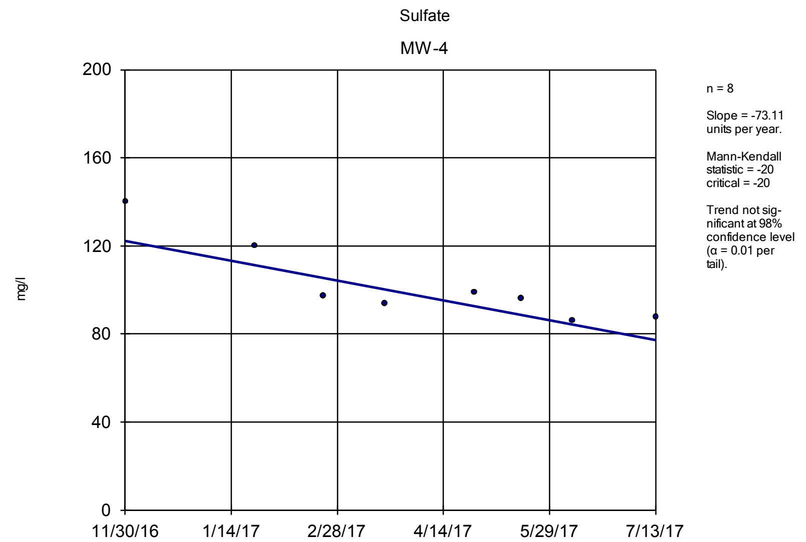
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM

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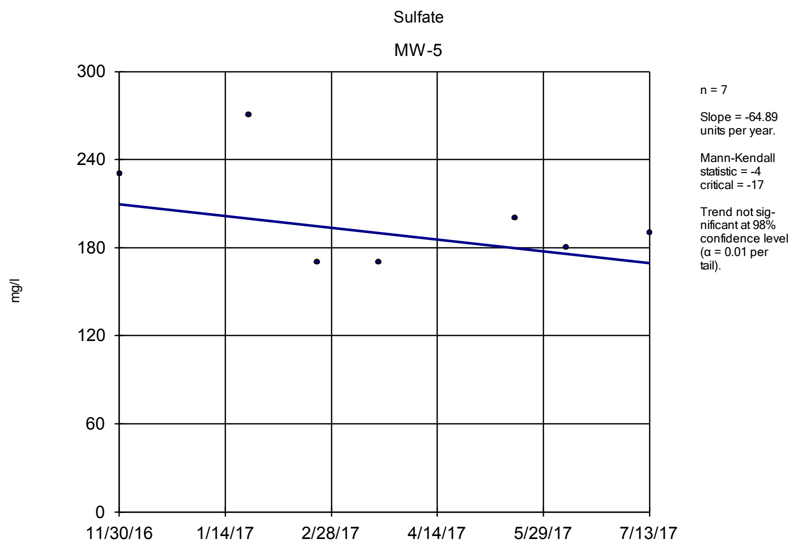
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM

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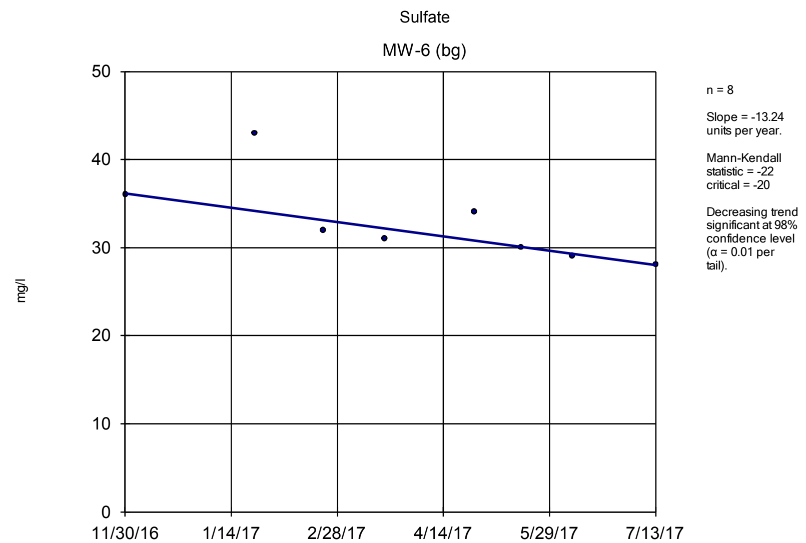
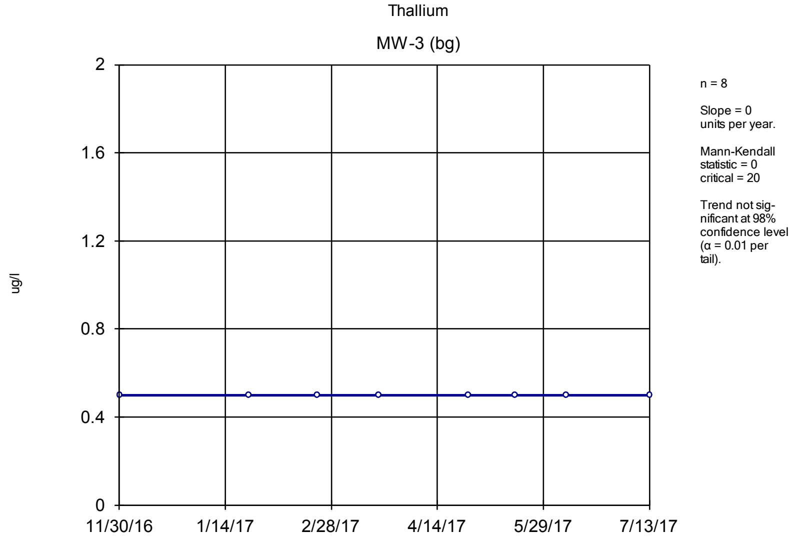
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.



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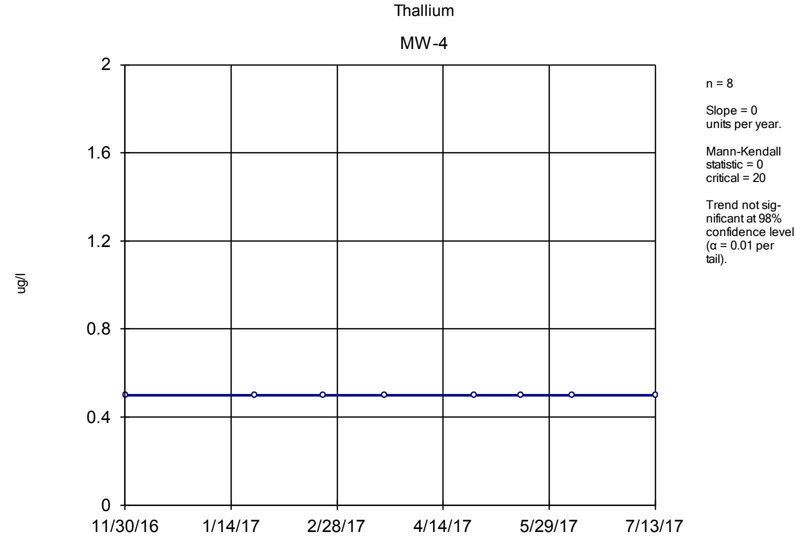
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.



Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
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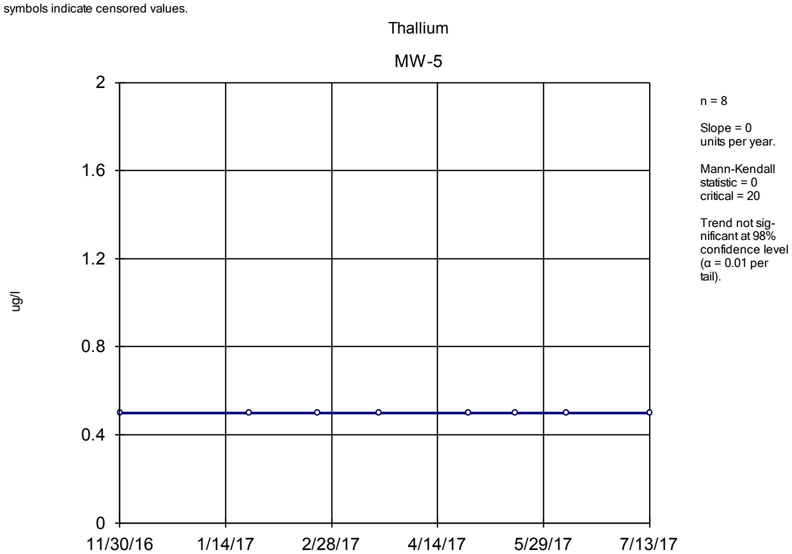

Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
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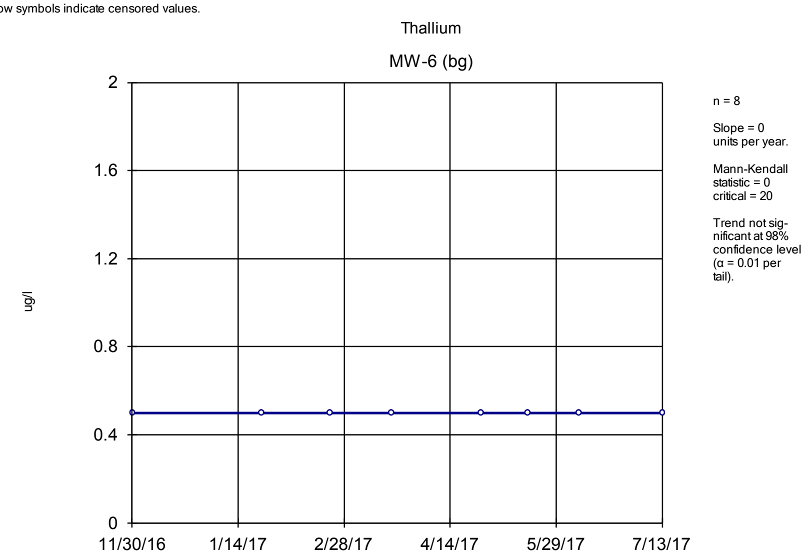
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.



Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM
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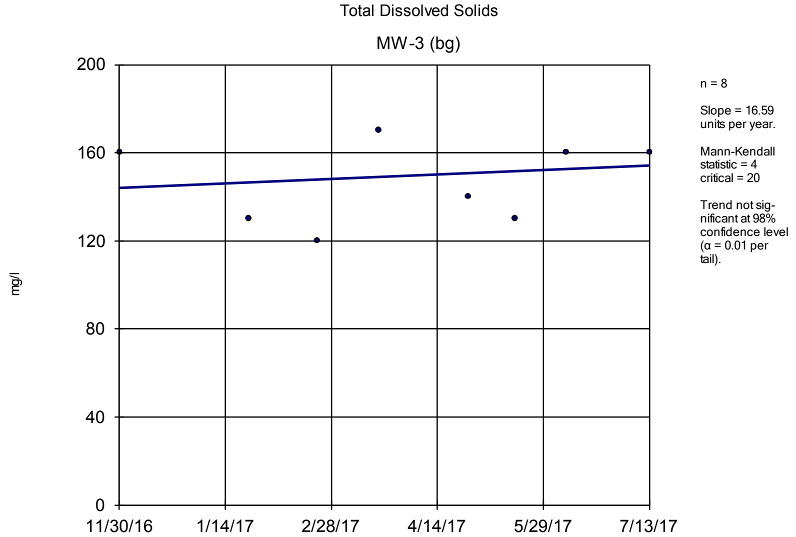
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



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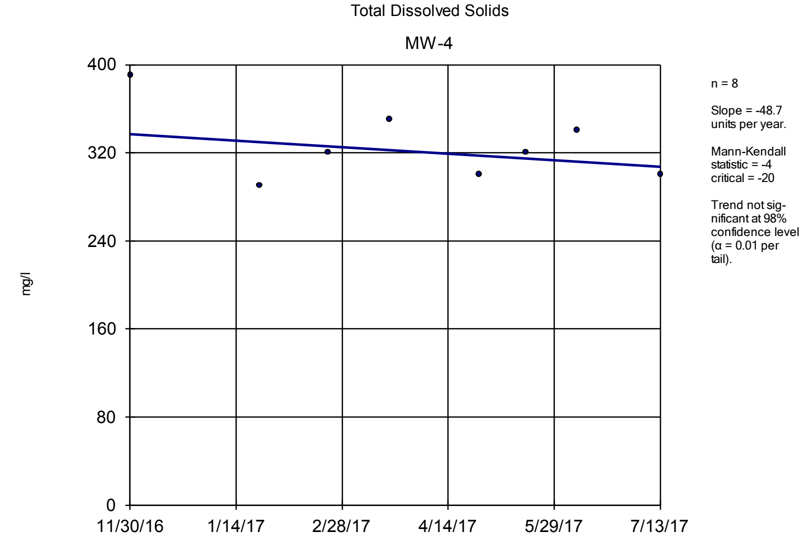
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



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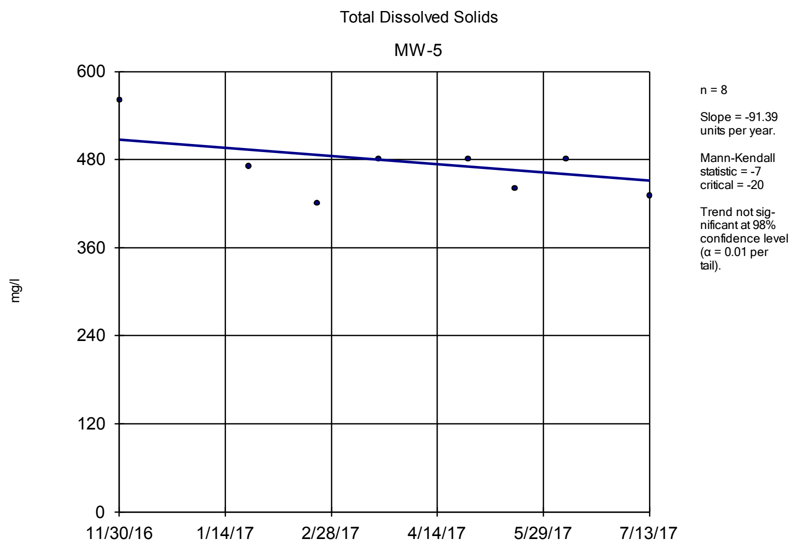

Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM

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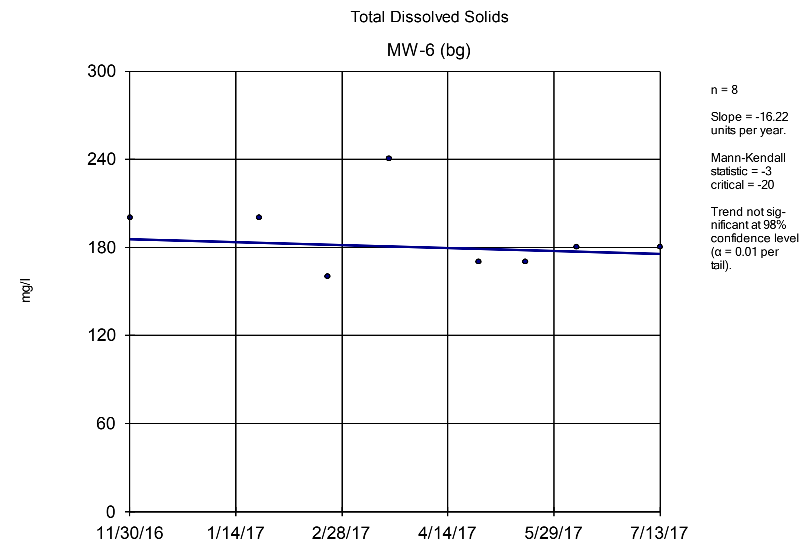
Sanitas™ v.9.5.32 Sanitas software licensed to GREDELL Engineering only. UG



Sen's Slope Estimator Analysis Run 9/28/2017 1:46 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

Appendix G

Analysis of Variance

Parametric ANOVA

Constituent: Arsenic   Analysis Run 10/3/2017 11:15 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

For observations made between 11/30/2016 and 7/13/2017 the parametric analysis of variance test indicates VARIATION at the 5% significance level. Because the calculated F statistic is greater than the tabulated F statistic, the hypothesis of a single homogeneous population is rejected.

Calculated F statistic = 122.3

Tabulated F statistic = 4.6 with 1 and 14 degrees of freedom at the 5% significance level.

ONE-WAY PARAMETRIC ANOVA TABLE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
Between Groups	6806	1	6806	13.74
Error Within Groups	6938	14	495.5	
Total	13744	15		

The Shapiro Wilk normality test on the residuals passed on the raw data. Alpha = 0.05, calculated = 0.9347, critical = 0.887. Levene's Equality of Variance test passed. Calculated = 3.071, tabulated = 4.6.

Parametric ANOVA

Constituent: Arsenic (ug/l) Analysis Run 10/3/2017 11:15 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

	MW-6 (bg)	MW-3 (bg)
11/30/2016	4.3	1.5
1/24/2017	5.7	1.2
2/22/2017	6.4	1
3/20/2017	5	<1
4/27/2017	3.2	<1
5/17/2017	4.9	<1
6/8/2017	4.6	<1
7/13/2017	5.8	<1

Parametric ANOVA

Constituent: Barium   Analysis Run 10/3/2017 11:15 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

For observations made between 11/30/2016 and 7/13/2017 the parametric analysis of variance test indicates VARIATION at the 5% significance level. Because the calculated F statistic is greater than the tabulated F statistic, the hypothesis of a single homogeneous population is rejected.

Calculated F statistic = 127.2

Tabulated F statistic = 4.6 with 1 and 14 degrees of freedom at the 5% significance level.

ONE-WAY PARAMETRIC ANOVA TABLE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
Between Groups	6806	1	6806	13.74
Error Within Groups	6938	14	495.5	
Total	13744	15		

The Shapiro Wilk normality test on the residuals passed on the raw data. Alpha = 0.05, calculated = 0.9592, critical = 0.887. Levene's Equality of Variance test passed. Calculated = 1.819, tabulated = 4.6.

Parametric ANOVA

Constituent: Barium (ug/l)   Analysis Run 10/3/2017 11:15 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

	MW-6 (bg)	MW-3 (bg)
11/30/2016	190	96
1/24/2017	220	120
2/22/2017	210	120
3/20/2017	160	110
4/27/2017	180	110
5/17/2017	190	120
6/8/2017	190	110
7/13/2017	200	100

Parametric ANOVA

Constituent: Boron   Analysis Run 10/3/2017 11:15 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

For observations made between 11/30/2016 and 7/13/2017 the parametric analysis of variance test (after natural log transformation) indicates VARIATION at the 5% significance level. Because the calculated F statistic is greater than the tabulated F statistic, the hypothesis of a single homogeneous population is rejected.

Calculated F statistic = 5.861

Tabulated F statistic = 4.67 with 1 and 13 degrees of freedom at the 5% significance level.

ONE-WAY PARAMETRIC ANOVA TABLE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
Between Groups	6806	1	6806	13.74
Error Within Groups	6938	14	495.5	
Total	13744	15		

The Shapiro Wilk normality test on the residuals passed after natural log transformation. Alpha = 0.05, calculated = 0.8812, critical = 0.881. Levene's Equality of Variance test passed. Calculated = 3.948, tabulated = 4.67.

Parametric ANOVA

Constituent: Boron (ug/l)   Analysis Run 10/3/2017 11:15 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

	MW-3 (bg)	MW-6 (bg)
11/30/2016	18	36
1/24/2017	12	27
2/22/2017	33	59 (o)
3/20/2017	22	37
4/27/2017	54	36
5/17/2017	19	35
6/8/2017	20	38
7/13/2017	18	31

Parametric ANOVA

Constituent: Calcium Analysis Run 10/3/2017 11:15 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

For observations made between 11/30/2016 and 7/13/2017 the parametric analysis of variance test indicates VARIATION at the 5% significance level. Because the calculated F statistic is greater than the tabulated F statistic, the hypothesis of a single homogeneous population is rejected.

Calculated F statistic = 115.7

Tabulated F statistic = 4.6 with 1 and 14 degrees of freedom at the 5% significance level.

ONE-WAY PARAMETRIC ANOVA TABLE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
Between Groups	6806	1	6806	13.74
Error Within Groups	6938	14	495.5	
Total	13744	15		

The Shapiro Wilk normality test on the residuals passed on the raw data. Alpha = 0.05, calculated = 0.9384, critical = 0.887. Levene's Equality of Variance test passed. Calculated = 1.51, tabulated = 4.6.

Parametric ANOVA

Constituent: Calcium (mg/l)   Analysis Run 10/3/2017 11:15 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

	MW-6 (bg)	MW-3 (bg)
11/30/2016	45	24
1/24/2017	41	21
2/22/2017	40	22
3/20/2017	39	19
4/27/2017	38	20
5/17/2017	30	17
6/8/2017	36	19
7/13/2017	40	20

Parametric ANOVA

Constituent: Chloride   Analysis Run 10/3/2017 11:15 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

For observations made between 11/30/2016 and 7/13/2017 the parametric analysis of variance test indicates NO VARIATION at the 5% significance level. Because the calculated F statistic is less than or equal to the tabulated F statistic, the hypothesis of a single homogeneous population is accepted.

Calculated F statistic = 1.075

Tabulated F statistic = 4.6 with 1 and 14 degrees of freedom at the 5% significance level.

ONE-WAY PARAMETRIC ANOVA TABLE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
Between Groups	6806	1	6806	13.74
Error Within Groups	6938	14	495.5	
Total	13744	15		

The Shapiro Wilk normality test on the residuals passed on the raw data. Alpha = 0.05, calculated = 0.9724, critical = 0.887. Levene's Equality of Variance test passed. Calculated = 1.009, tabulated = 4.6.

Parametric ANOVA

Constituent: Chloride (mg/l)   Analysis Run 10/3/2017 11:15 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

	MW-6 (bg)	MW-3 (bg)
11/30/2016	2.8	2.3
1/24/2017	2.4	2
2/22/2017	2.1	1.9
3/20/2017	2.1	1.8
4/27/2017	2.3	2
5/17/2017	1.8	1.5
6/8/2017	1.7	1.7
7/13/2017	1.6	2.2

Non-Parametric ANOVA

Constituent: Fluoride   Analysis Run 10/3/2017 11:15 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

For observations made between 11/30/2016 and 7/13/2017, the non-parametric analysis of variance test indicates a DIFFERENCE between the medians of the groups tested at the 5% significance level. Because the calculated Kruskal-Wallis statistic is greater than the Chi-squared value, we conclude that at least one group has a significantly different median concentration of this constituent when compared to another group.

Calculated Kruskal-Wallis statistic = 4.063

Tabulated Chi-Squared value = 3.841 with 1 degree of freedom at the 5% significance level.

There were 1 groups of ties in the data, consequently the Kruskal-Wallis statistic (H) was adjusted. The adjusted statistic (H') was utilized to determine if the medians were equal.
Kruskal-Wallis statistic (H) = 3.75
Adjusted Kruskal-Wallis statistic (H') = 4.063

Non-Parametric ANOVA

Constituent: Fluoride (mg/l) Analysis Run 10/3/2017 11:15 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

	MW-6 (bg)	MW-3 (bg)
11/30/2016	0.331	0.438 (o)
1/24/2017	<0.25	0.261
2/22/2017	0.269	0.29
3/20/2017	<0.25	0.286
4/27/2017	<0.25	0.257
5/17/2017	<0.25	<0.25 (o)
6/8/2017	<0.25	0.276
7/13/2017	<0.25	0.256

Non-Parametric ANOVA

Constituent: Mercury   Analysis Run 10/3/2017 11:15 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

For observations made between 11/30/2016 and 7/13/2017, the non-parametric analysis of variance test indicates NO DIFFERENCE between the medians of the groups tested at the 5% significance level. Because the calculated Kruskal-Wallis statistic is less than or equal to the Chi-squared value, we conclude that no group has a significantly different median concentration of this constituent when compared to another group.

Calculated Kruskal-Wallis statistic = 1

Tabulated Chi-Squared value = 3.841 with 1 degree of freedom at the 5% significance level.

There were 1 groups of ties in the data, consequently the Kruskal-Wallis statistic (H) was adjusted. The adjusted statistic (H') was utilized to determine if the medians were equal.
Kruskal-Wallis statistic (H) = 0.1765
Adjusted Kruskal-Wallis statistic (H') = 1

Non-Parametric ANOVA

Constituent: Mercury (ug/l)   Analysis Run 10/3/2017 11:15 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

	MW-6 (bg)	MW-3 (bg)
11/30/2016	<0.2	<0.2
1/24/2017	<0.2	<0.2
2/22/2017	<0.2	<0.2
3/20/2017	<0.2	<0.2
4/27/2017	<0.2	<0.2
5/17/2017	<0.2	0.4
6/8/2017	<0.2	<0.2
7/13/2017	<0.2	<0.2

Non-Parametric ANOVA

Constituent: Molybdenum Analysis Run 10/3/2017 11:15 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

For observations made between 11/30/2016 and 7/13/2017, the non-parametric analysis of variance test indicates NO DIFFERENCE between the medians of the groups tested at the 5% significance level. Because the calculated Kruskal-Wallis statistic is less than or equal to the Chi-squared value, we conclude that no group has a significantly different median concentration of this constituent when compared to another group.

Calculated Kruskal-Wallis statistic = 1

Tabulated Chi-Squared value = 3.841 with 1 degree of freedom at the 5% significance level.

There were 1 groups of ties in the data, consequently the Kruskal-Wallis statistic (H) was adjusted. The adjusted statistic (H') was utilized to determine if the medians were equal.
Kruskal-Wallis statistic (H) = 0.1765
Adjusted Kruskal-Wallis statistic (H') = 1

Non-Parametric ANOVA

Constituent: Molybdenum (ug/l) Analysis Run 10/3/2017 11:15 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

	MW-6 (bg)	MW-3 (bg)
11/30/2016	<1	<1
1/24/2017	<1	<1
2/22/2017	<1	<1
3/20/2017	<1	<1
4/27/2017	<1	9.9
5/17/2017	<1	<1
6/8/2017	<1	<1
7/13/2017	<1	<1

Parametric ANOVA

Constituent: pH   Analysis Run 10/3/2017 11:15 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

For observations made between 11/30/2016 and 7/13/2017 the parametric analysis of variance test indicates NO VARIATION at the 5% significance level. Because the calculated F statistic is less than or equal to the tabulated F statistic, the hypothesis of a single homogeneous population is accepted.

Calculated F statistic = 0.4922

Tabulated F statistic = 4.6 with 1 and 14 degrees of freedom at the 5% significance level.

ONE-WAY PARAMETRIC ANOVA TABLE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
Between Groups	6806	1	6806	13.74
Error Within Groups	6938	14	495.5	
Total	13744	15		

The Shapiro Wilk normality test on the residuals passed on the raw data. Alpha = 0.05, calculated = 0.8992, critical = 0.887. Levene's Equality of Variance test passed. Calculated = 2.948, tabulated = 4.6.

Parametric ANOVA

Constituent: pH (S.U.)   Analysis Run 10/3/2017 11:15 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

	MW-6 (bg)	MW-3 (bg)
11/30/2016	6.92	7.08
1/24/2017	6.87	6.88
2/22/2017	6.89	6.93
3/20/2017	6.73	6.68
4/27/2017	6.72	6.68
5/17/2017	6.76	6.59
6/8/2017	6.73	6.66
7/13/2017	6.98	6.71

Parametric ANOVA

Constituent: Radium   Analysis Run 10/3/2017 11:15 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

For observations made between 11/30/2016 and 7/13/2017 the parametric analysis of variance test indicates NO VARIATION at the 5% significance level. Because the calculated F statistic is less than or equal to the tabulated F statistic, the hypothesis of a single homogeneous population is accepted.

Calculated F statistic = 2.905

Tabulated F statistic = 4.6 with 1 and 14 degrees of freedom at the 5% significance level.

ONE-WAY PARAMETRIC ANOVA TABLE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
Between Groups	6806	1	6806	13.74
Error Within Groups	6938	14	495.5	
Total	13744	15		

The Shapiro Wilk normality test on the residuals passed on the raw data. Alpha = 0.05, calculated = 0.9734, critical = 0.887. Levene's Equality of Variance test passed. Calculated = 1.403, tabulated = 4.6.

Parametric ANOVA

Constituent: Radium (pCi/l)   Analysis Run 10/3/2017 11:15 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

	MW-6 (bg)	MW-3 (bg)
11/30/2016	1.532	1.668
1/24/2017	0.948 (U)	0.677 (U)
2/22/2017	0.685 (U)	0.46 (U)
3/20/2017	0.577 (U)	0.277 (U)
4/27/2017	1.243 (U)	-0.03 (U)
5/17/2017	1.173 (U)	0.844 (U)
6/8/2017	0.893 (U)	-0.469 (U)
7/13/2017	0.575 (U)	0.715 (U)

Parametric ANOVA

Constituent: Sulfate Analysis Run 10/3/2017 11:15 AM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SBMU-SPS EDD File 09-28-17

For observations made between 11/30/2016 and 7/13/2017 the parametric analysis of variance test indicates VARIATION at the 5% significance level. Because the calculated F statistic is greater than the tabulated F statistic, the hypothesis of a single homogeneous population is rejected.

Calculated F statistic = 15.78

Tabulated F statistic = 4.6 with 1 and 14 degrees of freedom at the 5% significance level.

ONE-WAY PARAMETRIC ANOVA TABLE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
Between Groups	6806	1	6806	13.74
Error Within Groups	6938	14	495.5	
Total	13744	15		

The Shapiro Wilk normality test on the residuals passed on the raw data. Alpha = 0.05, calculated = 0.9217, critical = 0.887. Levene's Equality of Variance test passed. Calculated = 0.03466, tabulated = 4.6.

Parametric ANOVA

Constituent: Sulfate (mg/l)   Analysis Run 10/3/2017 11:15 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

	MW-6 (bg)	MW-3 (bg)
11/30/2016	36	26
1/24/2017	43	30
2/22/2017	32	26
3/20/2017	31	21
4/27/2017	34	28
5/17/2017	30	21
6/8/2017	29	22
7/13/2017	28	19

Parametric ANOVA

Constituent: Total Dissolved Solids   Analysis Run 10/3/2017 11:15 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

For observations made between 11/30/2016 and 7/13/2017 the parametric analysis of variance test indicates VARIATION at the 5% significance level. Because the calculated F statistic is greater than the tabulated F statistic, the hypothesis of a single homogeneous population is rejected.

Calculated F statistic = 13.74

Tabulated F statistic = 4.6 with 1 and 14 degrees of freedom at the 5% significance level.

ONE-WAY PARAMETRIC ANOVA TABLE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
Between Groups	6806	1	6806	13.74
Error Within Groups	6938	14	495.5	
Total	13744	15		

The Shapiro Wilk normality test on the residuals passed on the raw data. Alpha = 0.05, calculated = 0.9059, critical = 0.887. Levene's Equality of Variance test passed. Calculated = 0.3002, tabulated = 4.6.

Parametric ANOVA

Constituent: Total Dissolved Solids (mg/l)   Analysis Run 10/3/2017 11:15 AM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17

	MW-6 (bg)	MW-3 (bg)
11/30/2016	200	160
1/24/2017	200	130
2/22/2017	160	120
3/20/2017	240	170
4/27/2017	170	140
5/17/2017	170	130
6/8/2017	180	160
7/13/2017	180	160

Analysis of Variance MW-3 & MW-6

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SBMU-SPS EDD File 09-28-17   Printed 10/3/2017, 11:15 AM

Constituent	Well	Calc.	Crit.	Sig.	Alpha	Transform	ANOVA Sig.	Alpha	Method
Arsenic (ug/l)	n/a	n/a	n/a	n/a	n/a	No	Yes	0.05	Param.
Barium (ug/l)	n/a	n/a	n/a	n/a	n/a	No	Yes	0.05	Param.
Boron (ug/l)	n/a	n/a	n/a	n/a	n/a	ln(x)	Yes	0.05	Param.
Calcium (mg/l)	n/a	n/a	n/a	n/a	n/a	No	Yes	0.05	Param.
Chloride (mg/l)	n/a	n/a	n/a	n/a	n/a	No	No	0.05	Param.
Fluoride (mg/l)	n/a	n/a	n/a	n/a	n/a	No	Yes	0.05	NP (normality)
Mercury (ug/l)	n/a	n/a	n/a	n/a	n/a	No	No	0.05	NP (NDs)
Molybdenum (ug/l)	n/a	n/a	n/a	n/a	n/a	No	No	0.05	NP (NDs)
pH (S.U.)	n/a	n/a	n/a	n/a	n/a	No	No	0.05	Param.
Radium (pCi/l)	n/a	n/a	n/a	n/a	n/a	No	No	0.05	Param.
Sulfate (mg/l)	n/a	n/a	n/a	n/a	n/a	No	Yes	0.05	Param.
Total Dissolved Solids (mg/l)	n/a	n/a	n/a	n/a	n/a	No	Yes	0.05	Param.

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Sikeston Power Station

Fly Ash Pond Baseline Statistical Evaluation
Scott County, Missouri

Prepared for:

Board of Municipal Utilities

Sikeston Power Station
1551 West Wakefield Avenue
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April 17, 2019

Sikeston Power Station

Fly Ash Pond Baseline Groundwater Statistical Evaluation
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Sikeston Power Station
Fly Ash Pond Baseline Groundwater Statistical Evaluation
Scott County, Missouri

April 17, 2019

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1.0 INTRODUCTION

Beginning in March 2018, the Sikeston Power Station (SPS) collected and analyzed groundwater samples from the Fly Ash Pond groundwater monitoring network. This network was developed as part of the Site Characterization (Gredell, 2017) and described in the Groundwater Monitoring and Sampling Plan (GMSAP) dated September 2018 (Gredell, 2018). The groundwater samples were collected to establish baseline water quality conditions prior to conducting detection monitoring in accordance with 40 CFR 257.94. The data was evaluated to determine baseline conditions using appropriate statistical analysis methodology. All field sampling activities, sample transport, laboratory analytical testing, and reporting of background sample results are consistent with the GMSAP. This Baseline Groundwater Statistical Evaluation report has been prepared in accordance with 40 CFR 257.93(f) and the 2009 *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance: EPA 530/R-09-007*, hereinafter referred to as the *Unified Guidance*.

The background water quality data (background data) were analyzed in accordance with the GMSAP and in general accordance with the Unified Guidance (2009). The background data were evaluated using the groundwater statistical software program Sanitas Technologies, Version v.9.6.12 (Sanitas). The method detection limits (MDL), practical quantitation limits (PQL), reporting limits (RL) and detected concentrations (quantified values) of the (non-Radium) background data received from the contract analytical laboratory's electronic data deliverable (EDD) files for each background sampling event were imported into Sanitas. The PQL and RL values for each constituent in the background data are identical except for Radium 226 and 228 (combined). Radium results are combined additively (Ra226 + Ra228) and compared to the sum of the respective Minimum Detectable Concentrations (MDCs) to assess detection. Upon importing the EDD files into Sanitas, the MDL for each constituent, except Radium, is assigned the reported concentration less the reported PQL/RL. Radium 226 and 228 (combined) values lower than the sum of MDCs are treated as qualified data, which are used in the background data analyses as qualified concentrations.

2.0 GROUNDWATER DETECTION MONITORING NETWORK

The Fly Ash Pond groundwater detection monitoring network consists of five permanent wells (Figure 1). All five wells are relatively shallow (approximately 35 feet) in depth and are identified as MW-1, MW-2, MW-3, MW-7 and MW-9 (Table 1). All wells constituting the Fly Ash Pond detection monitoring network are screened within and obtain groundwater from the alluvial (uppermost) aquifer that underlies the ash pond site. Based on an overall west-southwestward groundwater flow direction, wells considered hydraulically downgradient of Fly Ash Pond include MW-1, MW-7, and MW-9. Similarly, wells considered hydraulically upgradient of the Fly Ash Pond include MW-2 and MW-3. The Fly Ash Pond groundwater detection monitoring well network summary provided in Table 1 contains additional details concerning the location and construction aspects of the five-well network.

Three of the monitoring wells (MW-1 through MW-3) were installed in April 2016. Monitoring well MW-7 was installed in April 2017. The remaining well (MW-9) was installed in November 2017. All Fly Ash Pond wells have been sampled eight times (beginning in late-March, 2018, and ending in mid-December 2018) for establishing baseline groundwater data.

Statistical independence of groundwater samples is most likely when samples are collected at time intervals sufficiently large to prevent sampling the same volume of groundwater. Accordingly, time intervals separating monitoring events were sufficient to ensure physical independence of samples. A minimum interval was calculated with hydraulic gradient, hydraulic conductivity and effective porosity based on Unified Guidance. The calculated interval is based on the time required for groundwater to travel the distance of the well bore (maximum diameter of the well and surrounding filter pack). Groundwater sampling was then conducted at intervals greater than this calculated interval.

A summary of background analytical data results for the Fly Ash Pond groundwater detection monitoring network is presented in Table 2.

3.0 EXPLORATORY DATA ANALYSIS

Exploratory Data Analysis (EDA) of the background data refers to a collection of descriptive and graphical statistical tools used to explore and understand a data set (ITRC, 2013). Generally, EDA includes a numerical summary and graphical displays such as Time Series Plots, Box and Whisker Plots, Histograms and Probability Plots. EDA methods were selected to generate outputs using Sanitas software. The seven constituents for detection monitoring listed in 40 CFR 257 - Appendix III and the 15 constituents for assessment monitoring listed in 40 CFR 257 - Appendix IV (note Fluoride is included in detection and assessment monitoring) (Table 3) were evaluated by EDA methods for each of the monitoring wells located at the SPS Fly Ash Pond site. This report includes complete data sets for five wells for a total of 105 well/constituent pairs (21 constituents x 5 wells), and a total of 840 (105 well/constituent pairs x 8 background sampling events) individual background data points. Table 3 lists the required constituents for detection and assessment monitoring, as shown in 40 CSR 257 - Appendix III and IV, respectively. This table also specifies the analytical method used by the contract laboratory for each constituent. Units of measurement, PQL/RL and range of MDL for each constituent are also summarized.

3.1 Time Series Plots

A Time Series Plot of concentration data versus time allows for the observation and assessment of the lack of randomness, changes in location, change in scale, small scale trends, or large-scale trends over time (Unified Guidance, 2009). Possible outliers may also be apparent in Time Series Plots. Time Series Plots (Appendix A) were generated for each well/constituent pair from the sets of background data.

Trends are visually suggested in the data for some constituents. However, some of these trends are decreasing and may be attributed to initial data spikes that are data ‘artifacts’ following installation of the wells. These apparent trends may also be the result of seasonal fluctuations in the groundwater table. In the case of Radium, apparent trends may be an artifact of drift in MDCs, which varies as a function of sample volume, recovery, and detector efficiency.

3.2 Box and Whisker Plots

Box and Whisker Plots graphically illustrate the range and extreme values found in a set of data. Box and Whisker Plots (Appendix B) were developed for each well/constituent pair from the sets of background data. The Box and Whisker Plots in Appendix B are preceded by a data summary table, which is generated by Sanitas.

The 25th and 75th percentiles show the typical concentration range or the interquartile range (IQR) of each constituent. The median value (50th percentile), which is represented in the Sanitas Box and Whisker Plots as a solid line between the 25th and 75th percentiles, is an estimate of the typical value found for the concentration of the constituent in the well. The “Whiskers” indicate the extreme values of the data set. The mean (average) value is denoted by a "+". If a value is not plotted for a well/constituent pair, all values were reported less than the PQL/RL. Sample population means (averages) for constituents that show variation among a set of compared wells may indicate spatial variation, which is defined as statistically identifiable differences in mean and/or variance levels across the well field (Unified Guidance, 2009).

Each of the wells include several well/constituent pairs suggestive of spatial variation and the possibility of multiple target populations as defined by Unified Guidance (2009). This observation is based on the variation in mean values and IQR as demonstrated by an assessment of the Box and Whisker Plots. Multiple target populations are apparent on Box and Whisker Plots in Appendix B for Barium, Boron, Calcium, Chloride, Cobalt, Fluoride, Lithium, Molybdenum, pH, Selenium, Sulfate, and Total Dissolved Solids (TDS).

3.3 Histograms

"*A histogram is a visual representation of the data collected into groups. This graphical technique provides a visual method of identifying the underlying distribution of the data. The data range is divided into several bins or classes and the data is sorted into the bins. A histogram is a bar graph conveying the bins and the frequency of data points in each bin*" (Unified Guidance, 2009).

The 'frequency' of the background data values is represented on the y-axis versus the range of constituent concentrations (data values) within the 'bins' along the x-axis. The Histograms provide a visual method to evaluate the skewness, kurtosis and symmetry (the overall location, shape and spread) of the background data, and are useful in showing how the background data may not be normally distributed (Unified Guidance, 2009).

Histograms (Appendix C) were generated for the well/constituent pairs from the background data and provide an additional EDA method for observation and assessment. As an example, the well/constituent pair of Arsenic from the background data set for MW-9 show the data is right-skewed (positive value) due to the prevalence of relatively low concentrations, whereas the values for Barium from the background data set for MW-3 show a left-skewed (negative value) due to the low frequency relatively low concentrations in this data set. A symmetrical, bell-shaped curve (normal distribution) is apparent in the Histogram for the constituent Chloride for the MW-2 background data set.

3.4 Probability Plots

"*Probability plots are particularly useful for spotting irregularities within the data when compared to a specific distributional model (usually, but not always, the normal). It is easy to determine whether departures from normality are occurring more or less in the middle ranges of the data or in the extreme tails. Probability plots can also indicate the presence of possible outlier values that do not follow the basic pattern of the data and can show the presence of significant positive or negative skewness*" (Unified Guidance, 2009).

Probability Plots (Appendix D) were generated for the well/constituent pairs from the background data and provide an additional EDA method for observation and assessment.

The Probability Plots aid in determining if there are multiple possible outliers or a single possible outlier within a well/constituent pair and are used, with Time Series Plots and Box and Whisker Plots, to justify possible outliers. Possible outliers are data points on the Probability Plots that visually appear out of alignment with the rest of the data.

As an example, possible outliers for Arsenic and Chromium are apparent on Time Series Plots for monitoring well MW-9 for the April 15, 2018 and May 23, 2018 background sampling events. The Probability Plots for these constituents suggest possible outliers as the data points are out of alignment with the rest of the sample population. Additionally, the Box and Whisker Plots provide further support for a possible outlier for Chromium in MW-9 as the sample population data show an extended upper ‘whisker’ that exceeds three times the IQR (described in Section 3.2). These potential outliers were not statistically confirmed because the Shapiro-Wilk testing method for normality failed and the results for Tukey’s method were invalid due to equal upper and lower IQRs as further discussed in Section 4.1.

4.0 RESULTS SUMMARY

The evaluation of the SPS Fly Ash Pond site background data was completed using a series of four statistical evaluation techniques generated by Sanitas software. These include Exploratory Data Analysis (EDA), Outlier Analysis, Trend Testing, and Analysis of Variance (ANOVA). The EDA technique is discussed in Section 3.0 and the remaining background data statistical evaluation techniques are discussed below.

4.1 Outlier Analysis

"*Outliers or observations not derived from the same population as the rest of the sample violate the basic statistical assumption of identically-distributed measurements. The Unified Guidance recommends that testing of outliers be performed on background data, but they generally not be removed unless some basis for a likely error or discrepancy can be identified. Such possible errors or discrepancies could include data recording errors, unusual sampling and laboratory procedures or conditions, inconsistent sample turbidity, and values significantly outside the historical ranges of background data*" (Unified Guidance, 2009).

"*If an outlier value with much higher concentration than other background observations is not removed from background prior to statistical testing, it will tend to increase both the background sample mean and standard deviation…It may be advisable at times to remove high-magnitude outliers in background even if the reasons for these apparently extreme observations are not known. The overall impact of removal will tend to improve the power of prediction limits and control charts, and thus result in a more environmentally protective program*" (Unified Guidance, 2009).

The background data was initially evaluated for possible outliers using the EDA outputs, which included Time Series Plots, Box and Whisker Plots, Histograms and Probability Plots. The following procedure provides the basis for the 'statistical' evaluation of possible outliers:

1. The background data well/constituent pairs sample populations were analyzed for outliers using the Sanitas program by initially screening for possible outliers with the EPA 1989 Outlier Test (Grubb's Test).
2. The data points within the sample populations were normality tested using the Shapiro-Wilk Test. The purpose of normality testing is to determine whether the sample populations are normally distributed.
3. Data that is normally distributed or can be normalized through transformation by the Ladder of Powers methods were then further analyzed for possible outliers using Dixon's Test, which is a parametric statistical outlier identification test. If the sample populations cannot be normalized by the Shapiro-Wilk test or through Ladder of Powers transformation, Dixon's Test method is halted.
4. All possible outliers selected during the EDA evaluation were not identified by the above procedures due to the non-normalizable sample population. These possible outliers were further tested (continued even if the distribution remained non-

normalizable) to determine if they could be confirmed. None of the possible outliers were confirmed as a result of the additional testing.

5. Possible outliers selected during the EDA evaluation that were not identified by the above procedures were reanalyzed using Tukey's method for outlier analysis, which indicates possible 'extreme' low or high outliers (Tukey, 1977; Unified Guidance, 2009), if the outlier concentrations exceed three times the interquartile range (IQR) on the Box and Whisker Plots, as described in Section 3.2. Outliers were not confirmed as a result of Tukey's method analysis.

Using the above-mentioned outlier analysis procedures, no outliers (Appendix E) were identified out of 840 background data points. The outlier plots are located in Appendix E, as generated by Sanitas.

4.2 Trend Analysis

"*A key implication of the independent and identically distributed assumption is that a series of sample measurements should be stationary over time (i.e., stable in mean level and variance). Data that are trending upward or downward violate this assumption since the mean level is changing. Seasonal fluctuations also violate this assumption since both the mean and variance will likely oscillate…With interwell tests and a common (upgradient) background, a trend can signify several possibilities: Contaminated background; A 'break-in' period following new well installation; Site-wide changes in the aquifer; and Seasonal fluctuations, perhaps on the order of several months to a few years*" (Unified Guidance, 2009).

The Sen's Slope/Mann-Kendall (non-parametric) trend test within Sanitas was selected to identify statistically significant downward or upward trends (Appendix F) in the background data. The trend analysis plots located in Appendix F are preceded with a data summary table of significant trends, as generated by Sanitas. Trend testing of monitoring wells and their respective results are as follows:

- The upgradient wells (MW-2 and MW-3) display apparent increasing and decreasing trends among the 42 well/constituent pairs (2 wells x 21 constituents). However, only Boron and Calcium were identified in the MW-2 background data set as having significant trends by Sanitas. Both identified significant trends were increasing.
- The downgradient wells (MW-1, MW-7 and MW-9) display apparent increasing and decreasing trends among the 63 well/constituent pairs (3 wells x 21 constituents). Sanitas trend analyses confirmed increasing trends in MW-1 (Barium, Calcium, Chloride, pH and Radium) and decreasing trends in MW-7 (Chloride) and MW-9 (Boron and Molybdenum).

4.3 Analysis of Variance

Analysis of Variance (ANOVA) is defined as a statistical method for identifying differences among several population means or medians. "*If a one-way ANOVA on the set of* *background wells finds significant differences in the mean levels for some constituents, and hence, evidence of spatial variability, the guidance recommends using intrawell tests...The method is particularly useful for a group of multiple upgradient wells, to determine whether or not there are large average concentration differences from one location to the next due to natural groundwater fluctuations and/or differences in geochemistry* (Unified Guidance, 2009).

In accordance with the Unified Guidance (2009), natural or man-made differences in mean levels, referred to as spatial variability, impact how background is established and evidence of spatial variation supports the selection of an intrawell statistical approach. The following general procedure provides the basis for ANOVA testing within Sanitas.

1. The background data was analyzed via one-way ANOVA using the Shapiro-Wilk (n ≤ 50) or the Shapiro-Francia (n > 50) parametric methods to test residuals for normality.
2. If the distributions are determined to be non-normal as a result of the Shapiro-Wilk parametric method, they are analyzed by the Ladder of Powers transformation.
3. Levene's Equality of Variance is then performed on the residuals of the data. "*Levene's test is a formal procedure for testing homogeneity of variance that is fairly robust (i.e., not overly sensitive) to non-normality in the data"* (Unified Guidance, 2009).
4. Background data that is not normalized by transformation, or does not pass Levene's test after transformation, are then analyzed using the Kruskal-Wallis non-parametric method by testing the differences among average population ranks equivalent to the medians to assess spatial variability.

One-way ANOVA (Appendix G) for normal distribution (parametric) and non-normal distribution (non-parametric) was performed on the background data from the upgradient wells (MW-2 and MW-3) to assess spatial variability. The ANOVA data summary sheets provided in Appendix G are preceded by a data summary table of significant ANOVA results, as generated by Sanitas. Overall, the ANOVA tests (parametric and non-parametric) indicated three of seven Appendix III constituents and one of three Appendix IV constituents (4 of 10 total) were significantly different in the comparison among the upgradient wells. However, two of the Appendix IV constituents (Cobalt and Selenium) had few reported concentrations and variance is not apparent. The three Appendix III and one Appendix IV constituents identified by ANOVA as being statistically significant and having spatial variation are generally apparent on the Box and Whisker Plots for the same upgradient wells. The constituents Antimony, Arsenic, Beryllium, Cadmium, Chromium, Lead, Lithium, Mercury, Molybdenum, and Thallium were not analyzed by ANOVA because 100 percent of the sample population values are less than the PQL/RL.

ANOVA testing by comparing the 'pooled' upgradient wells (MW-2 and MW-3) to the downgradient wells is not justified because spatial variation is present among the upgradient wells. According to the Unified Guidance (2009), "*If the spatial variation is ignored and data* *are pooled across wells with differing mean levels (and perhaps variances) to run an interwell parametric prediction limit or control chart test, the pooled standard deviation will tend to be substantially larger than expected. This will result in a higher critical limit for the test. Using pooled data with spatial variation will also tends to increase observed maximum values in background, leading to higher and less powerful non-parametric prediction limit tests. In either application, there will be a loss of statistical power for detecting concentration changes at individual compliance wells. Compliance wells with naturally higher mean levels will also be more frequently determined to exceed the limit than expected, while real increases at compliance wells with naturally lower means will go undetected more often*".

5.0 CONCLUSIONS

This Baseline Groundwater Statistical Evaluation report provides record of baseline concentrations of 40 CFR 257 – Appendix III and IV constituents for detection and assessment monitoring (Table 2) around the SPS Fly Ash Pond site. The concentrations reflect the quality of the groundwater over eight physically independent rounds of background sampling. As additional analytical results from future semi-annual groundwater detection sampling events are added to the data set, the sample population for each well/constituent pair will be refined.

The comparison of values among the detection monitoring well network indicates that the wells at the SPS Fly Ash Pond site should not be compared in the context of upgradient to downgradient using interwell analysis for the following reasons:

- Box and Whisker Plots indicate the presence of spatial variation among the upgradient wells;
- As verified by ANOVA testing, there is spatial variation among the upgradient wells, and;
- Evidence of increasing data trends among an upgradient well (Boron and Calcium in MW-2).

Overall, the bullet items provided above support the conclusion that there is more than one statistically different target population within the groundwater detection monitoring well network. The different target populations are attributable to the natural spatial variation inherent in an alluvial setting, where groundwater flow conditions are variable and alluvial sediments are a heterogeneous mixture of sands, silts, and clays. The dissimilarity in water quality data among wells during the background monitoring period indicates that intrawell analysis is an appropriate statistical method to evaluate possible changes in groundwater quality during semi-annual detection monitoring events. The background data set should be reviewed and updated every two to three years as additional data are acquired. In addition, the statistical analysis methodology of such future events may be updated and modified as appropriate

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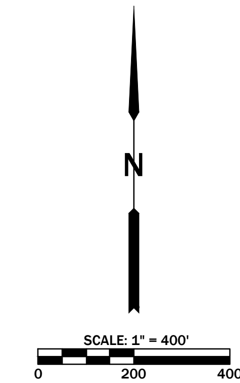
FIGURES



LEGEND

PROPERTY LINE	PL
MONITORING WELL (FLY ASH POND)	F
UP GRADIENT MONITORING LOCATION	UG
DOWN GRADIENT MONITORING LOCATION	DG

NOTES:

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

#	DATE	REVISION DESCRIPTION	BY

FIGURE 1
GROUNDWATER MONITORING
WELL LOCATION MAP

SIKESTON POWER STATION
FLY ASH POND
BASELINE GROUNDWATER
STATISTICAL EVALUATION

SURVEYED	DESIGNED	DRAWN	CHECKED	APPROVED	DATE	SCALE	PROJECT NAME	FILE NAME	SHEET #
NA	NA	CP	TAD	MCC	4/2019	AS NOTED	SIKESTON/CCR	GW MON WELL LOC MAP	1 OF 1

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

M:\Share\CADDFiles\SIKESTON\FLY AS POND APRIL EDITS\GW MONITORING WELL LOCATION MAP.dwg, FIGURE, 4/3/2019 1:32:24 PM

TABLES

Sikeston Board of Municipal Utilities
Sikeston Power Station
Fly Ash Pond Baseline Groundwater Statistical Evaluation
Sikeston, Missouri

Well Construction Summary
Table 1

Monitoring Well ID[1,2]	Northing Location[3]	Easting Location[3]	Ground Surface Elevation[3] (feet)	Top of Riser Elevation[3] (feet)	Well Depth[4] (feet)	Base of Well Elevation[5] (feet)	Screen Length[6] (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. MW-1 through MW-3 formerly termed TPZ-1 through TPZ-3 in Site Characterization Report (May 2017).
2. Refer to Figure 1 for monitoring well locations.
3. Monitoring well survey data provided by Bowen Engineering & Surveying, Inc.
   Horizontal Datum: Missouri State Plane Coordinates - NAD 83 (Feet), Vertical Datum: NAVD 88 (Feet).
4. Depth measurements relative to surveyed point on top of well casing.
5. Sump installed at base of screen (0.2 feet length).
6. Actual screen length (9.7 feet) is the machine-slotted section of the 10-foot length of Schedule 40 PVC pipe.

April 17, 2019
Prepared by: TAD
Checked by: MCC

Sikeston Board of Municipal Utilities - Sikeston Power Station
Fly Ash Pond Baseline Groundwater Statistical Evaluation
Scott County, Missouri

Table 2 - Groundwater Quality Summary

		Field Parameters						Appendix III Monitoring Constituents (Detection)						Appendix IV Monitoring Constituents (Assessment)													
Well	Date	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
MW-1 (DG)	3/21/2018	249.6	7.31	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	233.8	7.36	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	220.0	7.35	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	227.4	7.27	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	264.3	7.16	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	281.3	7.14	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	311.8	7.11	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	317.5	7.06	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)
MW-2 (UG)	3/21/2018	157.8	6.35	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	159.8	6.36	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)
	5/23/2018	175.3	6.18	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)
	6/27/2018	172.1	6.16	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)
	8/1/2018	184.2	6.11	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	187.9	6.09	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
	11/6/2018	174.3	6.19	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	186.3	6.13	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)
MW-3 (UG)	3/21/2018	220.7	6.57	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	224.7	6.48	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	221.3	6.49	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	198.7	6.45	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	209.2	6.55	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	196.8	6.51	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	206.7	6.49	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	195.6	6.50	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)
MW-7 (DG)	3/21/2018	901.8	7.30	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)
	4/15/2018	936.4	7.24	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	899.1	7.25	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	891.4	7.22	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	958.3	7.22	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)
	9/5/2018	873.3	7.29	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	787.9	7.35	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
	12/12/2018	784.8	7.27	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)
MW-9 (DG)	3/21/2018	979.8	7.35	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	972.7	7.37	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	1020.5	7.34	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	902.9	7.32	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	942.6	7.28	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	829.2	7.31	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	732.8	7.34	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	742.9	7.33	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)

Notes:
1. Less than (<) symbol denotes concentration below reportable limits.
2. ND = Radium 226/228 reported less than Minimum Detectable Concentration.

Sikeston Board of Municipal Utilities
Sikeston Power Station
Fly Ash Pond Baseline Groundwater Statistical Evaluation

Table 3
Groundwater Monitoring Constituents

40 CFR 257			
Appendix III - Constituents for Detection Monitoring		**Appendix IV - Monitoring Constituents for Assessment Monitoring**	
Chemical Constituent	**Method**	**Chemical Constituent**	**Method**
pH (S.U.)	Field	Antimony (µg/L)	SW 6020
Boron (µg/L)	SW 6020	Arsenic (µg/L)	SW 6020
Calcium (mg/L)	SW 6020	Barium (µg/L)	SW 6020
Chloride (mg/L)	EPA 300.0	Beryllium (µg/L)	SW 6020
Fluoride (mg/L)	EPA 300.0	Cadmium (µg/L)	SW 6020
Sulfate (mg/L)	EPA 300.0	Chromium (µg/L)	SW 6020
Total Dissolved Solids (mg/L)	SM 2540C	Cobalt (µg/L)	SW 6020
		Fluoride (mg/L)	EPA 300
		Lead (µg/L)	SW 6020
		Lithium (µg/L)	SW 6020
		Mercury (µg/L)	SW 6020
		Molybdenum (µg/L)	SW 6020
		Selenium (µg/L)	SW 6020
		Thallium (µg/L)	SW 6020
		Radium 226 and 228 combined (pCi/L)	EPA 903.1 & 904.0

APPENDICES

Appendix A
Time Series Plots

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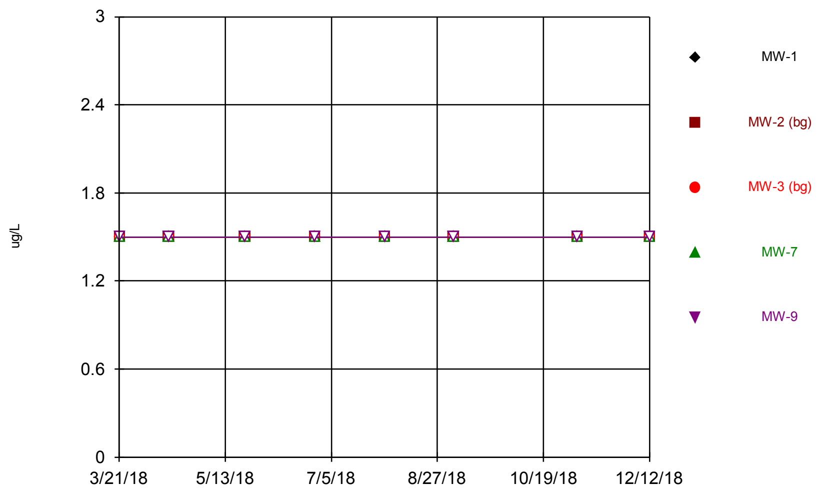
Hollow symbols indicate censored values.

Antimony



Time Series Analysis Run 3/4/2019 1:45 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

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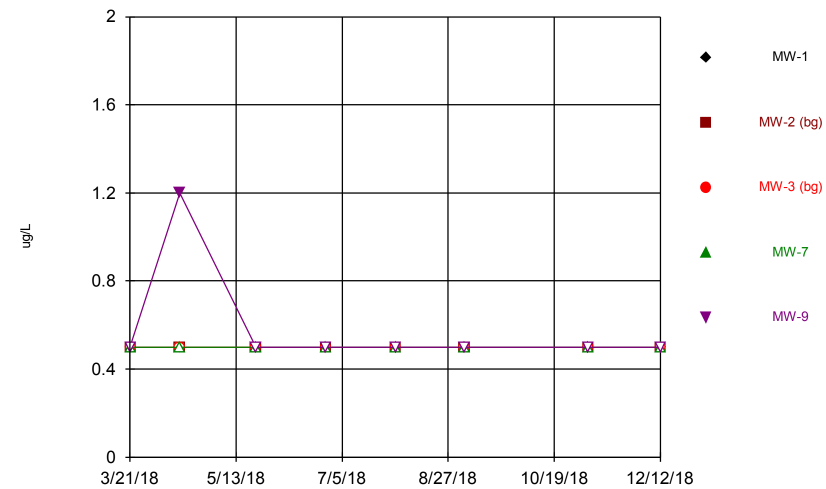
Hollow symbols indicate censored values.

Arsenic



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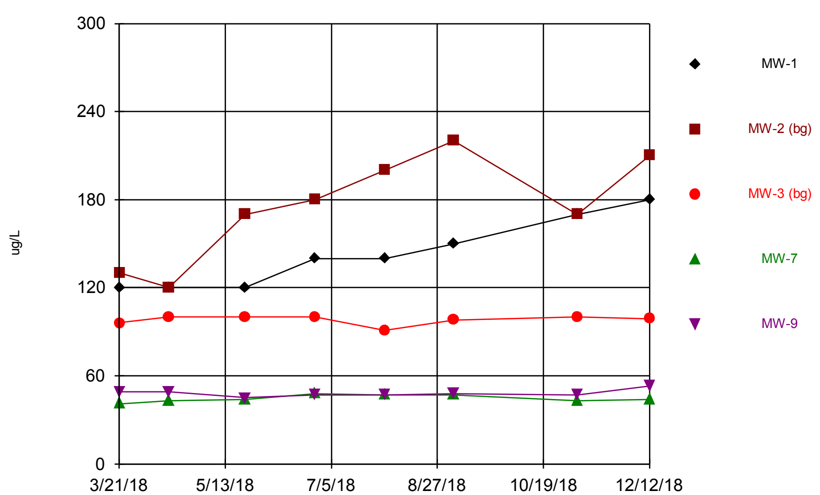
Barium



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SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

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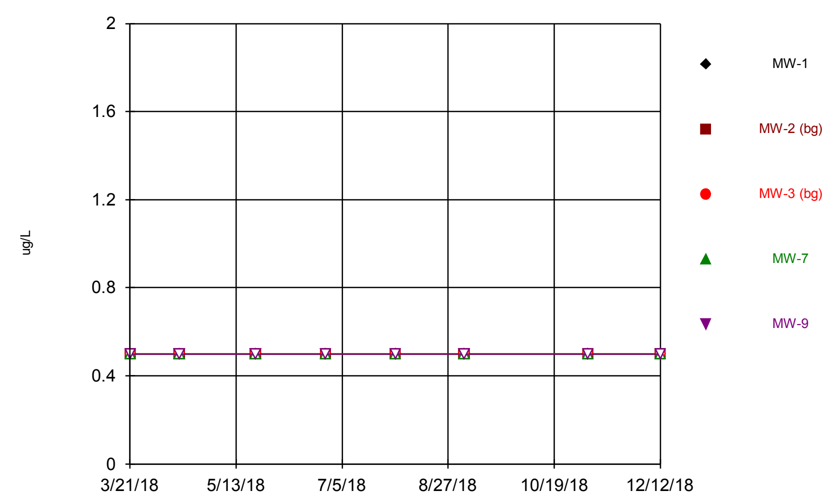
Beryllium



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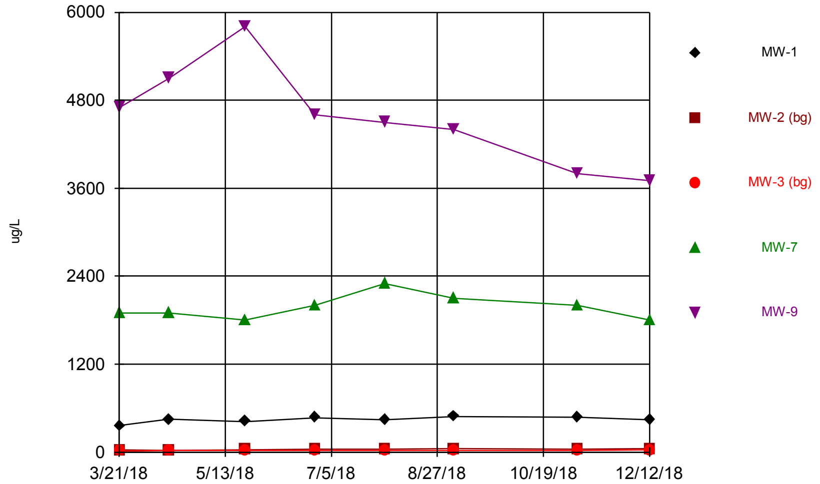
Boron



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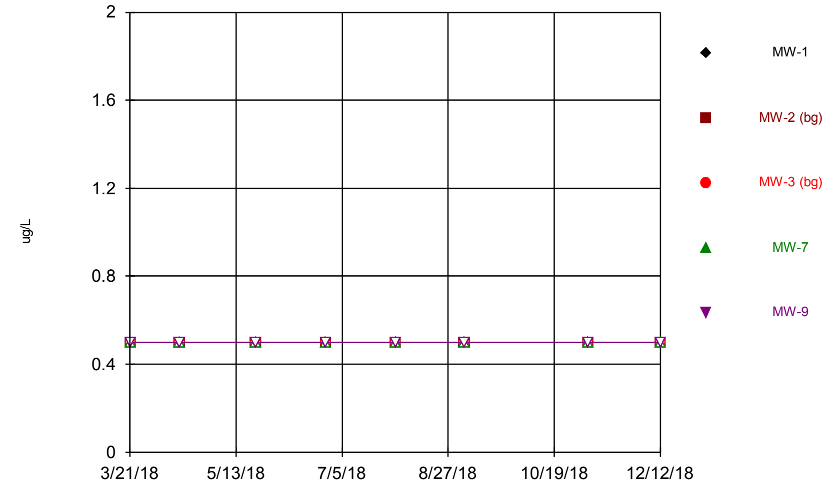
Hollow symbols indicate censored values.

Cadmium



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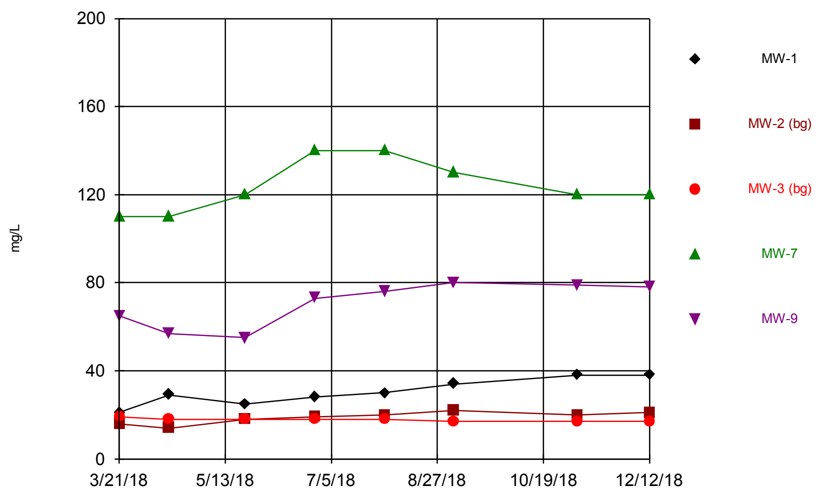
Calcium



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SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

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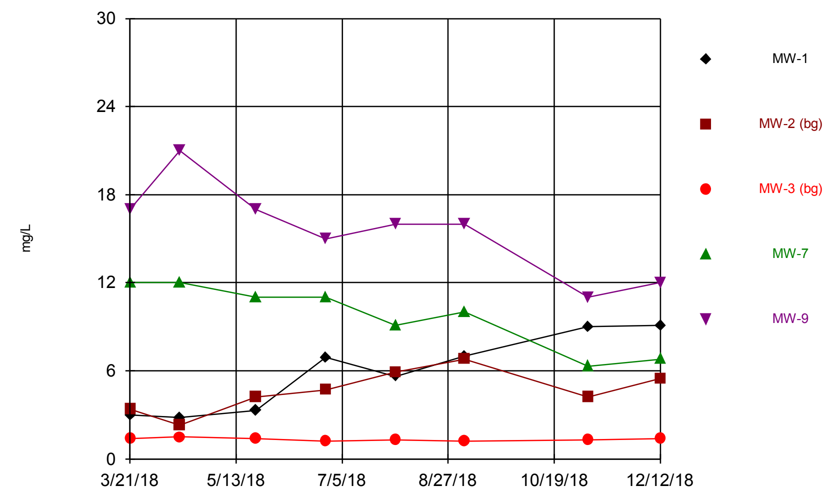
Chloride



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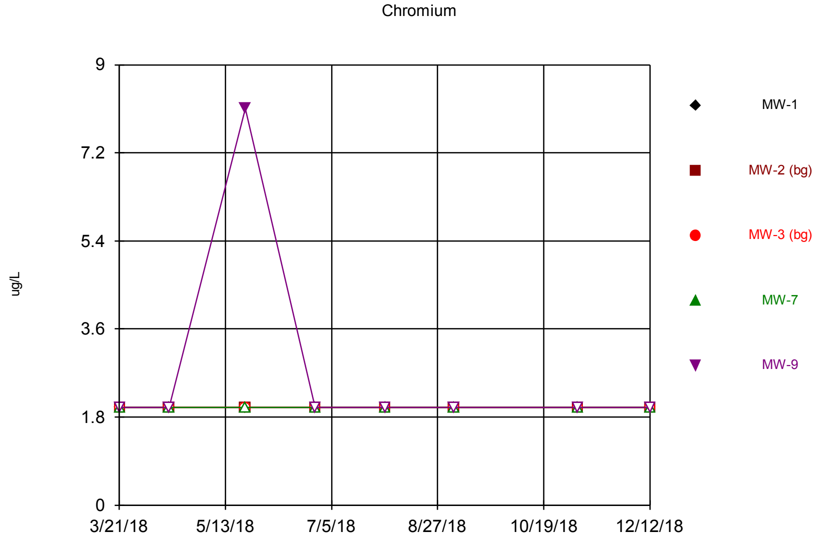

Time Series Analysis Run 3/4/2019 1:45 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

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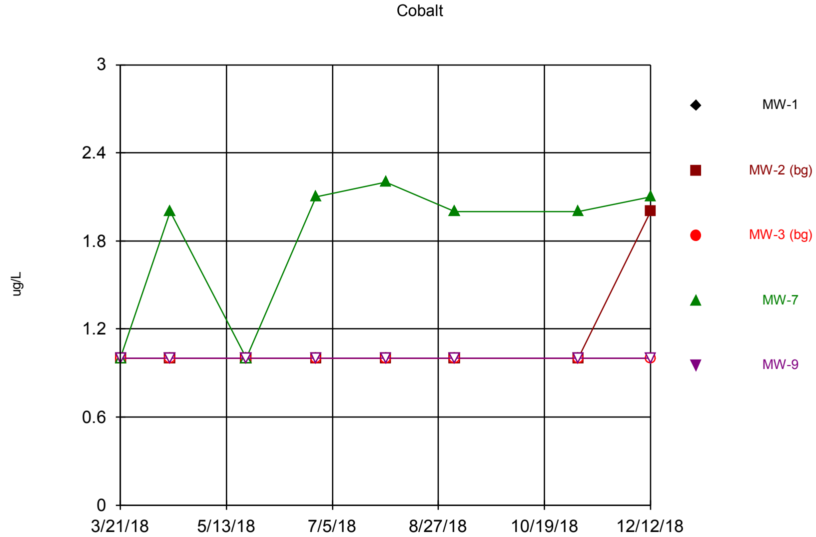
Hollow symbols indicate censored values.



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SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

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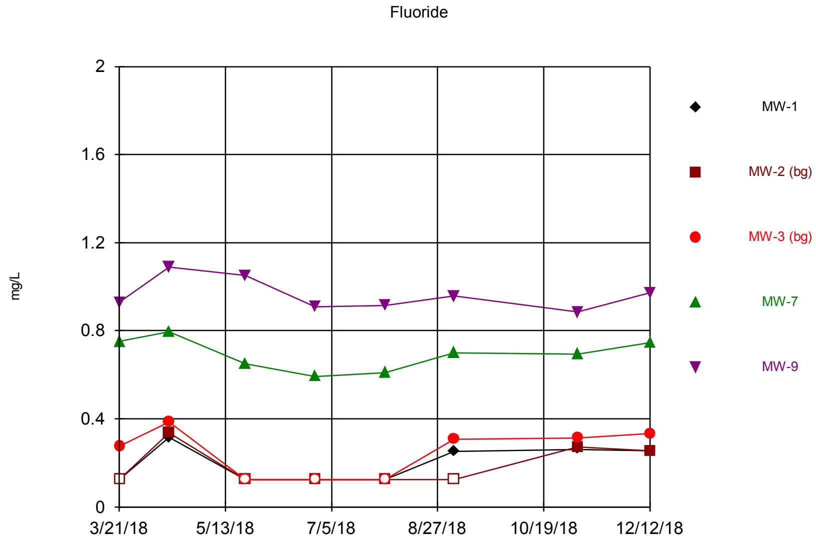
Hollow symbols indicate censored values.



Time Series Analysis Run 3/4/2019 1:45 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

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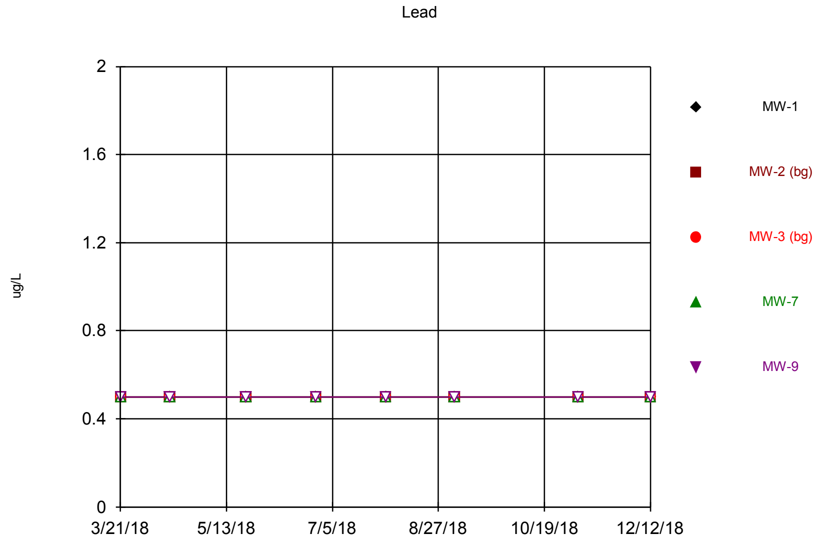

Time Series Analysis Run 3/4/2019 1:45 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

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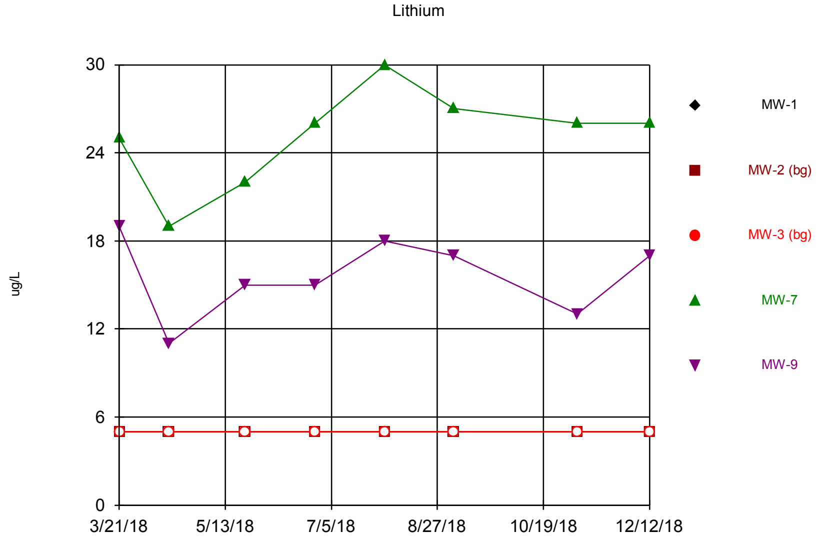
Hollow symbols indicate censored values.



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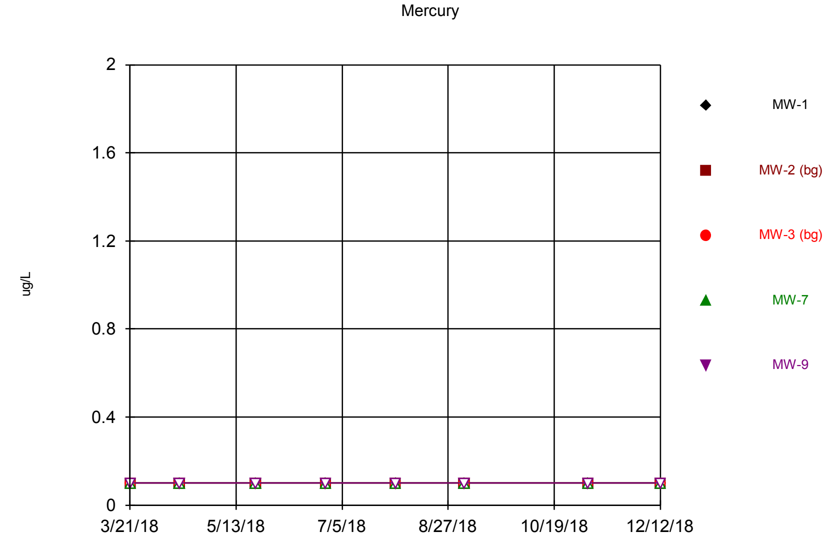

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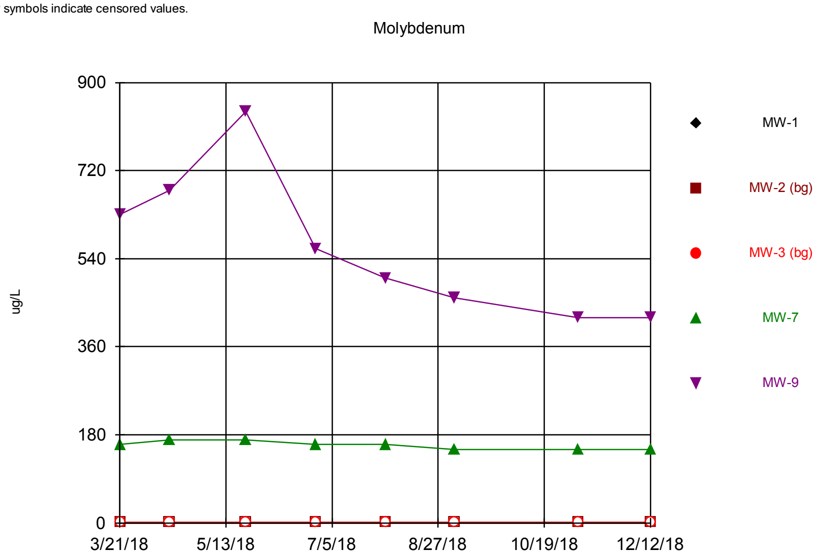

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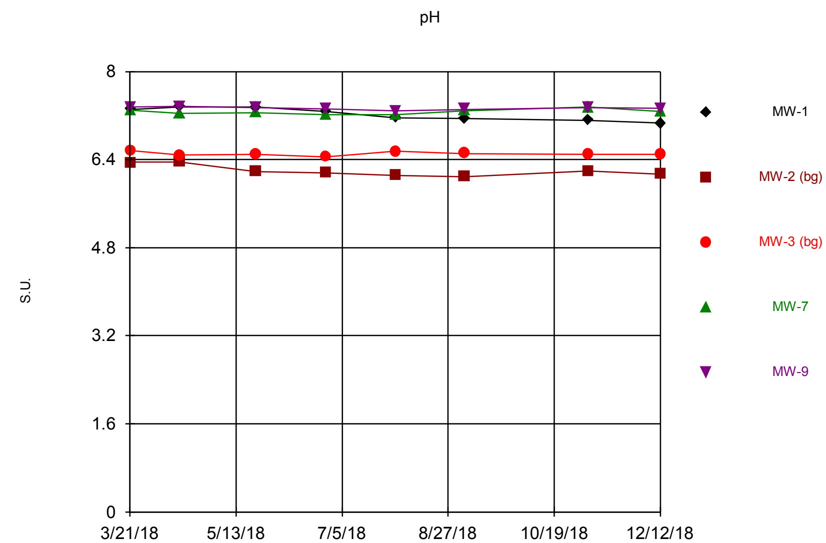

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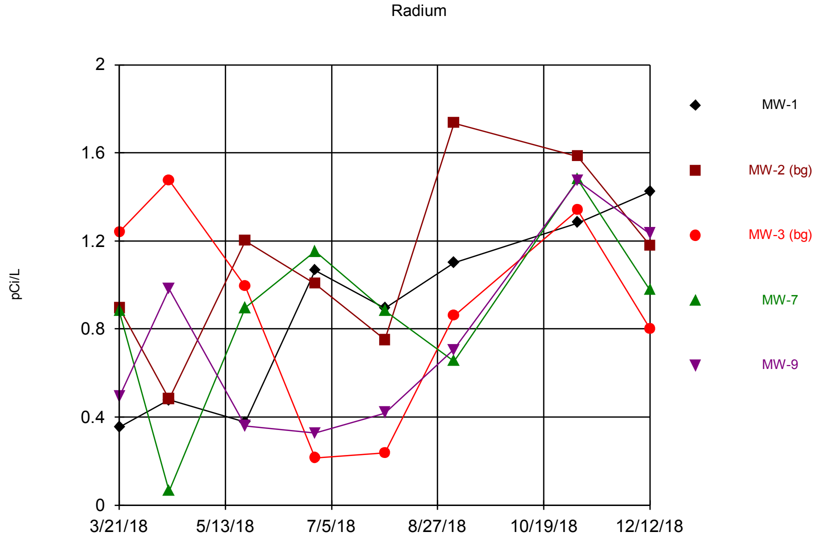

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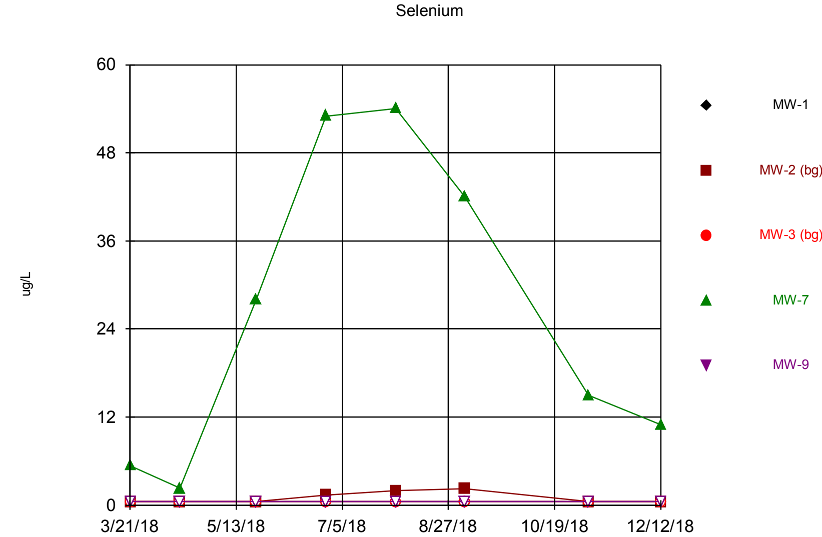

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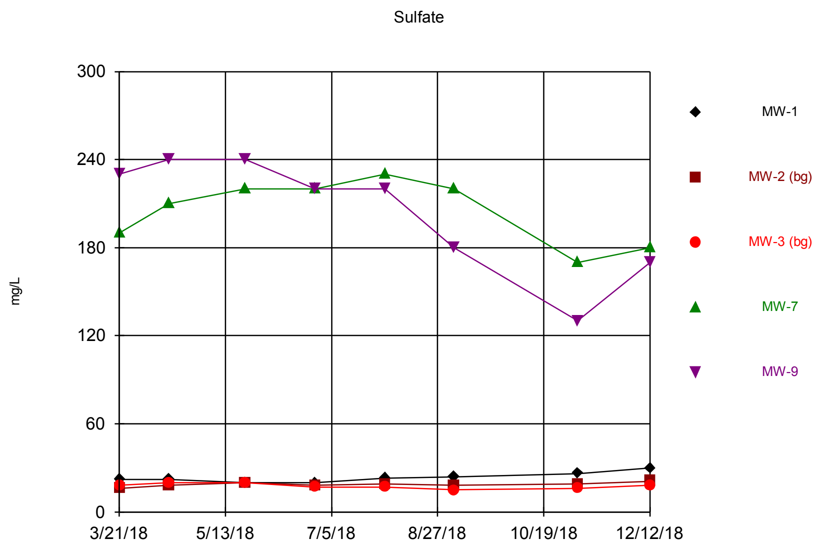

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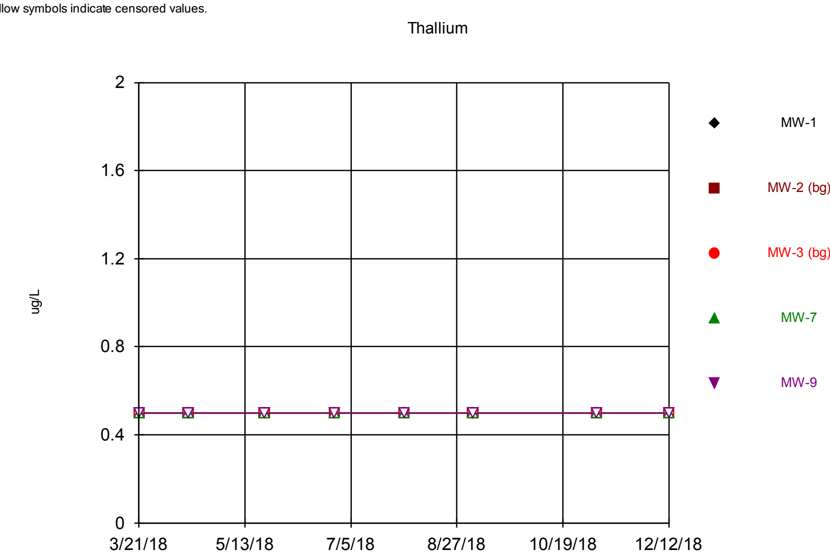

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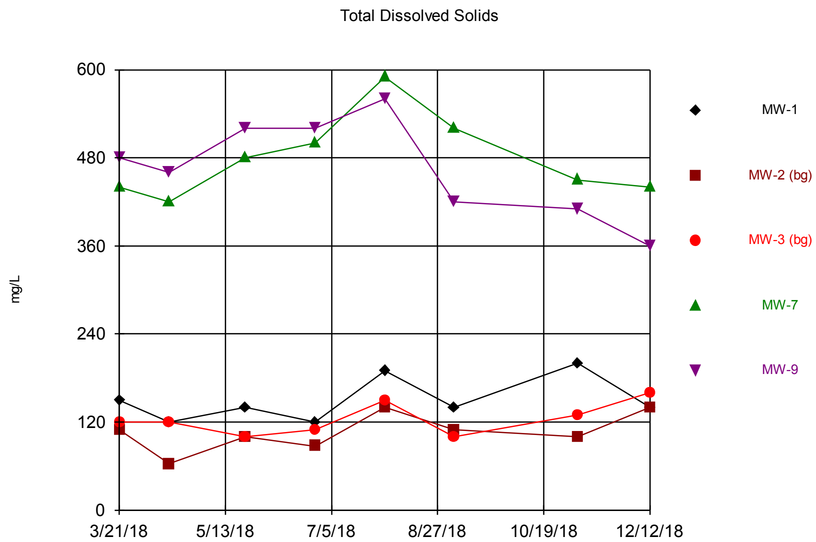

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SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Appendix B

Box and Whisker Plots

Box & Whiskers Plot

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background   Printed 3/4/2019, 1:49 PM

Constituent	Well	N	Mean	Median	Lower Q.	Upper Q.	Min.	Max.	%NDs
Antimony (ug/L)	MW-1	8	1.5	1.5	1.5	1.5	1.5	1.5	100
Antimony (ug/L)	MW-2 (bg)	8	1.5	1.5	1.5	1.5	1.5	1.5	100
Antimony (ug/L)	MW-3 (bg)	8	1.5	1.5	1.5	1.5	1.5	1.5	100
Antimony (ug/L)	MW-7	8	1.5	1.5	1.5	1.5	1.5	1.5	100
Antimony (ug/L)	MW-9	8	1.5	1.5	1.5	1.5	1.5	1.5	100
Arsenic (ug/L)	MW-1	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Arsenic (ug/L)	MW-2 (bg)	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Arsenic (ug/L)	MW-3 (bg)	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Arsenic (ug/L)	MW-7	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Arsenic (ug/L)	MW-9	8	0.5875	0.5	0.5	0.5	0.5	1.2	87.5
Barium (ug/L)	MW-1	8	142.5	140	120	160	120	180	0
Barium (ug/L)	MW-2 (bg)	8	175	175	150	205	120	220	0
Barium (ug/L)	MW-3 (bg)	8	98	99.5	97	100	91	100	0
Barium (ug/L)	MW-7	8	44.63	44	43	47	41	48	0
Barium (ug/L)	MW-9	8	48.13	47.5	47	49	45	53	0
Beryllium (ug/L)	MW-1	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Beryllium (ug/L)	MW-2 (bg)	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Beryllium (ug/L)	MW-3 (bg)	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Beryllium (ug/L)	MW-7	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Beryllium (ug/L)	MW-9	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Boron (ug/L)	MW-1	8	443.8	445	430	475	360	490	0
Boron (ug/L)	MW-2 (bg)	8	38.63	42.5	32	44.5	23	48	0
Boron (ug/L)	MW-3 (bg)	8	23.25	23.5	20.5	26.5	17	28	0
Boron (ug/L)	MW-7	8	1975	1950	1850	2050	1800	2300	0
Boron (ug/L)	MW-9	8	4575	4550	4100	4900	3700	5800	0
Cadmium (ug/L)	MW-1	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Cadmium (ug/L)	MW-2 (bg)	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Cadmium (ug/L)	MW-3 (bg)	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Cadmium (ug/L)	MW-7	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Cadmium (ug/L)	MW-9	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Calcium (mg/L)	MW-1	8	30.38	29.5	26.5	36	21	38	0
Calcium (mg/L)	MW-2 (bg)	8	18.75	19.5	17	20.5	14	22	0
Calcium (mg/L)	MW-3 (bg)	8	17.75	18	17	18	17	19	0
Calcium (mg/L)	MW-7	8	123.8	120	115	135	110	140	0
Calcium (mg/L)	MW-9	8	70.38	74.5	61	78.5	55	80	0
Chloride (mg/L)	MW-1	8	5.838	6.25	3.15	8	2.8	9.1	0
Chloride (mg/L)	MW-2 (bg)	8	4.625	4.45	3.8	5.7	2.3	6.8	0
Chloride (mg/L)	MW-3 (bg)	8	1.338	1.35	1.25	1.4	1.2	1.5	0
Chloride (mg/L)	MW-7	8	9.775	10.5	7.95	11.5	6.3	12	0
Chloride (mg/L)	MW-9	8	15.63	16	13.5	17	11	21	0
Chromium (ug/L)	MW-1	8	2	2	2	2	2	2	100
Chromium (ug/L)	MW-2 (bg)	8	2	2	2	2	2	2	100
Chromium (ug/L)	MW-3 (bg)	8	2	2	2	2	2	2	100
Chromium (ug/L)	MW-7	8	2	2	2	2	2	2	100
Chromium (ug/L)	MW-9	8	2.763	2	2	2	2	8.1	87.5
Cobalt (ug/L)	MW-1	8	1	1	1	1	1	1	100
Cobalt (ug/L)	MW-2 (bg)	8	1.125	1	1	1	1	2	87.5
Cobalt (ug/L)	MW-3 (bg)	8	1	1	1	1	1	1	100
Cobalt (ug/L)	MW-7	8	1.8	2	1.5	2.1	1	2.2	25
Cobalt (ug/L)	MW-9	8	1	1	1	1	1	1	100

Box & Whiskers Plot

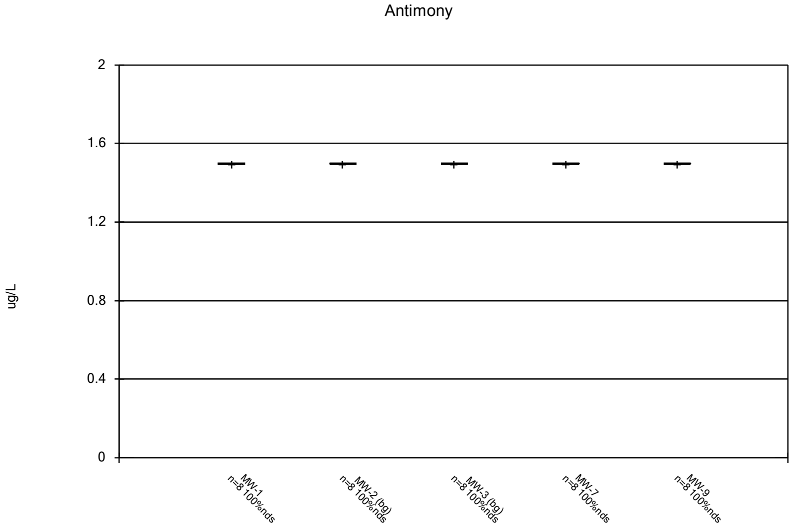
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background Printed 3/4/2019, 1:49 PM

Constituent	Well	N	Mean	Median	Lower Q.	Upper Q.	Min.	Max.	%NDs
Fluoride (mg/L)	MW-1	8	0.1983	0.1885	0.125	0.259	0.125	0.316	50
Fluoride (mg/L)	MW-2 (bg)	8	0.1858	0.125	0.125	0.263	0.125	0.335	62.5
Fluoride (mg/L)	MW-3 (bg)	8	0.2488	0.291	0.125	0.3235	0.125	0.386	37.5
Fluoride (mg/L)	MW-7	8	0.6919	0.6965	0.629	0.749	0.592	0.794	0
Fluoride (mg/L)	MW-9	8	0.9636	0.943	0.913	1.011	0.885	1.09	0
Lead (ug/L)	MW-1	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Lead (ug/L)	MW-2 (bg)	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Lead (ug/L)	MW-3 (bg)	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Lead (ug/L)	MW-7	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Lead (ug/L)	MW-9	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Lithium (ug/L)	MW-1	8	5	5	5	5	5	5	100
Lithium (ug/L)	MW-2 (bg)	8	5	5	5	5	5	5	100
Lithium (ug/L)	MW-3 (bg)	8	5	5	5	5	5	5	100
Lithium (ug/L)	MW-7	8	25.13	26	23.5	26.5	19	30	0
Lithium (ug/L)	MW-9	8	15.63	16	14	17.5	11	19	0
Mercury (ug/L)	MW-1	8	0.1	0.1	0.1	0.1	0.1	0.1	100
Mercury (ug/L)	MW-2 (bg)	8	0.1	0.1	0.1	0.1	0.1	0.1	100
Mercury (ug/L)	MW-3 (bg)	8	0.1	0.1	0.1	0.1	0.1	0.1	100
Mercury (ug/L)	MW-7	8	0.1	0.1	0.1	0.1	0.1	0.1	100
Mercury (ug/L)	MW-9	8	0.1	0.1	0.1	0.1	0.1	0.1	100
Molybdenum (ug/L)	MW-1	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Molybdenum (ug/L)	MW-2 (bg)	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Molybdenum (ug/L)	MW-3 (bg)	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Molybdenum (ug/L)	MW-7	8	158.8	160	150	165	150	170	0
Molybdenum (ug/L)	MW-9	8	563.8	530	440	655	420	840	0
pH (S.U.)	MW-1	8	7.22	7.215	7.125	7.33	7.06	7.36	0
pH (S.U.)	MW-2 (bg)	8	6.196	6.17	6.12	6.27	6.09	6.36	0
pH (S.U.)	MW-3 (bg)	8	6.505	6.495	6.485	6.53	6.45	6.57	0
pH (S.U.)	MW-7	8	7.268	7.26	7.23	7.295	7.22	7.35	0
pH (S.U.)	MW-9	8	7.33	7.335	7.315	7.345	7.28	7.37	0
Radium (pCi/L)	MW-1	8	0.8715	0.979	0.428	1.191	0.353	1.423	0
Radium (pCi/L)	MW-2 (bg)	8	1.104	1.093	0.8235	1.391	0.483	1.734	0
Radium (pCi/L)	MW-3 (bg)	8	0.8951	0.927	0.5194	1.29	0.214	1.475	0
Radium (pCi/L)	MW-7	8	0.8729	0.89	0.7675	1.064	0.062	1.478	0
Radium (pCi/L)	MW-9	8	0.7486	0.599	0.3885	1.107	0.327	1.473	0
Selenium (ug/L)	MW-1	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Selenium (ug/L)	MW-2 (bg)	8	1.013	0.5	0.5	1.7	0.5	2.2	62.5
Selenium (ug/L)	MW-3 (bg)	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Selenium (ug/L)	MW-7	8	26.34	21.5	8.2	47.5	2.3	54	0
Selenium (ug/L)	MW-9	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Sulfate (mg/L)	MW-1	8	23.38	22.5	21	25	20	30	0
Sulfate (mg/L)	MW-2 (bg)	8	18.63	18.5	18	19.5	16	21	0
Sulfate (mg/L)	MW-3 (bg)	8	17.63	17.5	16.5	19	15	20	0
Sulfate (mg/L)	MW-7	8	205	215	185	220	170	230	0
Sulfate (mg/L)	MW-9	8	203.8	220	175	235	130	240	0
Thallium (ug/L)	MW-1	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Thallium (ug/L)	MW-2 (bg)	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Thallium (ug/L)	MW-3 (bg)	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Thallium (ug/L)	MW-7	8	0.5	0.5	0.5	0.5	0.5	0.5	100
Thallium (ug/L)	MW-9	8	0.5	0.5	0.5	0.5	0.5	0.5	100

Box & Whiskers Plot

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background   Printed 3/4/2019, 1:49 PM

Constituent	Well	N	Mean	Median	Lower Q.	Upper Q.	Min.	Max.	%NDs
Total Dissolved Solids (mg/L)	MW-1	8	150	140	130	170	120	200	0
Total Dissolved Solids (mg/L)	MW-2 (bg)	8	106.3	105	93.5	125	63	140	0
Total Dissolved Solids (mg/L)	MW-3 (bg)	8	123.8	120	105	140	100	160	0
Total Dissolved Solids (mg/L)	MW-7	8	480	465	440	510	420	590	0
Total Dissolved Solids (mg/L)	MW-9	8	466.3	470	415	520	360	560	0



Box & Whiskers Plot Analysis Run 3/4/2019 1:47 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

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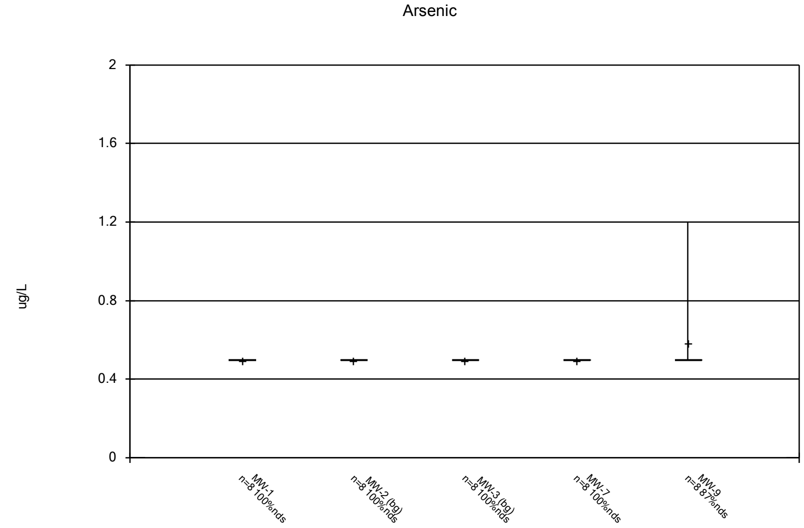

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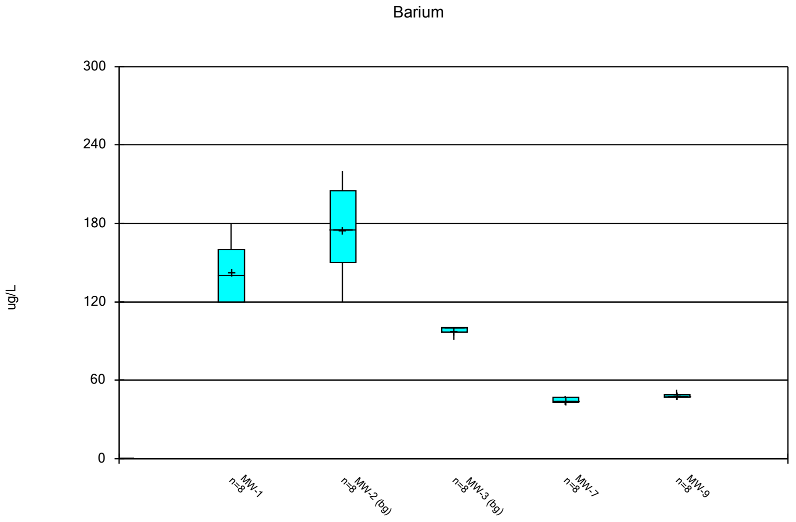

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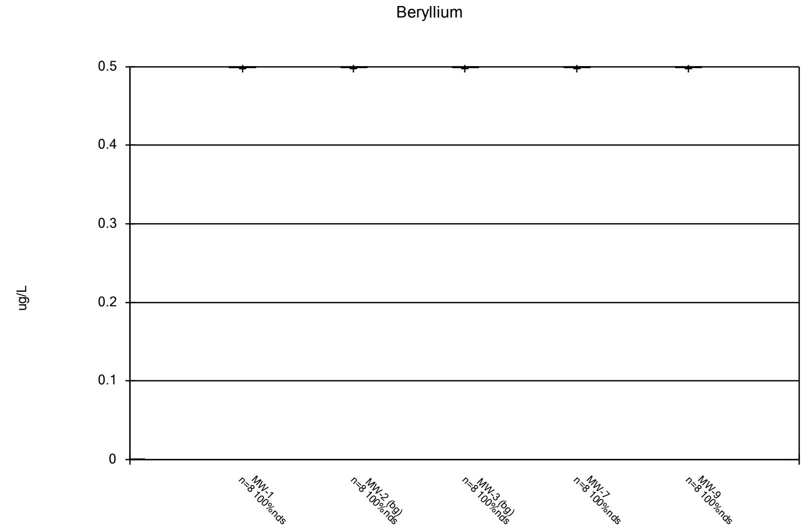

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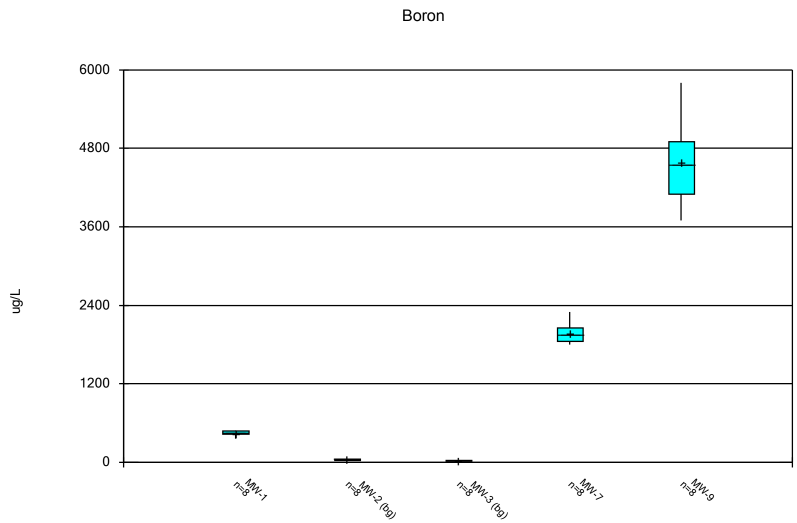

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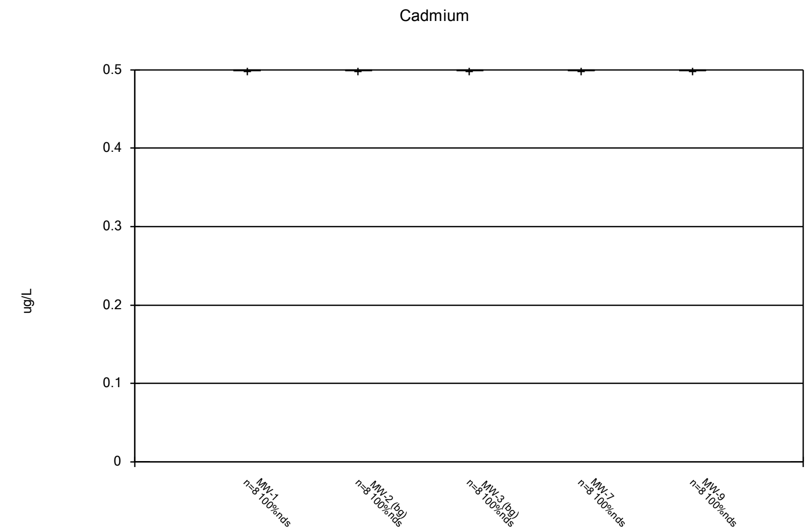

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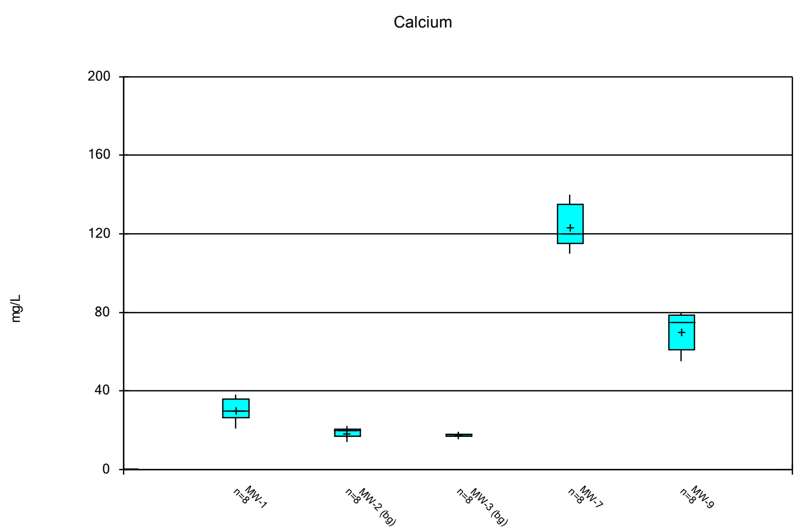

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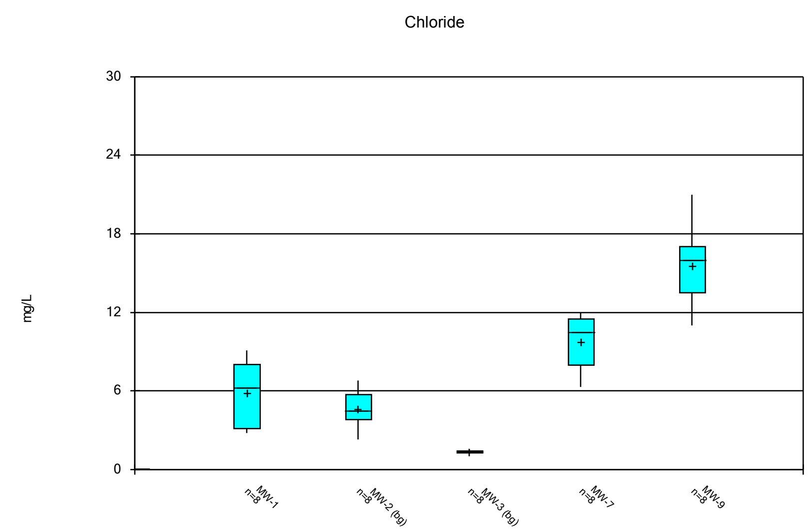

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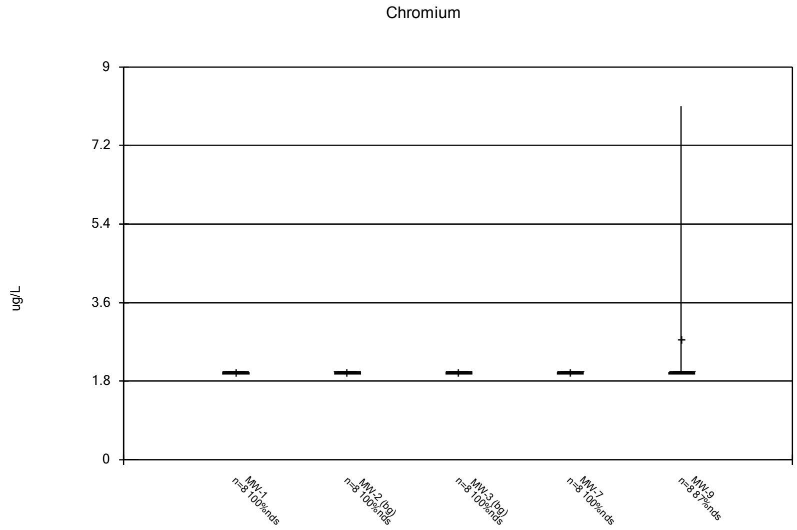

Box & Whiskers Plot   Analysis Run 3/4/2019 1:47 PM

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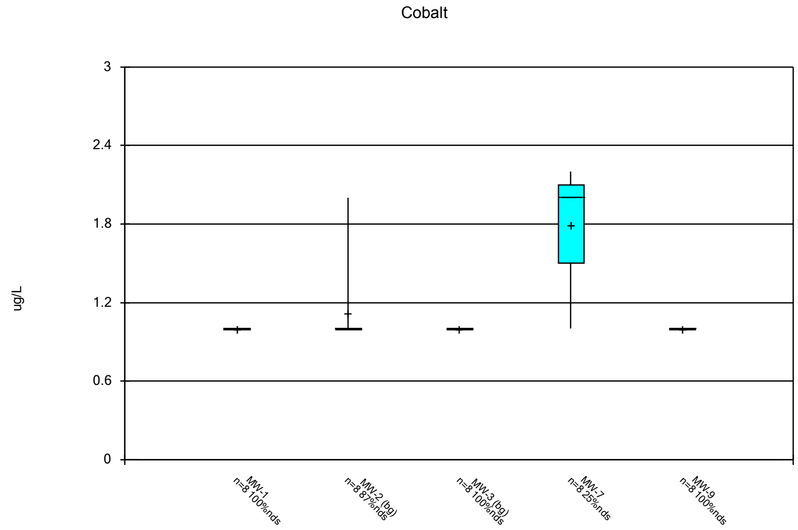

Box & Whiskers Plot   Analysis Run 3/4/2019 1:47 PM

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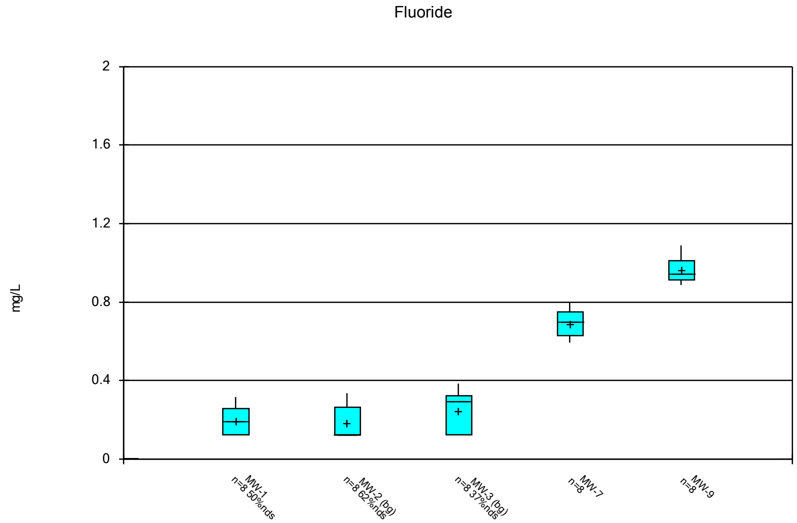

Box & Whiskers Plot   Analysis Run 3/4/2019 1:47 PM

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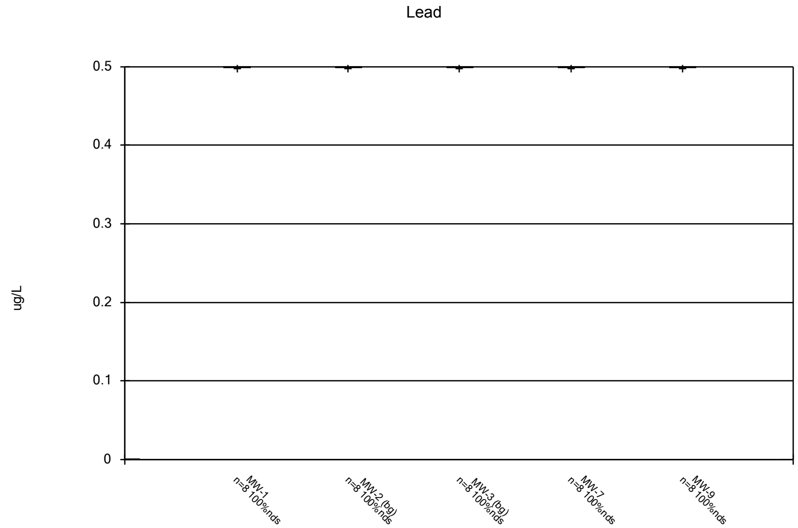

Box & Whiskers Plot   Analysis Run 3/4/2019 1:47 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

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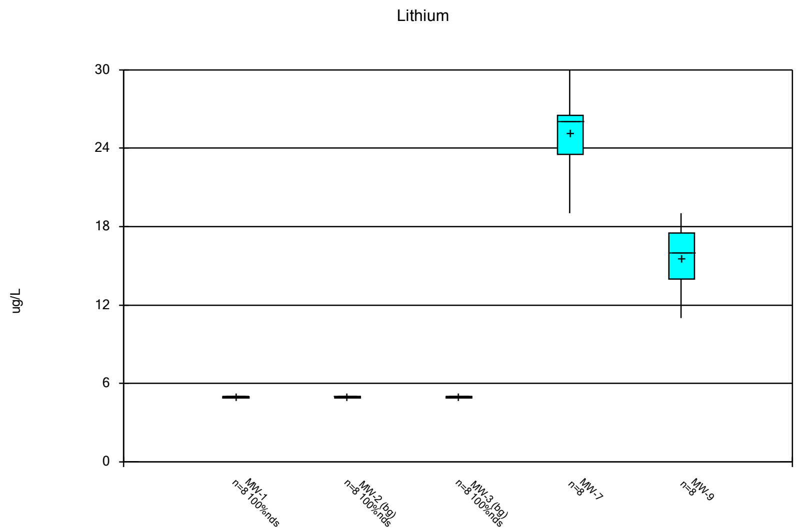

Box & Whiskers Plot   Analysis Run 3/4/2019 1:47 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

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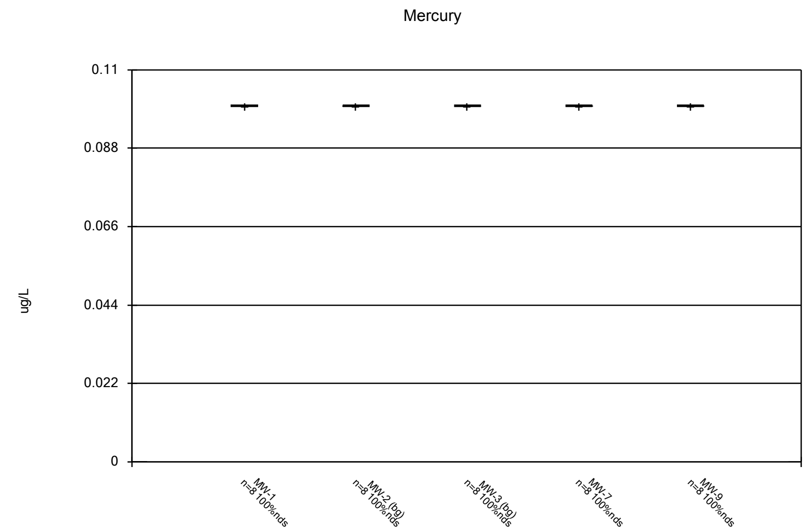
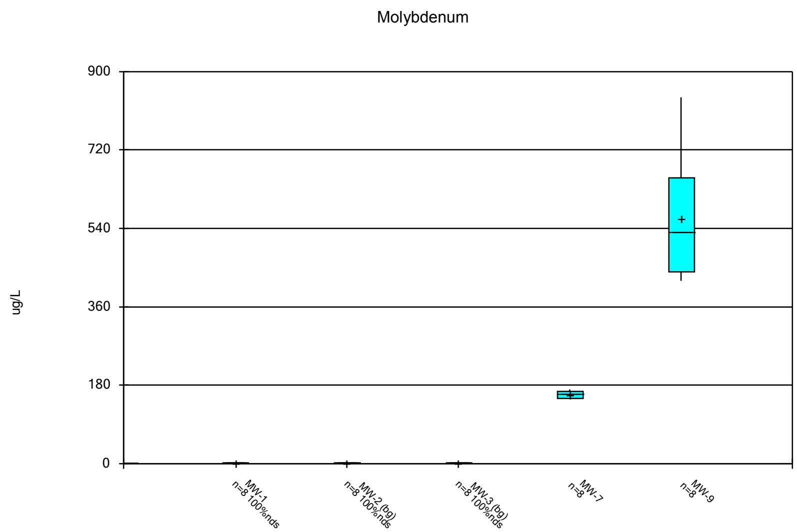


Box & Whiskers Plot   Analysis Run 3/4/2019 1:47 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

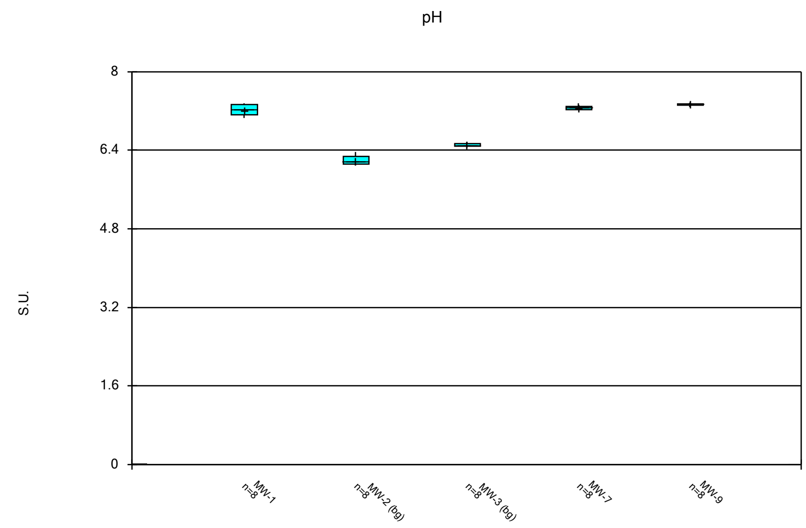
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG



Box & Whiskers Plot   Analysis Run 3/4/2019 1:47 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

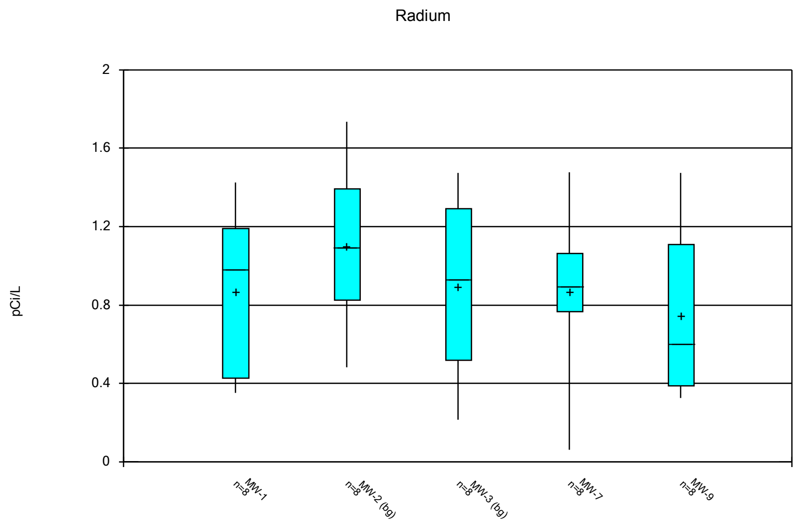
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG



Box & Whiskers Plot   Analysis Run 3/4/2019 1:47 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

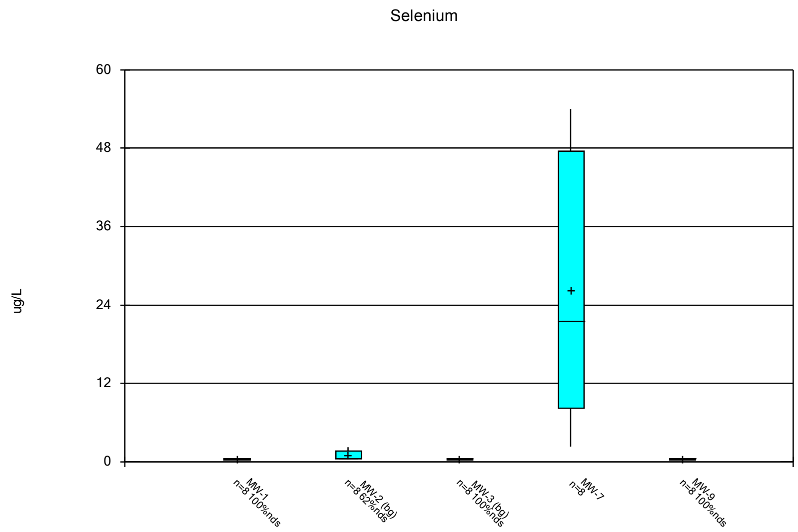
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG



Box & Whiskers Plot   Analysis Run 3/4/2019 1:47 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

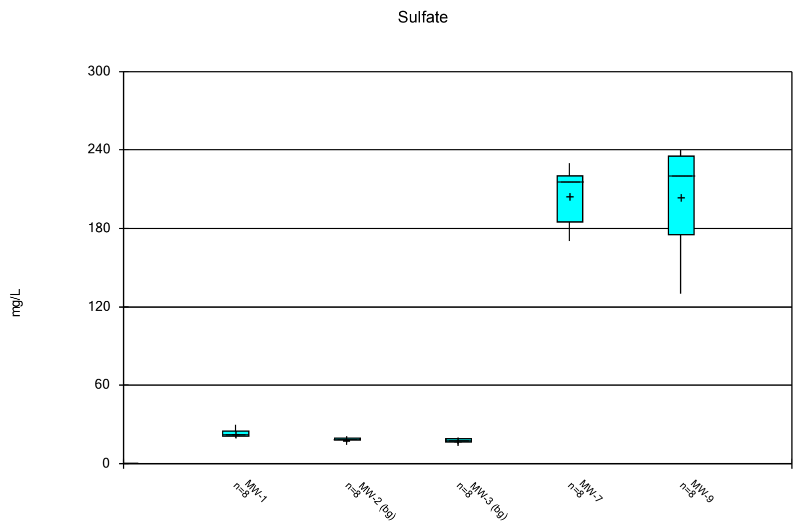
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG



Box & Whiskers Plot   Analysis Run 3/4/2019 1:47 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

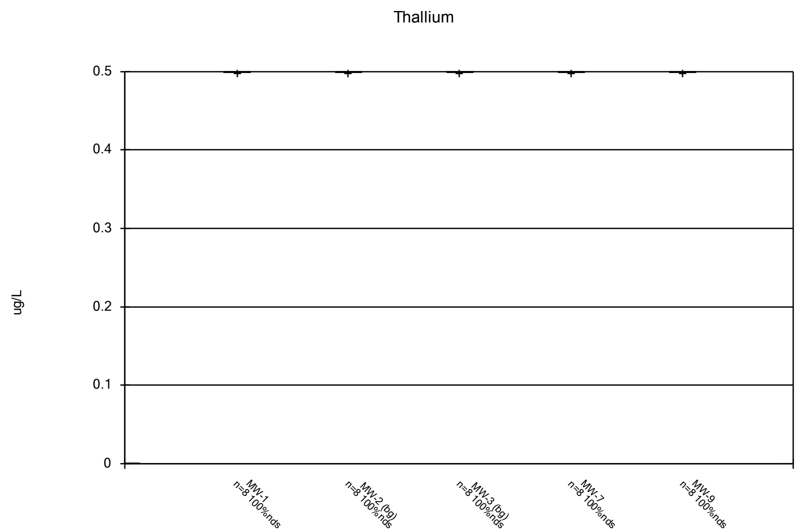
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG



Box & Whiskers Plot   Analysis Run 3/4/2019 1:47 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

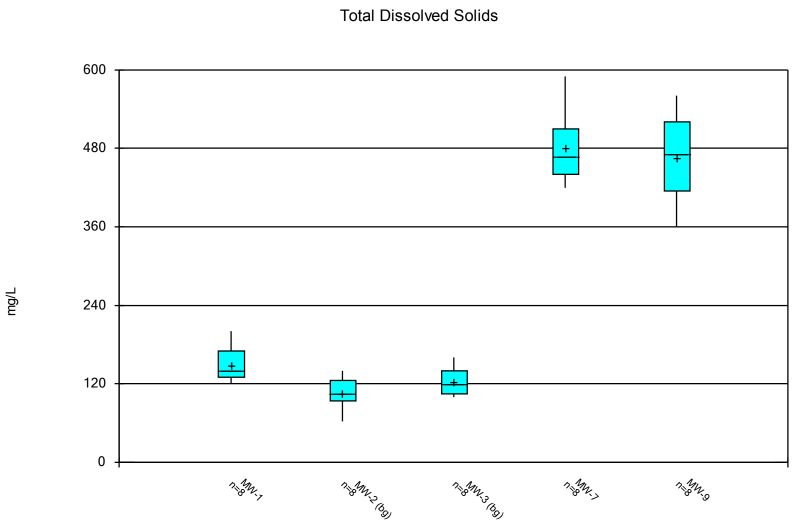
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG



Box & Whiskers Plot   Analysis Run 3/4/2019 1:47 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG



Box & Whiskers Plot   Analysis Run 3/4/2019 1:47 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

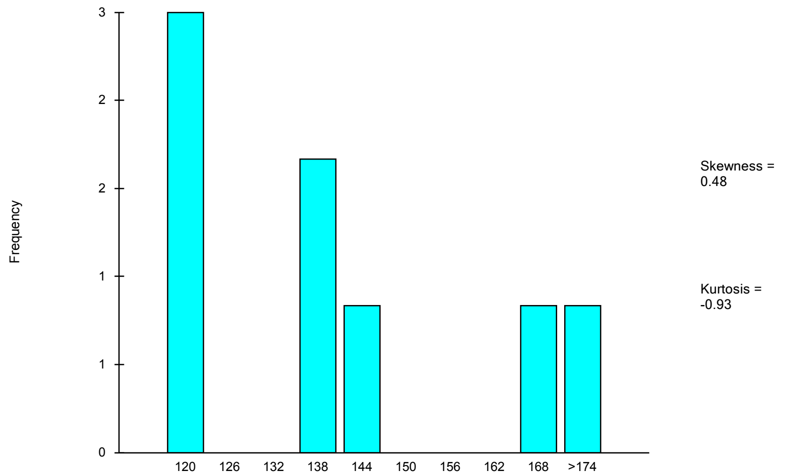
Appendix C

Histograms

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG

Barium

MW-1



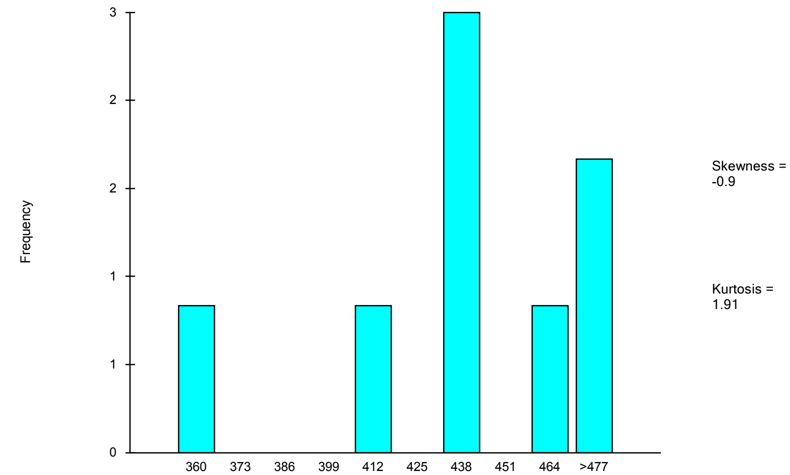
Histogram Analysis Run 3/4/2019 1:59 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG

Boron

MW-1



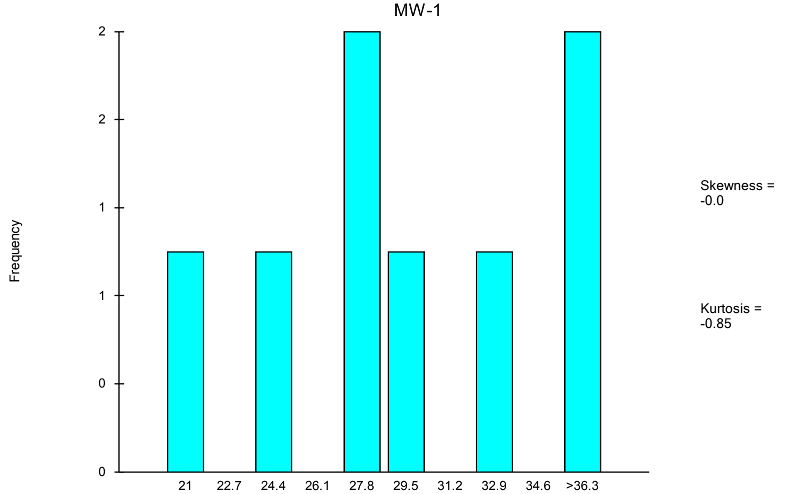
Histogram Analysis Run 3/4/2019 1:59 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG

Calcium

MW-1



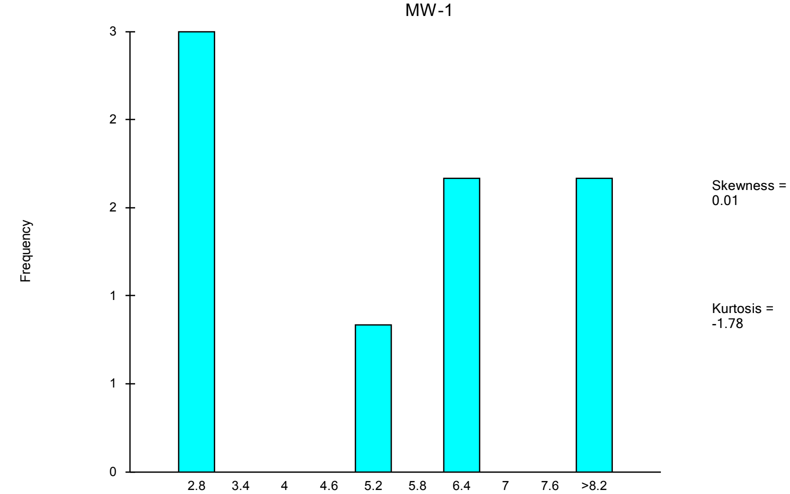
Histogram Analysis Run 3/4/2019 1:59 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG

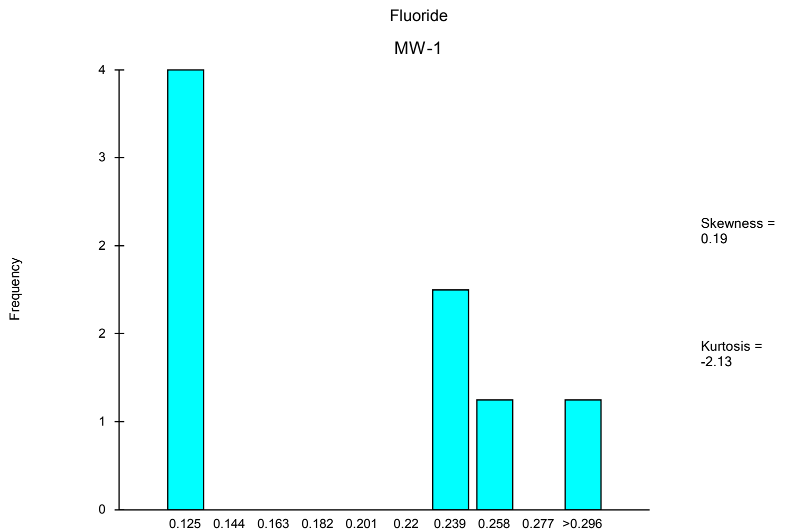
Chloride

MW-1



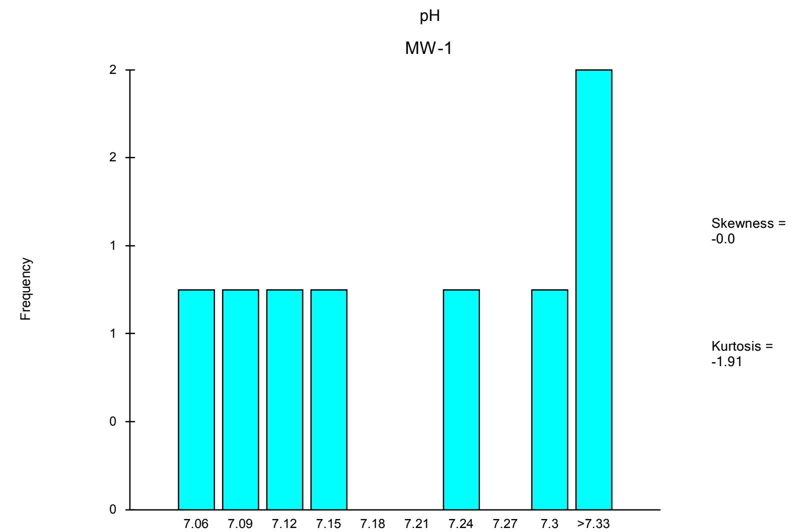
Histogram Analysis Run 3/4/2019 1:59 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



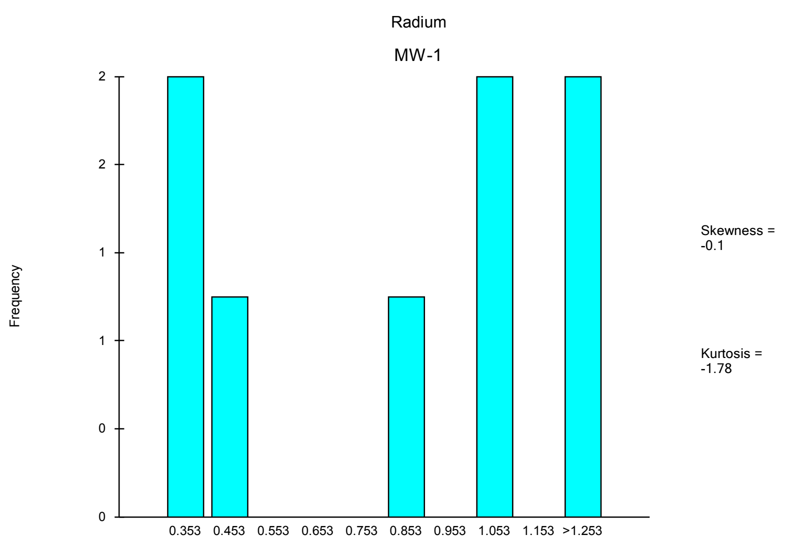
Histogram Analysis Run 3/4/2019 1:59 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



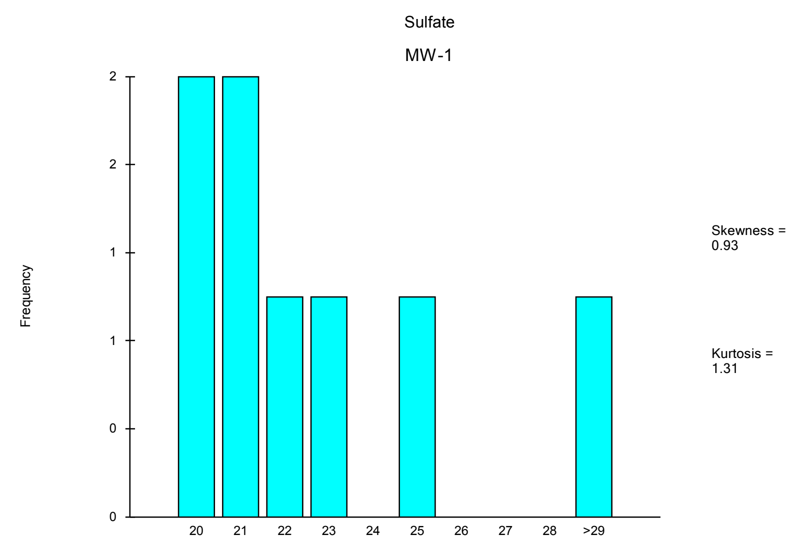
Histogram Analysis Run 3/4/2019 2:00 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



Histogram Analysis Run 3/4/2019 2:00 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



Histogram Analysis Run 3/4/2019 2:00 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

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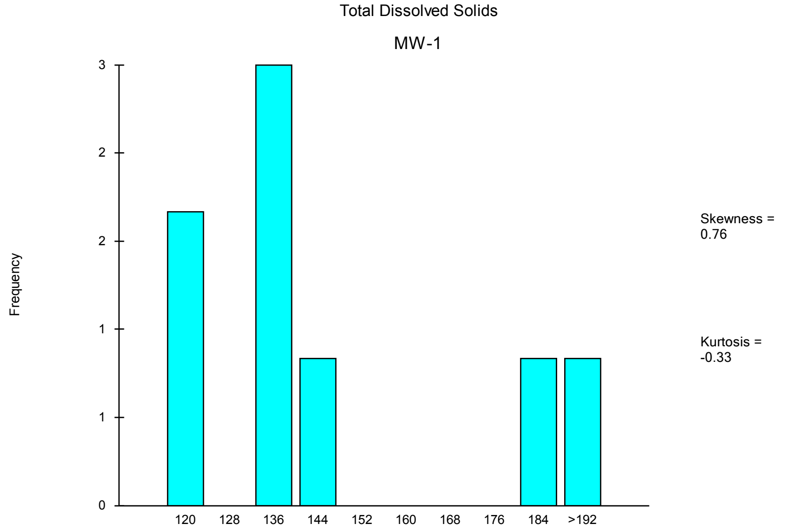
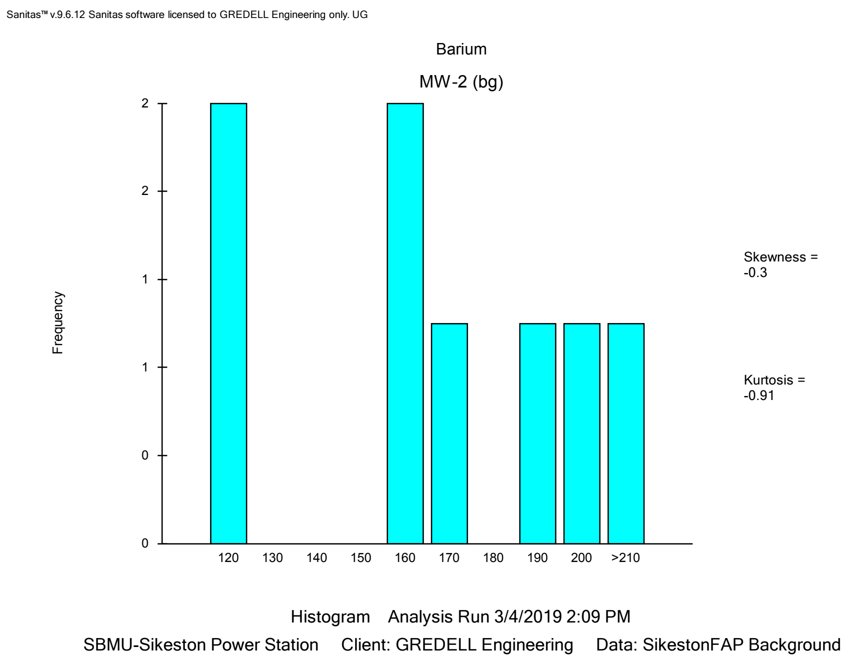
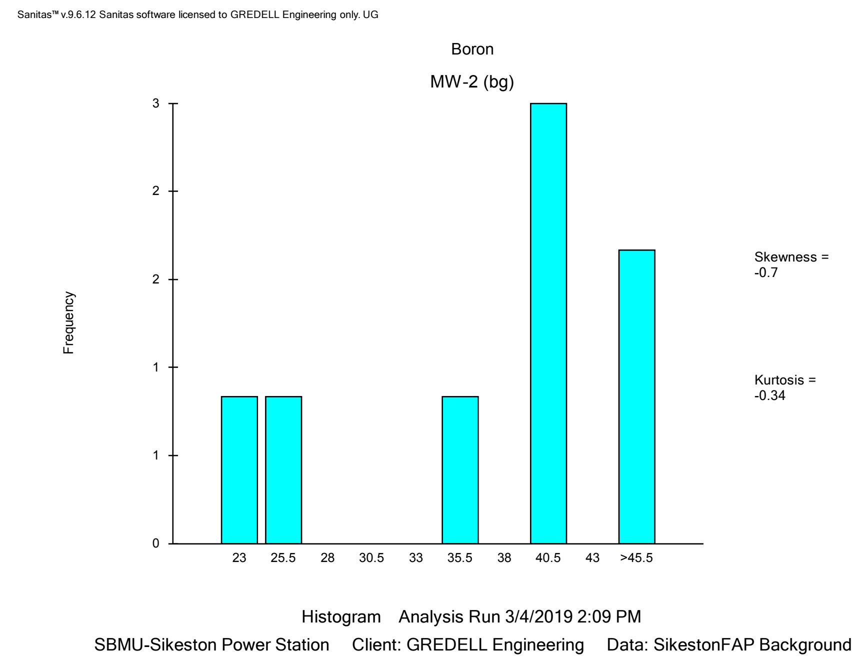
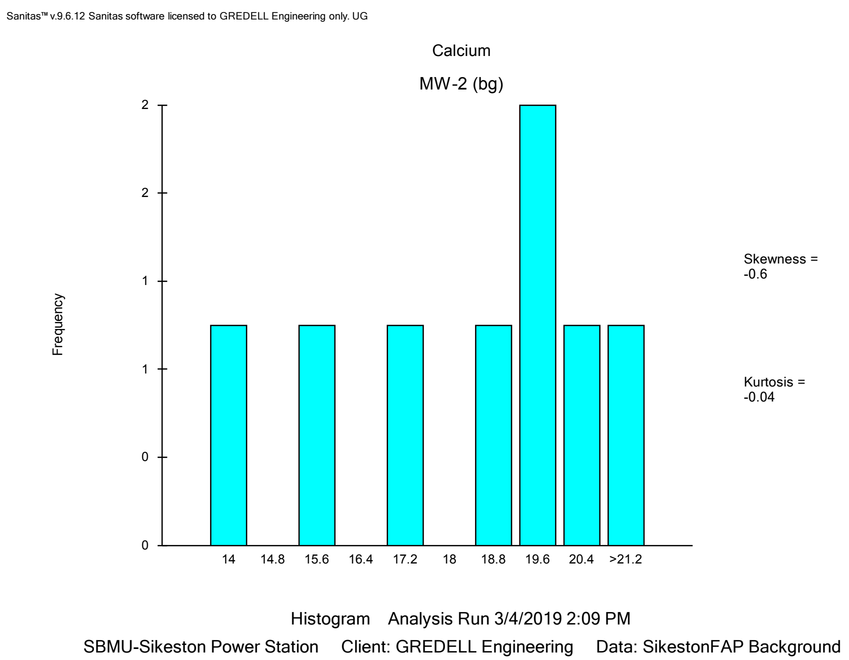


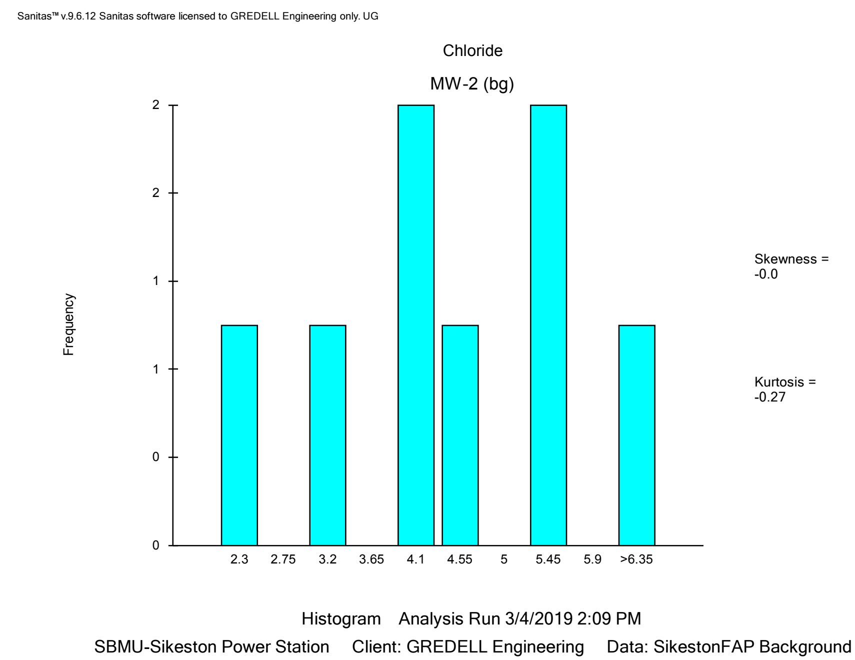
Histogram Analysis Run 3/4/2019 2:00 PM

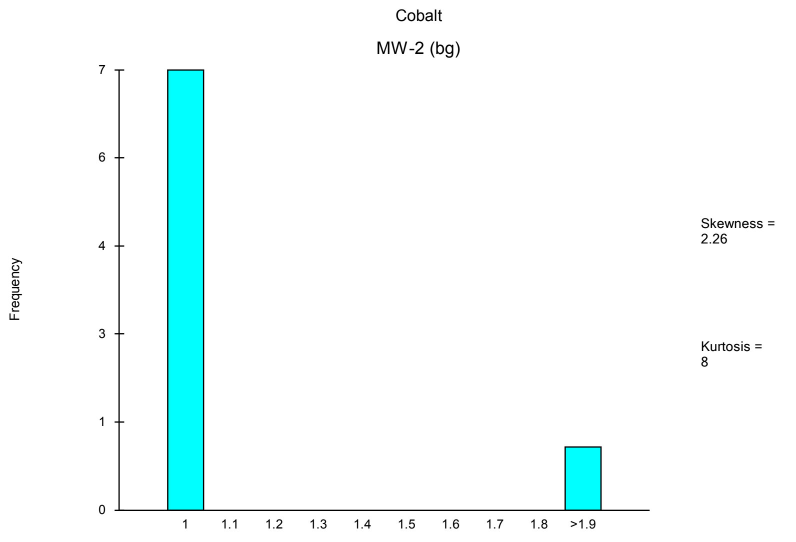
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background


Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Barium
MW-2 (bg)
Frequency
120
130
140
150
160
170
180
190
200
>210
Skewness =
-0.3
Kurtosis =
-0.91
Histogram Analysis Run 3/4/2019 2:09 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

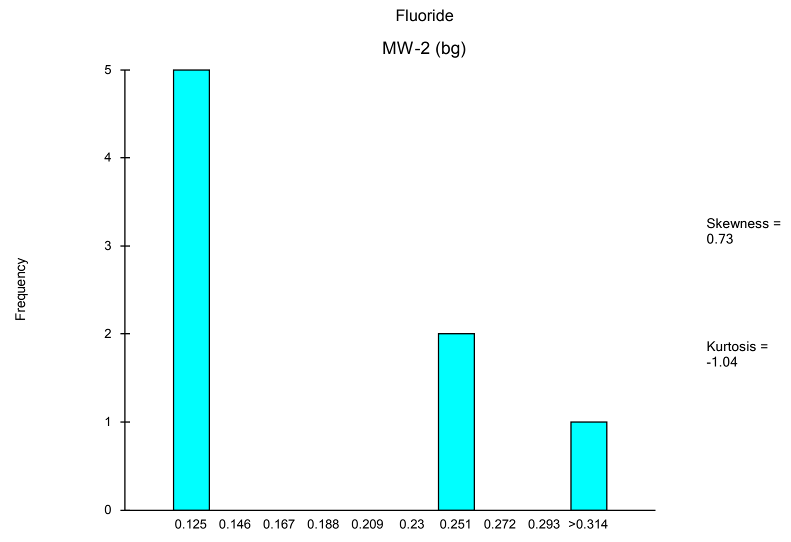

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Boron
MW-2 (bg)
Frequency
23
25.5
28
30.5
33
35.5
38
40.5
43
>45.5
Skewness =
-0.7
Kurtosis =
-0.34
Histogram Analysis Run 3/4/2019 2:09 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background


Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Calcium
MW-2 (bg)
Frequency
14
14.8
15.6
16.4
17.2
18
18.8
19.6
20.4
>21.2
Skewness =
-0.6
Kurtosis =
-0.04
Histogram Analysis Run 3/4/2019 2:09 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

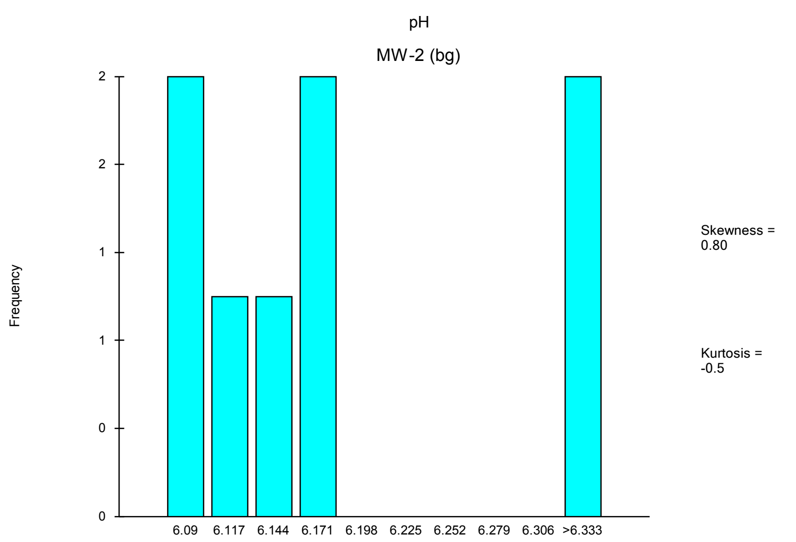

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Chloride
MW-2 (bg)
Frequency
2.3
2.75
3.2
3.65
4.1
4.55
5
5.45
5.9
>6.35
Skewness =
-0.0
Kurtosis =
-0.27
Histogram Analysis Run 3/4/2019 2:09 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



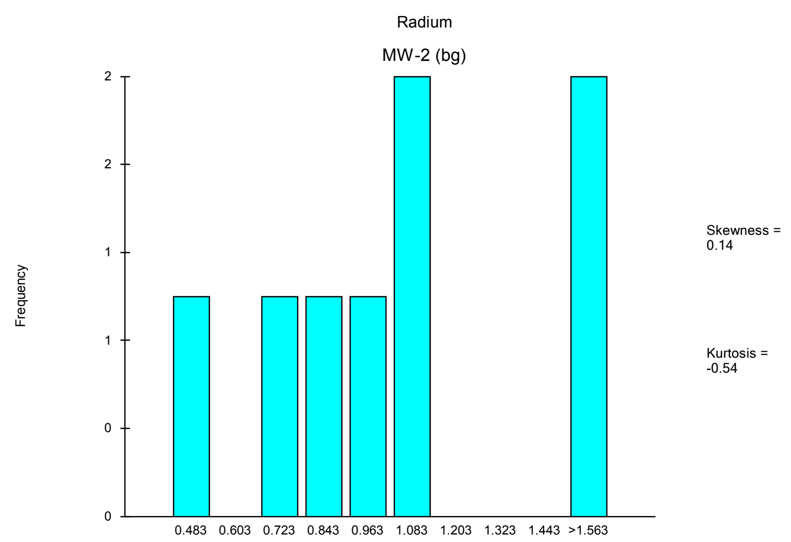
Histogram Analysis Run 3/4/2019 2:10 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



Histogram Analysis Run 3/4/2019 2:10 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



Histogram Analysis Run 3/4/2019 2:10 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



Histogram Analysis Run 3/4/2019 2:10 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

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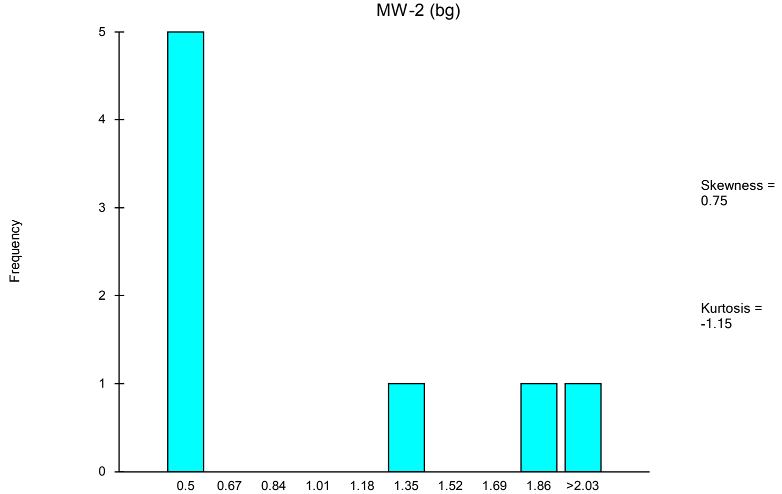
Selenium

MW-2 (bg)



Histogram   Analysis Run 3/4/2019 2:10 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

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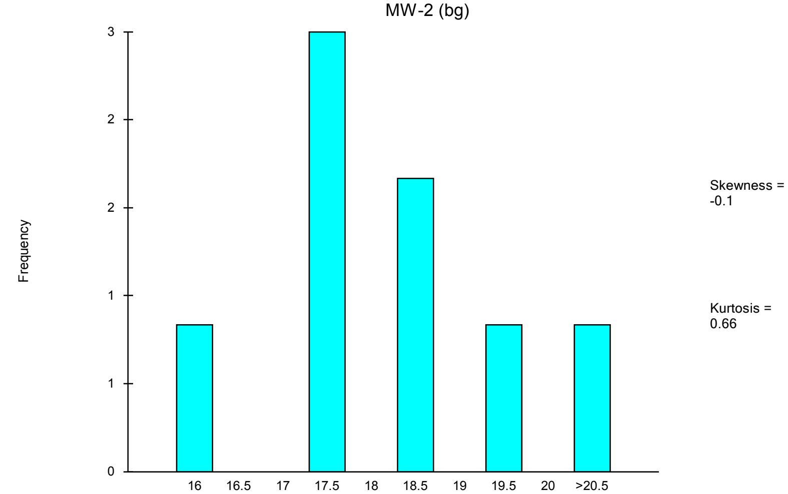
Sulfate

MW-2 (bg)



Histogram   Analysis Run 3/4/2019 2:10 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

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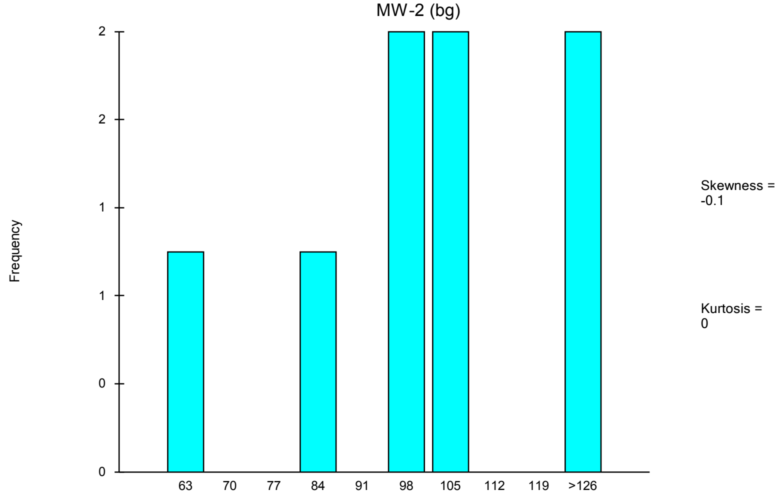
Total Dissolved Solids

MW-2 (bg)

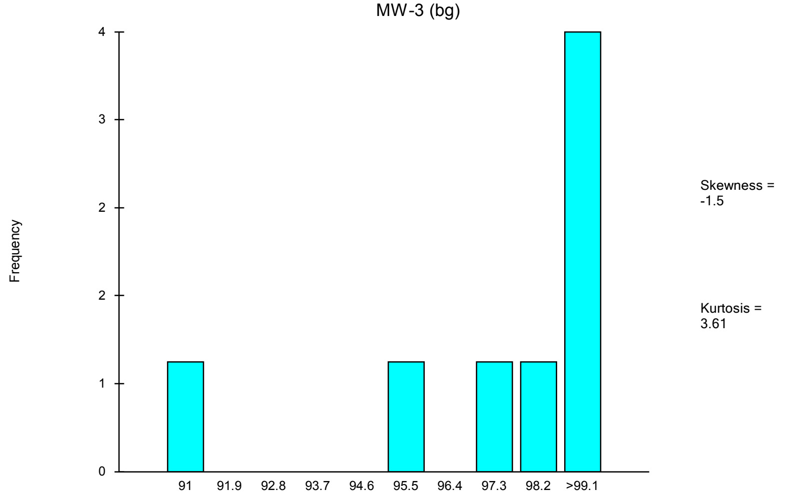


Histogram   Analysis Run 3/4/2019 2:10 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

Barium

MW-3 (bg)

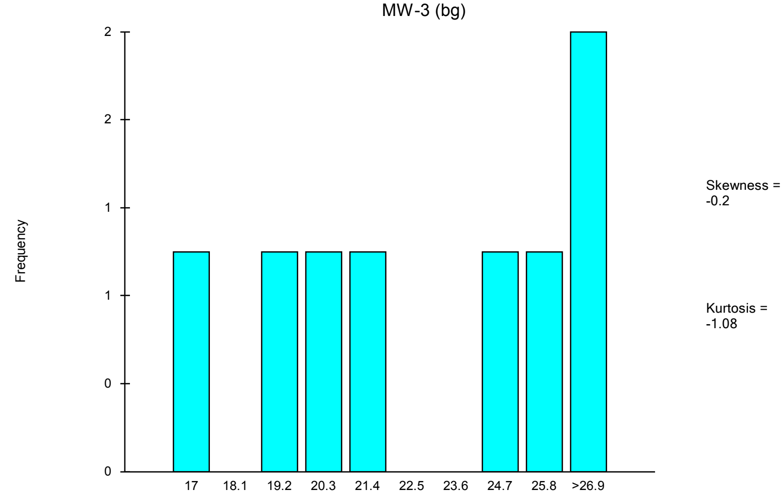


Histogram Analysis Run 3/4/2019 2:10 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Boron

MW-3 (bg)

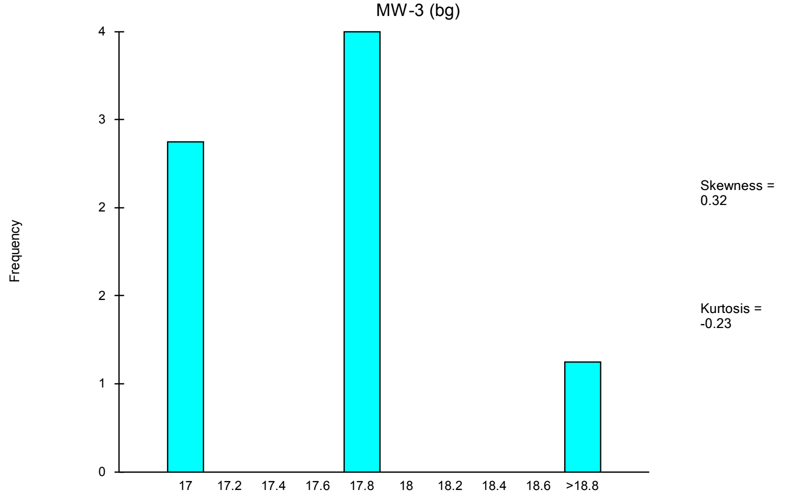


Histogram Analysis Run 3/4/2019 2:10 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Calcium

MW-3 (bg)

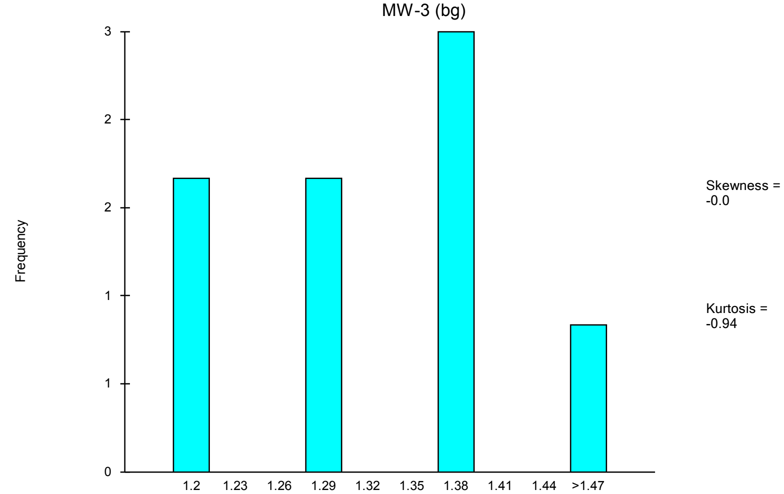


Histogram Analysis Run 3/4/2019 2:10 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Chloride

MW-3 (bg)

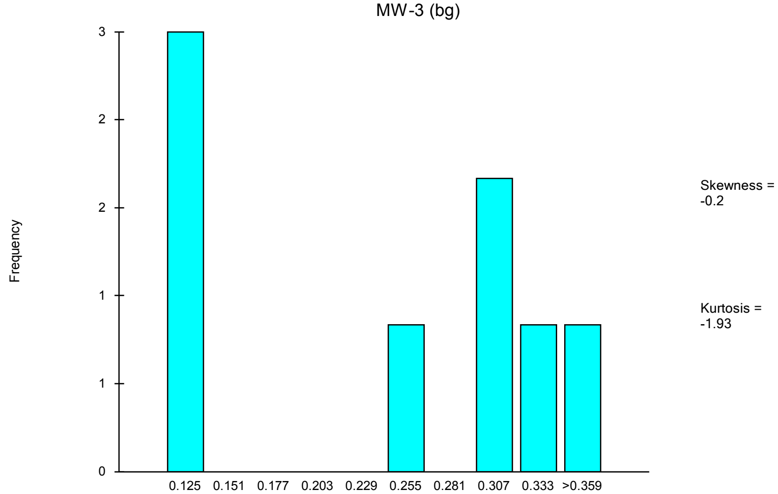


Histogram Analysis Run 3/4/2019 2:10 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Fluoride

MW-3 (bg)

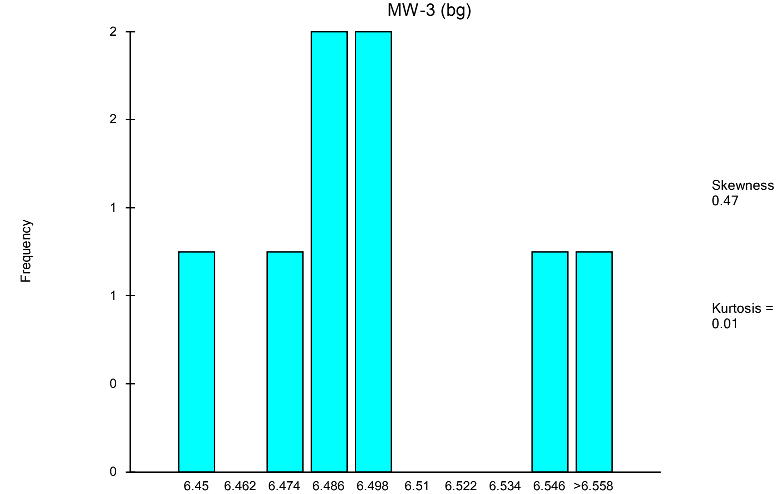


Histogram Analysis Run 3/4/2019 2:11 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

pH

MW-3 (bg)

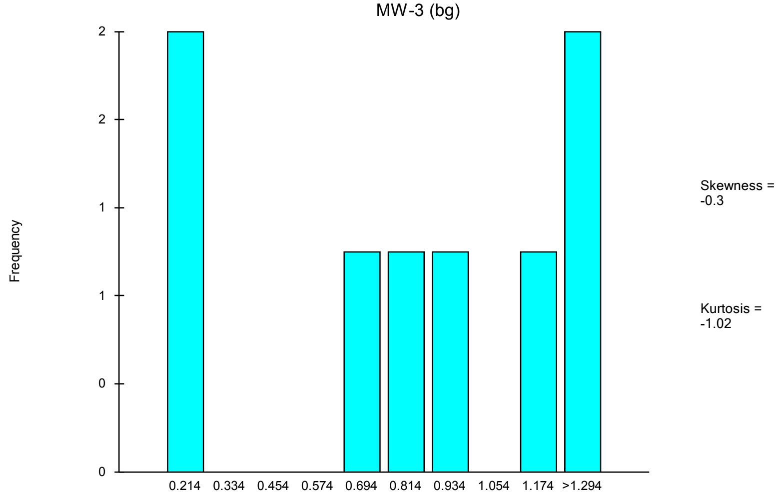


Histogram Analysis Run 3/4/2019 2:11 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Radium

MW-3 (bg)

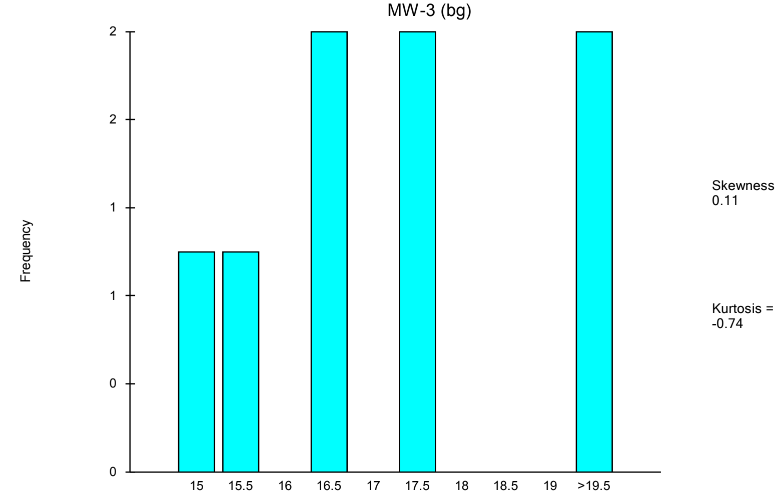


Histogram Analysis Run 3/4/2019 2:11 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

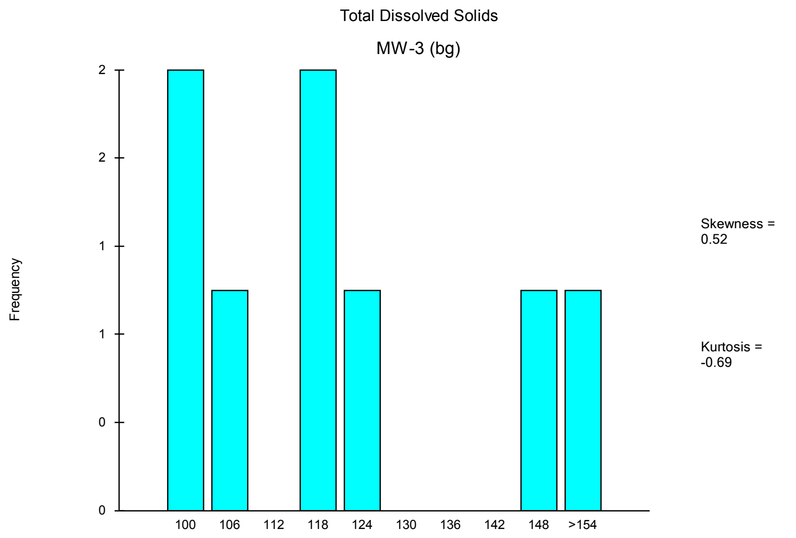
Sulfate

MW-3 (bg)



Histogram Analysis Run 3/4/2019 2:11 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



Histogram Analysis Run 3/4/2019 2:11 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

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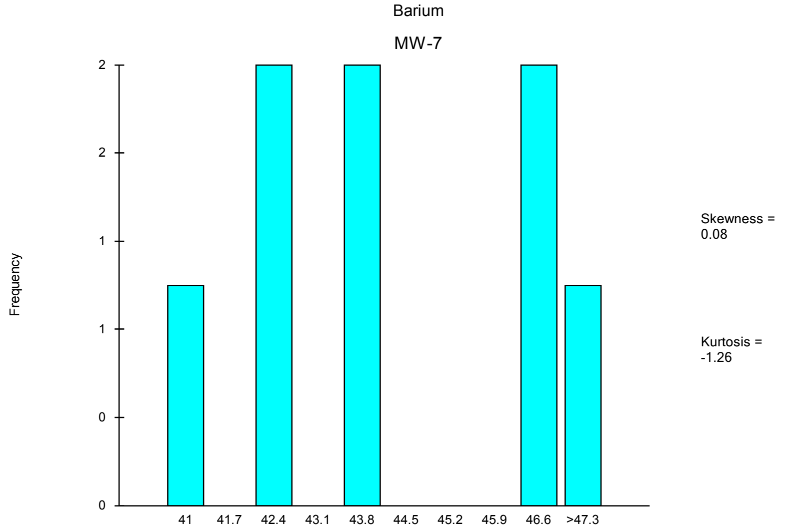
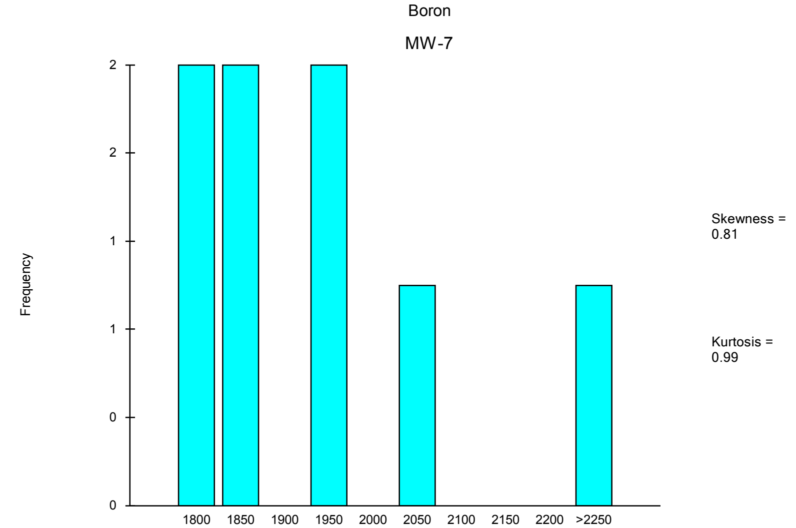


Histogram Analysis Run 3/4/2019 2:11 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

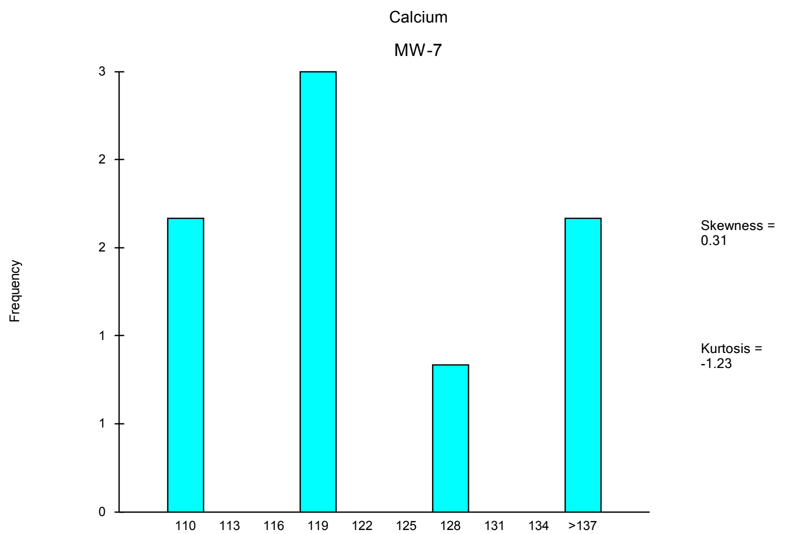
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG



Histogram Analysis Run 3/4/2019 2:11 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

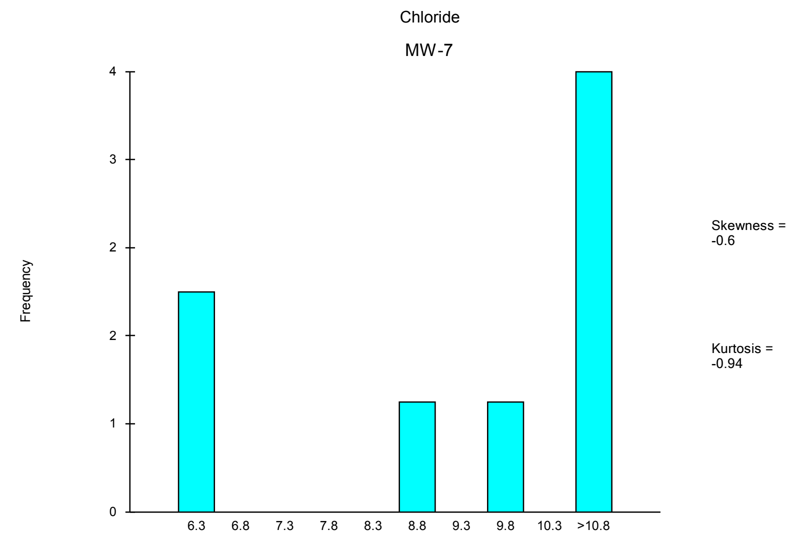
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG



Histogram Analysis Run 3/4/2019 2:11 PM

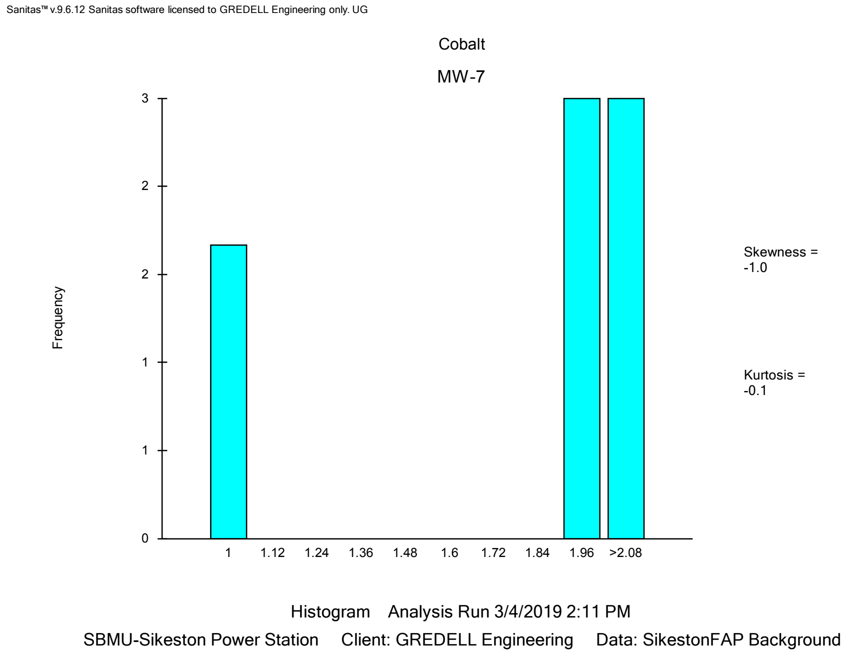
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG

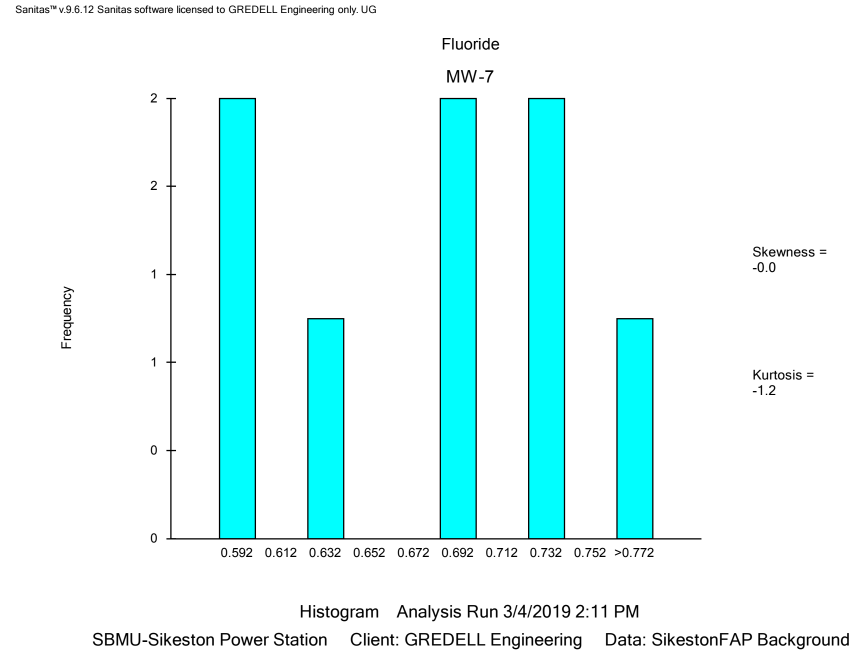


Histogram Analysis Run 3/4/2019 2:11 PM

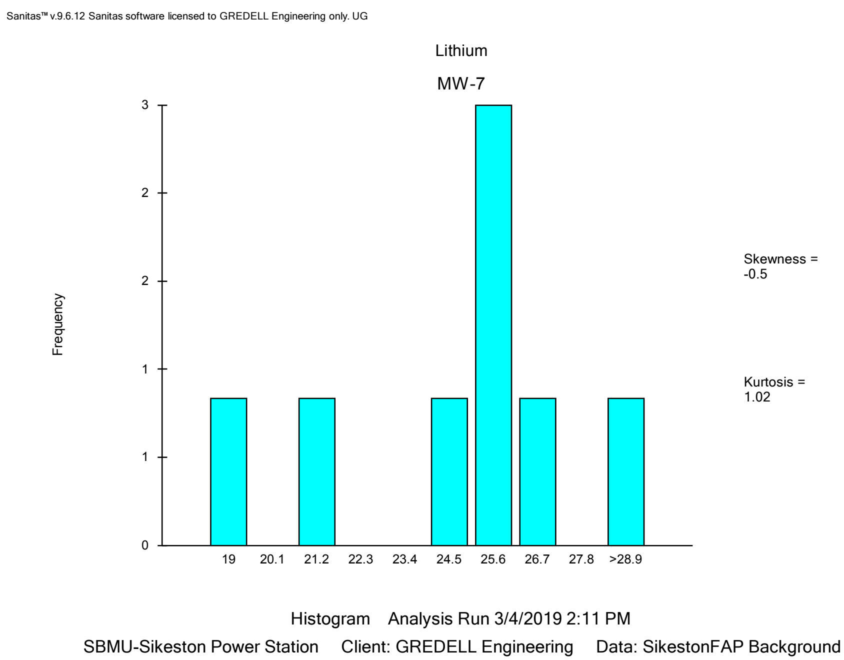
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



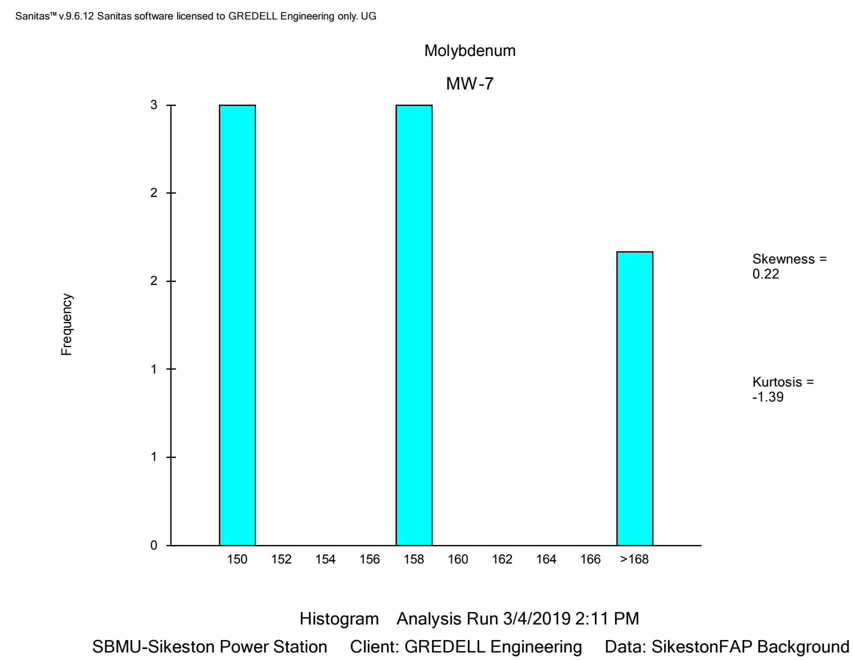
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Cobalt
MW-7
Frequency
1
1.12
1.24
1.36
1.48
1.6
1.72
1.84
1.96
>2.08
Skewness =
-1.0
Kurtosis =
-0.1
Histogram Analysis Run 3/4/2019 2:11 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Fluoride
MW-7
Frequency
0.592
0.612
0.632
0.652
0.672
0.692
0.712
0.732
0.752
>0.772
Skewness =
-0.0
Kurtosis =
-1.2
Histogram Analysis Run 3/4/2019 2:11 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



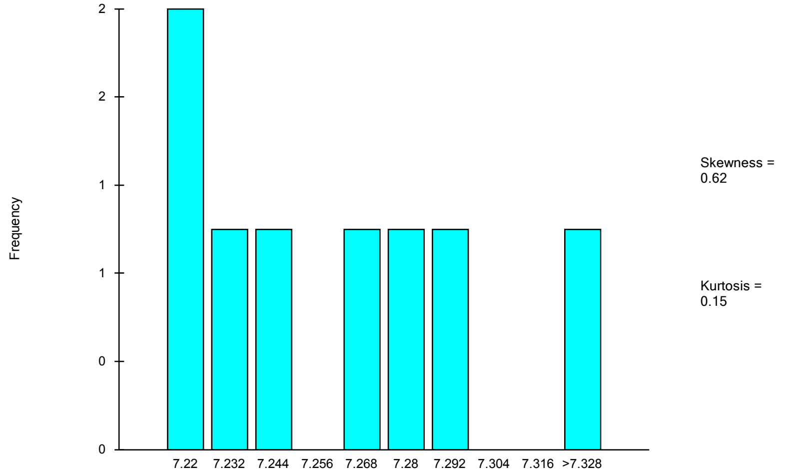
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Lithium
MW-7
Frequency
19
20.1
21.2
22.3
23.4
24.5
25.6
26.7
27.8
>28.9
Skewness =
-0.5
Kurtosis =
1.02
Histogram Analysis Run 3/4/2019 2:11 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Molybdenum
MW-7
Frequency
150
152
154
156
158
160
162
164
166
>168
Skewness =
0.22
Kurtosis =
-1.39
Histogram Analysis Run 3/4/2019 2:11 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

pH

MW-7



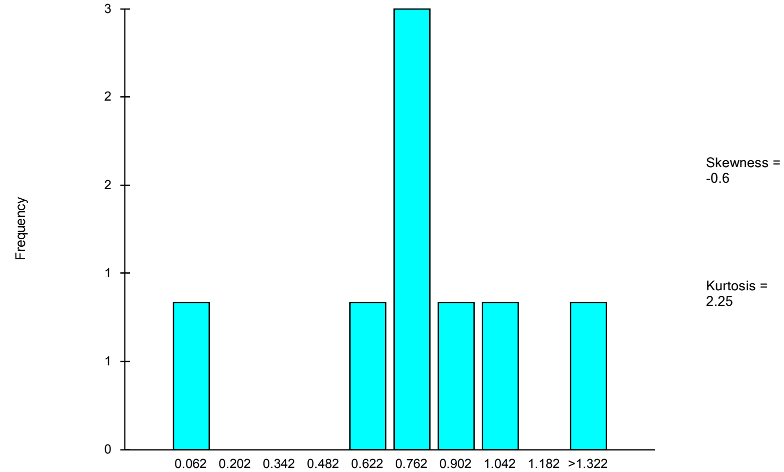
Histogram Analysis Run 3/4/2019 2:11 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG

Radium

MW-7



Histogram Analysis Run 3/4/2019 2:11 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

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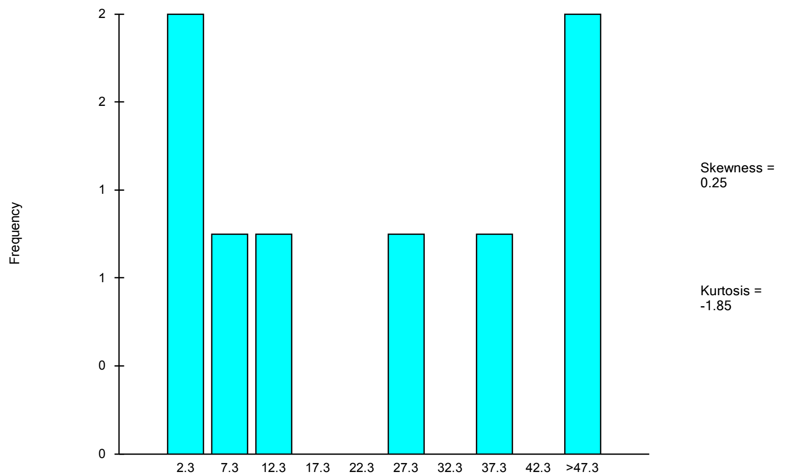
Selenium

MW-7



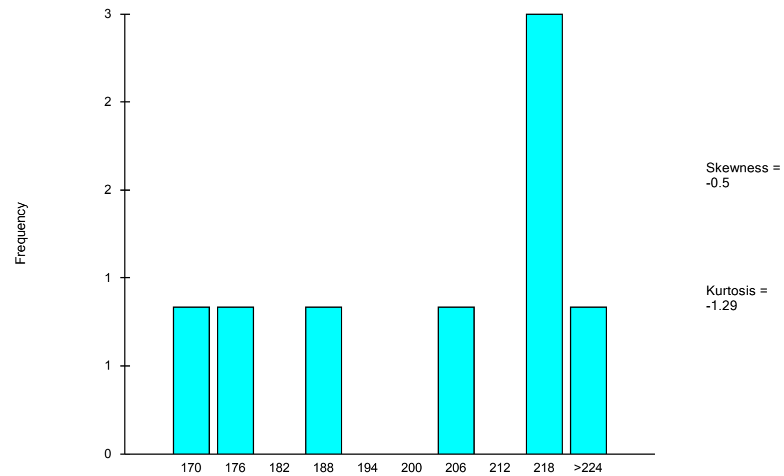
Histogram Analysis Run 3/4/2019 2:11 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG

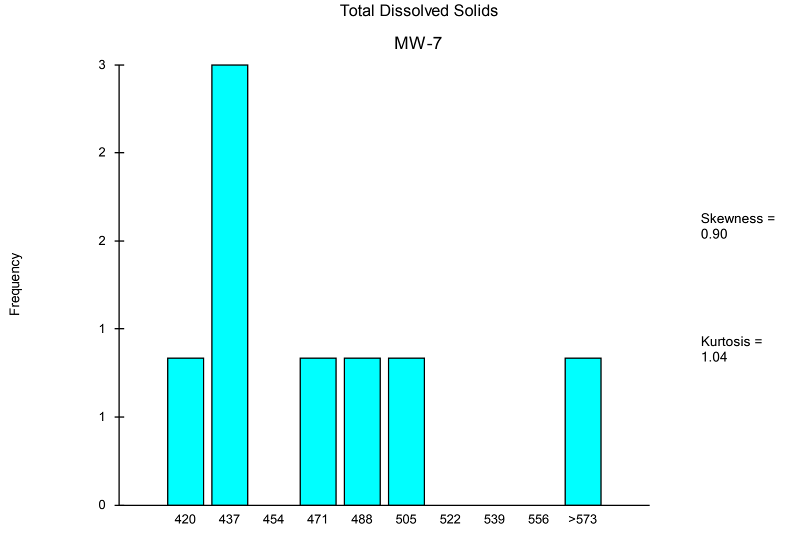
Sulfate

MW-7



Histogram Analysis Run 3/4/2019 2:11 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



Histogram   Analysis Run 3/4/2019 2:12 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

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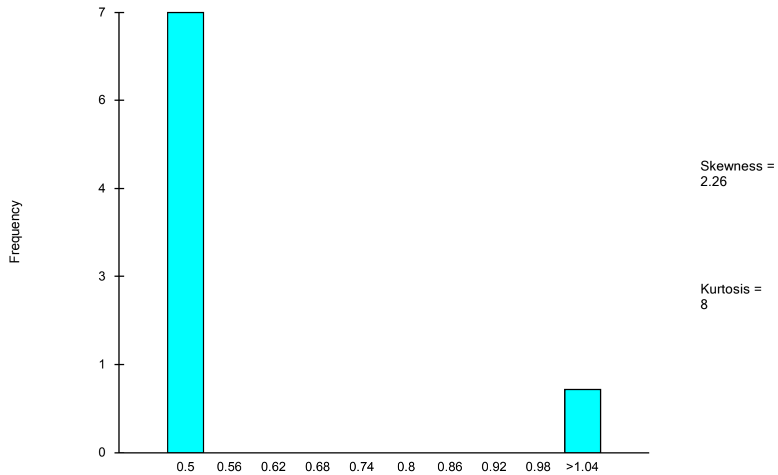
Arsenic

MW-9



Histogram Analysis Run 3/4/2019 2:12 PM

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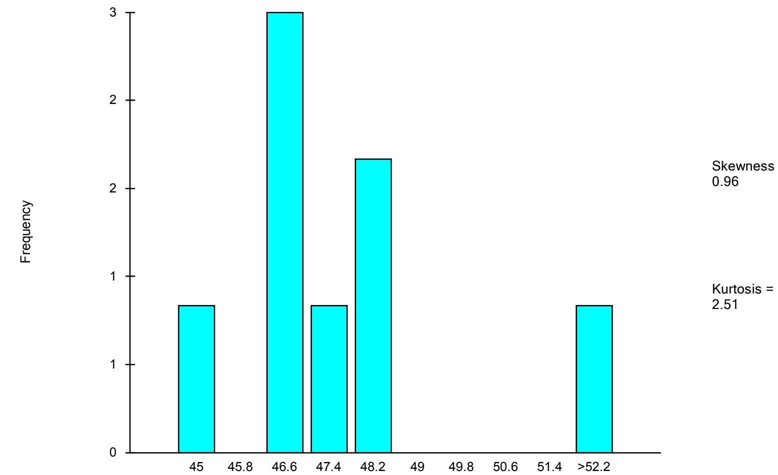
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG

Barium

MW-9



Histogram Analysis Run 3/4/2019 2:12 PM

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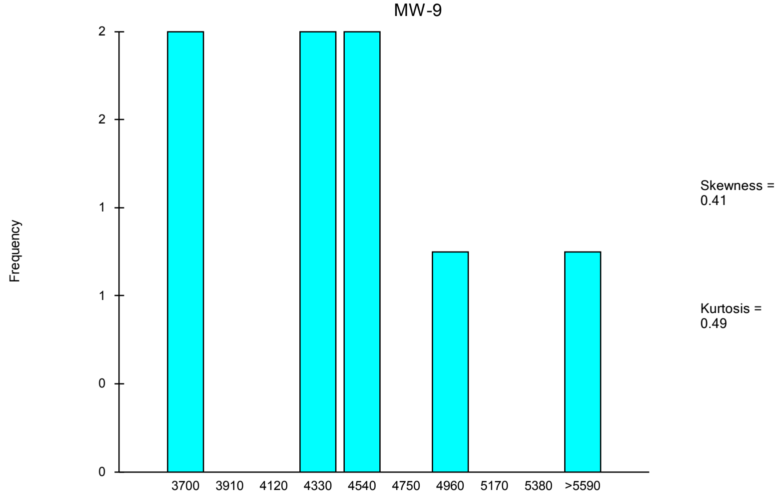
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG

Boron

MW-9



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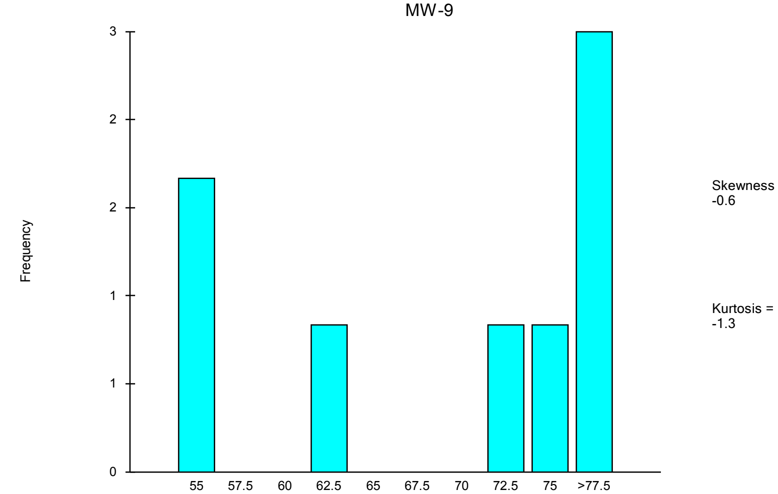
Calcium

MW-9



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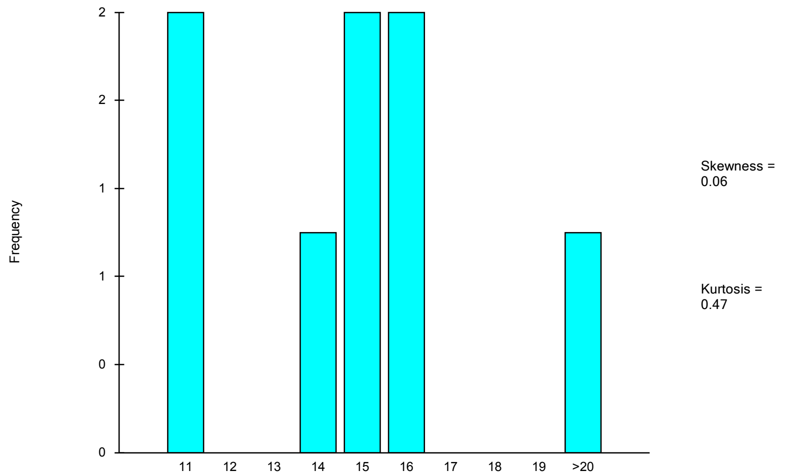
Chloride

MW-9



Histogram Analysis Run 3/4/2019 2:12 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

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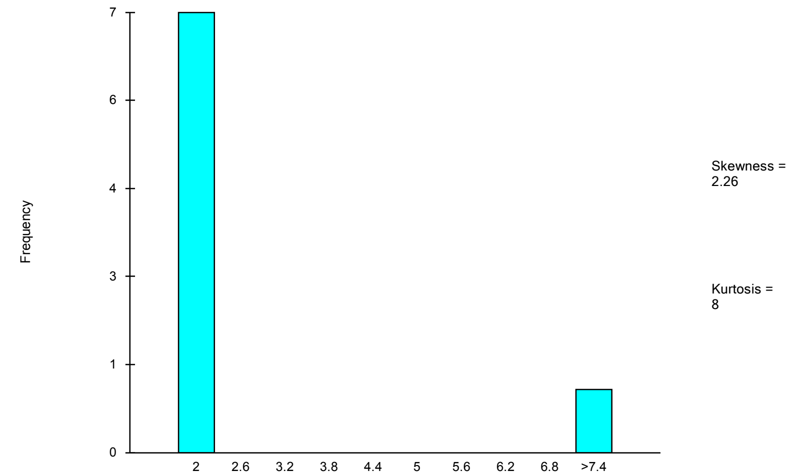
Chromium

MW-9



Histogram Analysis Run 3/4/2019 2:12 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

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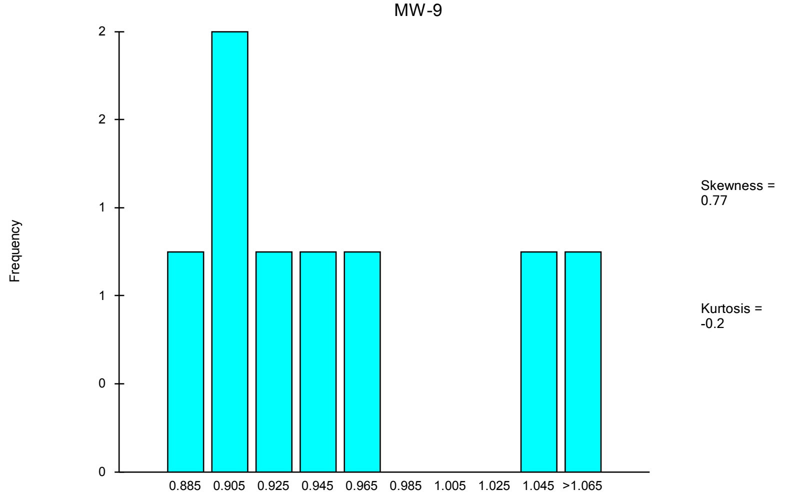
Fluoride

MW-9



Histogram Analysis Run 3/4/2019 2:12 PM

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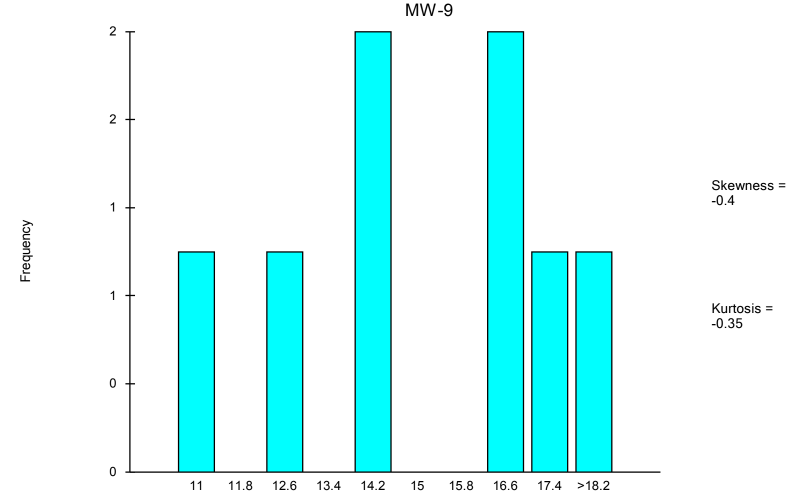
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG

Lithium

MW-9



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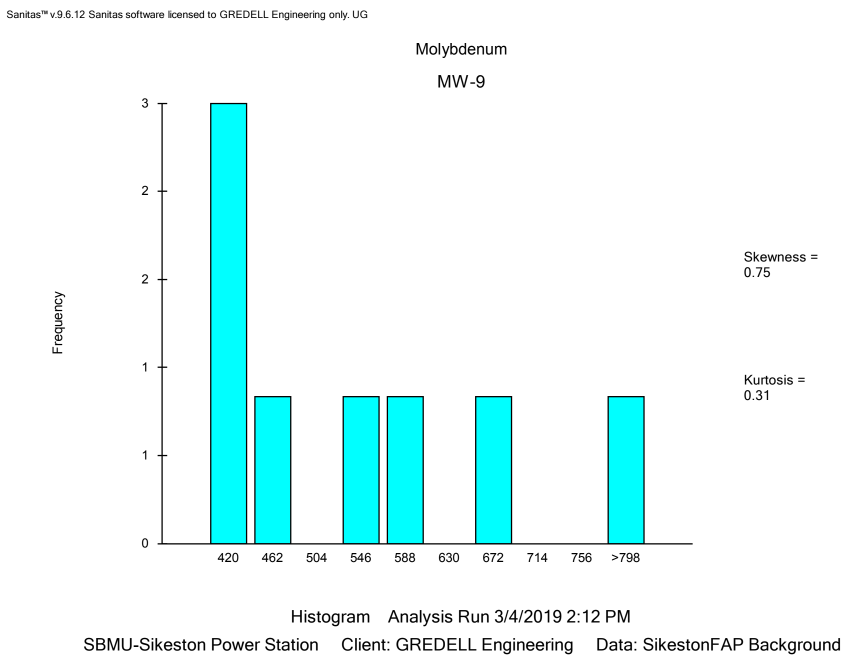
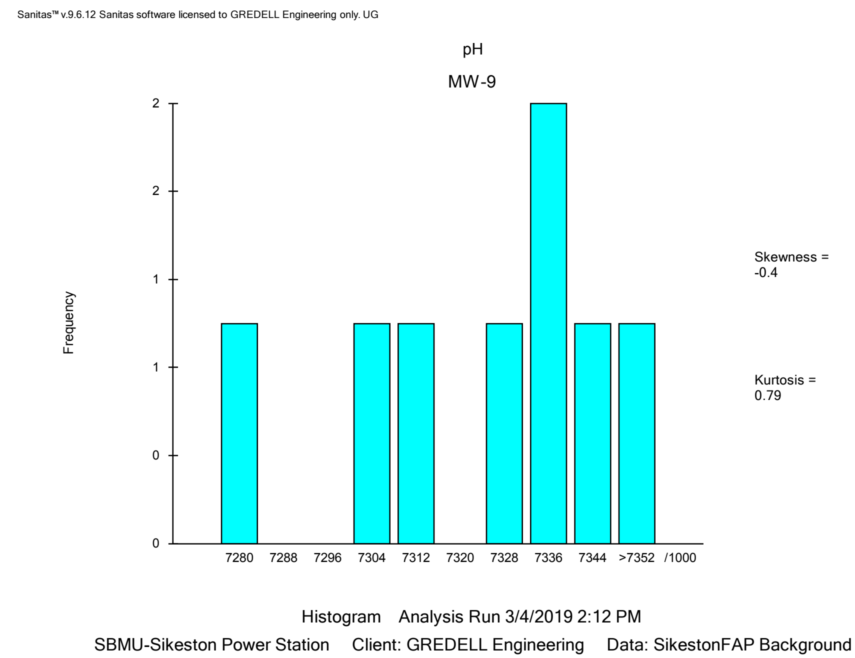

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Molybdenum
MW-9
Frequency
3
2
2
1
1
0
420
462
504
546
588
630
672
714
756
>798
Skewness =
0.75
Kurtosis =
0.31
Histogram Analysis Run 3/4/2019 2:12 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background


Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
pH
MW-9
Frequency
2
2
1
1
0
0
7280
7288
7296
7304
7312
7320
7328
7336
7344
>7352
/1000
Skewness =
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Kurtosis =
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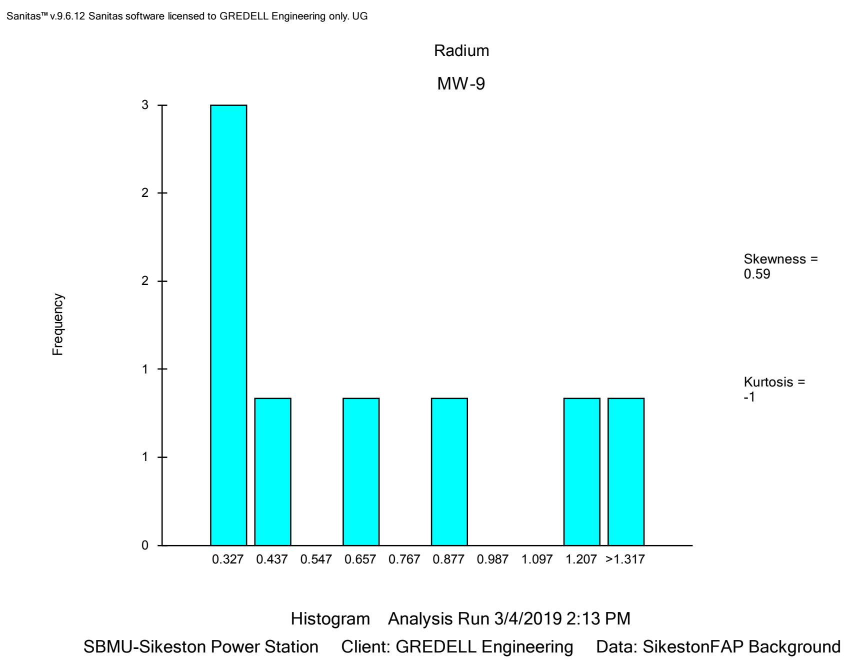
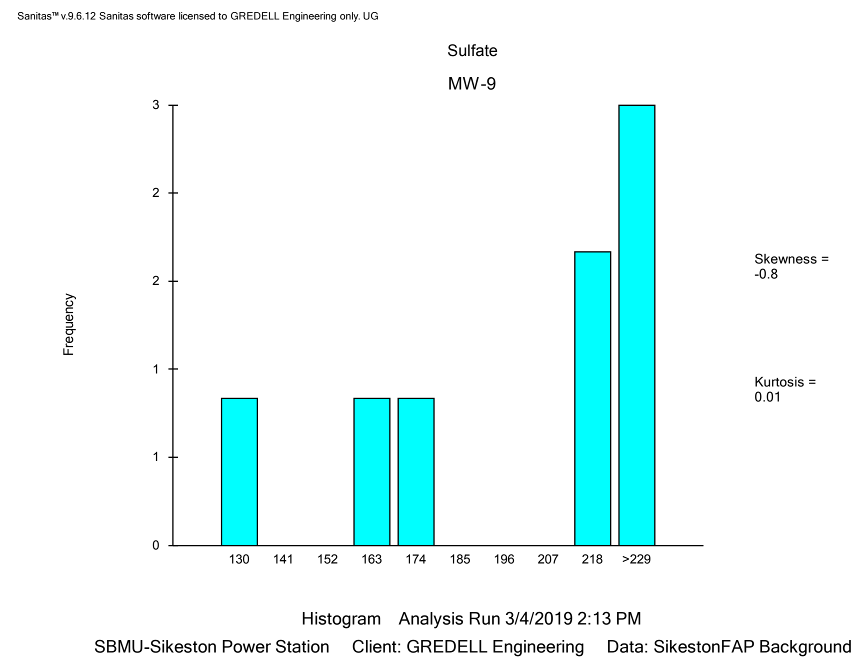
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background


Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Radium
MW-9
Frequency
3
2
2
1
1
0
0.327
0.437
0.547
0.657
0.767
0.877
0.987
1.097
1.207
>1.317
Skewness =
0.59
Kurtosis =
-1
Histogram Analysis Run 3/4/2019 2:13 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background


Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Sulfate
MW-9
Frequency
3
2
2
1
1
0
130
141
152
163
174
185
196
207
218
>229
Skewness =
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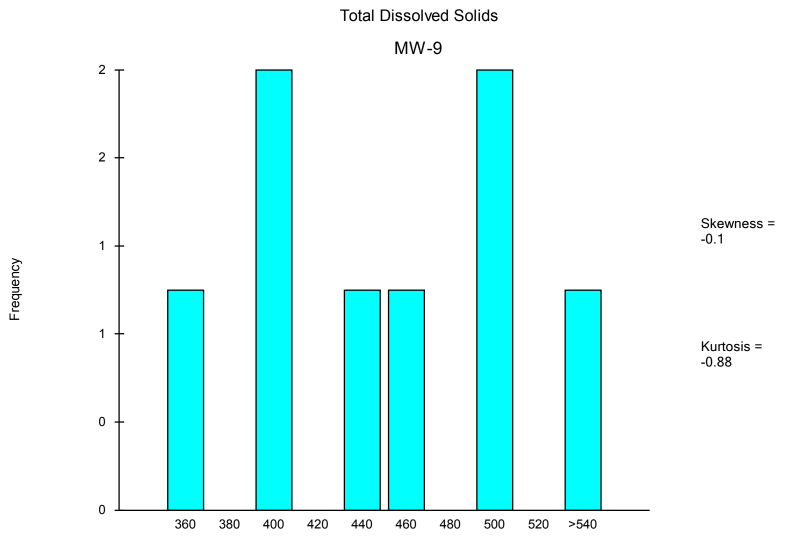
Histogram Analysis Run 3/4/2019 2:13 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

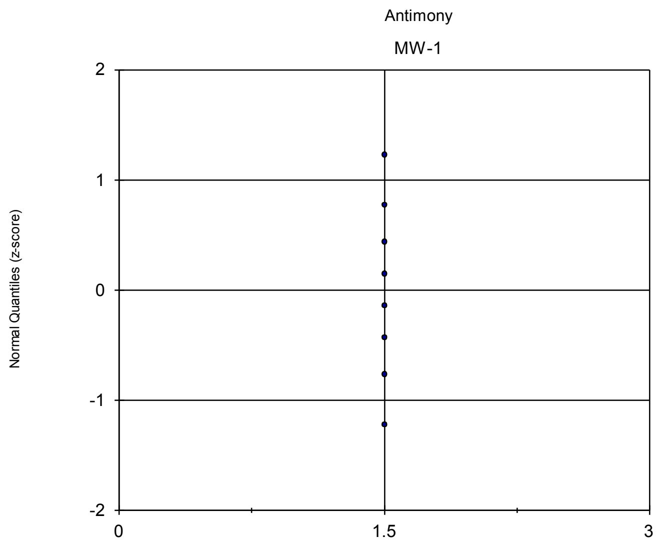


Histogram   Analysis Run 3/4/2019 2:13 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

Appendix D

Probability Plots



Probability Plot   Analysis Run 3/4/2019 2:21 PM

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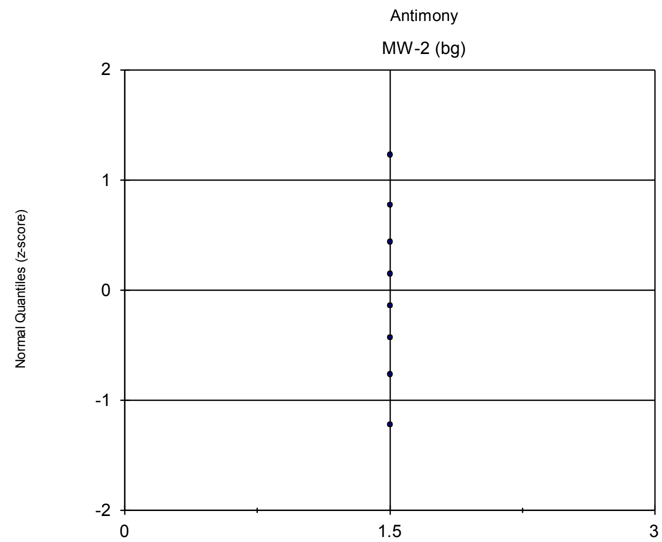

Probability Plot   Analysis Run 3/4/2019 2:21 PM

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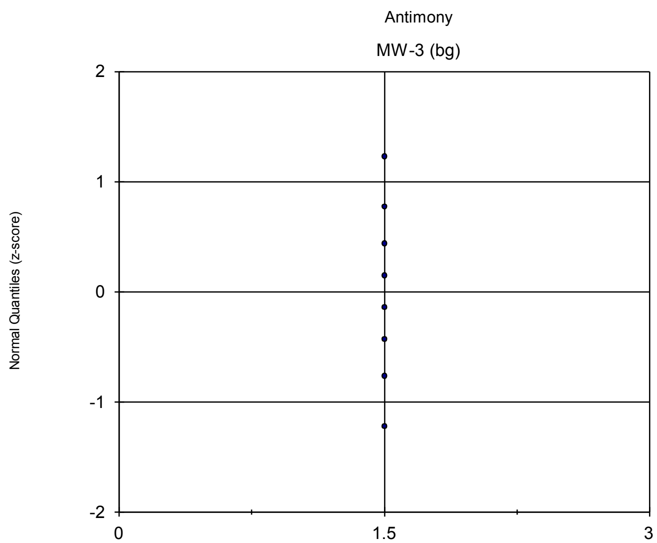

Probability Plot   Analysis Run 3/4/2019 2:21 PM

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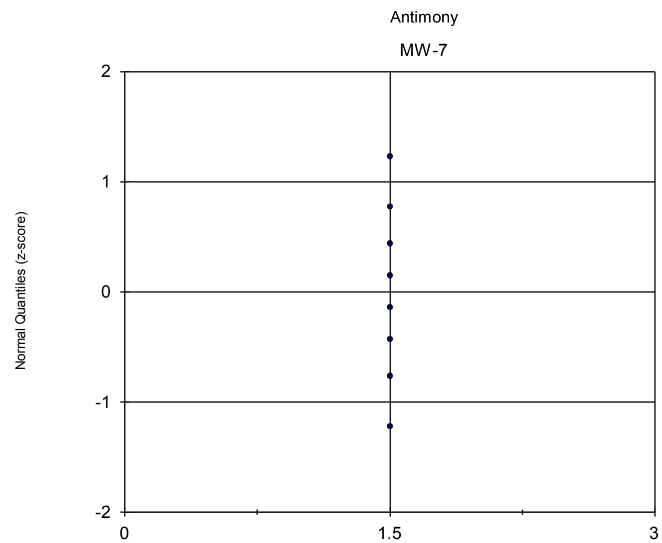

Probability Plot   Analysis Run 3/4/2019 2:21 PM

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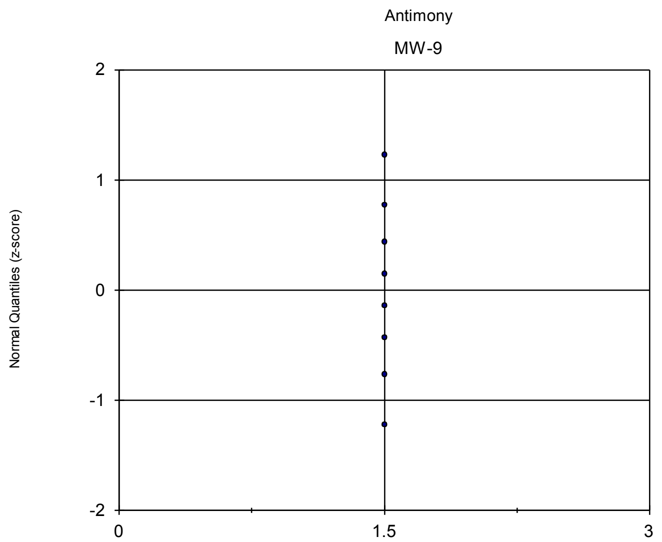
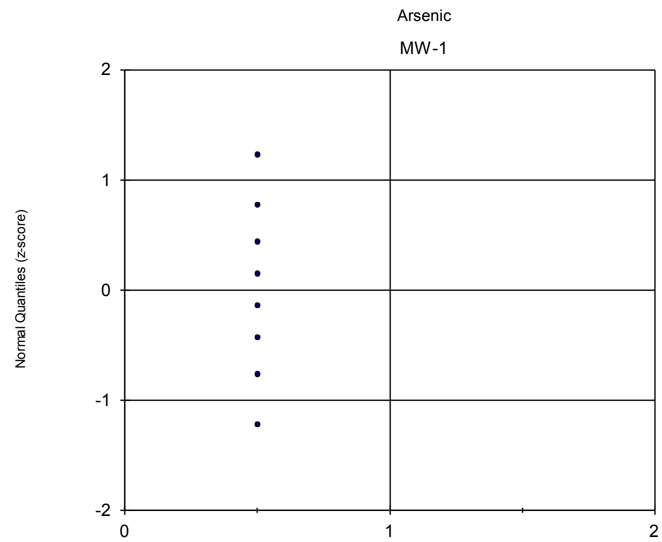


Probability Plot Analysis Run 3/4/2019 2:21 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG



Probability Plot Analysis Run 3/4/2019 2:21 PM
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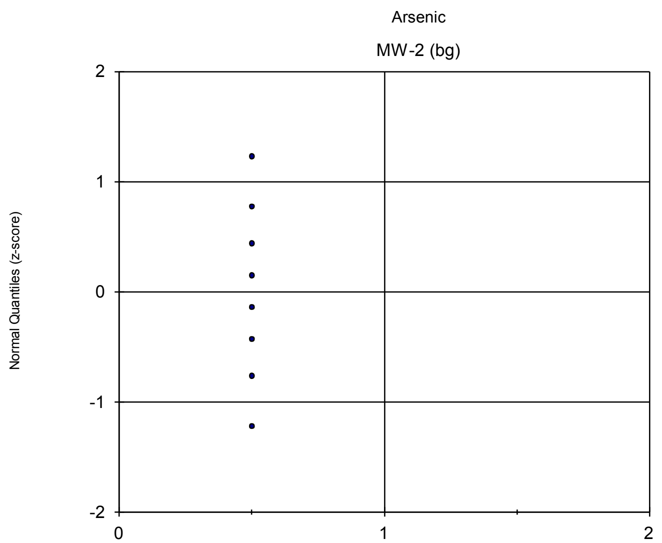
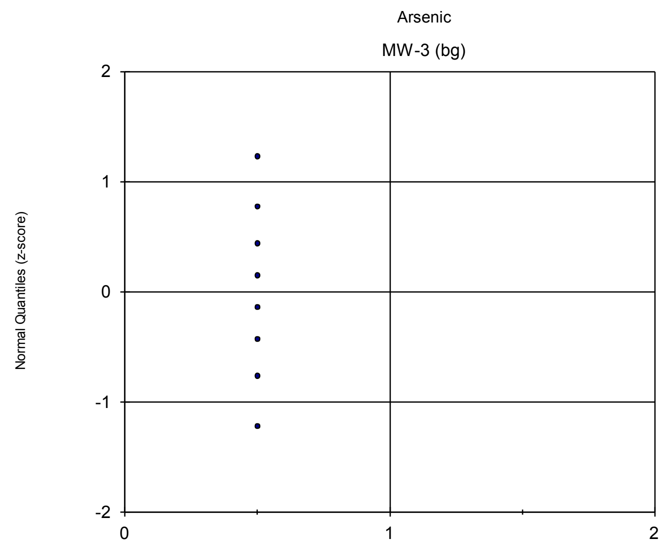
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG



Probability Plot Analysis Run 3/4/2019 2:21 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG



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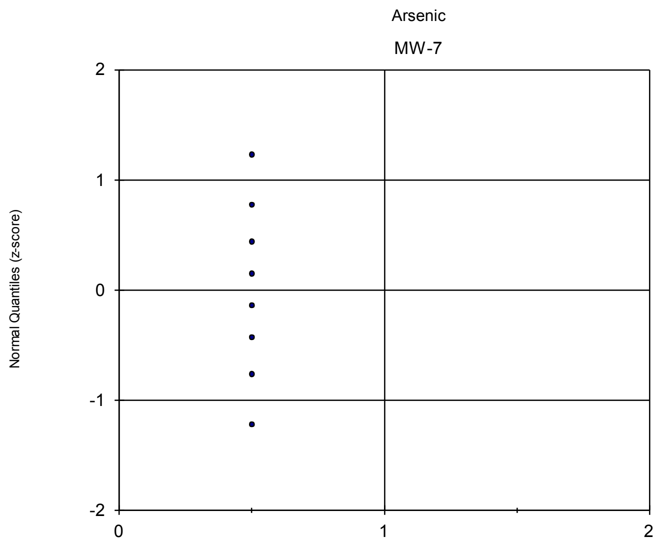

Probability Plot   Analysis Run 3/4/2019 2:21 PM
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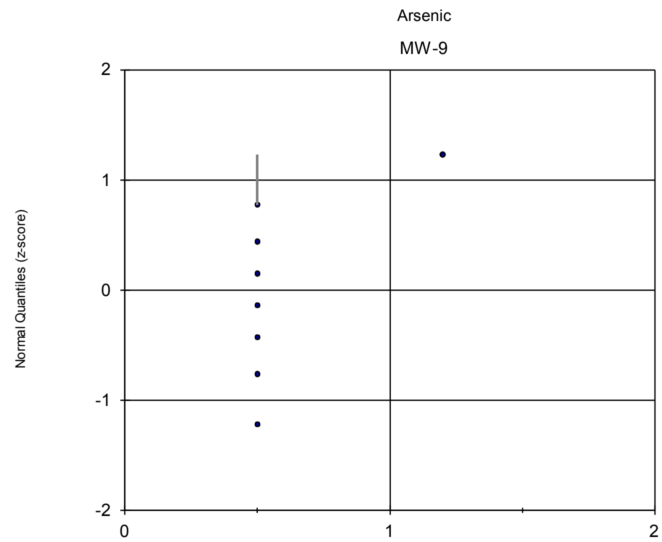

Probability Plot   Analysis Run 3/4/2019 2:21 PM
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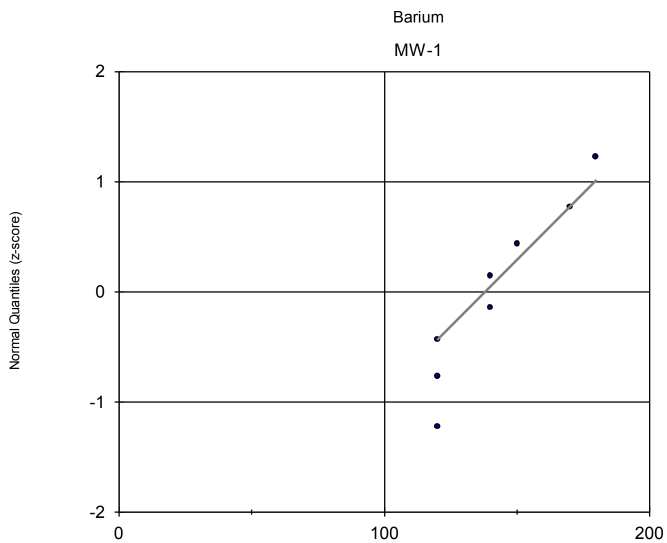

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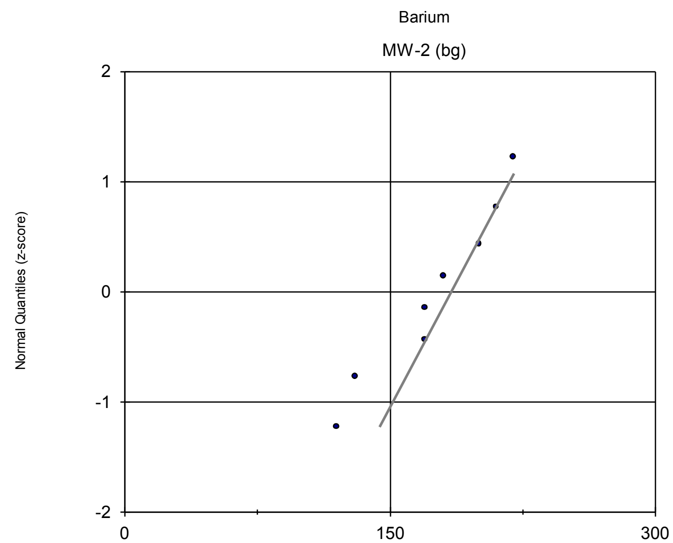

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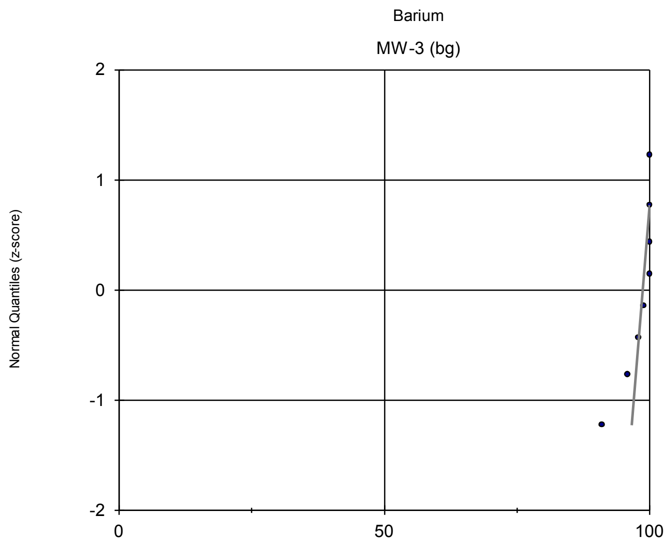

Probability Plot   Analysis Run 3/4/2019 2:21 PM
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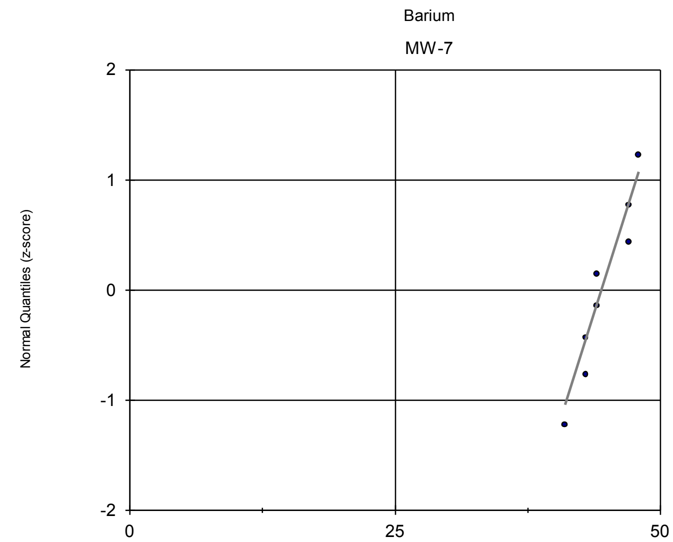

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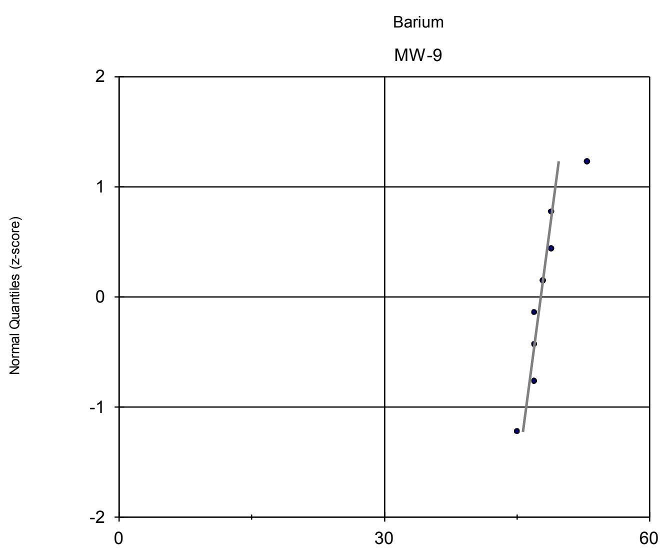

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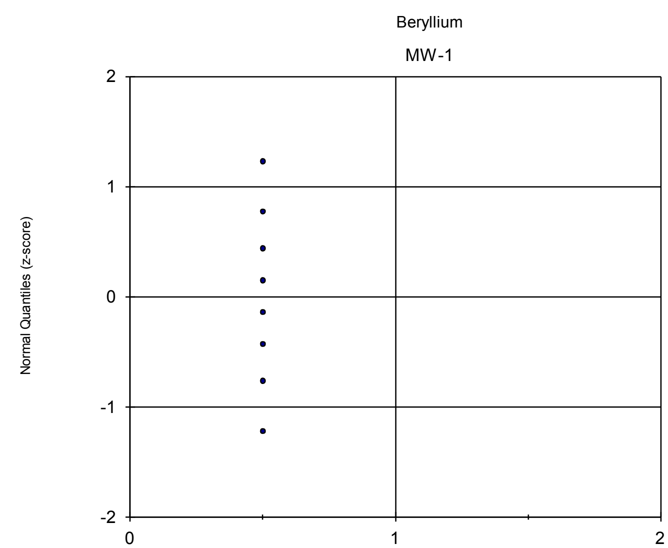

Probability Plot   Analysis Run 3/4/2019 2:21 PM
SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

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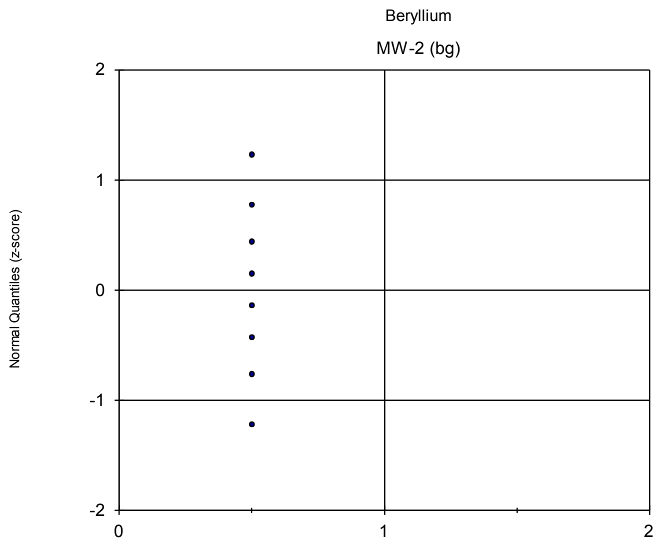

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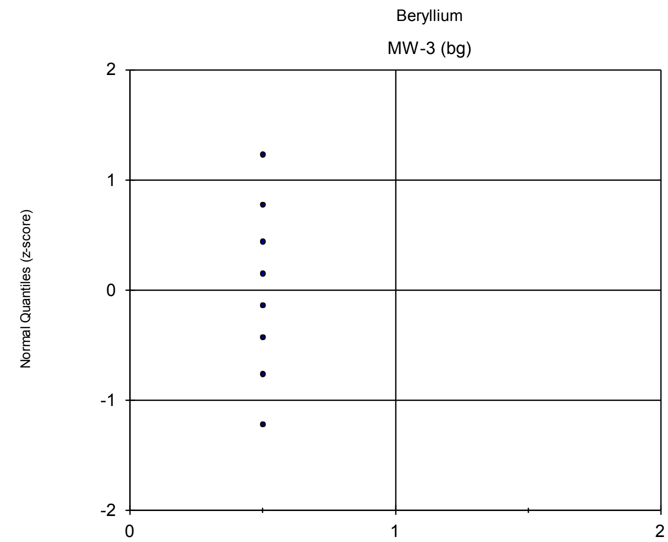
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG



Probability Plot   Analysis Run 3/4/2019 2:21 PM
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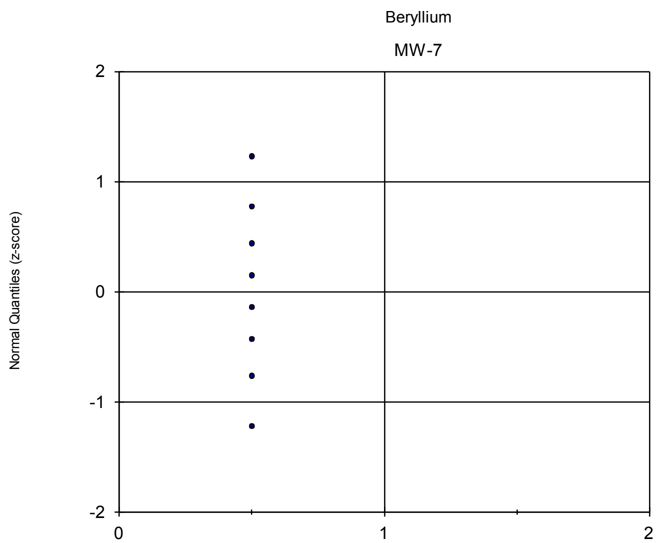
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG



Probability Plot   Analysis Run 3/4/2019 2:21 PM
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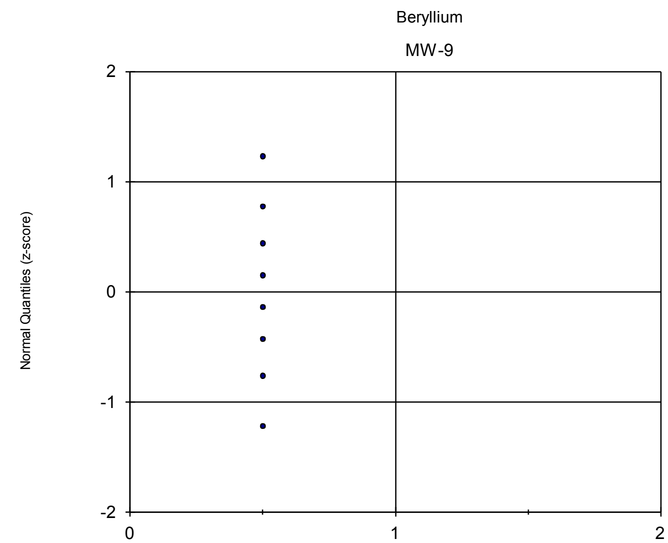
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG



Probability Plot   Analysis Run 3/4/2019 2:21 PM
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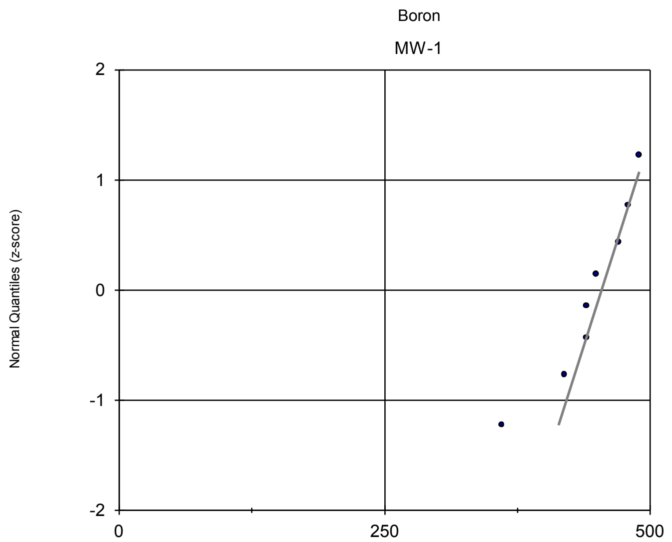
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG



Probability Plot   Analysis Run 3/4/2019 2:21 PM

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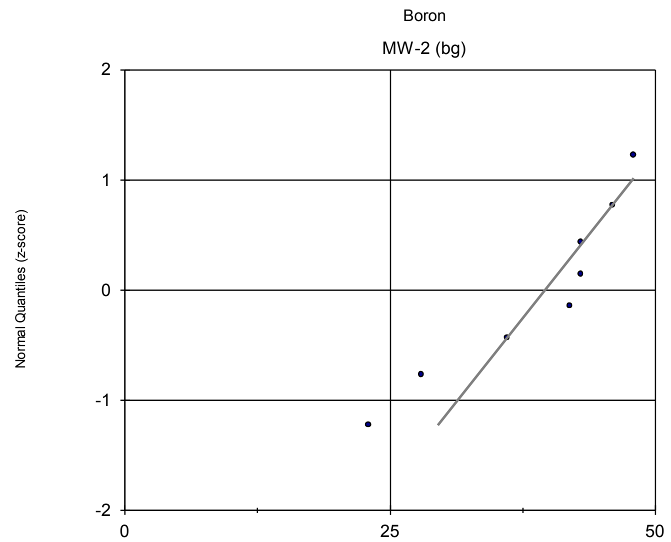
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG



Probability Plot   Analysis Run 3/4/2019 2:21 PM

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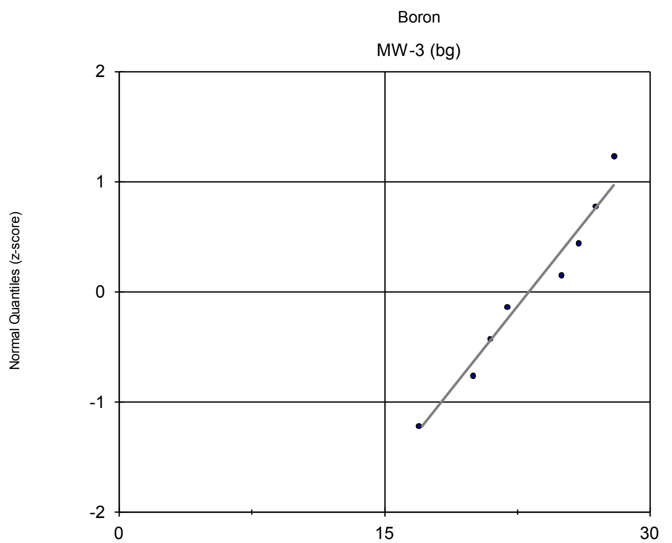
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG



Probability Plot   Analysis Run 3/4/2019 2:21 PM

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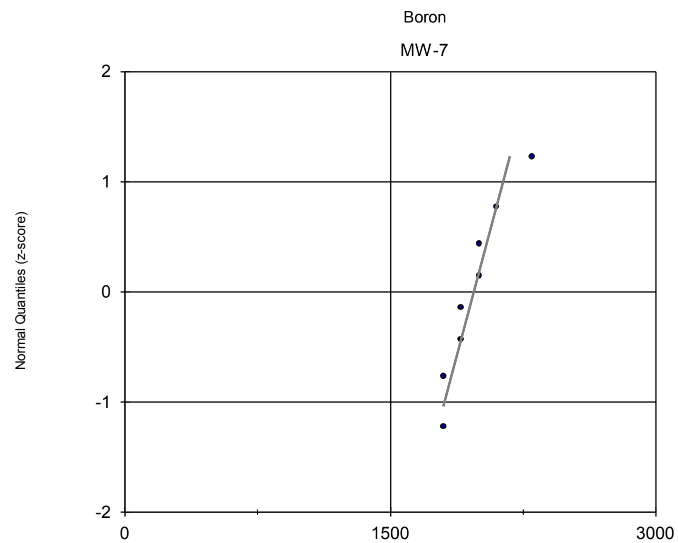
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG



Probability Plot   Analysis Run 3/4/2019 2:21 PM

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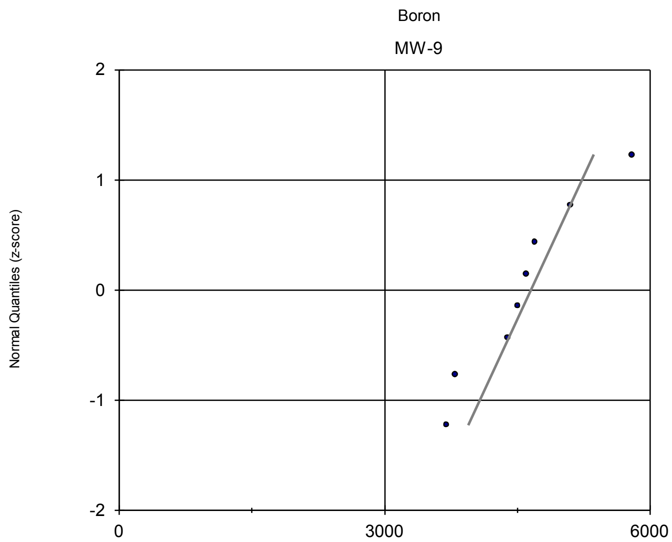

Probability Plot Analysis Run 3/4/2019 2:21 PM
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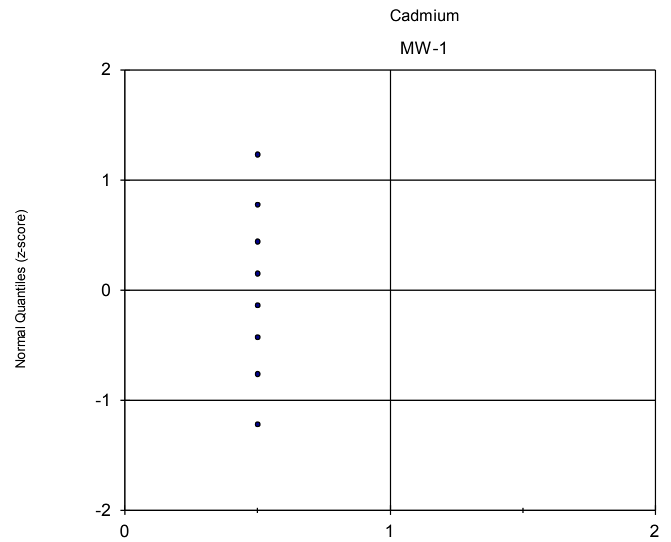
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG



Probability Plot Analysis Run 3/4/2019 2:21 PM
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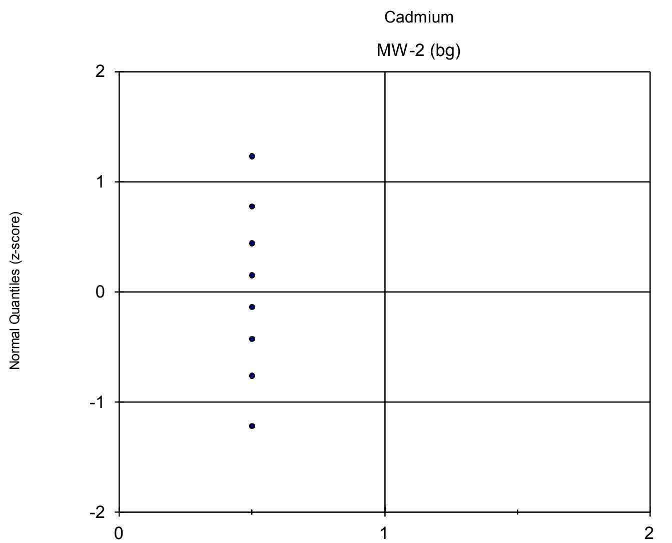
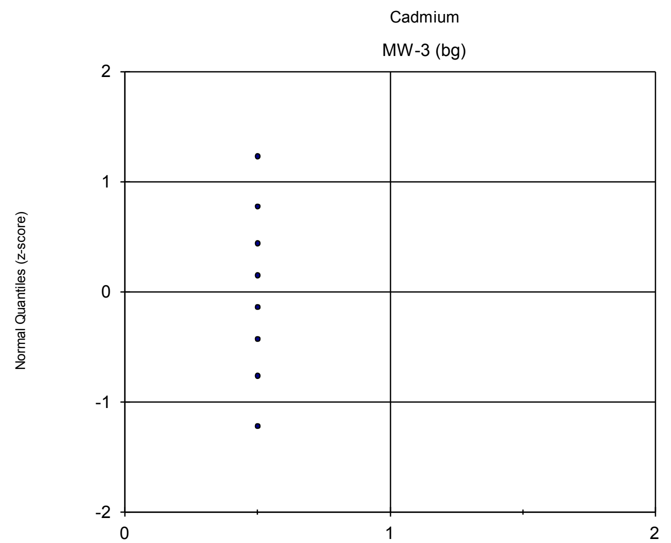
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG



Probability Plot Analysis Run 3/4/2019 2:21 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG



Probability Plot Analysis Run 3/4/2019 2:21 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

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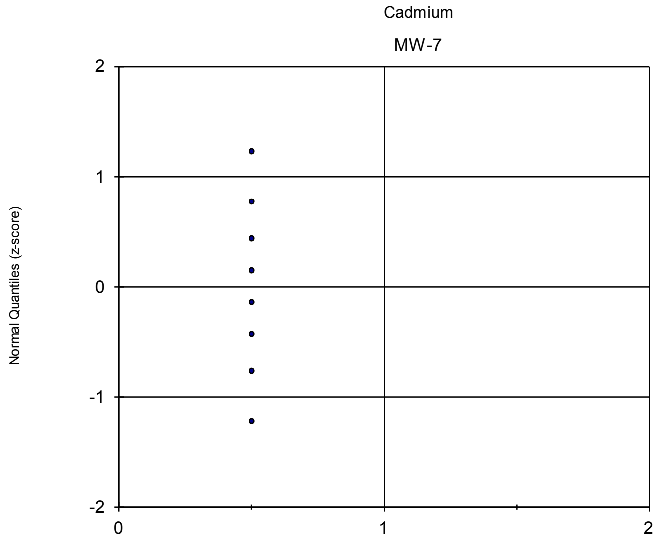

Probability Plot Analysis Run 3/4/2019 2:21 PM
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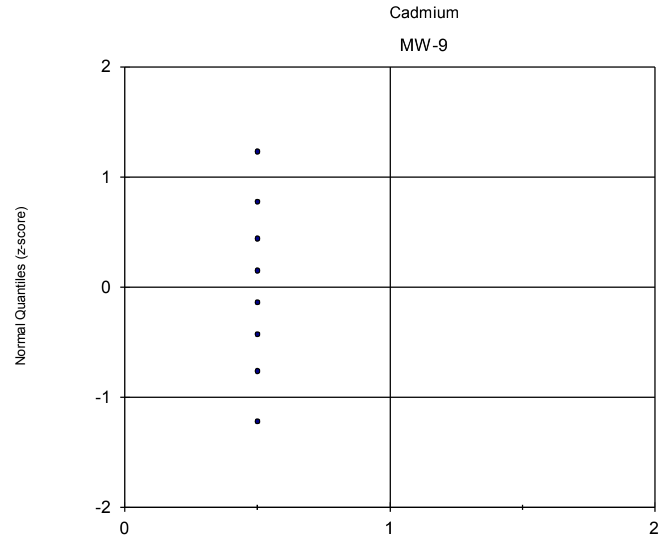

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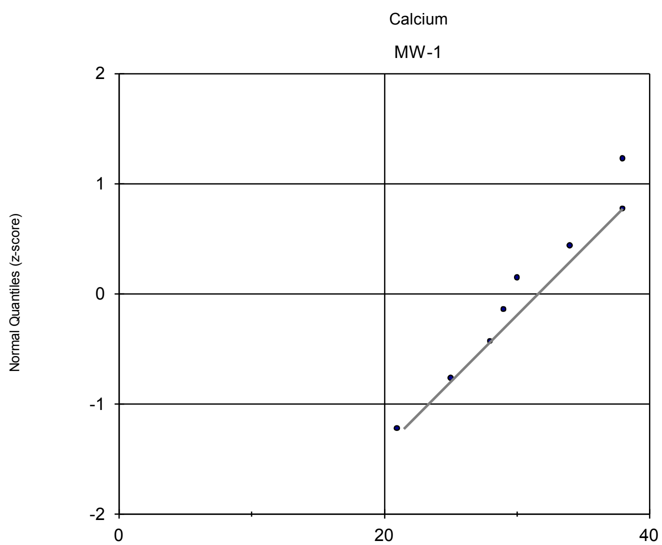

Probability Plot Analysis Run 3/4/2019 2:22 PM
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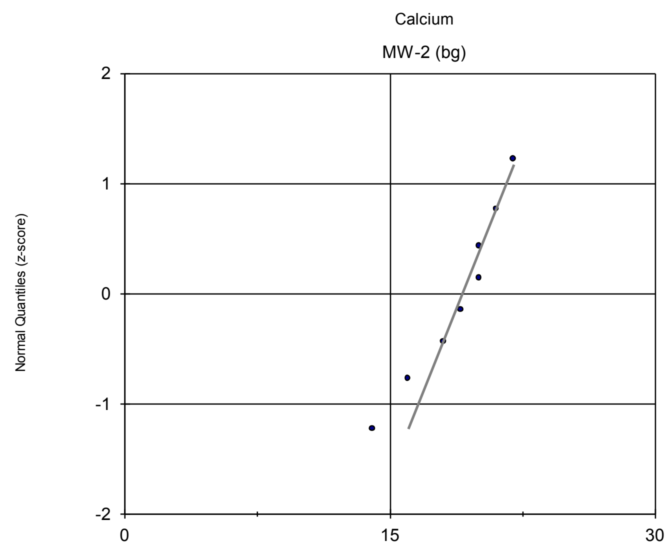

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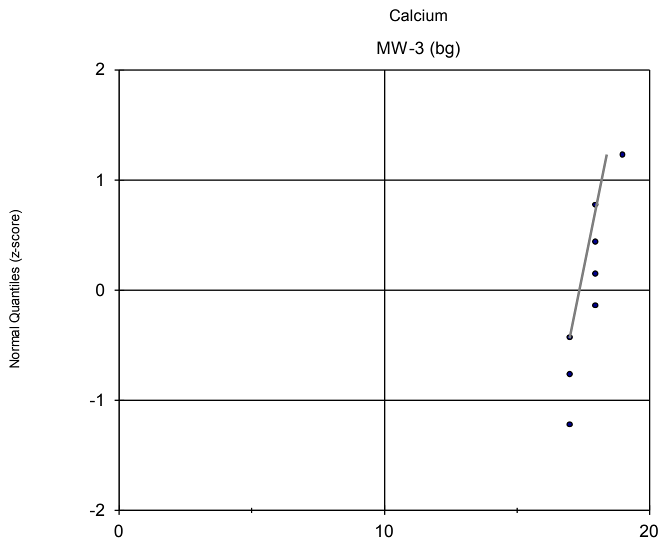

Probability Plot   Analysis Run 3/4/2019 2:22 PM
SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

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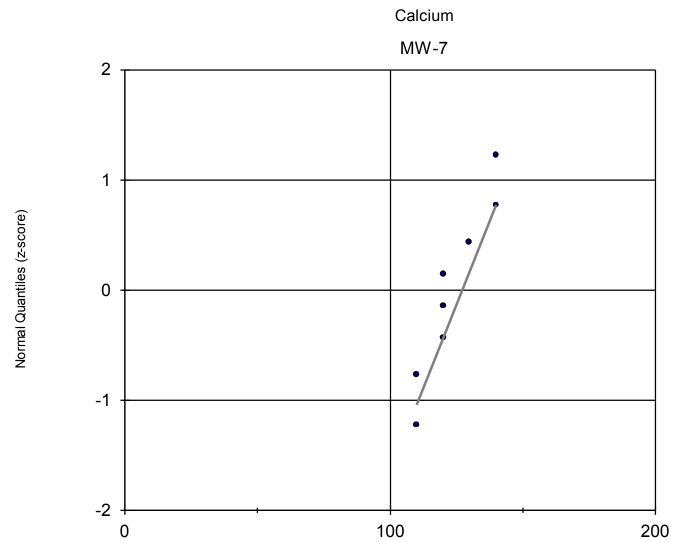

Probability Plot   Analysis Run 3/4/2019 2:22 PM
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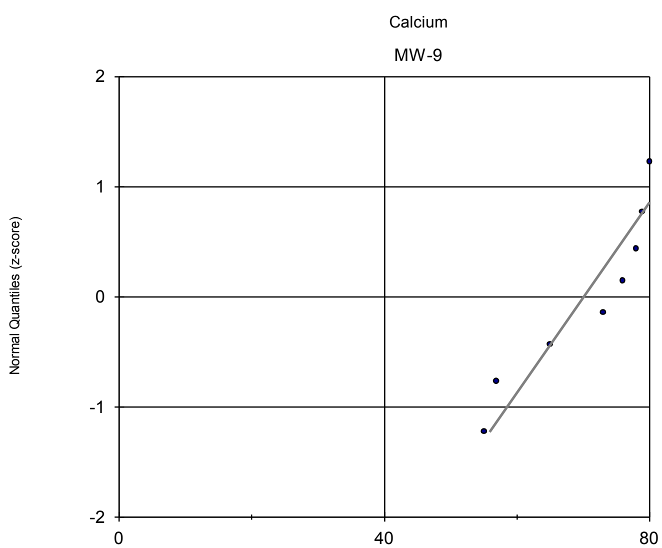

Probability Plot   Analysis Run 3/4/2019 2:22 PM
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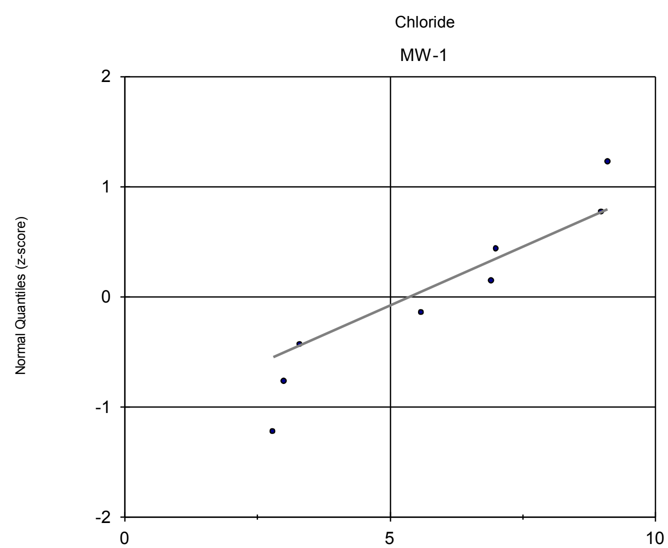

Probability Plot   Analysis Run 3/4/2019 2:22 PM
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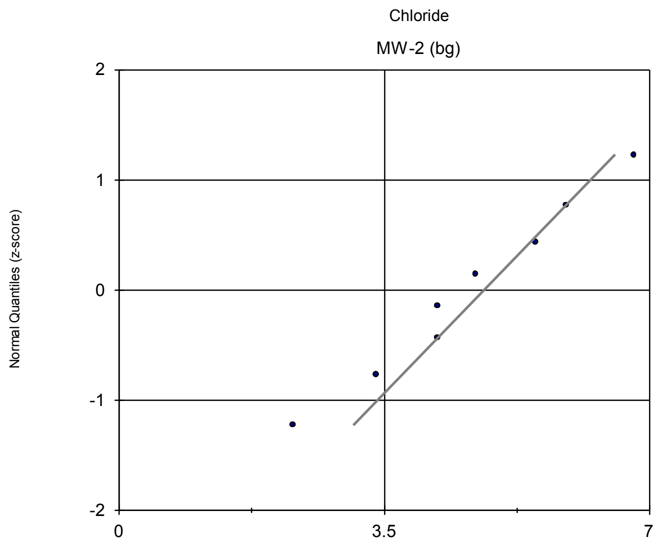

Probability Plot Analysis Run 3/4/2019 2:22 PM
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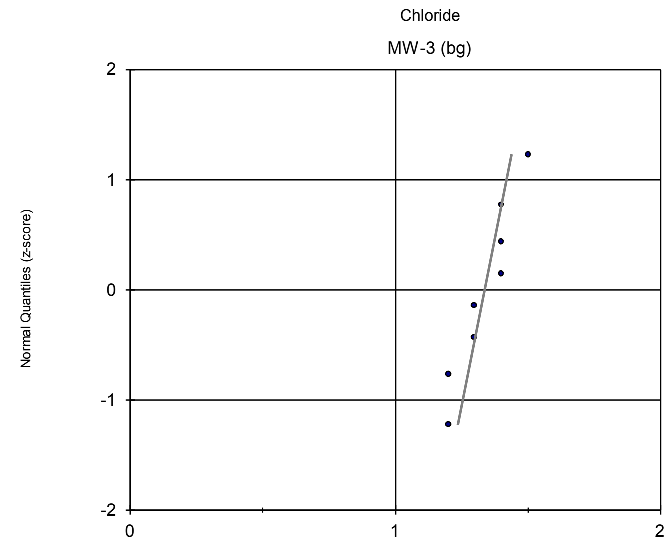

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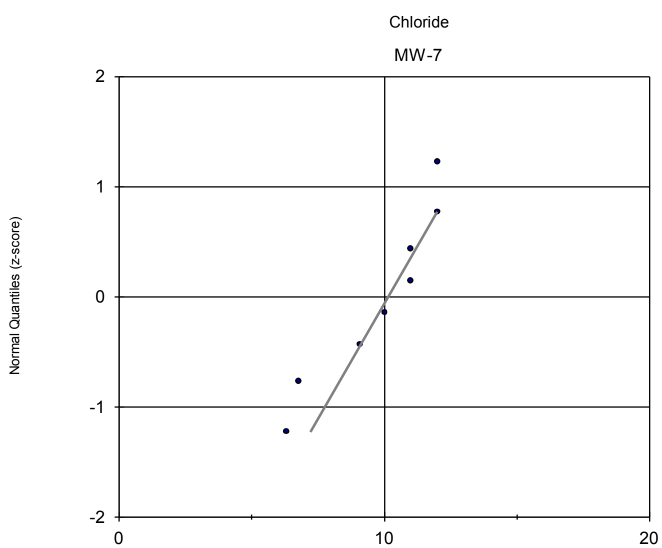

Probability Plot Analysis Run 3/4/2019 2:22 PM
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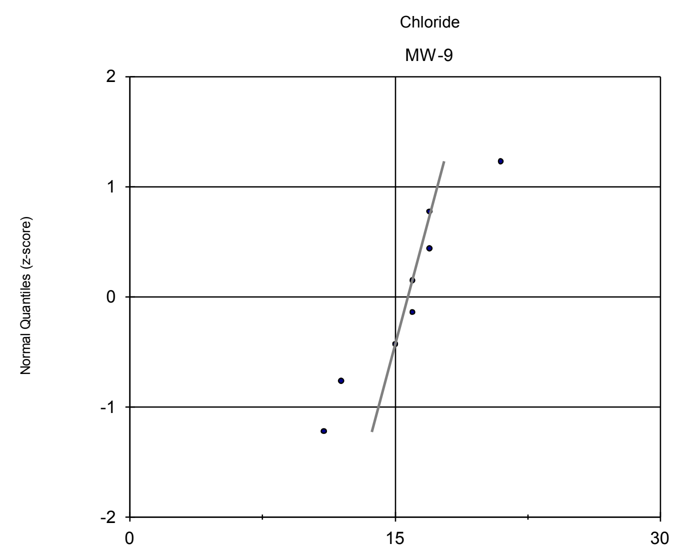
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG



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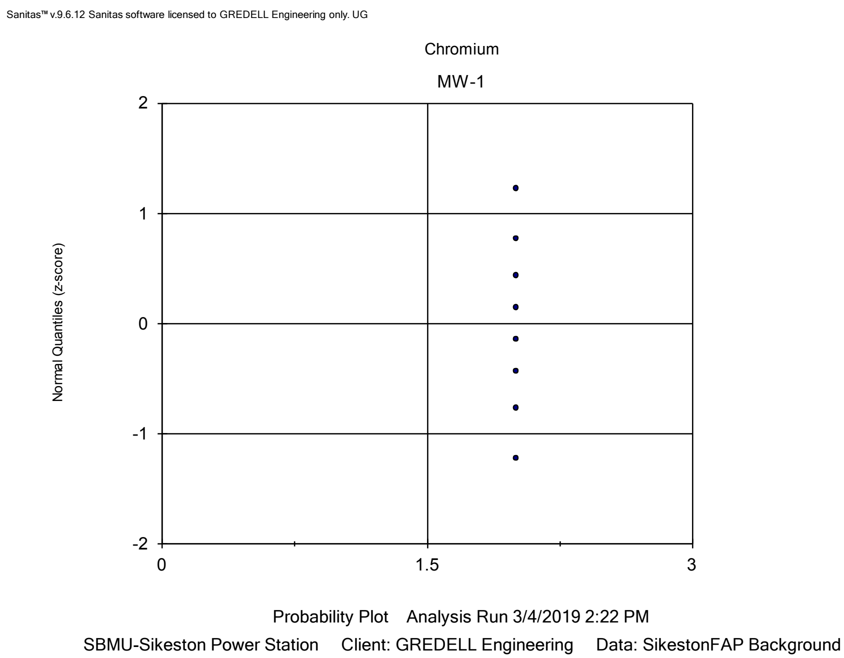
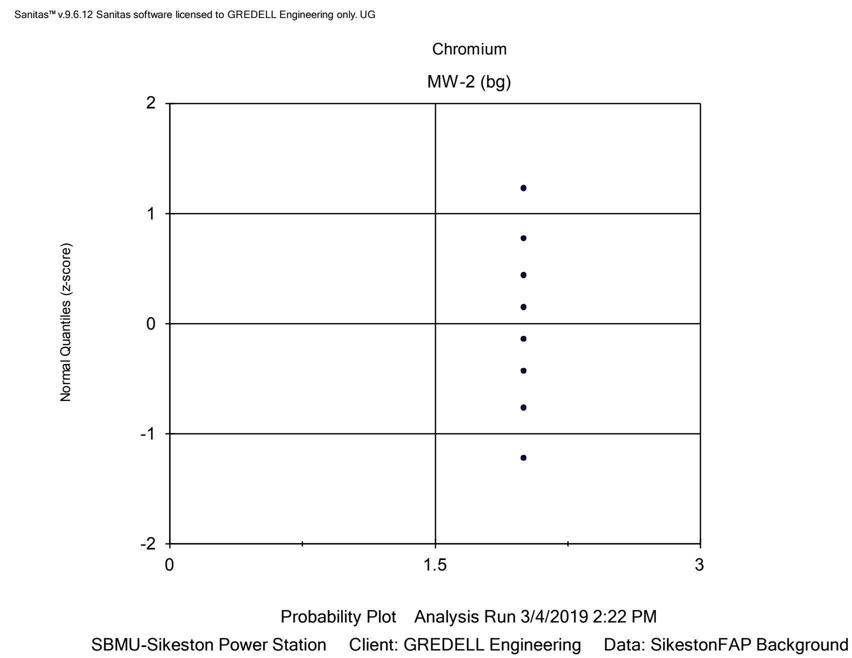
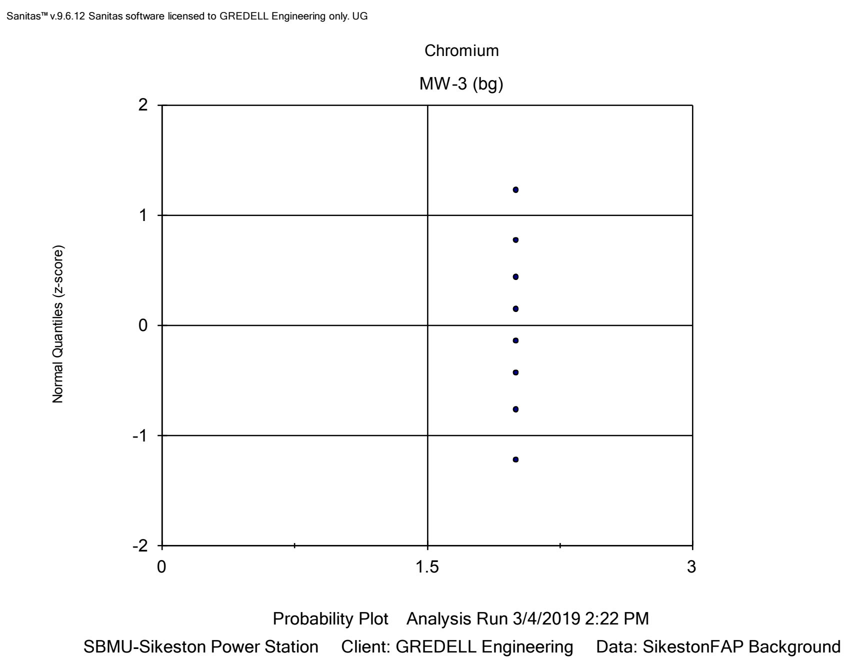


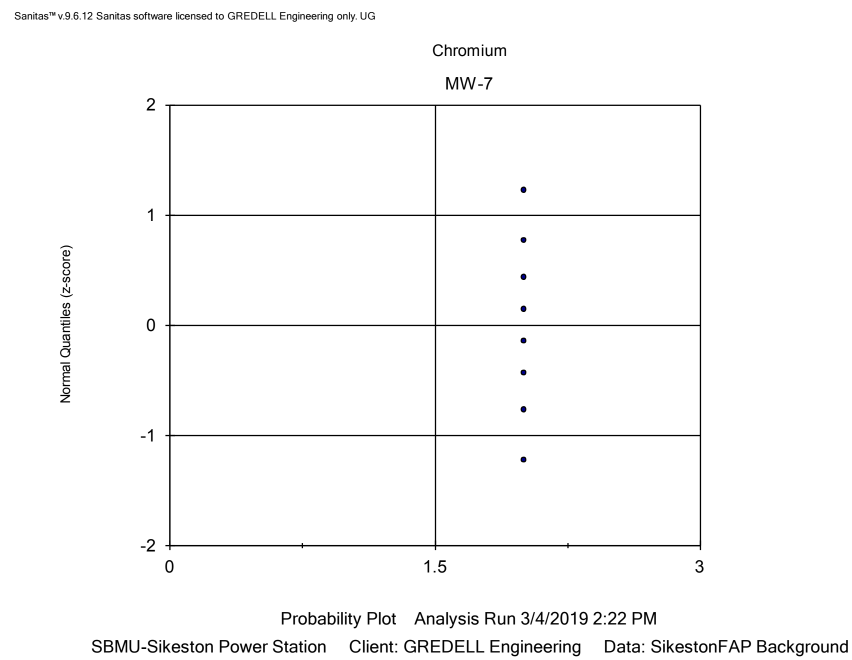
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Chromium
MW-1
Normal Quantiles (z-score)
2
1
0
-1
-2
0
1.5
3
Probability Plot Analysis Run 3/4/2019 2:22 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



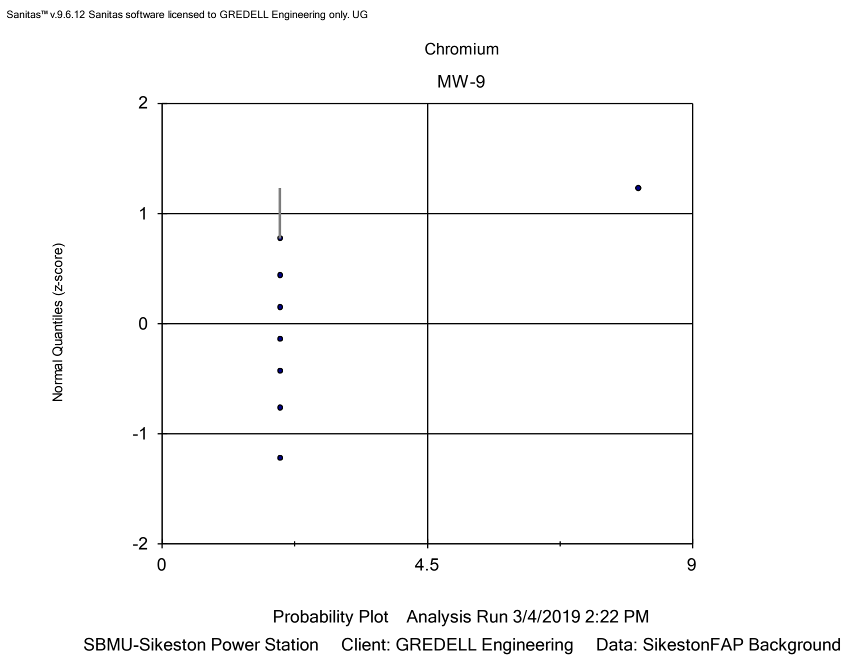
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Chromium
MW-2 (bg)
Normal Quantiles (z-score)
2
1
0
-1
-2
0
1.5
3
Probability Plot Analysis Run 3/4/2019 2:22 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



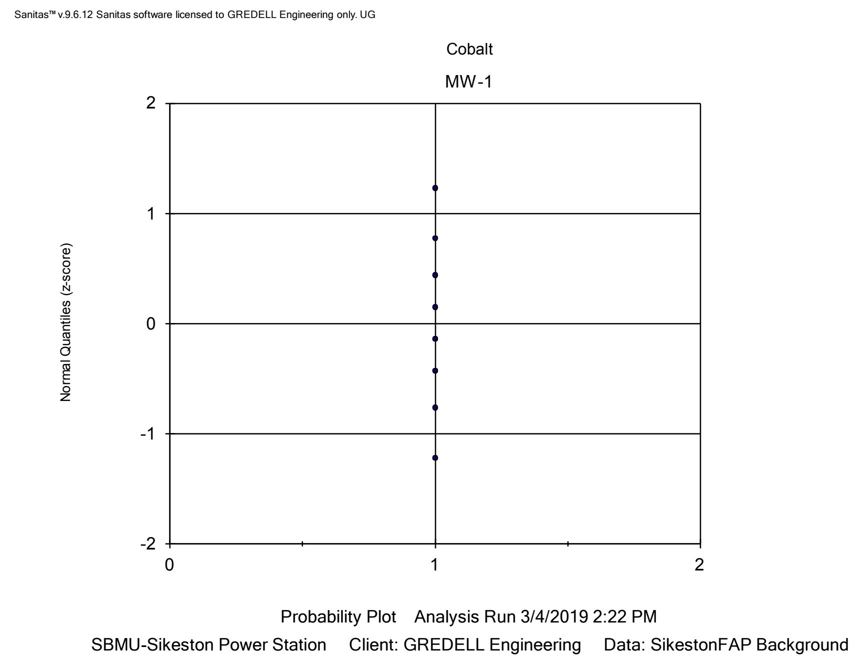
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Chromium
MW-3 (bg)
Normal Quantiles (z-score)
2
1
0
-1
-2
0
1.5
3
Probability Plot Analysis Run 3/4/2019 2:22 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



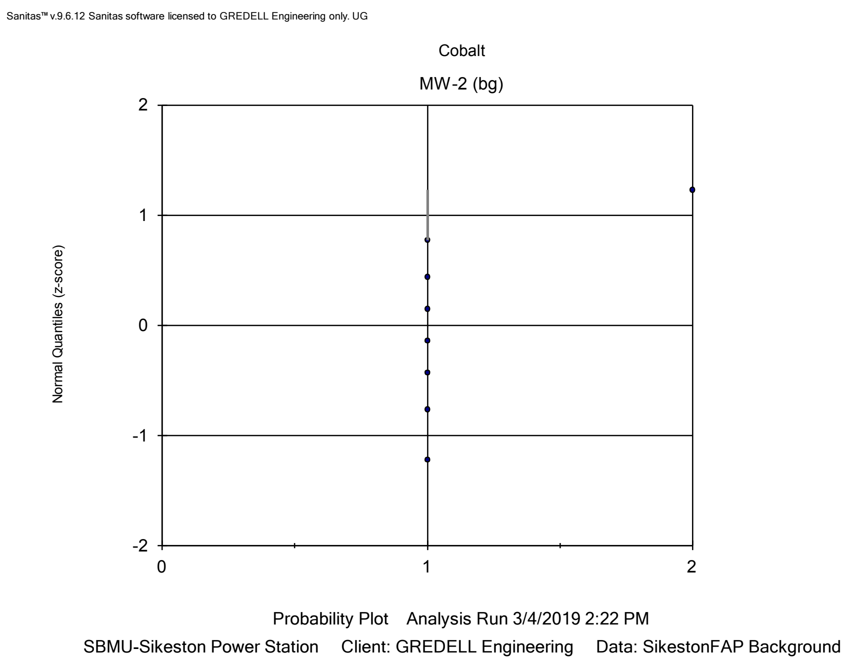
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Chromium
MW-7
Normal Quantiles (z-score)
2
1
0
-1
-2
0
1.5
3
Probability Plot Analysis Run 3/4/2019 2:22 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



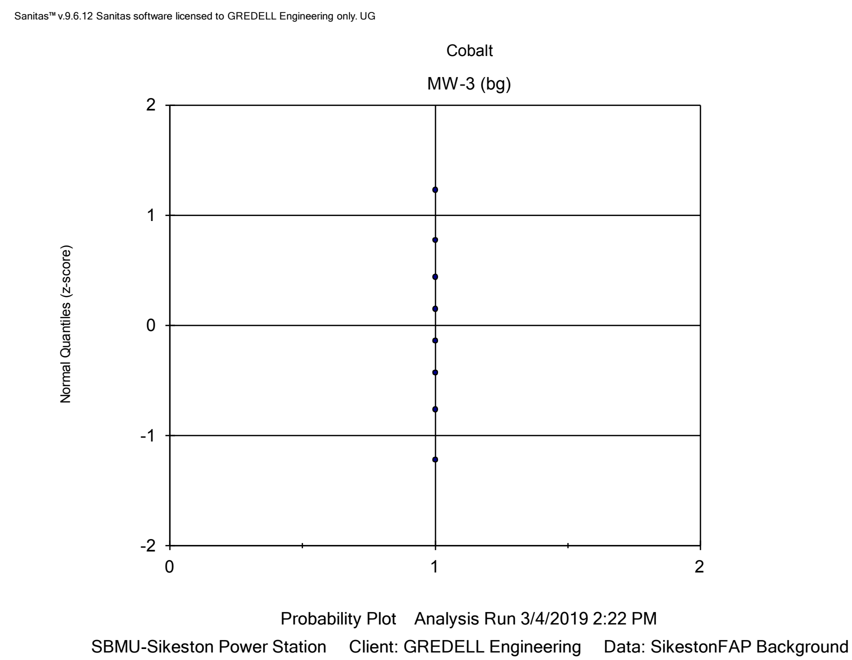
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Chromium
MW-9
Normal Quantiles (z-score)
2
1
0
-1
-2
0
4.5
9
Probability Plot Analysis Run 3/4/2019 2:22 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Cobalt
MW-1
Normal Quantiles (z-score)
2
1
0
-1
-2
0
1
2
Probability Plot Analysis Run 3/4/2019 2:22 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

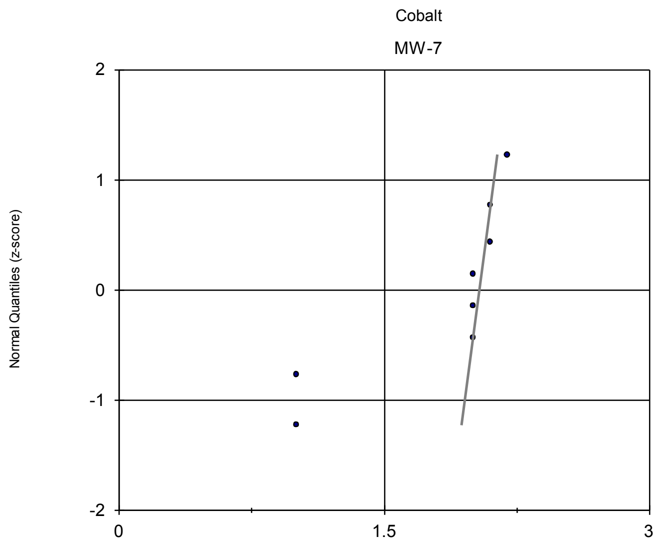


Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Cobalt
MW-2 (bg)
Normal Quantiles (z-score)
2
1
0
-1
-2
0
1
2
Probability Plot Analysis Run 3/4/2019 2:22 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Cobalt
MW-3 (bg)
Normal Quantiles (z-score)
2
1
0
-1
-2
0
1
2
Probability Plot Analysis Run 3/4/2019 2:22 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG



Probability Plot   Analysis Run 3/4/2019 2:22 PM

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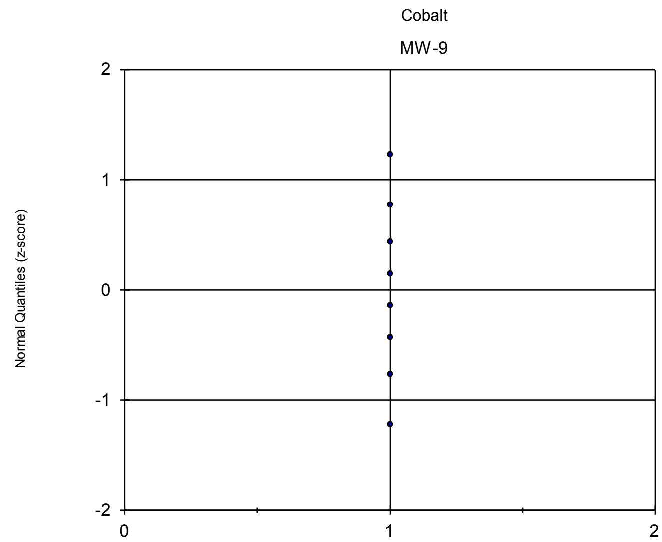

Probability Plot   Analysis Run 3/4/2019 2:22 PM

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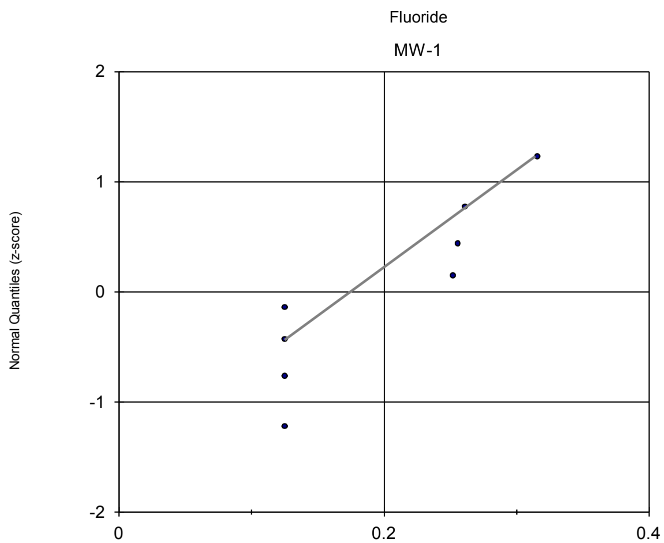

Probability Plot   Analysis Run 3/4/2019 2:22 PM

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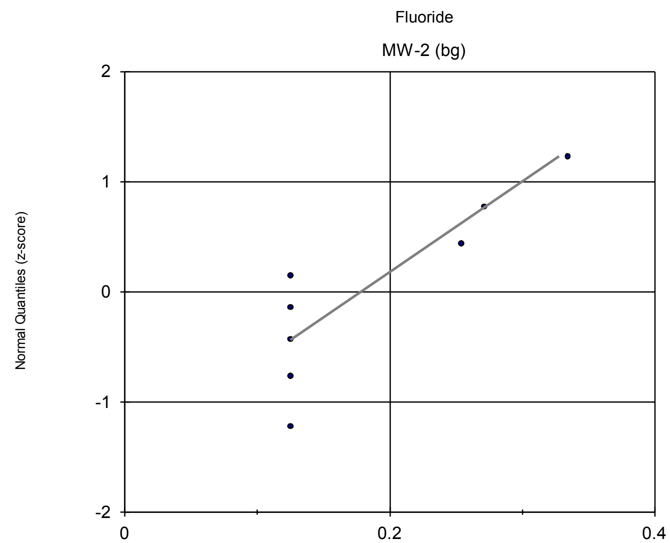

Probability Plot   Analysis Run 3/4/2019 2:22 PM

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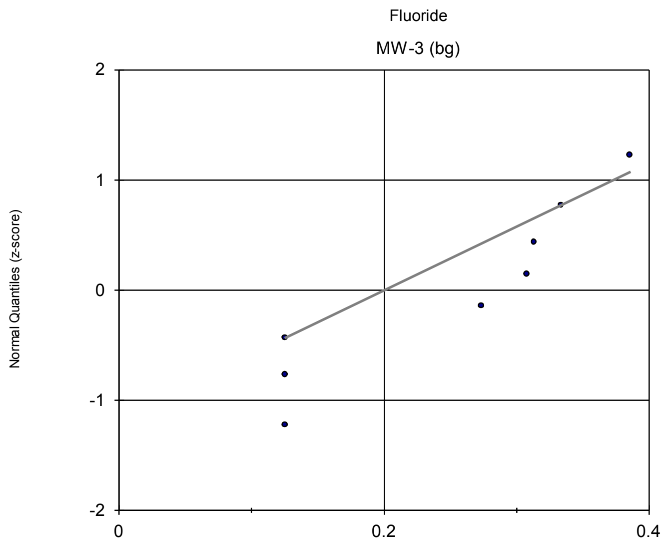

Probability Plot   Analysis Run 3/4/2019 2:22 PM

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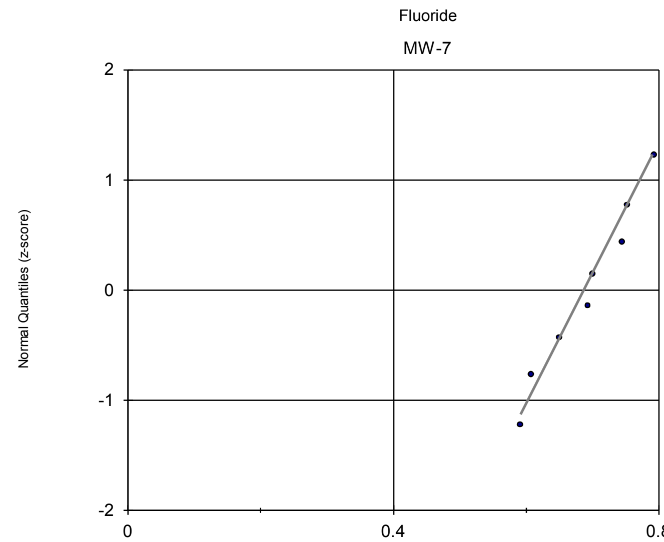

Probability Plot   Analysis Run 3/4/2019 2:22 PM

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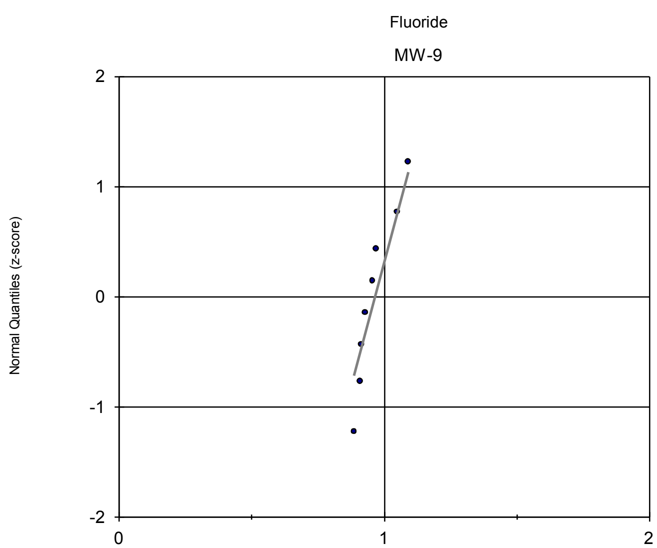

Probability Plot   Analysis Run 3/4/2019 2:22 PM

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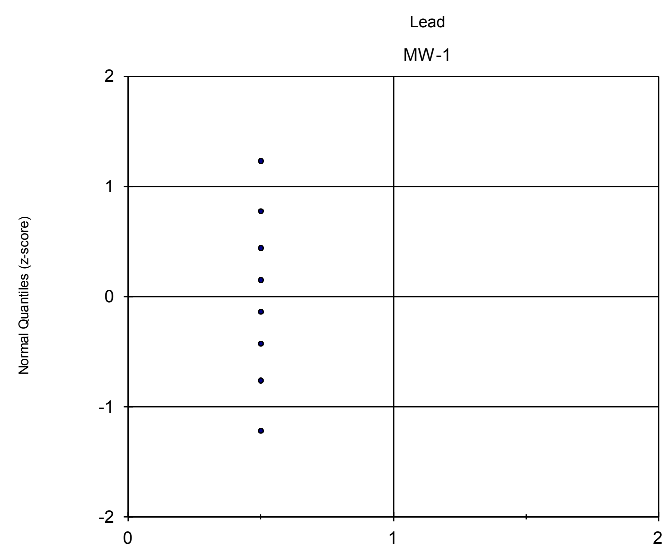

Probability Plot   Analysis Run 3/4/2019 2:22 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

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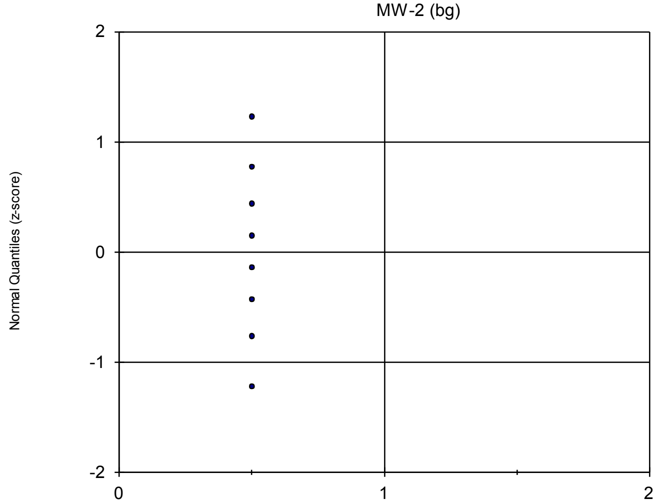
Lead

MW-2 (bg)



Probability Plot   Analysis Run 3/4/2019 2:22 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

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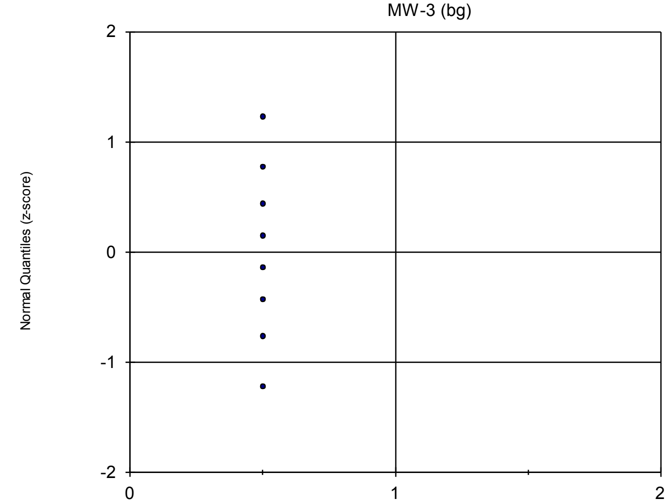
Lead

MW-3 (bg)



Probability Plot   Analysis Run 3/4/2019 2:22 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

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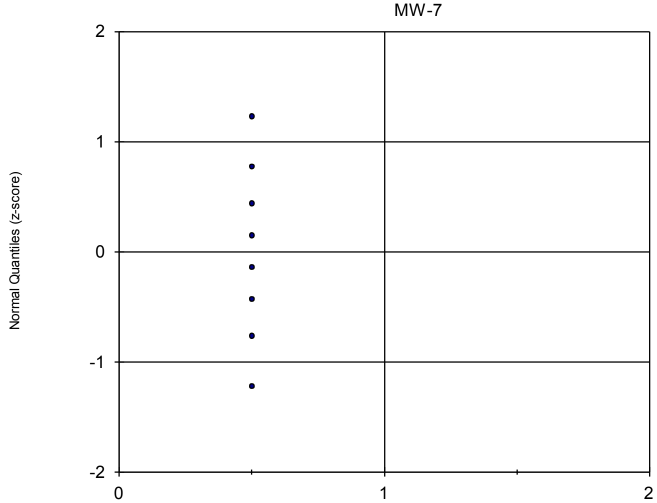
Lead

MW-7



Probability Plot   Analysis Run 3/4/2019 2:22 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

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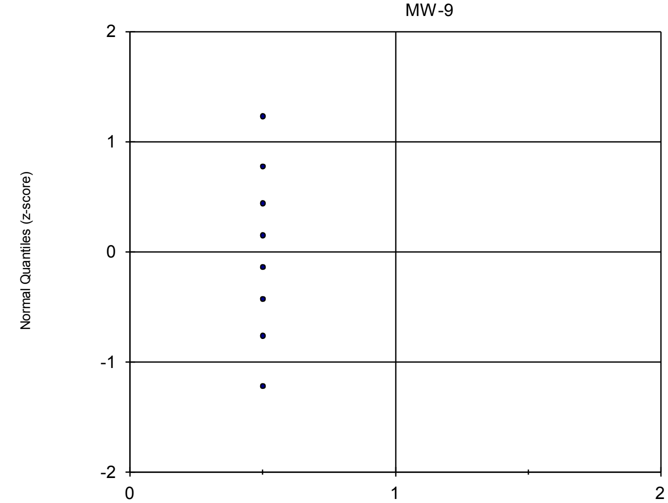
Lead

MW-9



Probability Plot   Analysis Run 3/4/2019 2:22 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

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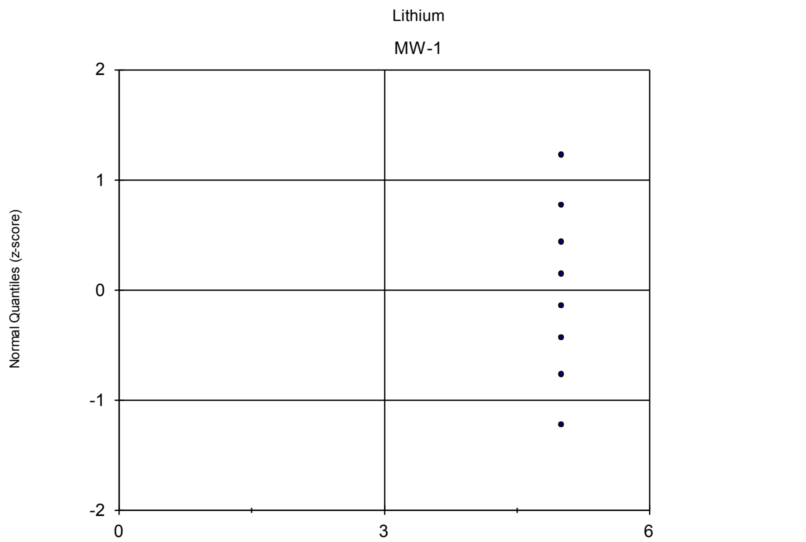

Probability Plot   Analysis Run 3/4/2019 2:22 PM
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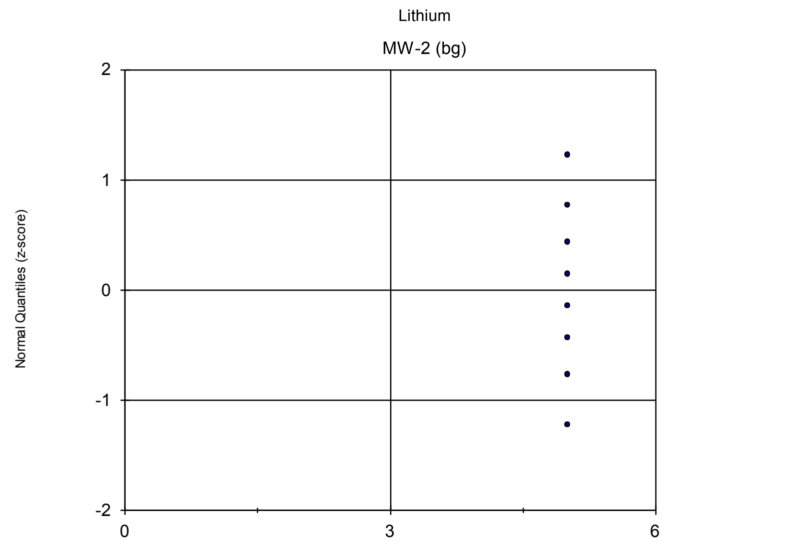

Probability Plot   Analysis Run 3/4/2019 2:22 PM
SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

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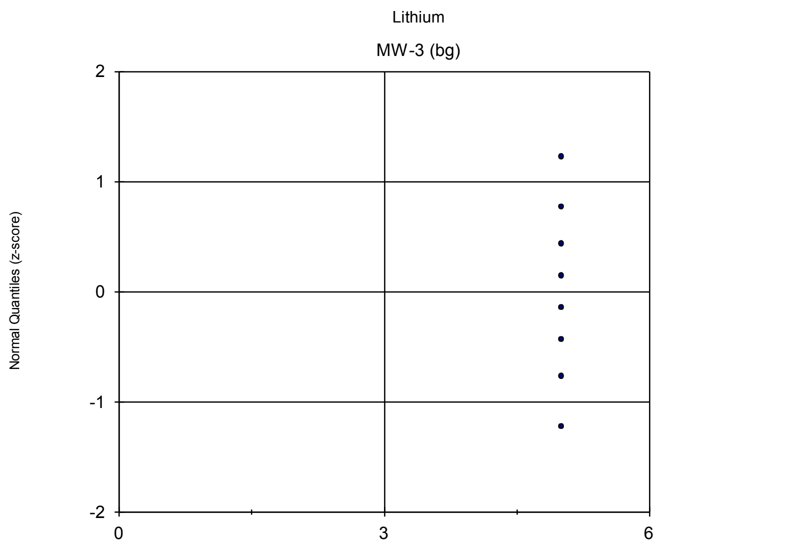
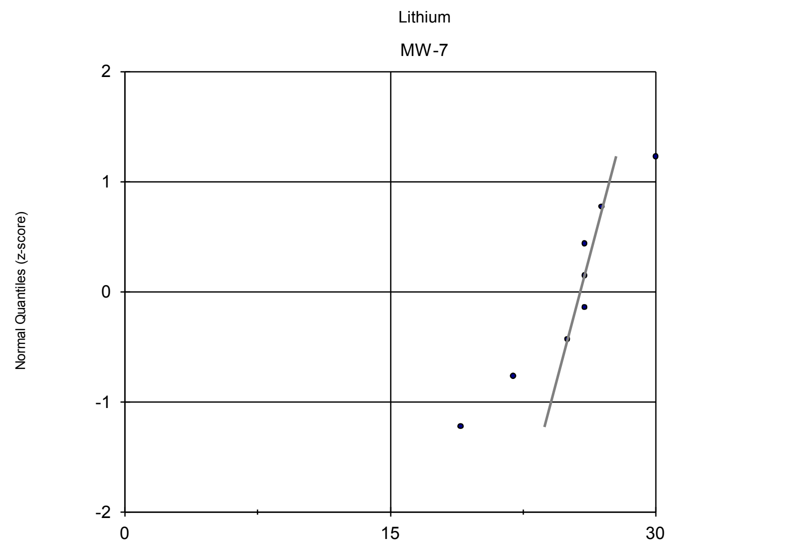


Probability Plot   Analysis Run 3/4/2019 2:22 PM
SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

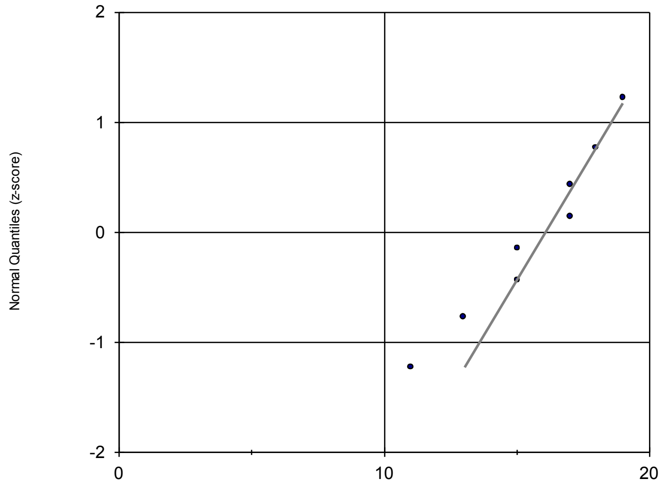
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG



Probability Plot   Analysis Run 3/4/2019 2:22 PM
SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

Lithium

MW-9



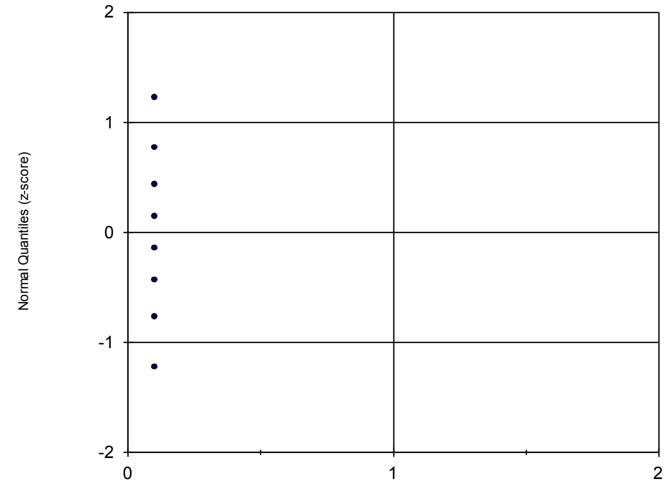
Probability Plot Analysis Run 3/4/2019 2:22 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG

Mercury

MW-1



Probability Plot Analysis Run 3/4/2019 2:22 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

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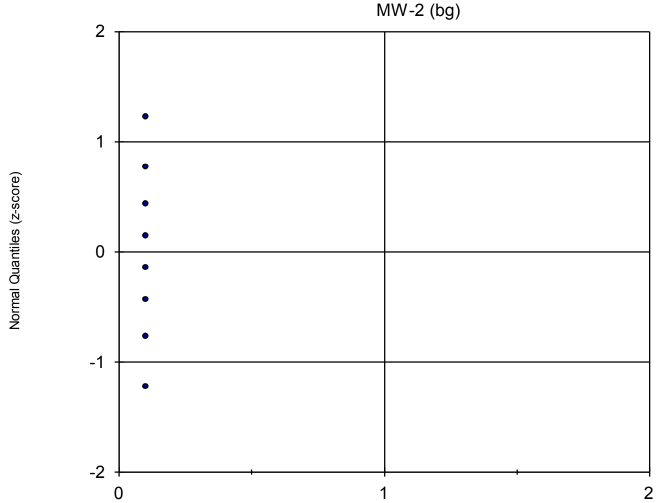
Mercury

MW-2 (bg)



Probability Plot Analysis Run 3/4/2019 2:22 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

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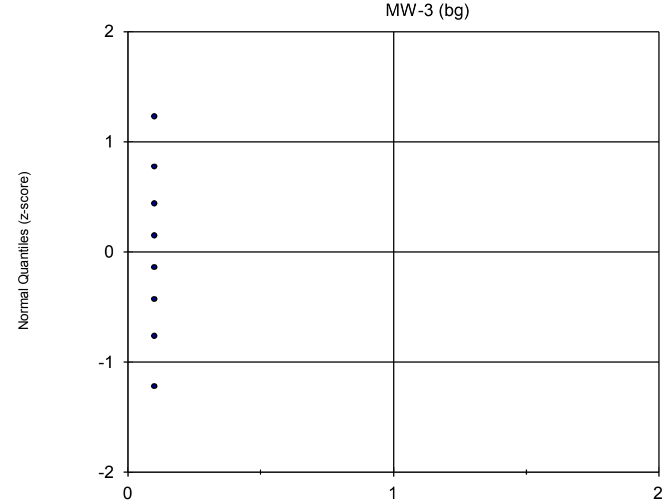
Mercury

MW-3 (bg)

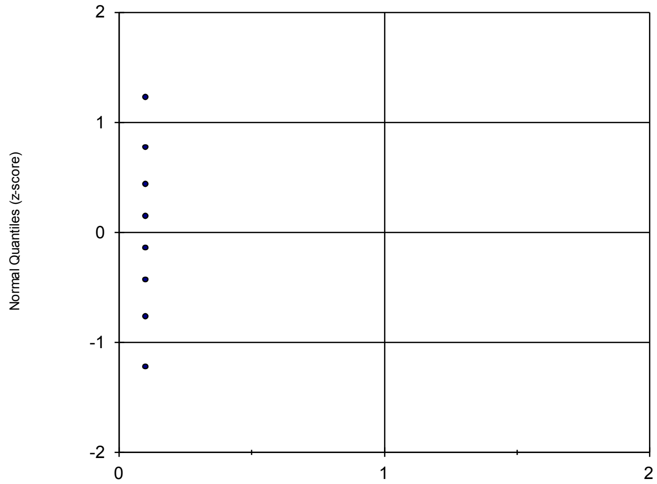


Probability Plot Analysis Run 3/4/2019 2:22 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Mercury

MW-7

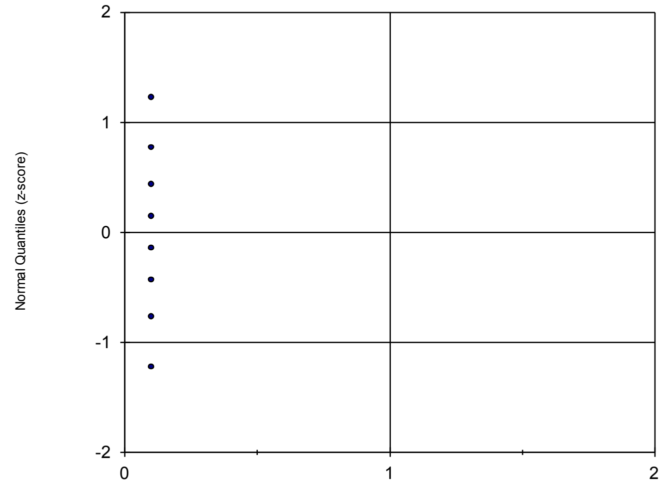


Probability Plot Analysis Run 3/4/2019 2:22 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Mercury

MW-9

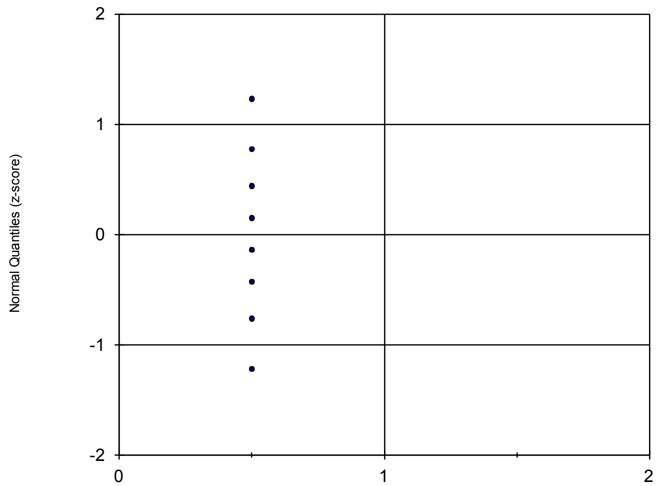


Probability Plot Analysis Run 3/4/2019 2:22 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Molybdenum

MW-1

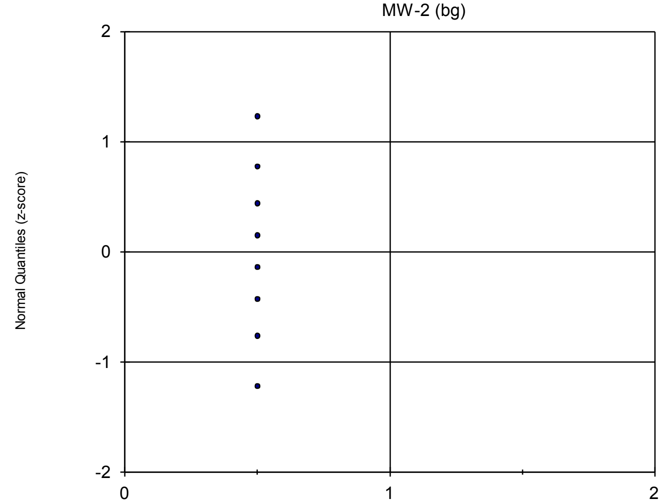


Probability Plot Analysis Run 3/4/2019 2:22 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Molybdenum

MW-2 (bg)



Probability Plot Analysis Run 3/4/2019 2:22 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

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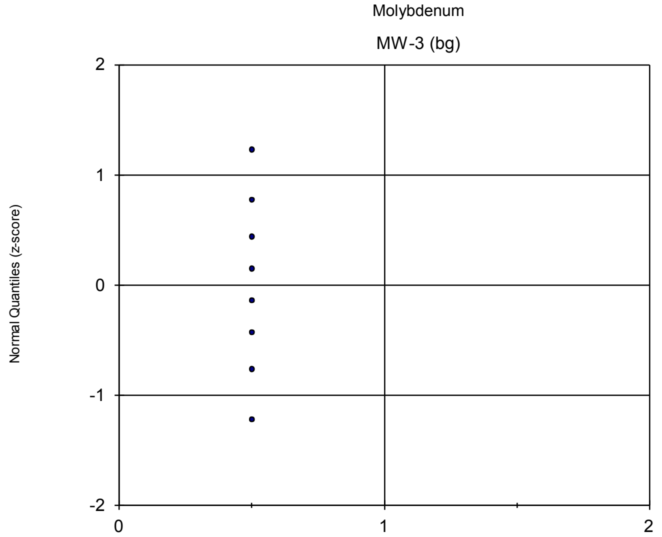

Probability Plot Analysis Run 3/4/2019 2:22 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

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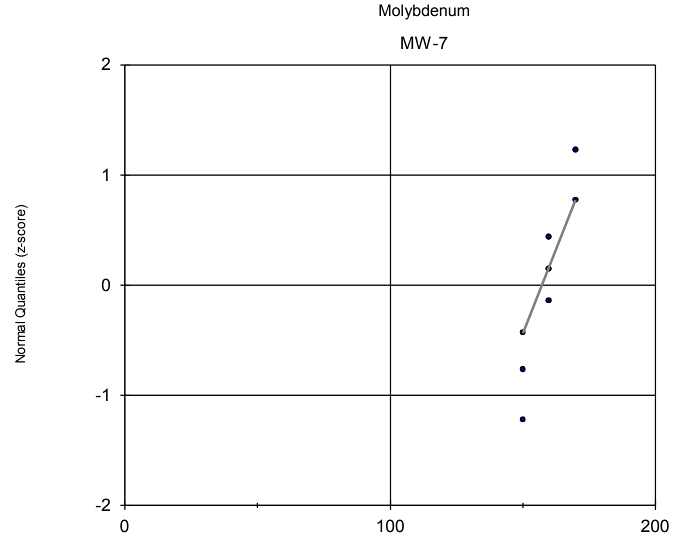

Probability Plot Analysis Run 3/4/2019 2:22 PM
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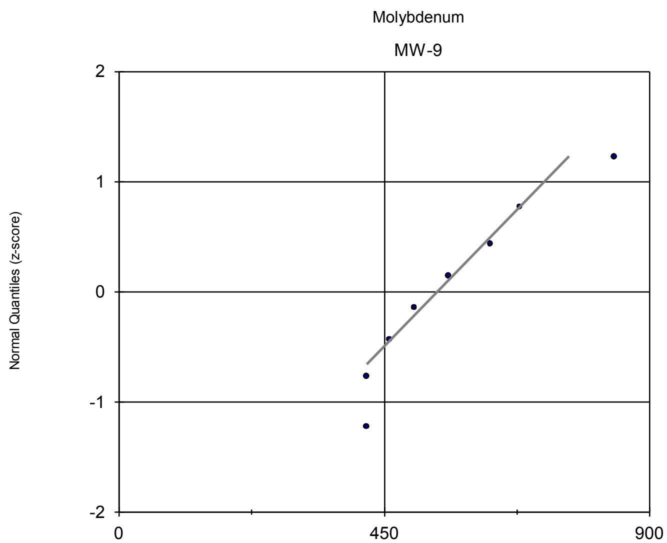

Probability Plot Analysis Run 3/4/2019 2:22 PM
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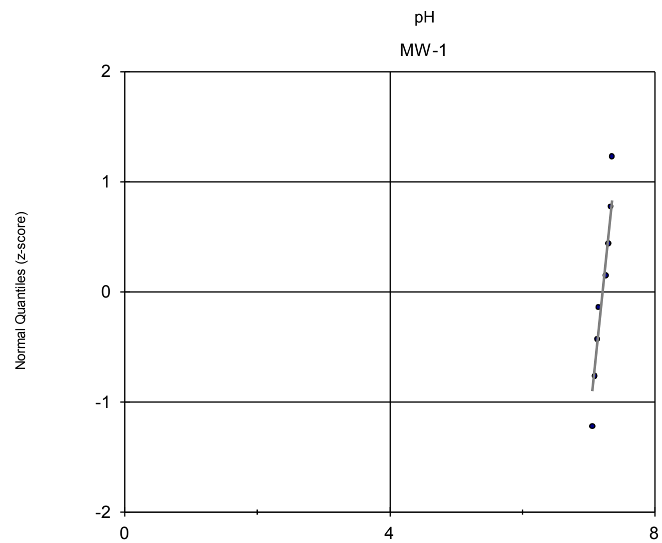

Probability Plot Analysis Run 3/4/2019 2:22 PM
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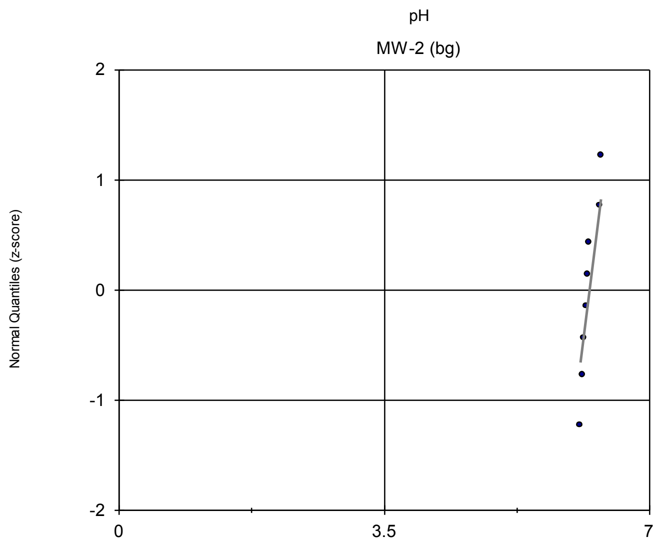

Probability Plot   Analysis Run 3/4/2019 2:22 PM

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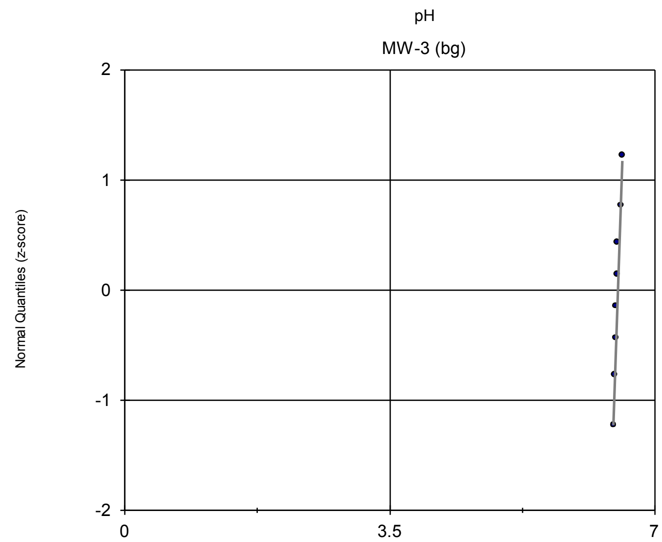

Probability Plot   Analysis Run 3/4/2019 2:22 PM

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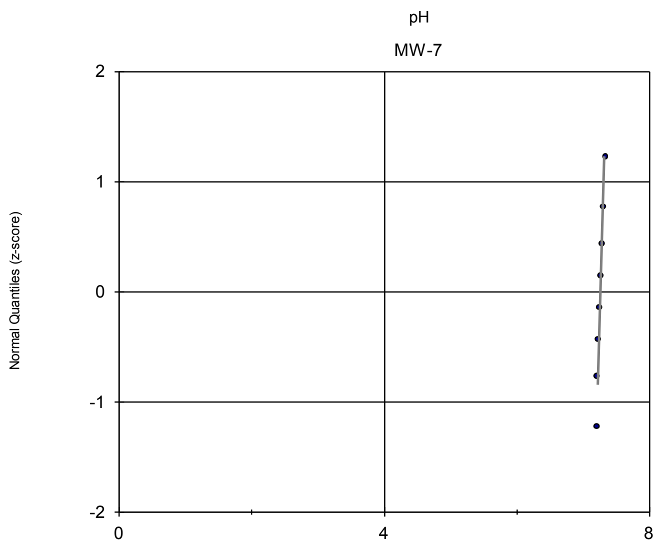

Probability Plot   Analysis Run 3/4/2019 2:22 PM

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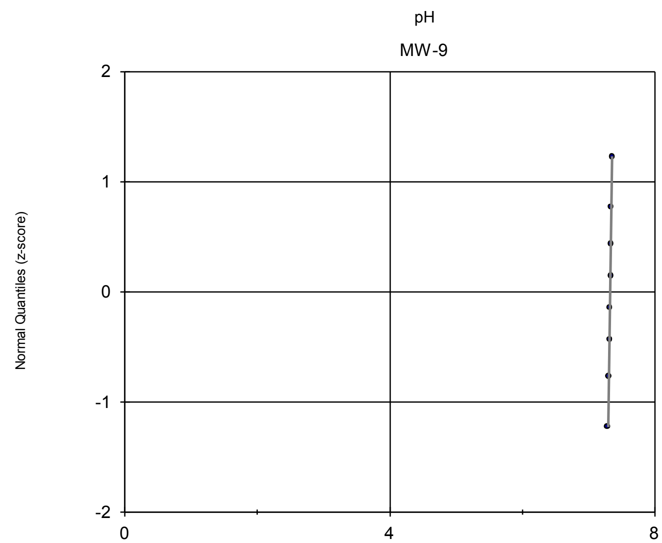

Probability Plot   Analysis Run 3/4/2019 2:22 PM

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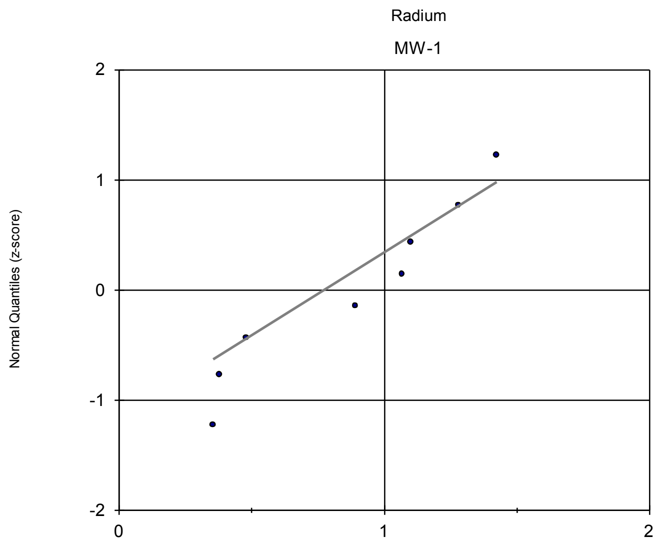

Probability Plot   Analysis Run 3/4/2019 2:22 PM

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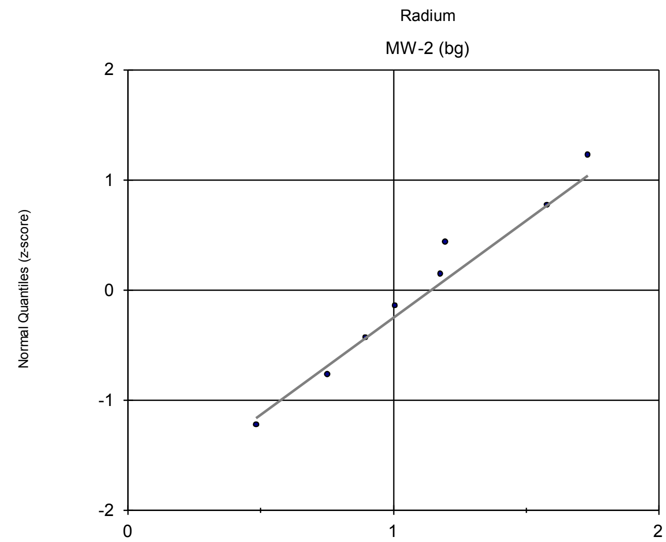

Probability Plot   Analysis Run 3/4/2019 2:22 PM

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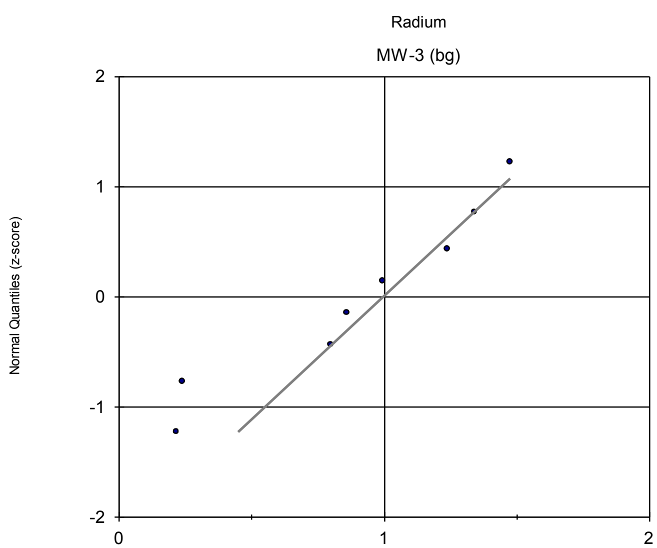

Probability Plot   Analysis Run 3/4/2019 2:22 PM

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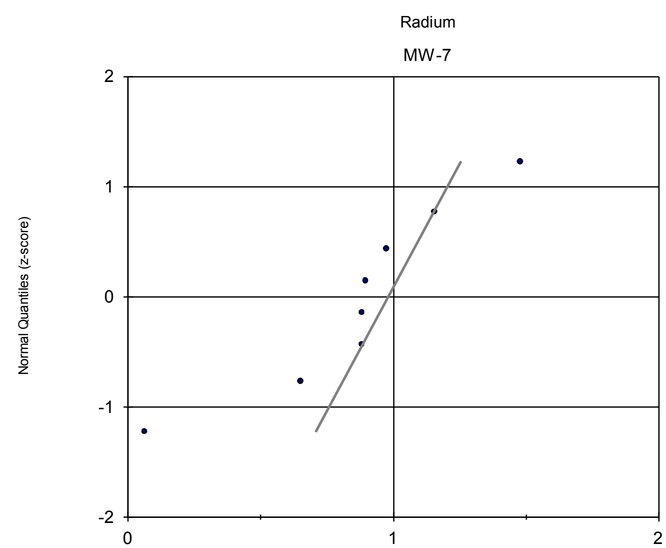

Probability Plot   Analysis Run 3/4/2019 2:22 PM

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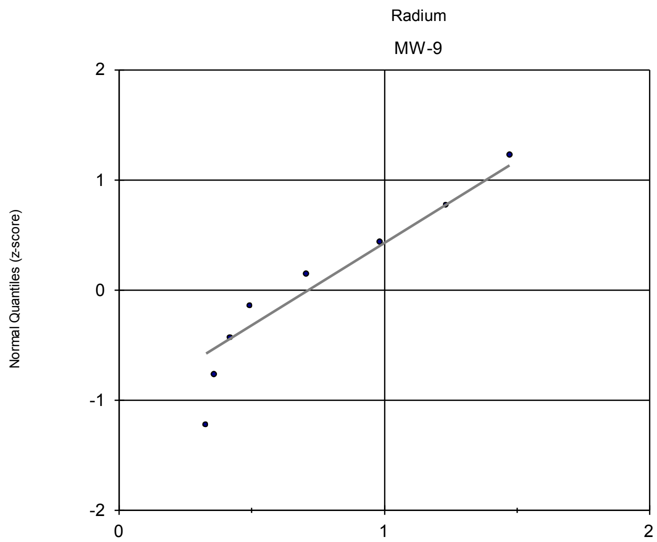

Probability Plot   Analysis Run 3/4/2019 2:22 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

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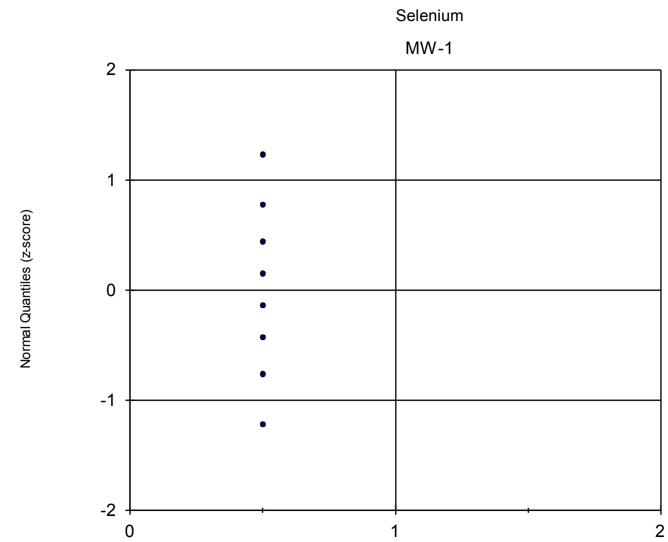

Probability Plot   Analysis Run 3/4/2019 2:22 PM

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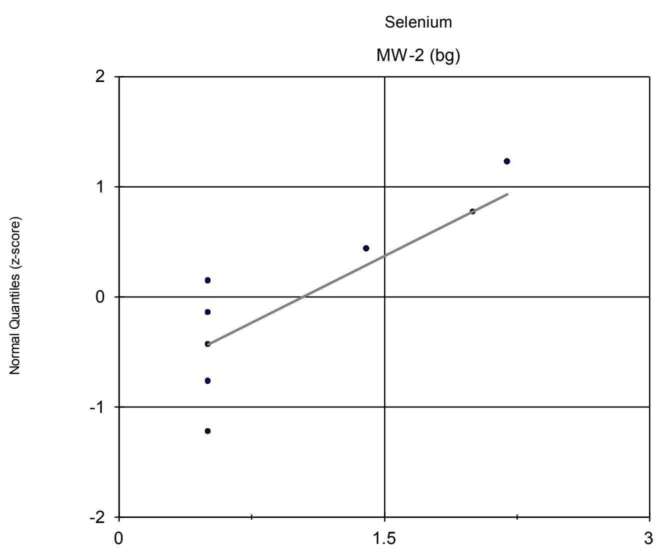

Probability Plot   Analysis Run 3/4/2019 2:22 PM

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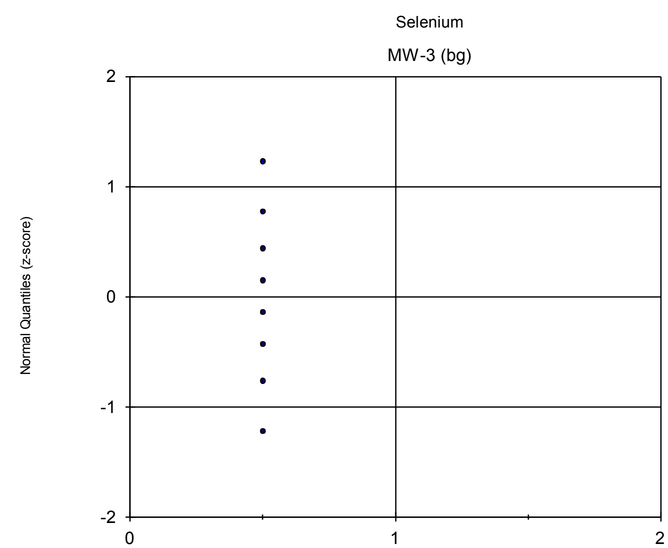

Probability Plot   Analysis Run 3/4/2019 2:22 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

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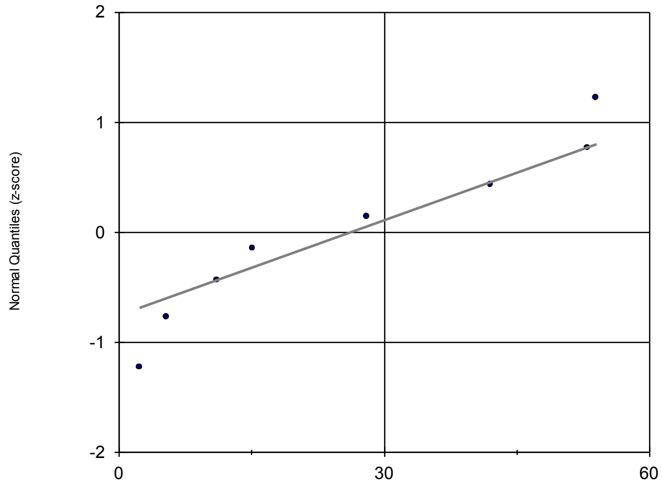
Selenium

MW-7



Probability Plot   Analysis Run 3/4/2019 2:22 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

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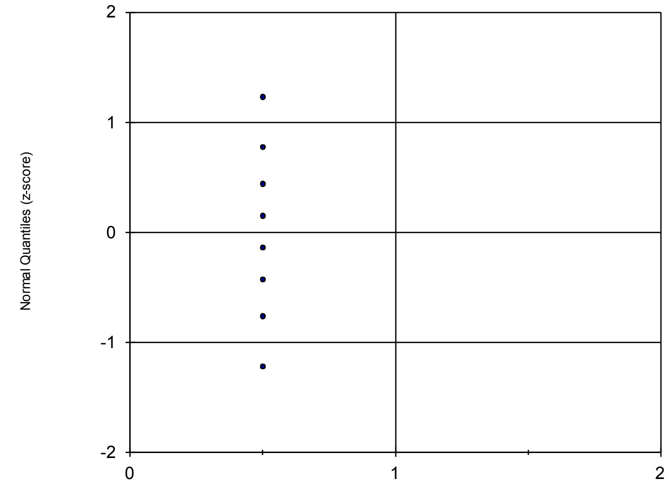
Selenium

MW-9



Probability Plot   Analysis Run 3/4/2019 2:22 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

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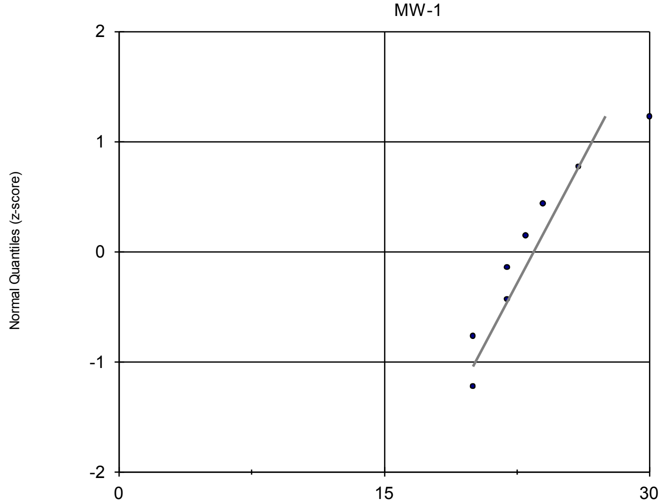
Sulfate

MW-1



Probability Plot   Analysis Run 3/4/2019 2:22 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

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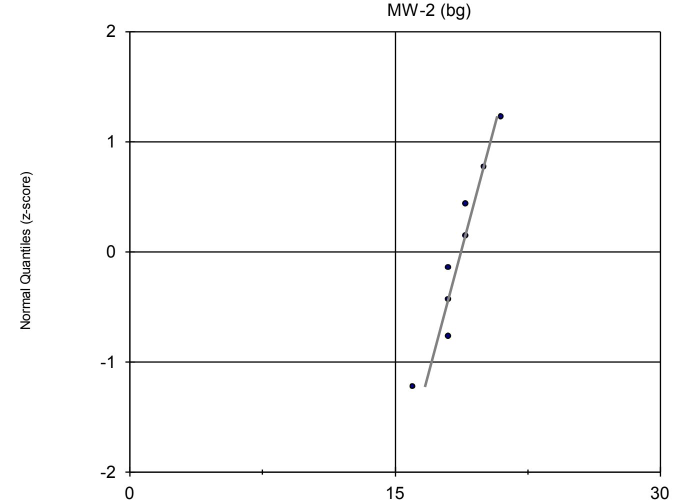
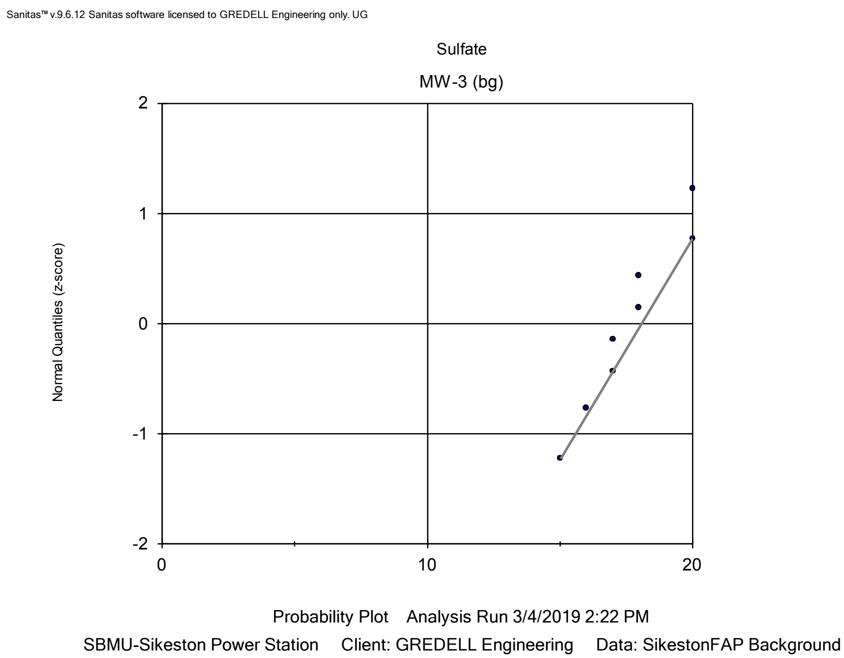
Sulfate

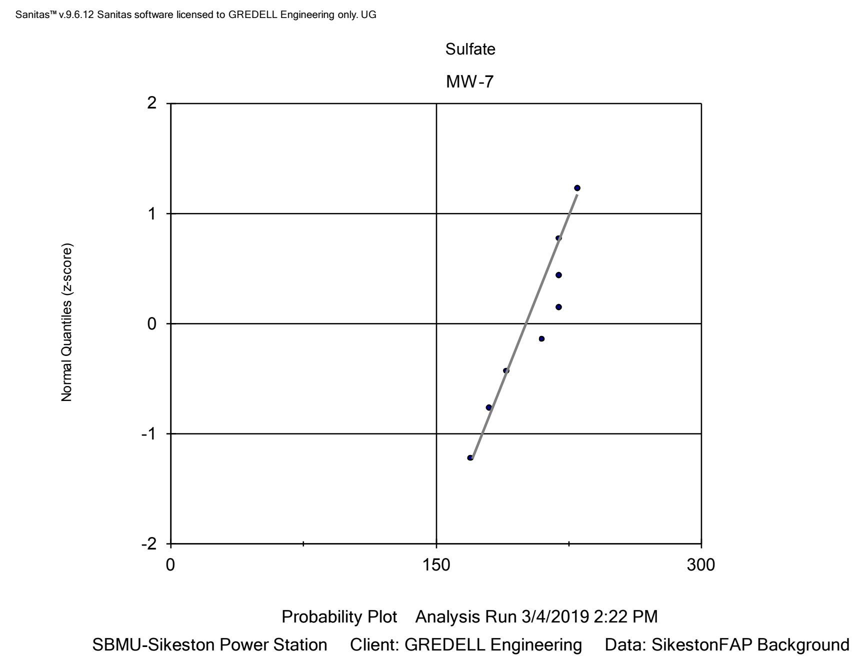
MW-2 (bg)

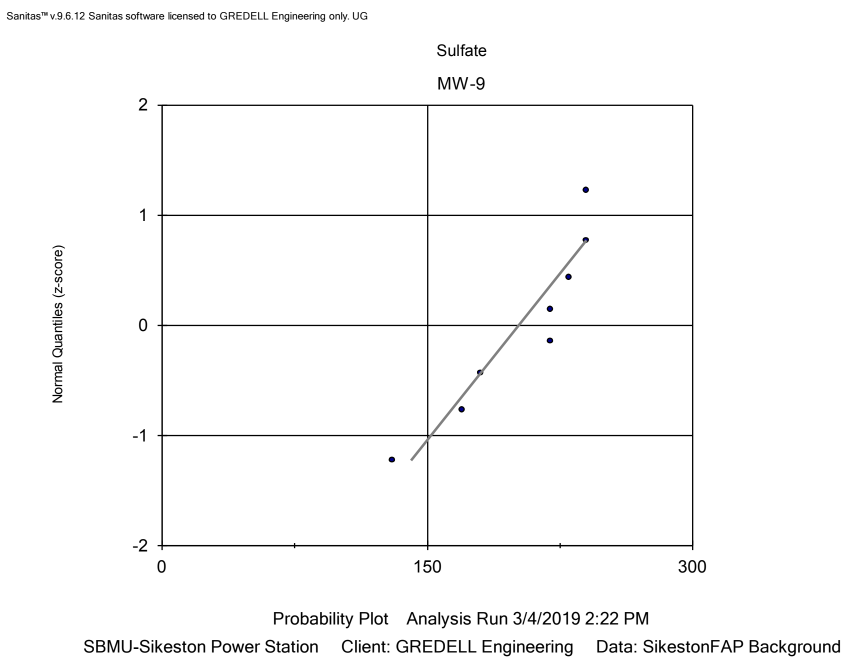


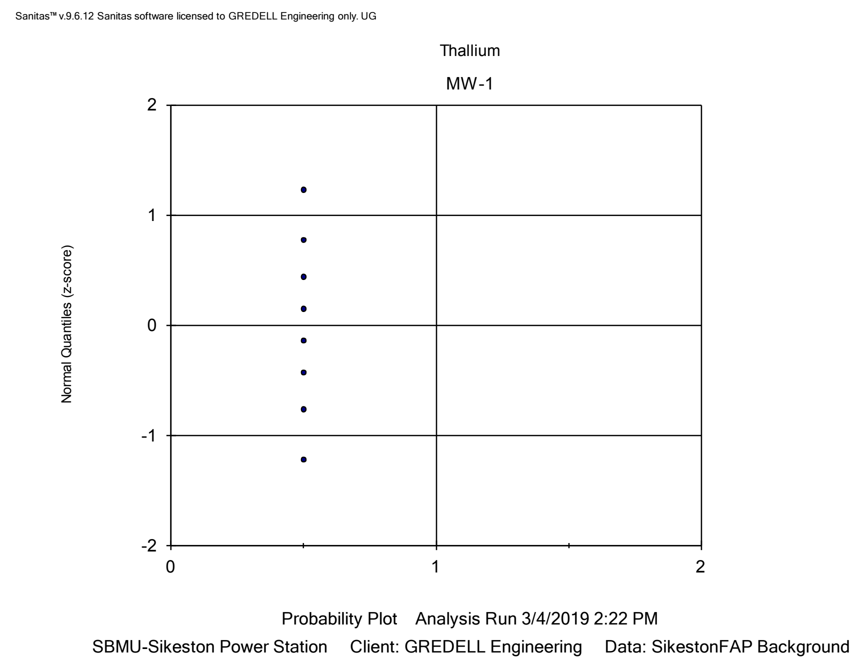
Probability Plot   Analysis Run 3/4/2019 2:22 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background


Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Sulfate
MW-3 (bg)
Normal Quantiles (z-score)
2
1
0
-1
-2
0
10
20
Probability Plot Analysis Run 3/4/2019 2:22 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background


Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Sulfate
MW-7
Normal Quantiles (z-score)
2
1
0
-1
-2
0
150
300
Probability Plot Analysis Run 3/4/2019 2:22 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background


Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Sulfate
MW-9
Normal Quantiles (z-score)
2
1
0
-1
-2
0
150
300
Probability Plot Analysis Run 3/4/2019 2:22 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background


Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Thallium
MW-1
Normal Quantiles (z-score)
2
1
0
-1
-2
0
1
2
Probability Plot Analysis Run 3/4/2019 2:22 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

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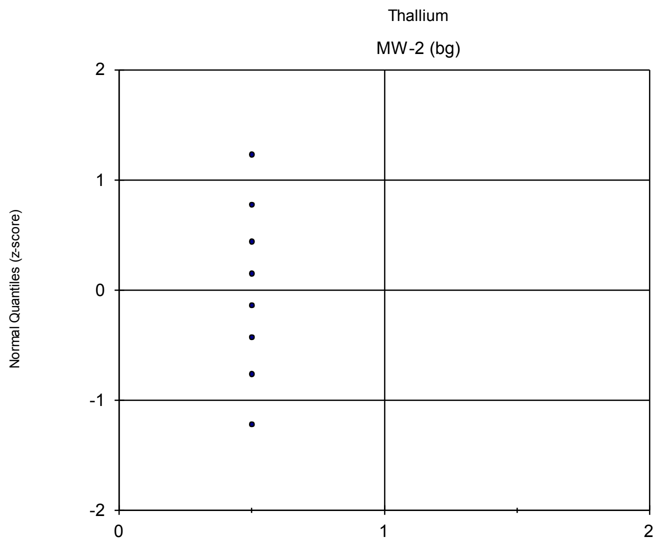

Probability Plot   Analysis Run 3/4/2019 2:22 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

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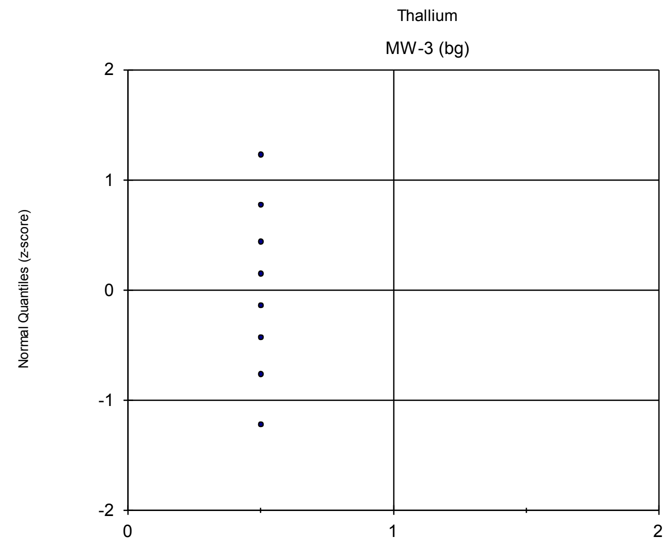

Probability Plot   Analysis Run 3/4/2019 2:22 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

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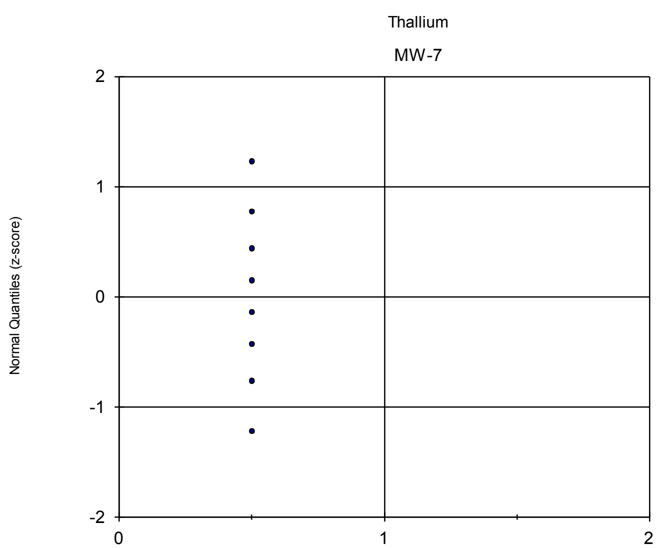
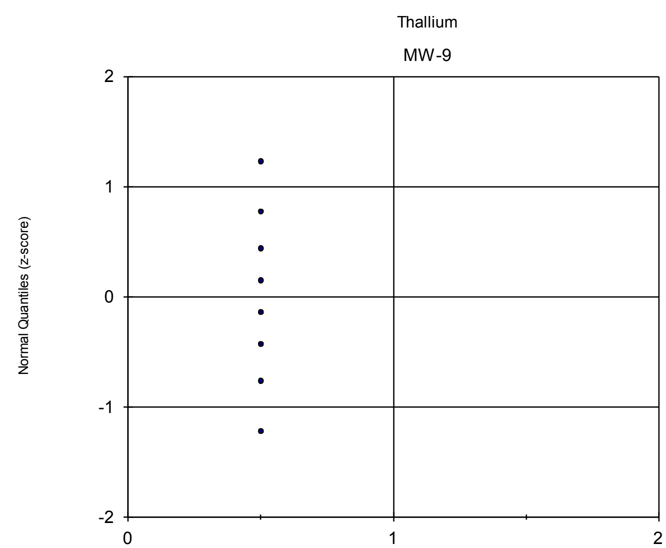


Probability Plot   Analysis Run 3/4/2019 2:22 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG



Probability Plot   Analysis Run 3/4/2019 2:22 PM

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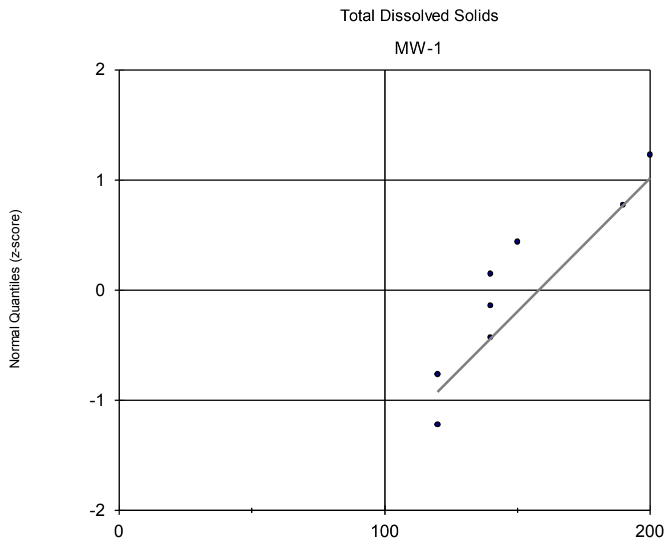

Probability Plot   Analysis Run 3/4/2019 2:22 PM

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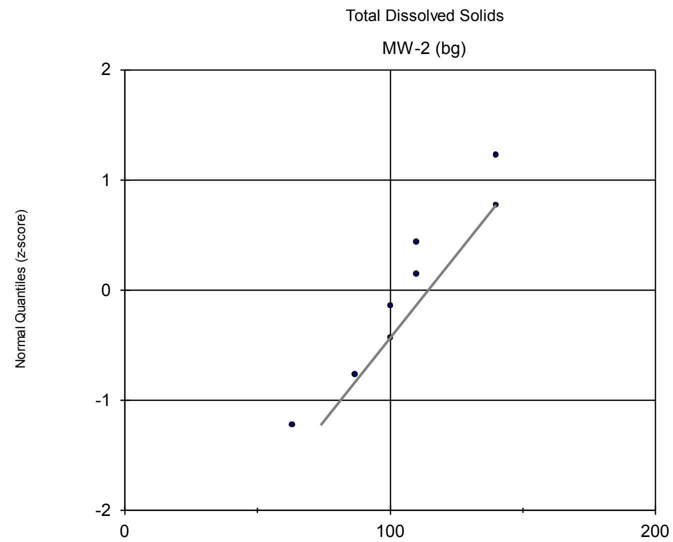

Probability Plot   Analysis Run 3/4/2019 2:22 PM

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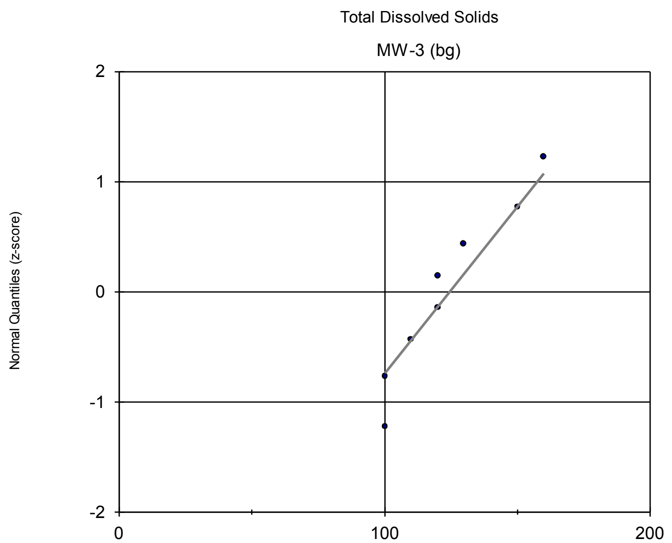

Probability Plot   Analysis Run 3/4/2019 2:22 PM

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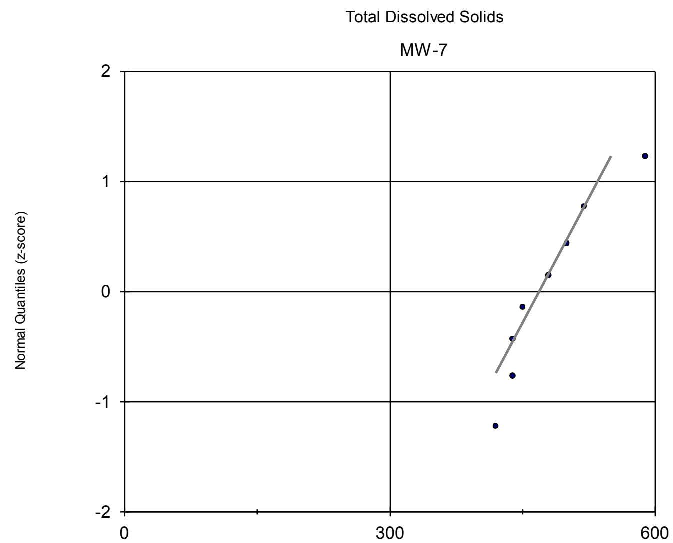

Probability Plot   Analysis Run 3/4/2019 2:22 PM

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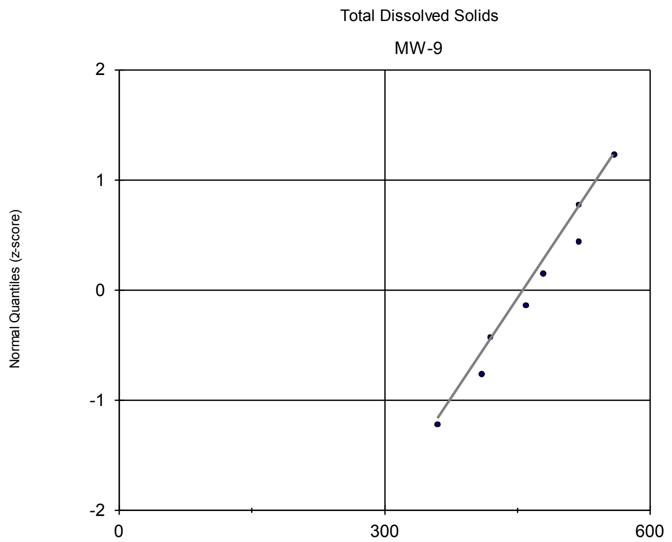


Probability Plot   Analysis Run 3/4/2019 2:22 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

Appendix E

Outlier Analysis

Outlier Analysis

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background   Printed 3/4/2019, 1:56 PM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Antimony (ug/L)	MW-1	n/a	n/a	n/a	NP (nrm)	NaN	8	1.5	0	unknown	ShapiroWilk
Antimony (ug/L)	MW-2 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	8	1.5	0	unknown	ShapiroWilk
Antimony (ug/L)	MW-3 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	8	1.5	0	unknown	ShapiroWilk
Antimony (ug/L)	MW-7	n/a	n/a	n/a	NP (nrm)	NaN	8	1.5	0	unknown	ShapiroWilk
Antimony (ug/L)	MW-9	n/a	n/a	n/a	NP (nrm)	NaN	8	1.5	0	unknown	ShapiroWilk
Arsenic (ug/L)	MW-1	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5	0	unknown	ShapiroWilk
Arsenic (ug/L)	MW-2 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5	0	unknown	ShapiroWilk
Arsenic (ug/L)	MW-3 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5	0	unknown	ShapiroWilk
Arsenic (ug/L)	MW-7	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5	0	unknown	ShapiroWilk
Arsenic (ug/L)	MW-9	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5875	0.2475	unknown	ShapiroWilk
Barium (ug/L)	MW-1	No	n/a	n/a	EPA 1989	0.05	8	142.5	23.15	normal	ShapiroWilk
Barium (ug/L)	MW-2 (bg)	No	n/a	n/a	EPA 1989	0.05	8	175	35.86	normal	ShapiroWilk
Barium (ug/L)	MW-3 (bg)	No	n/a	n/a	NP (nrm)	NaN	8	98	3.162	unknown	ShapiroWilk
Barium (ug/L)	MW-7	No	n/a	n/a	EPA 1989	0.05	8	44.63	2.446	normal	ShapiroWilk
Barium (ug/L)	MW-9	No	n/a	n/a	EPA 1989	0.05	8	48.13	2.357	normal	ShapiroWilk
Beryllium (ug/L)	MW-1	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5	0	unknown	ShapiroWilk
Beryllium (ug/L)	MW-2 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5	0	unknown	ShapiroWilk
Beryllium (ug/L)	MW-3 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5	0	unknown	ShapiroWilk
Beryllium (ug/L)	MW-7	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5	0	unknown	ShapiroWilk
Beryllium (ug/L)	MW-9	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5	0	unknown	ShapiroWilk
Boron (ug/L)	MW-1	No	n/a	n/a	Dixon`s	0.05	8	443.8	41.04	normal	ShapiroWilk
Boron (ug/L)	MW-2 (bg)	No	n/a	n/a	EPA 1989	0.05	8	38.63	8.911	normal	ShapiroWilk
Boron (ug/L)	MW-3 (bg)	No	n/a	n/a	EPA 1989	0.05	8	23.25	3.845	normal	ShapiroWilk
Boron (ug/L)	MW-7	No	n/a	n/a	EPA 1989	0.05	8	1975	166.9	normal	ShapiroWilk
Boron (ug/L)	MW-9	No	n/a	n/a	EPA 1989	0.05	8	4575	675.6	normal	ShapiroWilk
Cadmium (ug/L)	MW-1	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5	0	unknown	ShapiroWilk
Cadmium (ug/L)	MW-2 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5	0	unknown	ShapiroWilk
Cadmium (ug/L)	MW-3 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5	0	unknown	ShapiroWilk
Cadmium (ug/L)	MW-7	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5	0	unknown	ShapiroWilk
Cadmium (ug/L)	MW-9	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5	0	unknown	ShapiroWilk
Calcium (mg/L)	MW-1	No	n/a	n/a	EPA 1989	0.05	8	30.38	6.022	normal	ShapiroWilk
Calcium (mg/L)	MW-2 (bg)	No	n/a	n/a	EPA 1989	0.05	8	18.75	2.659	normal	ShapiroWilk
Calcium (mg/L)	MW-3 (bg)	No	n/a	n/a	NP (nrm)	NaN	8	17.75	0.7071	unknown	ShapiroWilk
Calcium (mg/L)	MW-7	No	n/a	n/a	EPA 1989	0.05	8	123.8	11.88	normal	ShapiroWilk
Calcium (mg/L)	MW-9	No	n/a	n/a	NP (nrm)	NaN	8	70.38	10.06	unknown	ShapiroWilk
Chloride (mg/L)	MW-1	No	n/a	n/a	EPA 1989	0.05	8	5.838	2.588	normal	ShapiroWilk
Chloride (mg/L)	MW-2 (bg)	No	n/a	n/a	EPA 1989	0.05	8	4.625	1.434	normal	ShapiroWilk
Chloride (mg/L)	MW-3 (bg)	No	n/a	n/a	EPA 1989	0.05	8	1.338	0.1061	normal	ShapiroWilk
Chloride (mg/L)	MW-7	No	n/a	n/a	EPA 1989	0.05	8	9.775	2.215	normal	ShapiroWilk
Chloride (mg/L)	MW-9	No	n/a	n/a	EPA 1989	0.05	8	15.63	3.114	normal	ShapiroWilk
Chromium (ug/L)	MW-1	n/a	n/a	n/a	NP (nrm)	NaN	8	2	0	unknown	ShapiroWilk
Chromium (ug/L)	MW-2 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	8	2	0	unknown	ShapiroWilk
Chromium (ug/L)	MW-3 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	8	2	0	unknown	ShapiroWilk
Chromium (ug/L)	MW-7	n/a	n/a	n/a	NP (nrm)	NaN	8	2	0	unknown	ShapiroWilk
Chromium (ug/L)	MW-9	n/a	n/a	n/a	NP (nrm)	NaN	8	2.763	2.157	unknown	ShapiroWilk
Cobalt (ug/L)	MW-1	n/a	n/a	n/a	NP (nrm)	NaN	8	1	0	unknown	ShapiroWilk
Cobalt (ug/L)	MW-2 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	8	1.125	0.3536	unknown	ShapiroWilk
Cobalt (ug/L)	MW-3 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	8	1	0	unknown	ShapiroWilk
Cobalt (ug/L)	MW-7	No	n/a	n/a	NP (nrm)	NaN	8	1.8	0.4986	unknown	ShapiroWilk
Cobalt (ug/L)	MW-9	n/a	n/a	n/a	NP (nrm)	NaN	8	1	0	unknown	ShapiroWilk

Outlier Analysis

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background   Printed 3/4/2019, 1:56 PM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Fluoride (mg/L)	MW-1	No	n/a	n/a	NP (nrm)	NaN	8	0.1983	0.08072	unknown	ShapiroWilk
Fluoride (mg/L)	MW-2 (bg)	No	n/a	n/a	NP (nrm)	NaN	8	0.1858	0.08687	unknown	ShapiroWilk
Fluoride (mg/L)	MW-3 (bg)	No	n/a	n/a	NP (nrm)	NaN	8	0.2488	0.1071	unknown	ShapiroWilk
Fluoride (mg/L)	MW-7	No	n/a	n/a	EPA 1989	0.05	8	0.6919	0.07152	normal	ShapiroWilk
Fluoride (mg/L)	MW-9	No	n/a	n/a	EPA 1989	0.05	8	0.9636	0.07178	normal	ShapiroWilk
Lead (ug/L)	MW-1	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5	0	unknown	ShapiroWilk
Lead (ug/L)	MW-2 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5	0	unknown	ShapiroWilk
Lead (ug/L)	MW-3 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5	0	unknown	ShapiroWilk
Lead (ug/L)	MW-7	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5	0	unknown	ShapiroWilk
Lead (ug/L)	MW-9	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5	0	unknown	ShapiroWilk
Lithium (ug/L)	MW-1	n/a	n/a	n/a	NP (nrm)	NaN	8	5	0	unknown	ShapiroWilk
Lithium (ug/L)	MW-2 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	8	5	0	unknown	ShapiroWilk
Lithium (ug/L)	MW-3 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	8	5	0	unknown	ShapiroWilk
Lithium (ug/L)	MW-7	No	n/a	n/a	EPA 1989	0.05	8	25.13	3.314	normal	ShapiroWilk
Lithium (ug/L)	MW-9	No	n/a	n/a	EPA 1989	0.05	8	15.63	2.669	normal	ShapiroWilk
Mercury (ug/L)	MW-1	n/a	n/a	n/a	NP (nrm)	NaN	8	0.1	0	unknown	ShapiroWilk
Mercury (ug/L)	MW-2 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	8	0.1	0	unknown	ShapiroWilk
Mercury (ug/L)	MW-3 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	8	0.1	0	unknown	ShapiroWilk
Mercury (ug/L)	MW-7	n/a	n/a	n/a	NP (nrm)	NaN	8	0.1	0	unknown	ShapiroWilk
Mercury (ug/L)	MW-9	n/a	n/a	n/a	NP (nrm)	NaN	8	0.1	0	unknown	ShapiroWilk
Molybdenum (ug/L)	MW-1	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5	0	unknown	ShapiroWilk
Molybdenum (ug/L)	MW-2 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5	0	unknown	ShapiroWilk
Molybdenum (ug/L)	MW-3 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5	0	unknown	ShapiroWilk
Molybdenum (ug/L)	MW-7	No	n/a	n/a	NP (nrm)	NaN	8	158.8	8.345	unknown	ShapiroWilk
Molybdenum (ug/L)	MW-9	No	n/a	n/a	EPA 1989	0.05	8	563.8	146.6	normal	ShapiroWilk
pH (S.U.)	MW-1	No	n/a	n/a	EPA 1989	0.05	8	7.22	0.1164	normal	ShapiroWilk
pH (S.U.)	MW-2 (bg)	No	n/a	n/a	NP (nrm)	NaN	8	6.196	0.1036	unknown	ShapiroWilk
pH (S.U.)	MW-3 (bg)	No	n/a	n/a	EPA 1989	0.05	8	6.505	0.03854	normal	ShapiroWilk
pH (S.U.)	MW-7	No	n/a	n/a	EPA 1989	0.05	8	7.268	0.04464	normal	ShapiroWilk
pH (S.U.)	MW-9	No	n/a	n/a	EPA 1989	0.05	8	7.33	0.02726	normal	ShapiroWilk
Radium (pCi/L)	MW-1	No	n/a	n/a	EPA 1989	0.05	8	0.8715	0.4192	normal	ShapiroWilk
Radium (pCi/L)	MW-2 (bg)	No	n/a	n/a	EPA 1989	0.05	8	1.104	0.4148	normal	ShapiroWilk
Radium (pCi/L)	MW-3 (bg)	No	n/a	n/a	EPA 1989	0.05	8	0.8951	0.4732	normal	ShapiroWilk
Radium (pCi/L)	MW-7	No	n/a	n/a	Dixon`s	0.05	8	0.8729	0.4075	normal	ShapiroWilk
Radium (pCi/L)	MW-9	No	n/a	n/a	EPA 1989	0.05	8	0.7486	0.4342	normal	ShapiroWilk
Selenium (ug/L)	MW-1	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5	0	unknown	ShapiroWilk
Selenium (ug/L)	MW-2 (bg)	No	n/a	n/a	NP (nrm)	NaN	8	1.013	0.7415	unknown	ShapiroWilk
Selenium (ug/L)	MW-3 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5	0	unknown	ShapiroWilk
Selenium (ug/L)	MW-7	No	n/a	n/a	EPA 1989	0.05	8	26.34	21.06	normal	ShapiroWilk
Selenium (ug/L)	MW-9	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5	0	unknown	ShapiroWilk
Sulfate (mg/L)	MW-1	No	n/a	n/a	EPA 1989	0.05	8	23.38	3.335	normal	ShapiroWilk
Sulfate (mg/L)	MW-2 (bg)	No	n/a	n/a	EPA 1989	0.05	8	18.63	1.506	normal	ShapiroWilk
Sulfate (mg/L)	MW-3 (bg)	No	n/a	n/a	EPA 1989	0.05	8	17.63	1.768	normal	ShapiroWilk
Sulfate (mg/L)	MW-7	No	n/a	n/a	EPA 1989	0.05	8	205	22.04	normal	ShapiroWilk
Sulfate (mg/L)	MW-9	No	n/a	n/a	EPA 1989	0.05	8	203.8	39.62	normal	ShapiroWilk
Thallium (ug/L)	MW-1	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5	0	unknown	ShapiroWilk
Thallium (ug/L)	MW-2 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5	0	unknown	ShapiroWilk
Thallium (ug/L)	MW-3 (bg)	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5	0	unknown	ShapiroWilk
Thallium (ug/L)	MW-7	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5	0	unknown	ShapiroWilk
Thallium (ug/L)	MW-9	n/a	n/a	n/a	NP (nrm)	NaN	8	0.5	0	unknown	ShapiroWilk

Outlier Analysis

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background   Printed 3/4/2019, 1:56 PM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Total Dissolved Solids (mg/L)	MW-1	No	n/a	n/a	EPA 1989	0.05	8	150	29.76	ln(x)	ShapiroWilk
Total Dissolved Solids (mg/L)	MW-2 (bg)	No	n/a	n/a	EPA 1989	0.05	8	106.3	25.71	normal	ShapiroWilk
Total Dissolved Solids (mg/L)	MW-3 (bg)	No	n/a	n/a	EPA 1989	0.05	8	123.8	22	normal	ShapiroWilk
Total Dissolved Solids (mg/L)	MW-7	No	n/a	n/a	EPA 1989	0.05	8	480	55.81	normal	ShapiroWilk
Total Dissolved Solids (mg/L)	MW-9	No	n/a	n/a	EPA 1989	0.05	8	466.3	66.96	normal	ShapiroWilk

Appendix F

Trend Analysis

Trend Test

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background Printed 3/4/2019, 2:16 PM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Antimony (ug/L)	MW-1	0	0	20	No	8	100	n/a	n/a	0.02	NP
Antimony (ug/L)	MW-2 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Antimony (ug/L)	MW-3 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Antimony (ug/L)	MW-7	0	0	20	No	8	100	n/a	n/a	0.02	NP
Antimony (ug/L)	MW-9	0	0	20	No	8	100	n/a	n/a	0.02	NP
Arsenic (ug/L)	MW-1	0	0	20	No	8	100	n/a	n/a	0.02	NP
Arsenic (ug/L)	MW-2 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Arsenic (ug/L)	MW-3 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Arsenic (ug/L)	MW-7	0	0	20	No	8	100	n/a	n/a	0.02	NP
Arsenic (ug/L)	MW-9	0	-5	-20	No	8	87.5	n/a	n/a	0.02	NP
Barium (ug/L)	**MW-1**	**87.96**	**24**	**20**	**Yes**	**8**	**0**	**n/a**	**n/a**	**0.02**	**NP**
Barium (ug/L)	MW-2 (bg)	146.4	17	20	No	8	0	n/a	n/a	0.02	NP
Barium (ug/L)	MW-3 (bg)	0	0	20	No	8	0	n/a	n/a	0.02	NP
Barium (ug/L)	MW-7	3.645	7	20	No	8	0	n/a	n/a	0.02	NP
Barium (ug/L)	MW-9	0	2	20	No	8	0	n/a	n/a	0.02	NP
Beryllium (ug/L)	MW-1	0	0	20	No	8	100	n/a	n/a	0.02	NP
Beryllium (ug/L)	MW-2 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Beryllium (ug/L)	MW-3 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Beryllium (ug/L)	MW-7	0	0	20	No	8	100	n/a	n/a	0.02	NP
Beryllium (ug/L)	MW-9	0	0	20	No	8	100	n/a	n/a	0.02	NP
Boron (ug/L)	MW-1	103.2	11	20	No	8	0	n/a	n/a	0.02	NP
Boron (ug/L)	**MW-2 (bg)**	**33.02**	**23**	**20**	**Yes**	**8**	**0**	**n/a**	**n/a**	**0.02**	**NP**
Boron (ug/L)	MW-3 (bg)	10.92	16	20	No	8	0	n/a	n/a	0.02	NP
Boron (ug/L)	MW-7	79.35	3	20	No	8	0	n/a	n/a	0.02	NP
Boron (ug/L)	**MW-9**	**-1992**	**-22**	**-20**	**Yes**	**8**	**0**	**n/a**	**n/a**	**0.02**	**NP**
Cadmium (ug/L)	MW-1	0	0	20	No	8	100	n/a	n/a	0.02	NP
Cadmium (ug/L)	MW-2 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Cadmium (ug/L)	MW-3 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Cadmium (ug/L)	MW-7	0	0	20	No	8	100	n/a	n/a	0.02	NP
Cadmium (ug/L)	MW-9	0	0	20	No	8	100	n/a	n/a	0.02	NP
Calcium (mg/L)	**MW-1**	**23.46**	**23**	**20**	**Yes**	**8**	**0**	**n/a**	**n/a**	**0.02**	**NP**
Calcium (mg/L)	**MW-2 (bg)**	**10.43**	**21**	**20**	**Yes**	**8**	**0**	**n/a**	**n/a**	**0.02**	**NP**
Calcium (mg/L)	MW-3 (bg)	-2.369	-19	-20	No	8	0	n/a	n/a	0.02	NP
Calcium (mg/L)	MW-7	14.43	7	20	No	8	0	n/a	n/a	0.02	NP
Calcium (mg/L)	MW-9	30.74	16	20	No	8	0	n/a	n/a	0.02	NP
Chloride (mg/L)	**MW-1**	**9.532**	**24**	**20**	**Yes**	**8**	**0**	**n/a**	**n/a**	**0.02**	**NP**
Chloride (mg/L)	MW-2 (bg)	4.844	15	20	No	8	0	n/a	n/a	0.02	NP
Chloride (mg/L)	MW-3 (bg)	-0.1551	-7	-20	No	8	0	n/a	n/a	0.02	NP
Chloride (mg/L)	**MW-7**	**-7.714**	**-22**	**-20**	**Yes**	**8**	**0**	**n/a**	**n/a**	**0.02**	**NP**
Chloride (mg/L)	MW-9	-9.256	-18	-20	No	8	0	n/a	n/a	0.02	NP
Chromium (ug/L)	MW-1	0	0	20	No	8	100	n/a	n/a	0.02	NP
Chromium (ug/L)	MW-2 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Chromium (ug/L)	MW-3 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Chromium (ug/L)	MW-7	0	0	20	No	8	100	n/a	n/a	0.02	NP
Chromium (ug/L)	MW-9	0	-3	-20	No	8	87.5	n/a	n/a	0.02	NP
Cobalt (ug/L)	MW-1	0	0	20	No	8	100	n/a	n/a	0.02	NP
Cobalt (ug/L)	MW-2 (bg)	0	7	20	No	8	87.5	n/a	n/a	0.02	NP
Cobalt (ug/L)	MW-3 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Cobalt (ug/L)	MW-7	0.588	11	20	No	8	25	n/a	n/a	0.02	NP
Cobalt (ug/L)	MW-9	0	0	20	No	8	100	n/a	n/a	0.02	NP

Trend Test

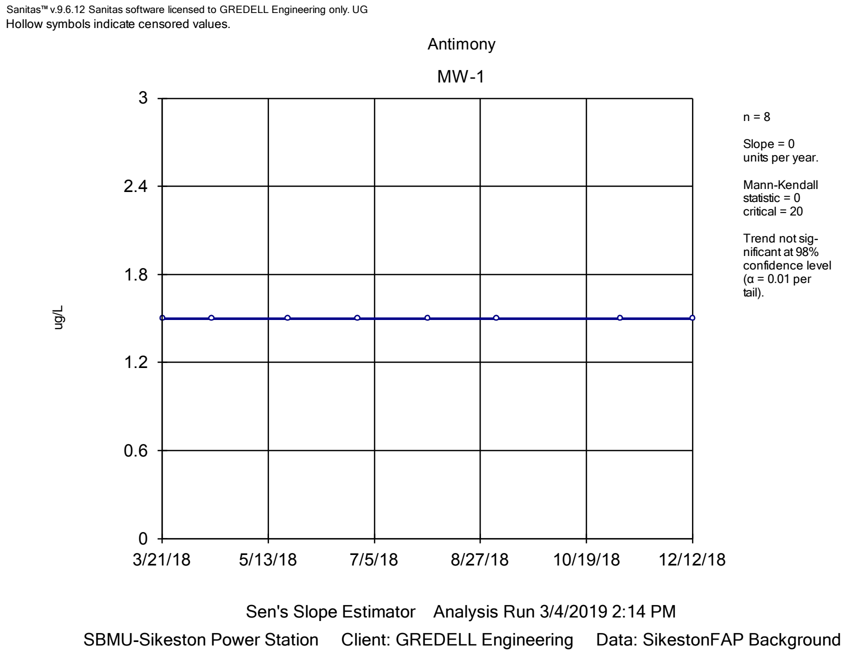
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background Printed 3/4/2019, 2:16 PM

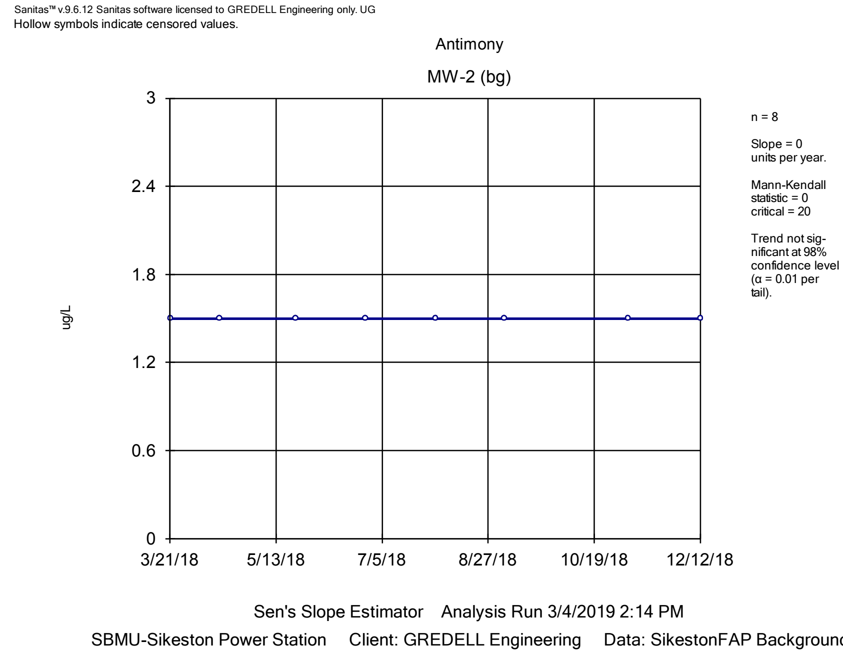
Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Fluoride (mg/L)	MW-1	0.03688	8	20	No	8	50	n/a	n/a	0.02	NP
Fluoride (mg/L)	MW-2 (bg)	0	4	20	No	8	62.5	n/a	n/a	0.02	NP
Fluoride (mg/L)	MW-3 (bg)	0.06788	7	20	No	8	37.5	n/a	n/a	0.02	NP
Fluoride (mg/L)	MW-7	-0.02472	-2	-20	No	8	0	n/a	n/a	0.02	NP
Fluoride (mg/L)	MW-9	-0.0703	-6	-20	No	8	0	n/a	n/a	0.02	NP
Lead (ug/L)	MW-1	0	0	20	No	8	100	n/a	n/a	0.02	NP
Lead (ug/L)	MW-2 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Lead (ug/L)	MW-3 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Lead (ug/L)	MW-7	0	0	20	No	8	100	n/a	n/a	0.02	NP
Lead (ug/L)	MW-9	0	0	20	No	8	100	n/a	n/a	0.02	NP
Lithium (ug/L)	MW-1	0	0	20	No	8	100	n/a	n/a	0.02	NP
Lithium (ug/L)	MW-2 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Lithium (ug/L)	MW-3 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Lithium (ug/L)	MW-7	4.78	11	20	No	8	0	n/a	n/a	0.02	NP
Lithium (ug/L)	MW-9	0	0	20	No	8	0	n/a	n/a	0.02	NP
Mercury (ug/L)	MW-1	0	0	20	No	8	100	n/a	n/a	0.02	NP
Mercury (ug/L)	MW-2 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Mercury (ug/L)	MW-3 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Mercury (ug/L)	MW-7	0	0	20	No	8	100	n/a	n/a	0.02	NP
Mercury (ug/L)	MW-9	0	0	20	No	8	100	n/a	n/a	0.02	NP
Molybdenum (ug/L)	MW-1	0	0	20	No	8	100	n/a	n/a	0.02	NP
Molybdenum (ug/L)	MW-2 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Molybdenum (ug/L)	MW-3 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Molybdenum (ug/L)	MW-7	-27.55	-17	-20	No	8	0	n/a	n/a	0.02	NP
Molybdenum (ug/L)	**MW-9**	**-378.2**	**-21**	**-20**	**Yes**	**8**	**0**	**n/a**	**n/a**	**0.02**	**NP**
pH (S.U.)	**MW-1**	**-0.4438**	**-24**	**-20**	**Yes**	**8**	**0**	**n/a**	**n/a**	**0.02**	**NP**
pH (S.U.)	MW-2 (bg)	-0.3078	-14	-20	No	8	0	n/a	n/a	0.02	NP
pH (S.U.)	MW-3 (bg)	-0.01862	-1	-20	No	8	0	n/a	n/a	0.02	NP
pH (S.U.)	MW-7	0.0407	3	20	No	8	0	n/a	n/a	0.02	NP
pH (S.U.)	MW-9	-0.05568	-11	-20	No	8	0	n/a	n/a	0.02	NP
Radium (pCi/L)	**MW-1**	**1.466**	**24**	**20**	**Yes**	**8**	**0**	**n/a**	**n/a**	**0.02**	**NP**
Radium (pCi/L)	MW-2 (bg)	0.9807	10	20	No	8	0	n/a	n/a	0.02	NP
Radium (pCi/L)	MW-3 (bg)	-0.4073	-6	-20	No	8	0	n/a	n/a	0.02	NP
Radium (pCi/L)	MW-7	0.5742	10	20	No	8	0	n/a	n/a	0.02	NP
Radium (pCi/L)	MW-9	0.9829	10	20	No	8	0	n/a	n/a	0.02	NP
Selenium (ug/L)	MW-1	0	0	20	No	8	100	n/a	n/a	0.02	NP
Selenium (ug/L)	MW-2 (bg)	0	6	20	No	8	62.5	n/a	n/a	0.02	NP
Selenium (ug/L)	MW-3 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Selenium (ug/L)	MW-7	11.8	4	20	No	8	0	n/a	n/a	0.02	NP
Selenium (ug/L)	MW-9	0	0	20	No	8	100	n/a	n/a	0.02	NP
Sulfate (mg/L)	MW-1	11.13	18	20	No	8	0	n/a	n/a	0.02	NP
Sulfate (mg/L)	MW-2 (bg)	4.444	14	20	No	8	0	n/a	n/a	0.02	NP
Sulfate (mg/L)	MW-3 (bg)	-3.385	-11	-20	No	8	0	n/a	n/a	0.02	NP
Sulfate (mg/L)	MW-7	0	-1	-20	No	8	0	n/a	n/a	0.02	NP
Sulfate (mg/L)	MW-9	-108.6	-20	-20	No	8	0	n/a	n/a	0.02	NP
Thallium (ug/L)	MW-1	0	0	20	No	8	100	n/a	n/a	0.02	NP
Thallium (ug/L)	MW-2 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Thallium (ug/L)	MW-3 (bg)	0	0	20	No	8	100	n/a	n/a	0.02	NP
Thallium (ug/L)	MW-7	0	0	20	No	8	100	n/a	n/a	0.02	NP
Thallium (ug/L)	MW-9	0	0	20	No	8	100	n/a	n/a	0.02	NP

Trend Test

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background   Printed 3/4/2019, 2:16 PM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Total Dissolved Solids (mg/L)	MW-1	33.96	6	20	No	8	0	n/a	n/a	0.02	NP
Total Dissolved Solids (mg/L)	MW-2 (bg)	53.52	9	20	No	8	0	n/a	n/a	0.02	NP
Total Dissolved Solids (mg/L)	MW-3 (bg)	41.17	8	20	No	8	0	n/a	n/a	0.02	NP
Total Dissolved Solids (mg/L)	MW-7	41.85	5	20	No	8	0	n/a	n/a	0.02	NP
Total Dissolved Solids (mg/L)	MW-9	-140.9	-11	-20	No	8	0	n/a	n/a	0.02	NP


Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.
Antimony
MW-1
ug/L
3
2.4
1.8
1.2
0.6
0
3/21/18
5/13/18
7/5/18
8/27/18
10/19/18
12/12/18
n = 8
Slope = 0
units per year.
Mann-Kendall
statistic = 0
critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 3/4/2019 2:14 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background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Hollow symbols indicate censored values.
Antimony
MW-2 (bg)
ug/L
3
2.4
1.8
1.2
0.6
0
3/21/18
5/13/18
7/5/18
8/27/18
10/19/18
12/12/18
n = 8
Slope = 0
units per year.
Mann-Kendall
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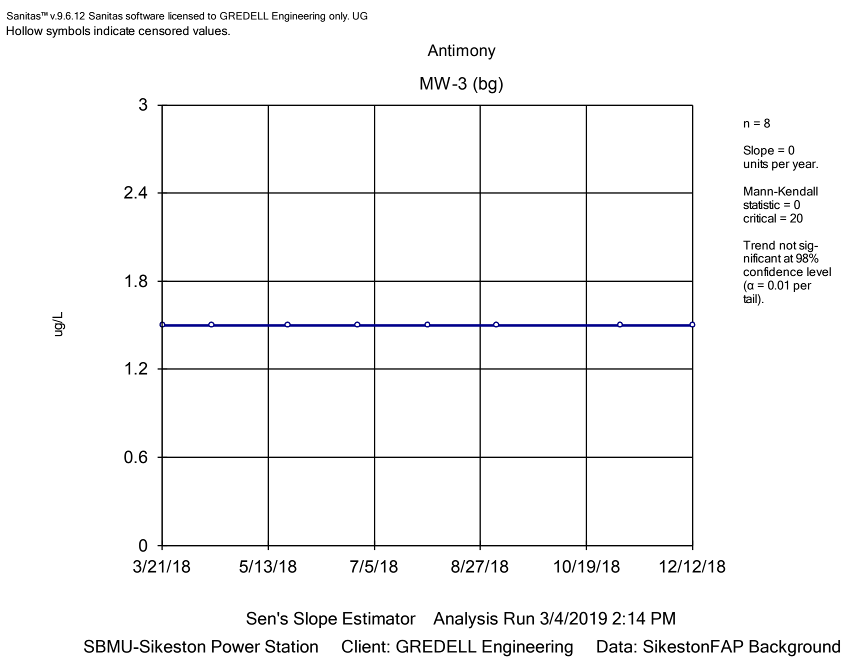
Sen's Slope Estimator Analysis Run 3/4/2019 2:14 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background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Hollow symbols indicate censored values.
Antimony
MW-3 (bg)
ug/L
3
2.4
1.8
1.2
0.6
0
3/21/18
5/13/18
7/5/18
8/27/18
10/19/18
12/12/18
n = 8
Slope = 0
units per year.
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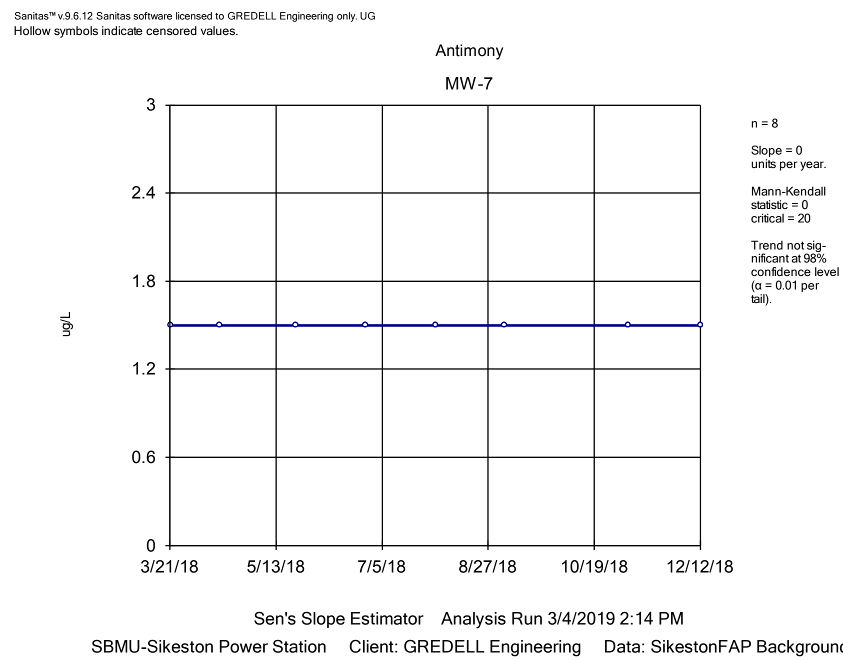
Sen's Slope Estimator Analysis Run 3/4/2019 2:14 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background


Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.
Antimony
MW-7
ug/L
3
2.4
1.8
1.2
0.6
0
3/21/18
5/13/18
7/5/18
8/27/18
10/19/18
12/12/18
n = 8
Slope = 0
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Sen's Slope Estimator Analysis Run 3/4/2019 2:14 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
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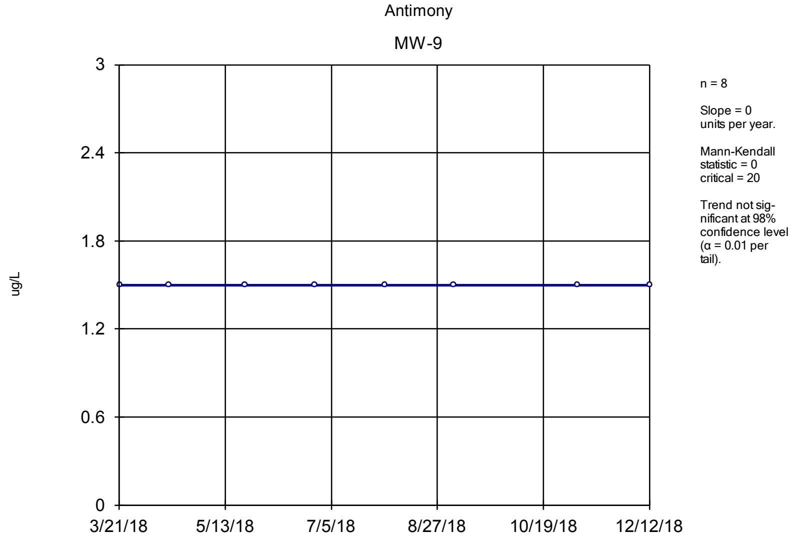

Sen's Slope Estimator Analysis Run 3/4/2019 2:14 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

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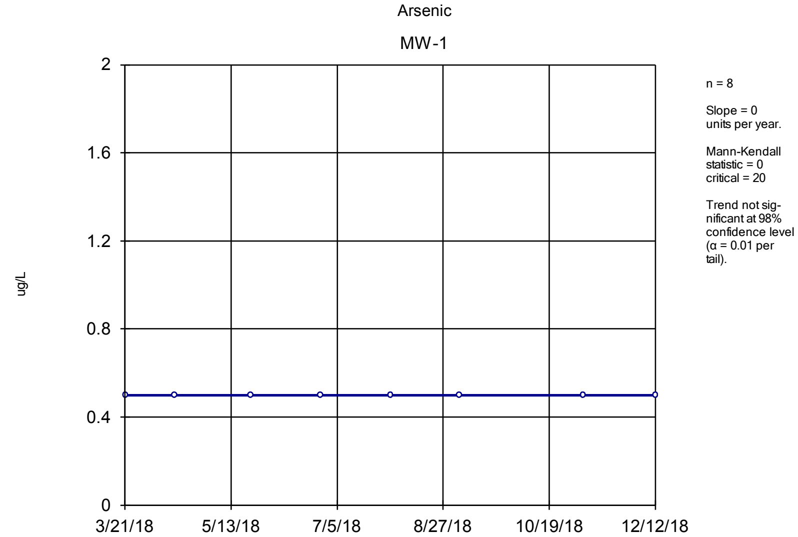

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SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

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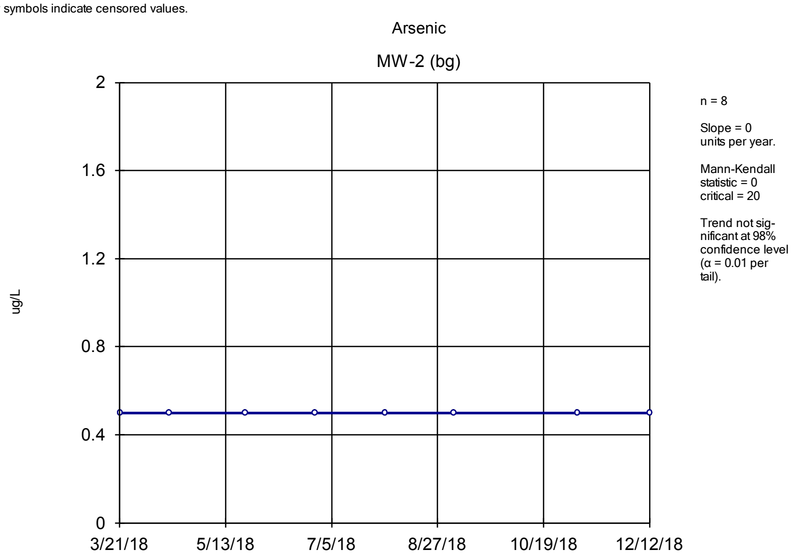

Sen's Slope Estimator Analysis Run 3/4/2019 2:14 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

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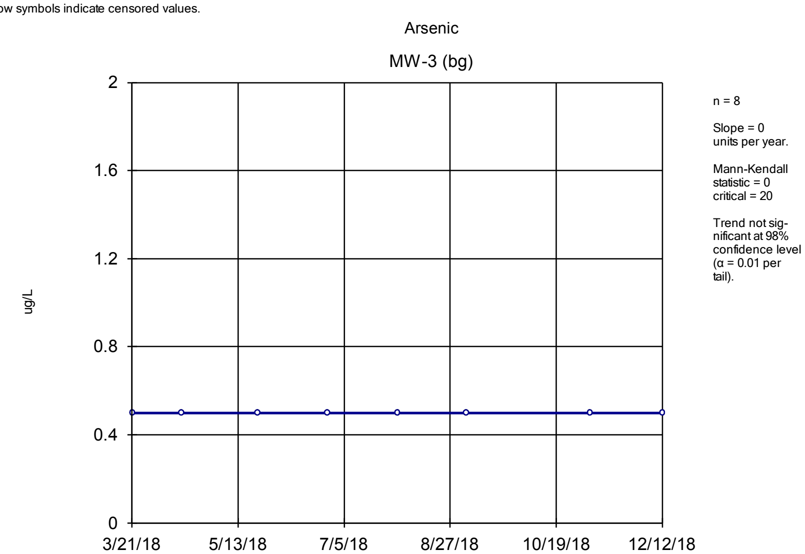

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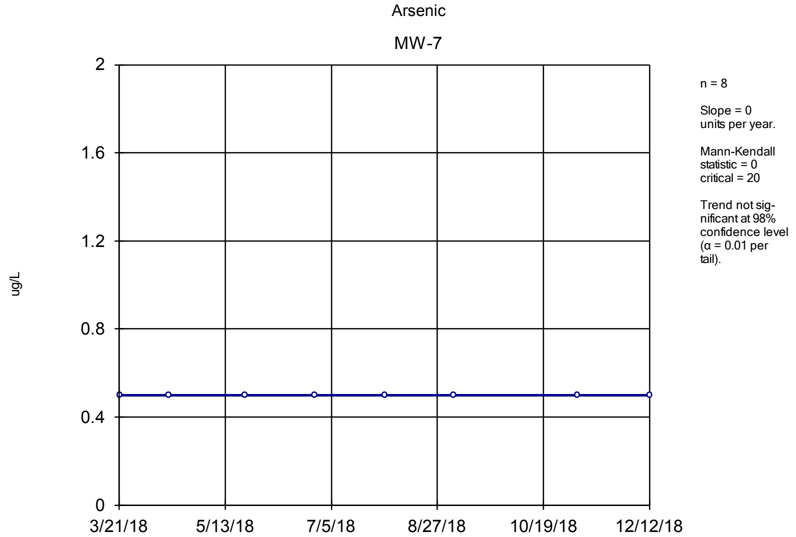

Sen's Slope Estimator Analysis Run 3/4/2019 2:14 PM
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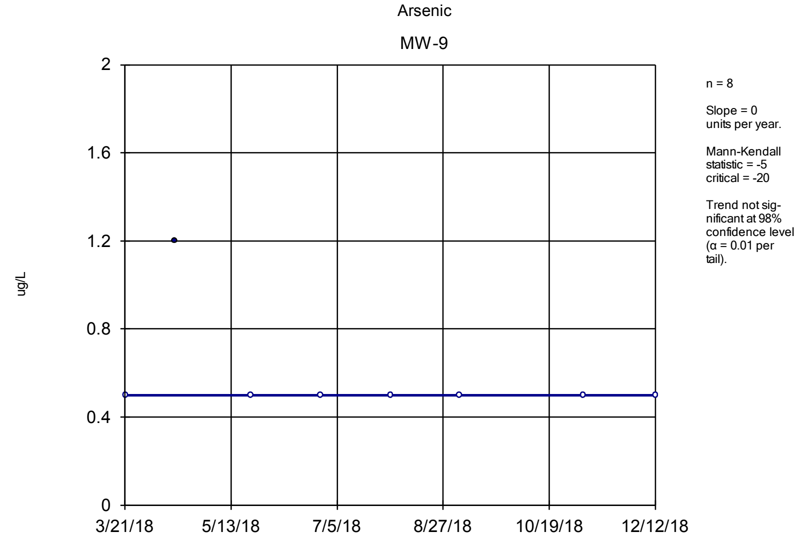

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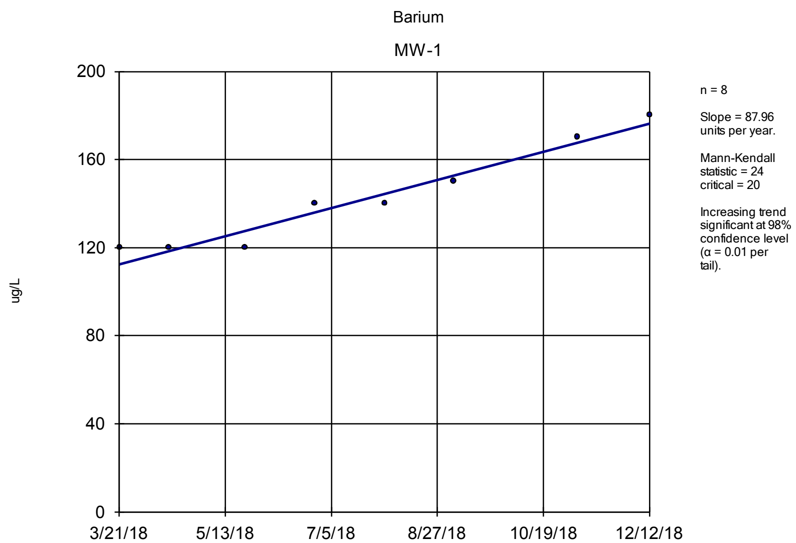

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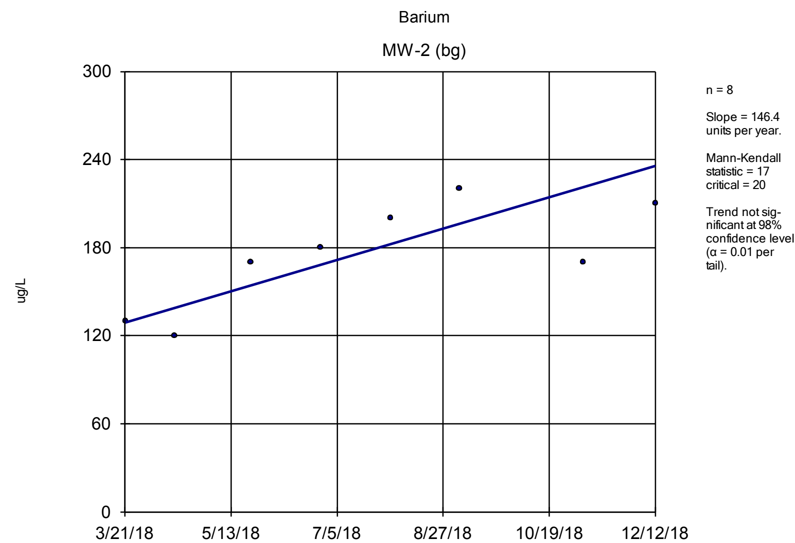

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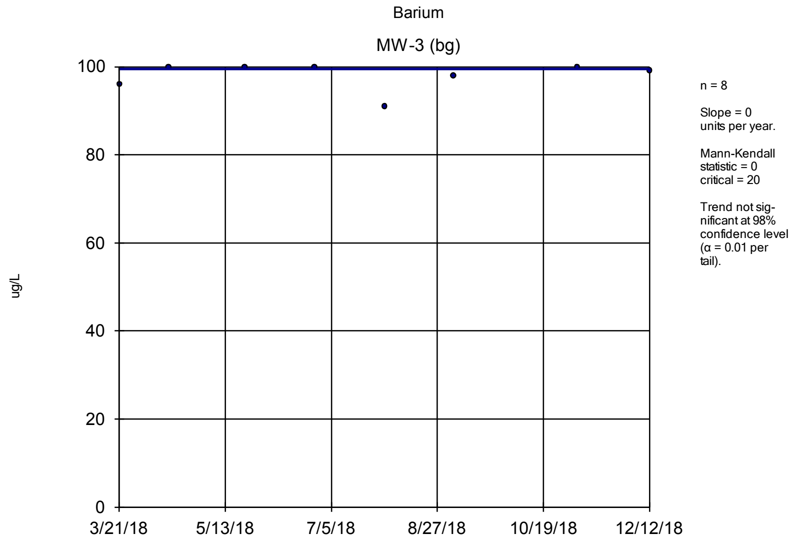

Sen's Slope Estimator Analysis Run 3/4/2019 2:15 PM

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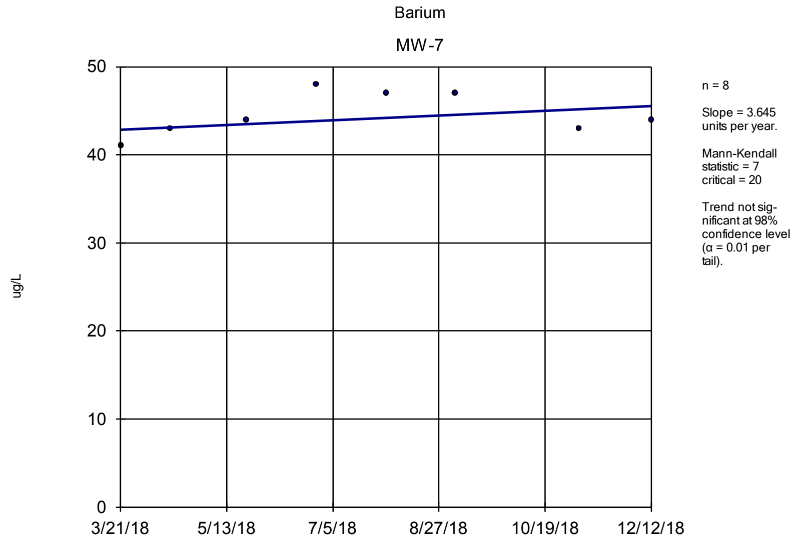

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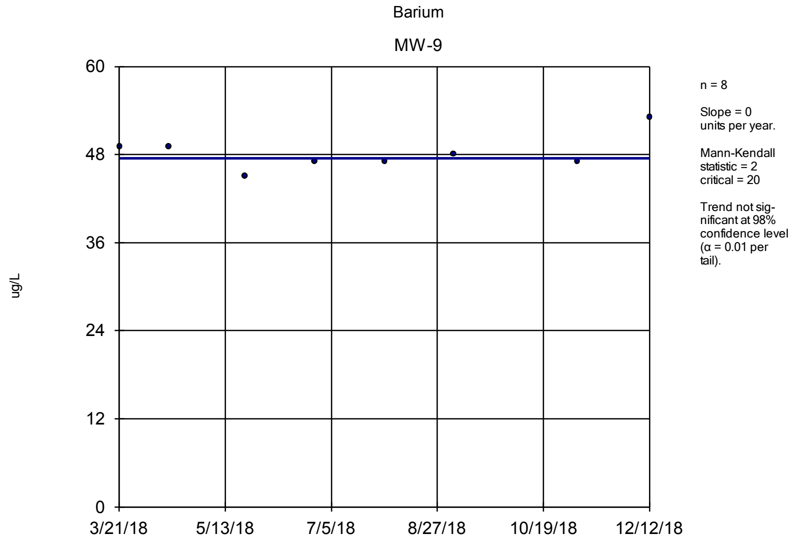
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG



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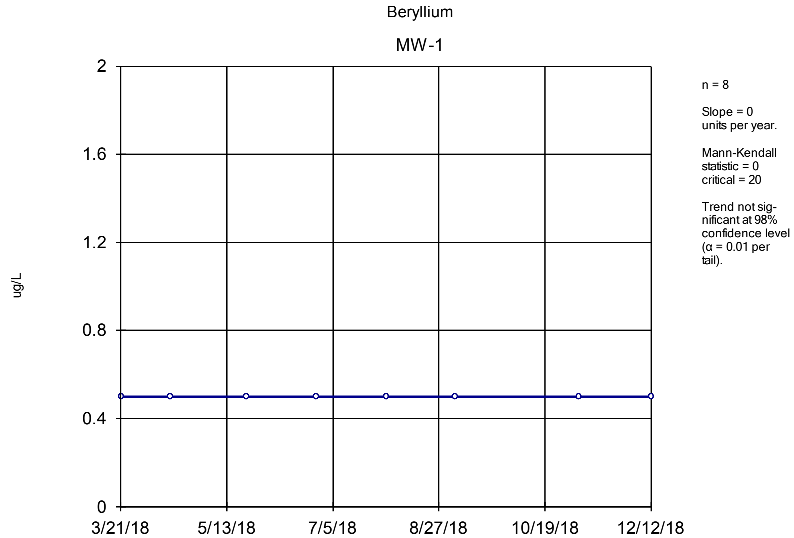

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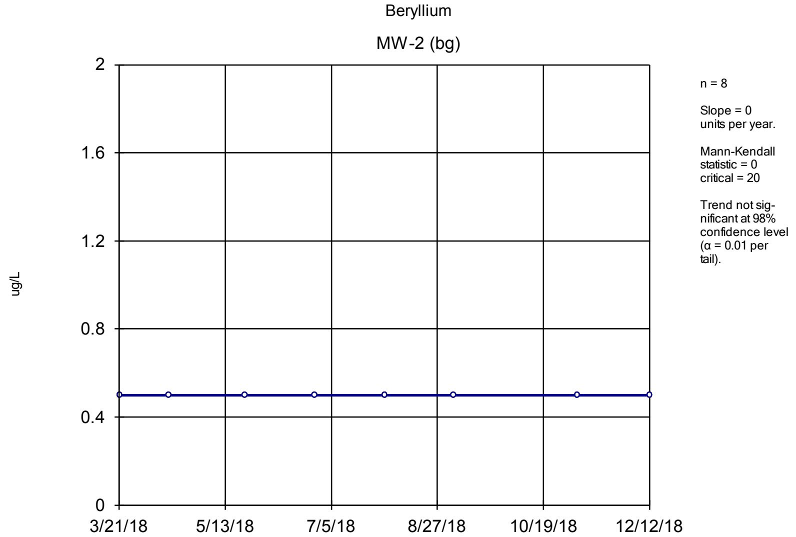

Sen's Slope Estimator   Analysis Run 3/4/2019 2:15 PM
SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

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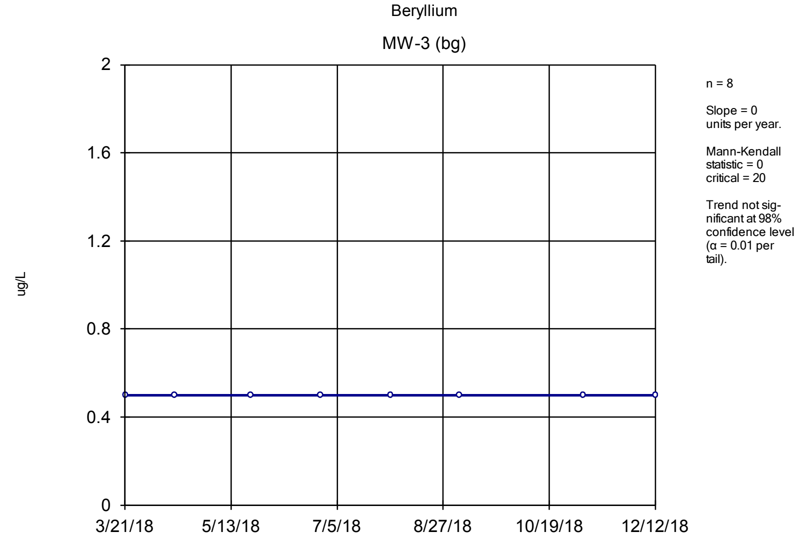

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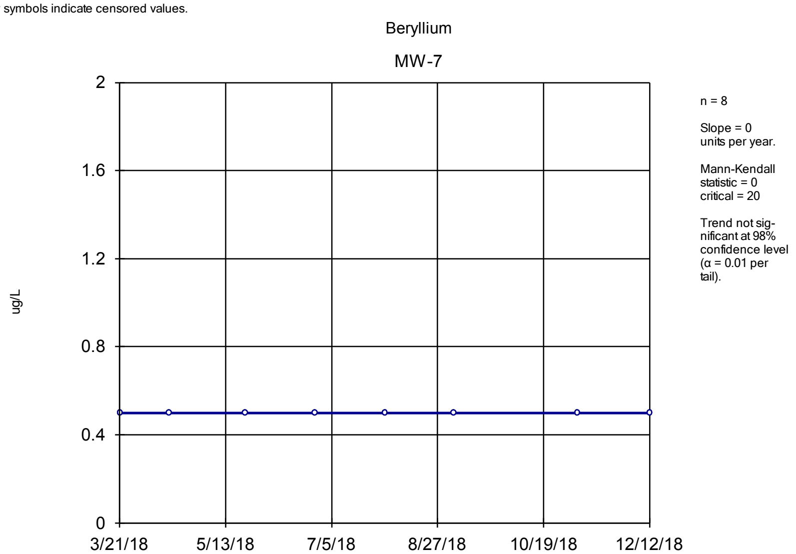

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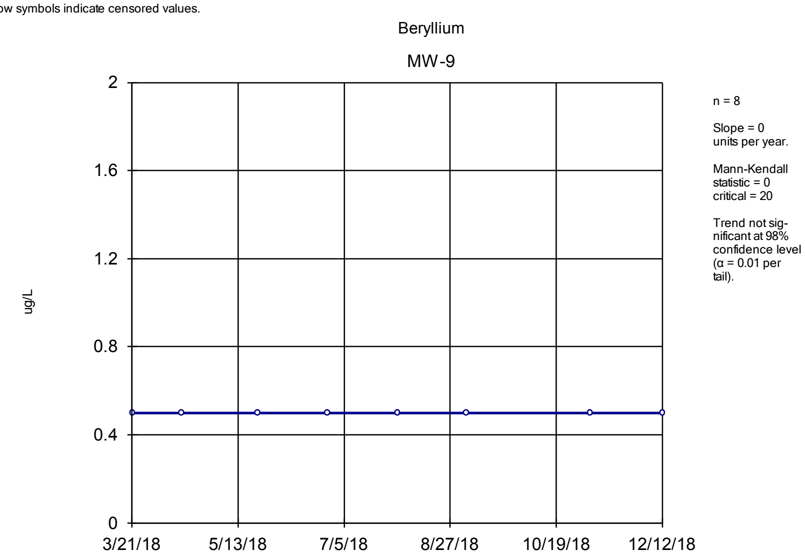

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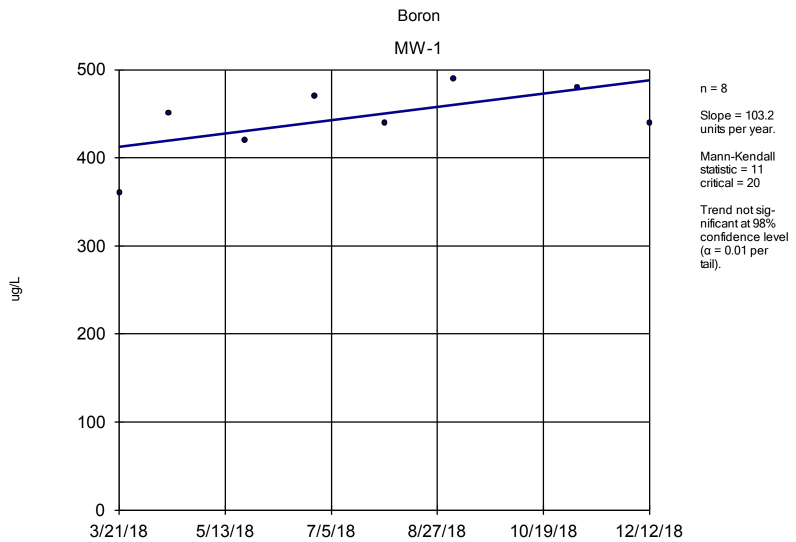

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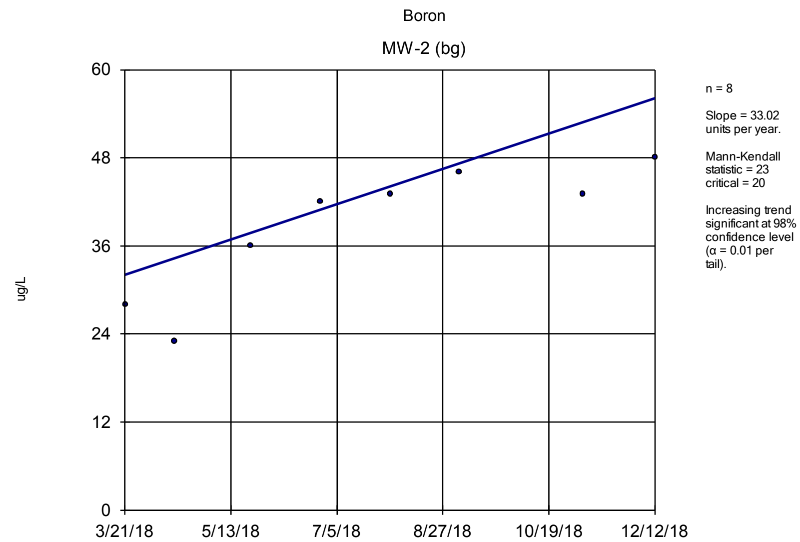

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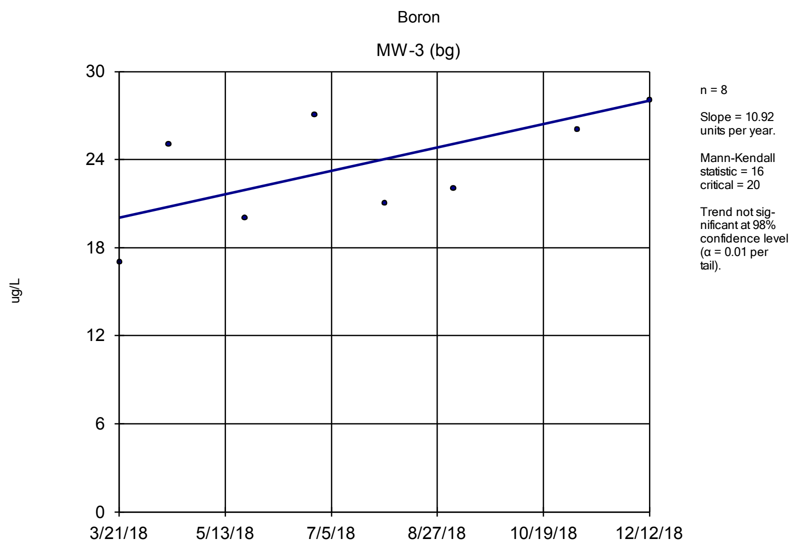

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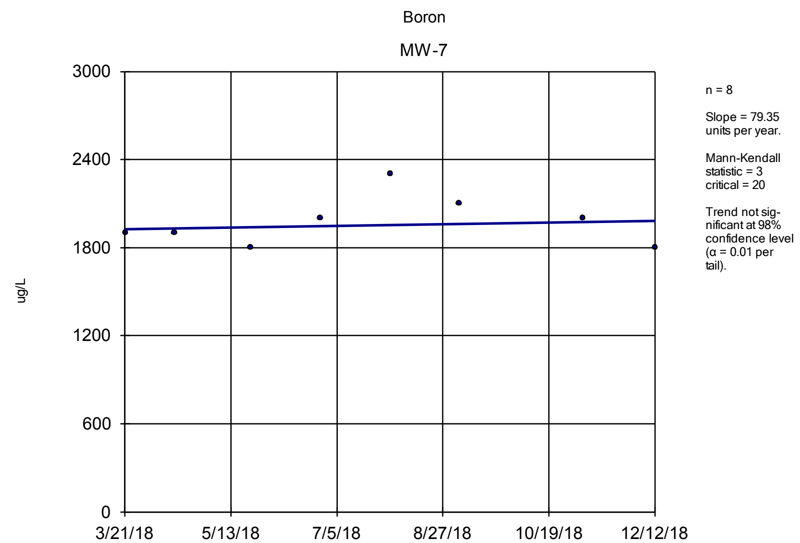

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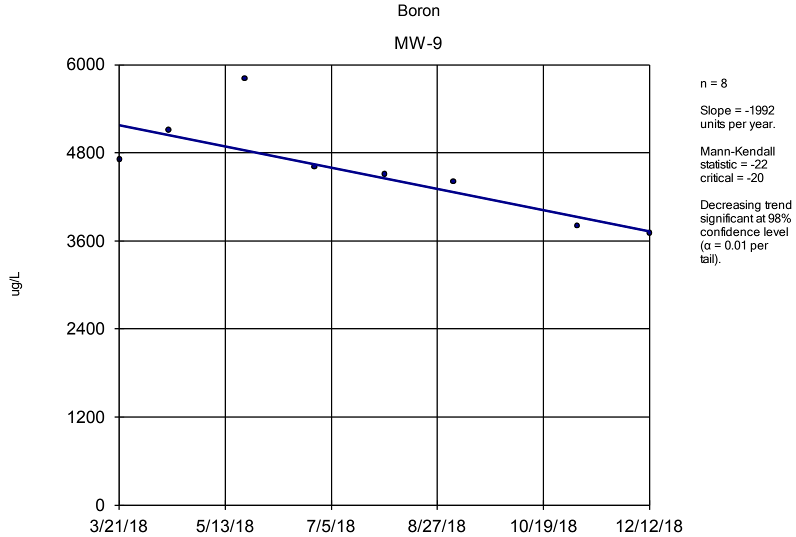

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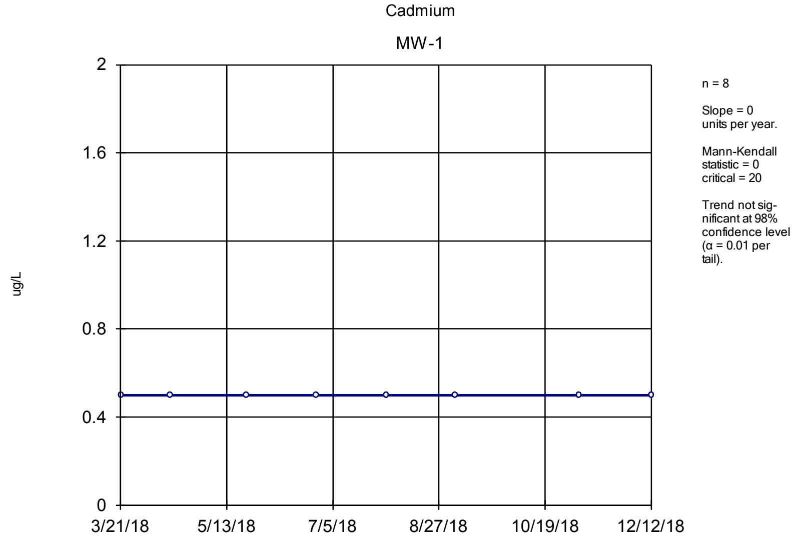

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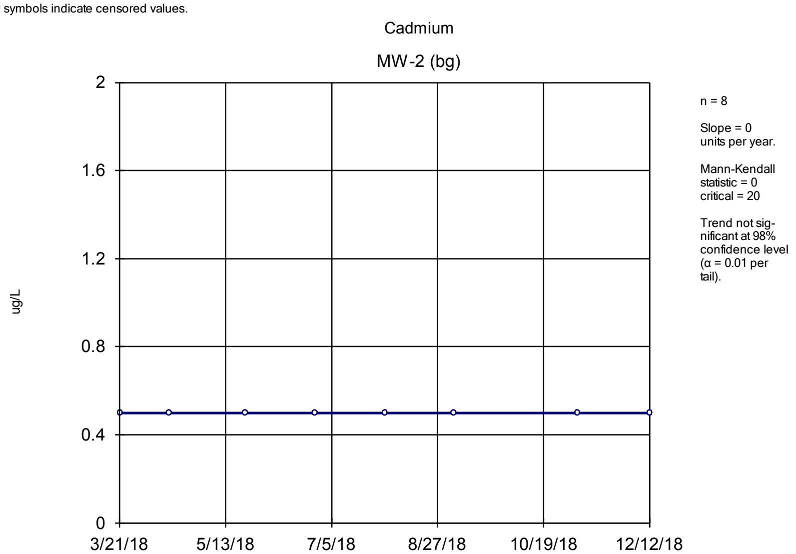

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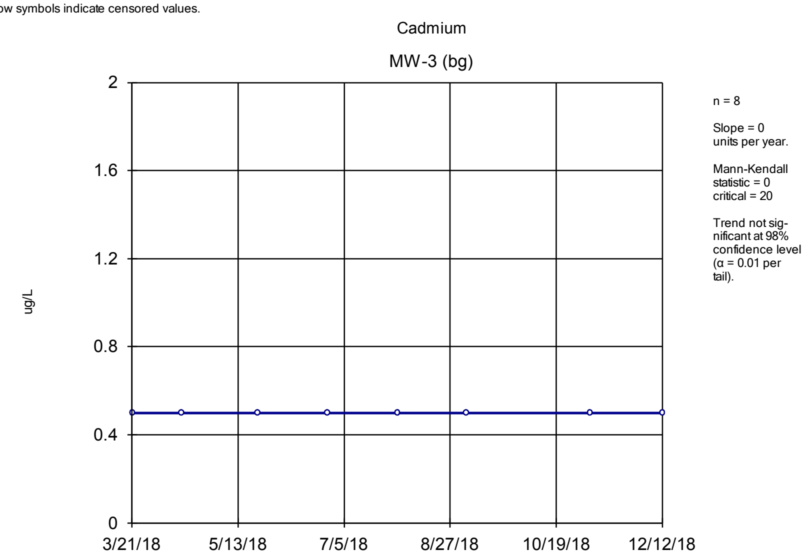

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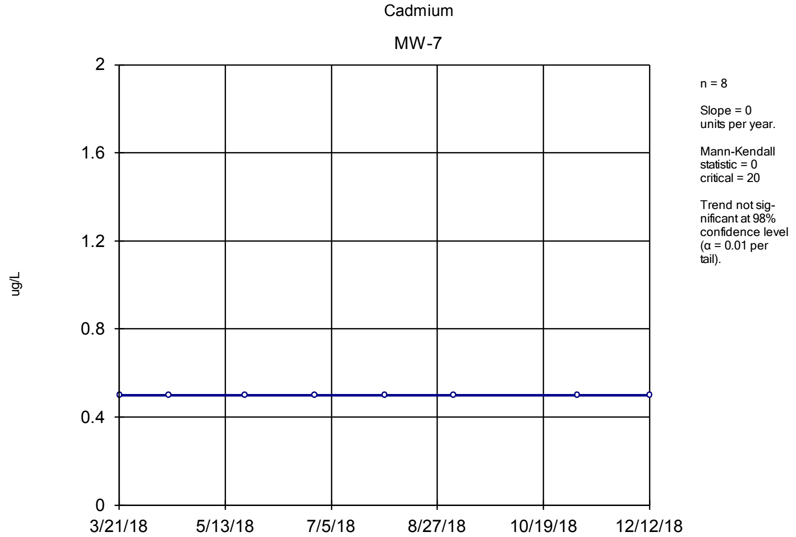

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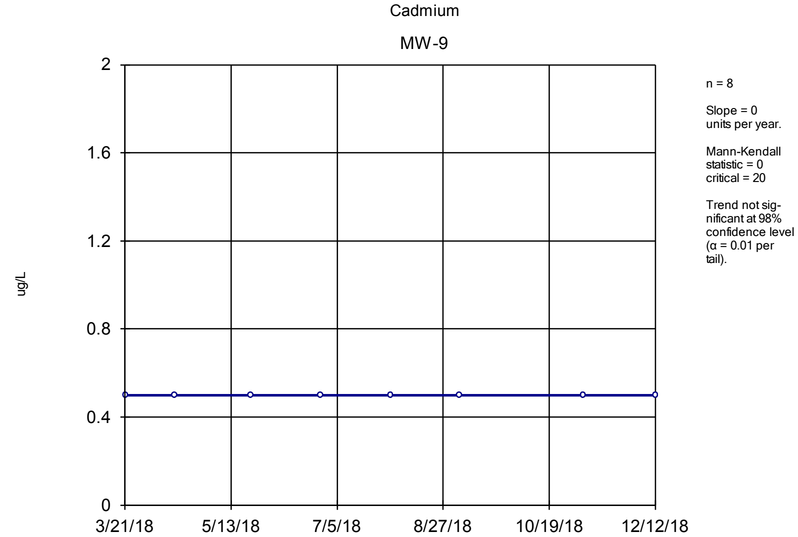

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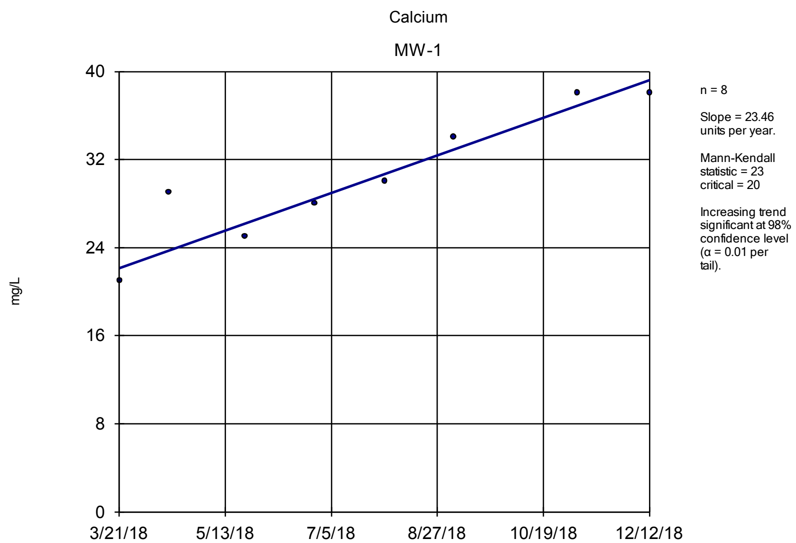

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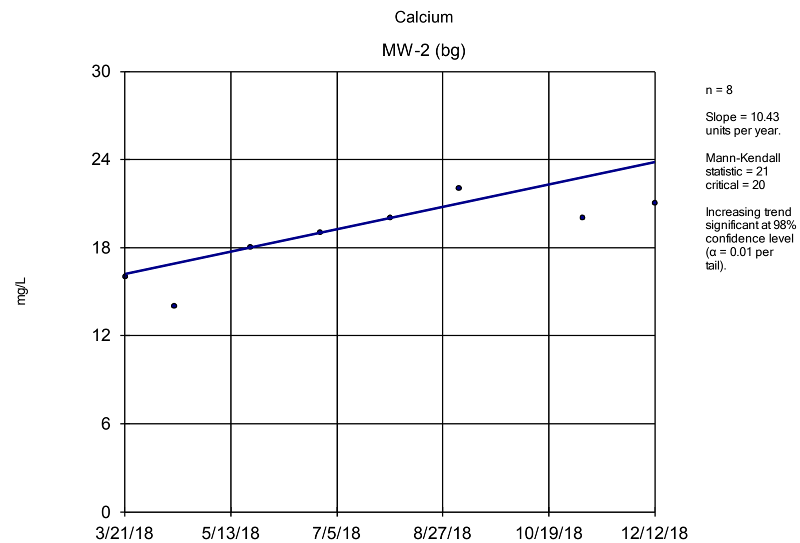
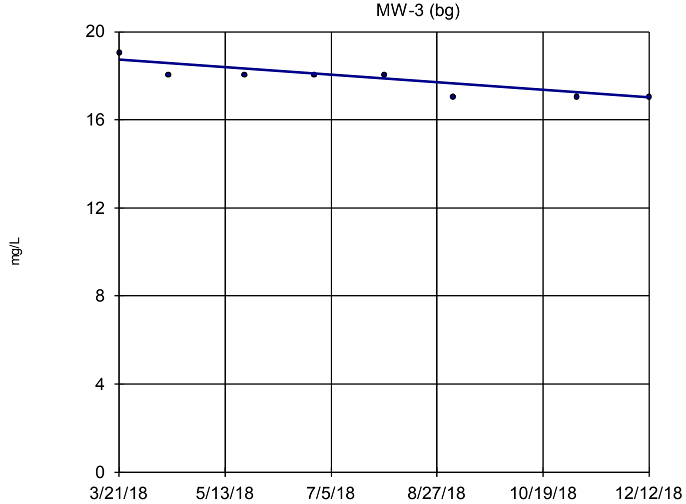


Sen's Slope Estimator Analysis Run 3/4/2019 2:15 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Calcium

MW-3 (bg)



n = 8

Slope = -2.369 units per year.

Mann-Kendall statistic = -19 critical = -20

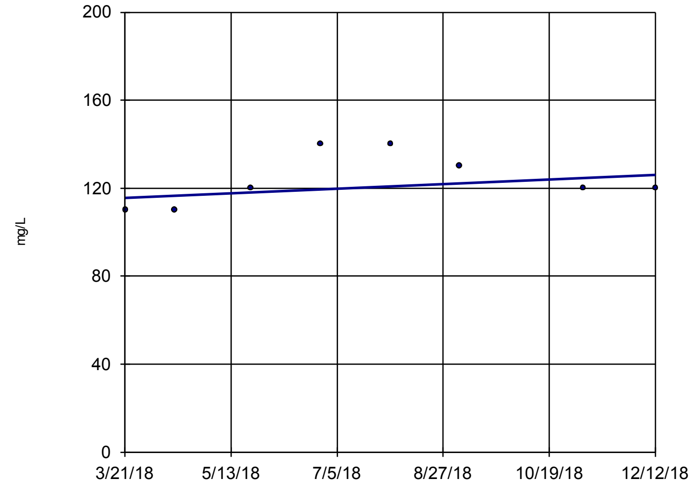
Trend not significant at 98% confidence level (α = 0.01 per tail).

Sen's Slope Estimator Analysis Run 3/4/2019 2:15 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Calcium

MW-7



n = 8

Slope = 14.43 units per year.

Mann-Kendall statistic = 7 critical = 20

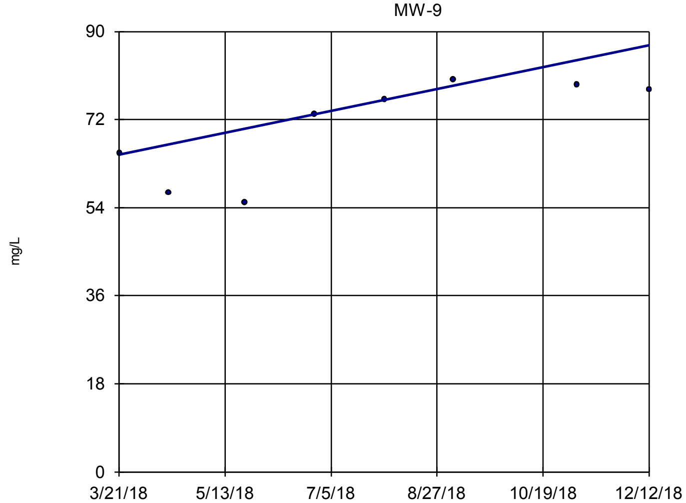
Trend not significant at 98% confidence level (α = 0.01 per tail).

Sen's Slope Estimator Analysis Run 3/4/2019 2:15 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Calcium

MW-9



n = 8

Slope = 30.74 units per year.

Mann-Kendall statistic = 16 critical = 20

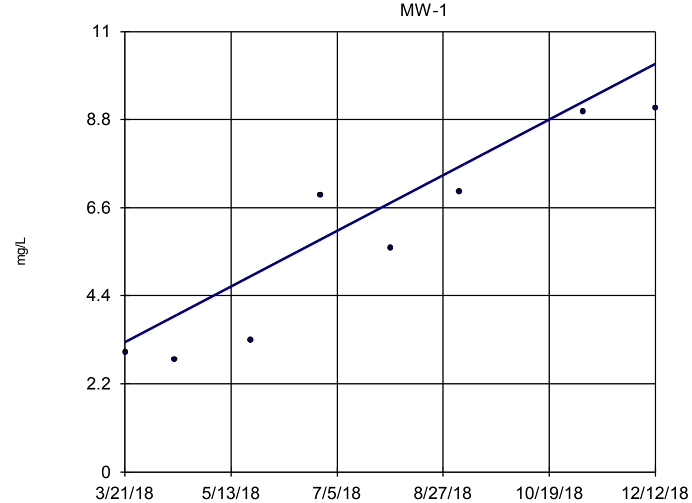
Trend not significant at 98% confidence level (α = 0.01 per tail).

Sen's Slope Estimator Analysis Run 3/4/2019 2:15 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Chloride

MW-1



n = 8

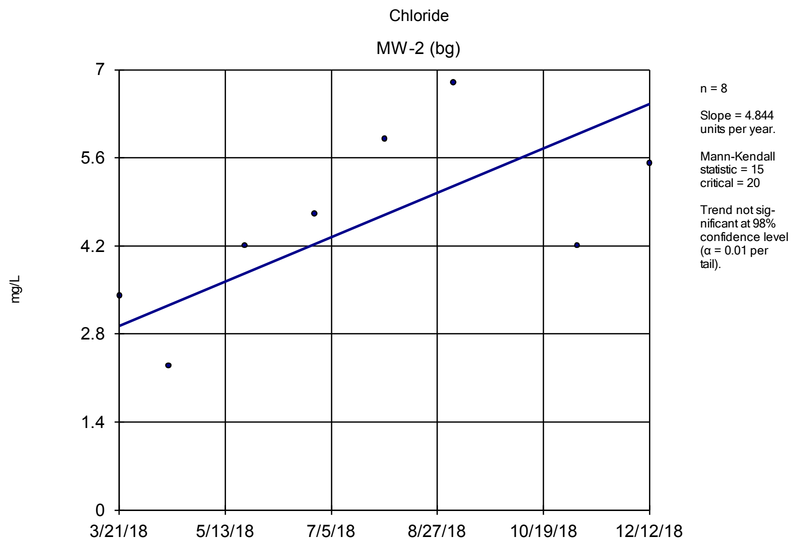
Slope = 9.532 units per year.

Mann-Kendall statistic = 24 critical = 20

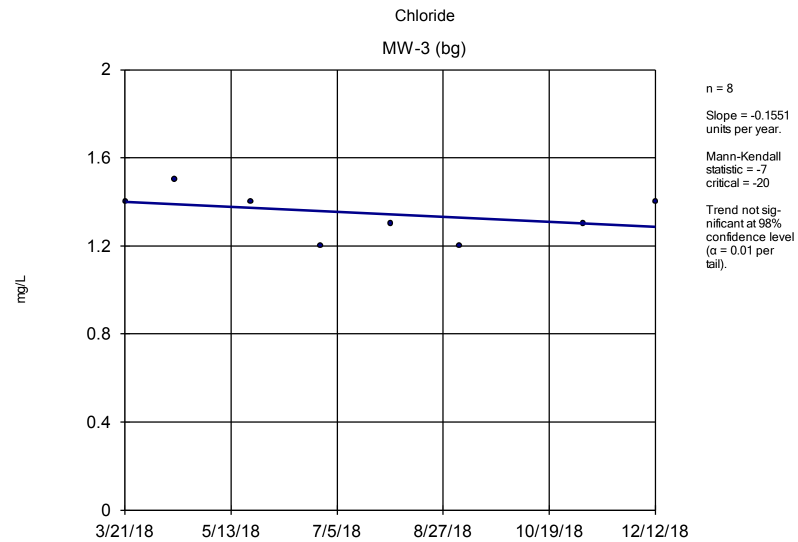
Increasing trend significant at 98% confidence level (α = 0.01 per tail).

Sen's Slope Estimator Analysis Run 3/4/2019 2:15 PM

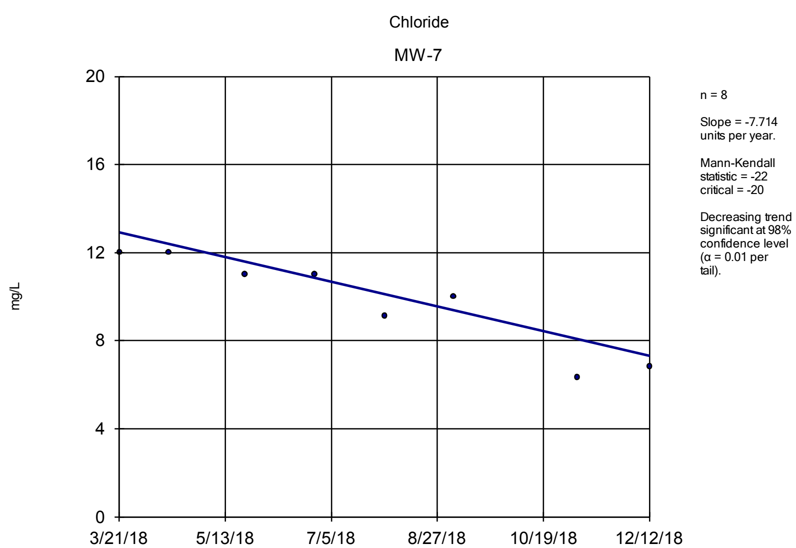
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



Sen's Slope Estimator Analysis Run 3/4/2019 2:15 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



Sen's Slope Estimator Analysis Run 3/4/2019 2:15 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



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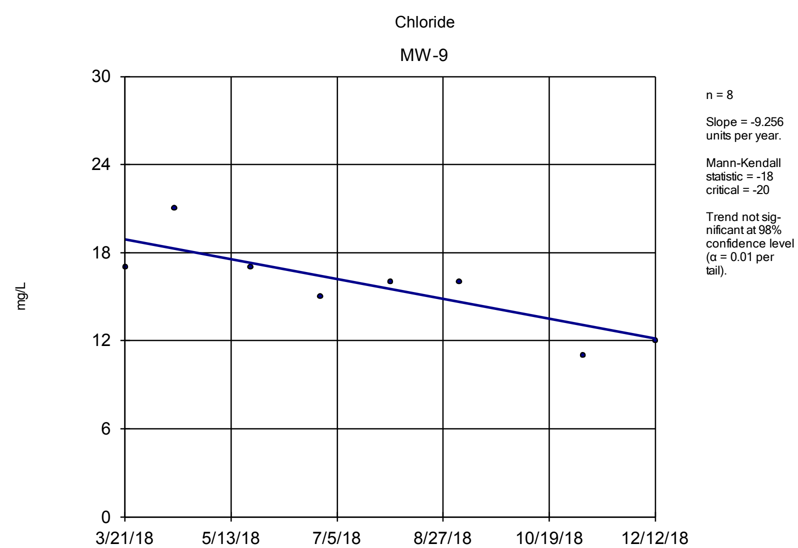
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



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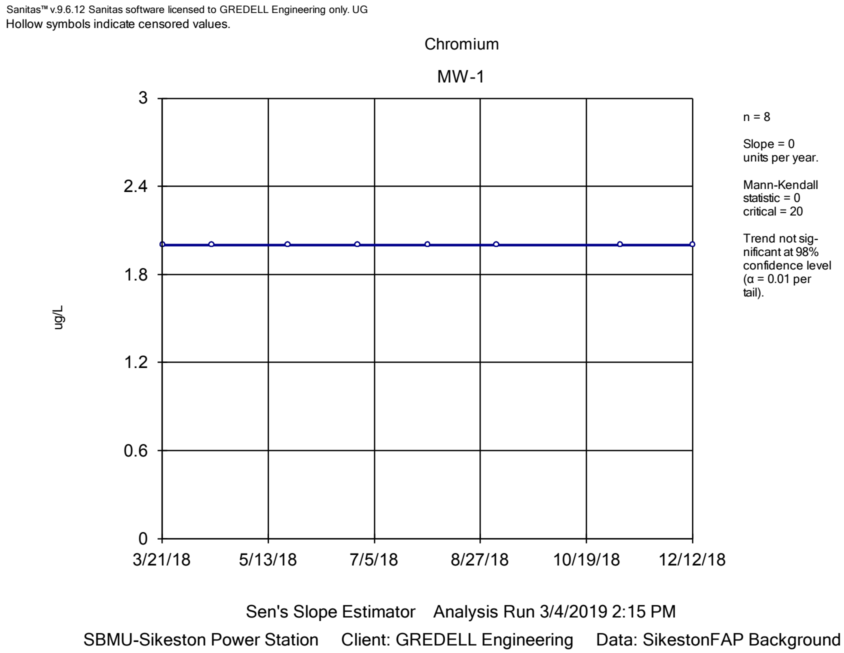
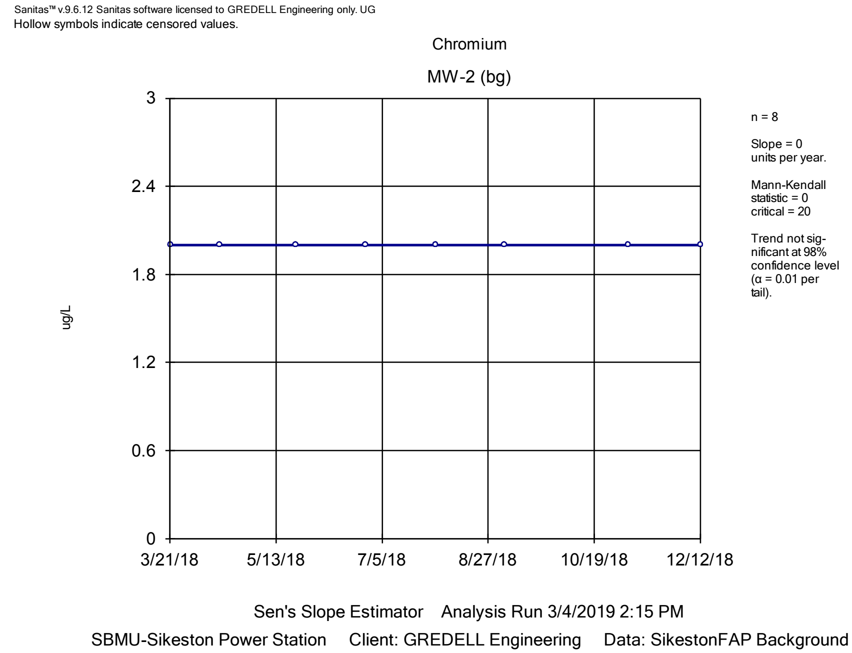
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background


Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.
Chromium
MW-1
ug/L
n = 8
Slope = 0 units per year.
Mann-Kendall statistic = 0 critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 3/4/2019 2:15 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background


Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.
Chromium
MW-2 (bg)
ug/L
n = 8
Slope = 0 units per year.
Mann-Kendall statistic = 0 critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 3/4/2019 2:15 PM
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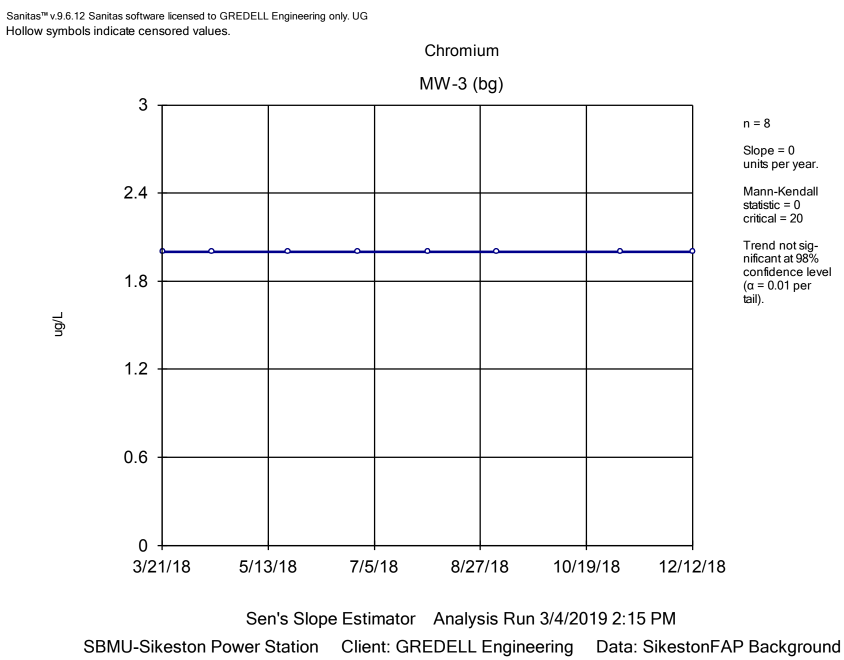
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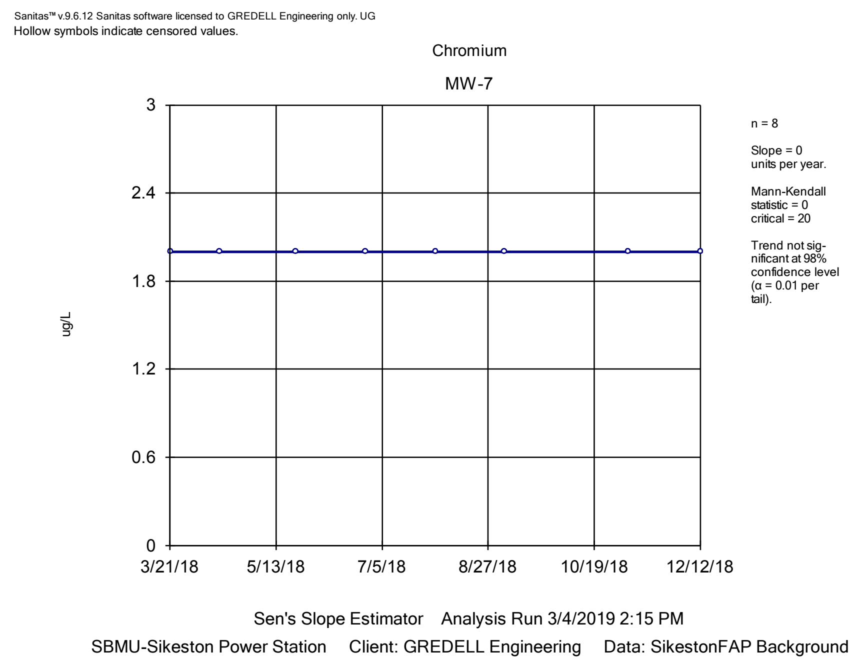
Hollow symbols indicate censored values.
Chromium
MW-3 (bg)
ug/L
n = 8
Slope = 0 units per year.
Mann-Kendall statistic = 0 critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 3/4/2019 2:15 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background


Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.
Chromium
MW-7
ug/L
n = 8
Slope = 0 units per year.
Mann-Kendall statistic = 0 critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 3/4/2019 2:15 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
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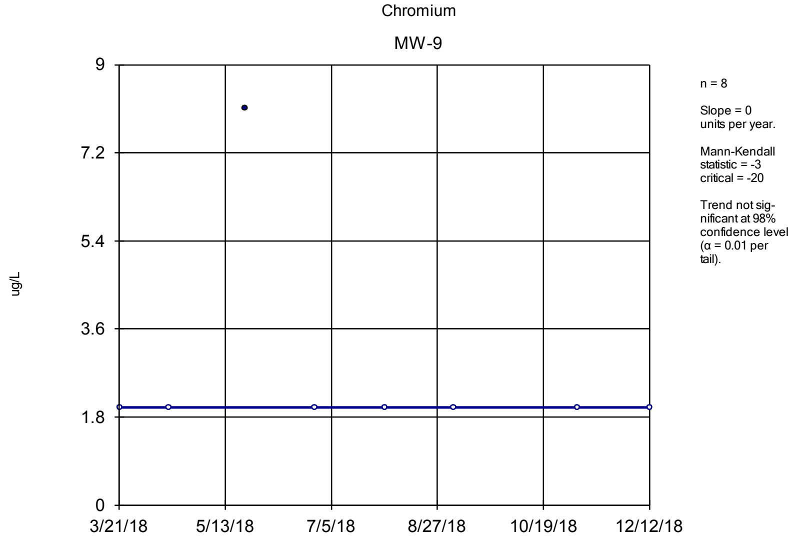

Sen's Slope Estimator Analysis Run 3/4/2019 2:15 PM
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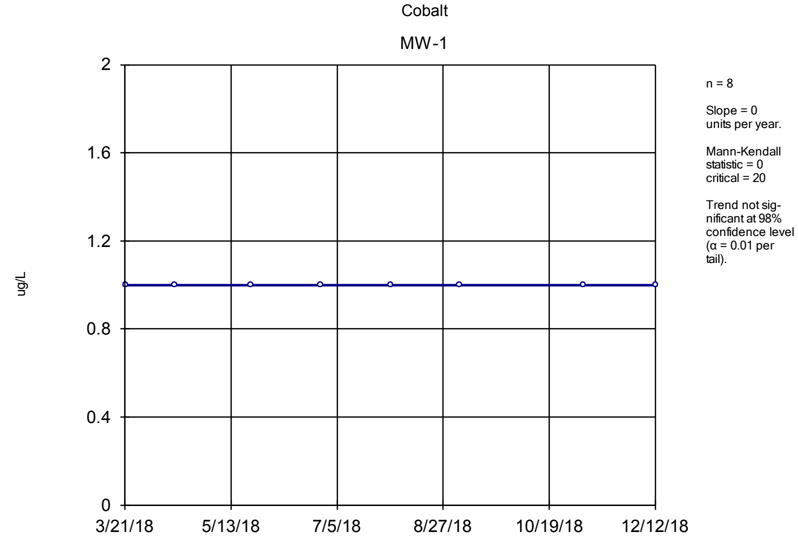

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Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
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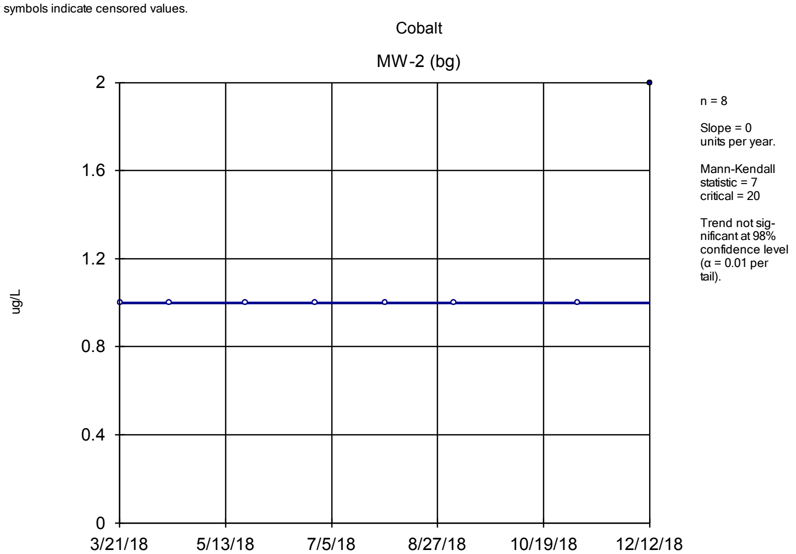

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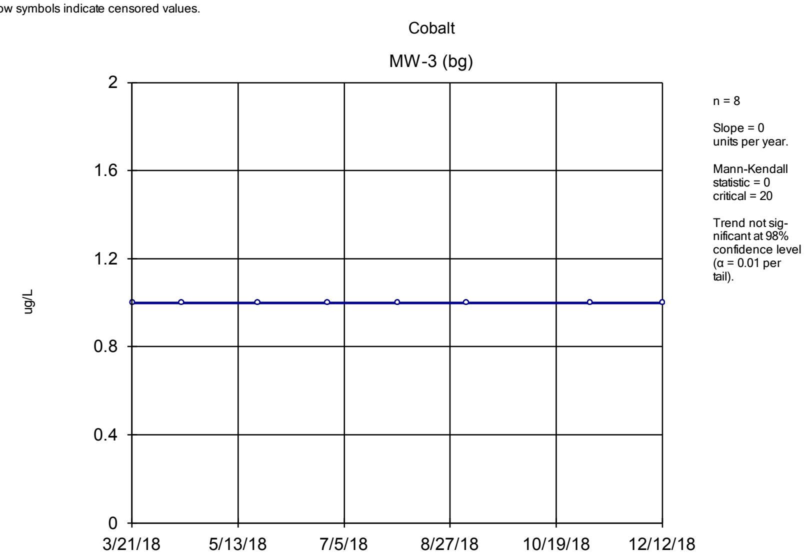

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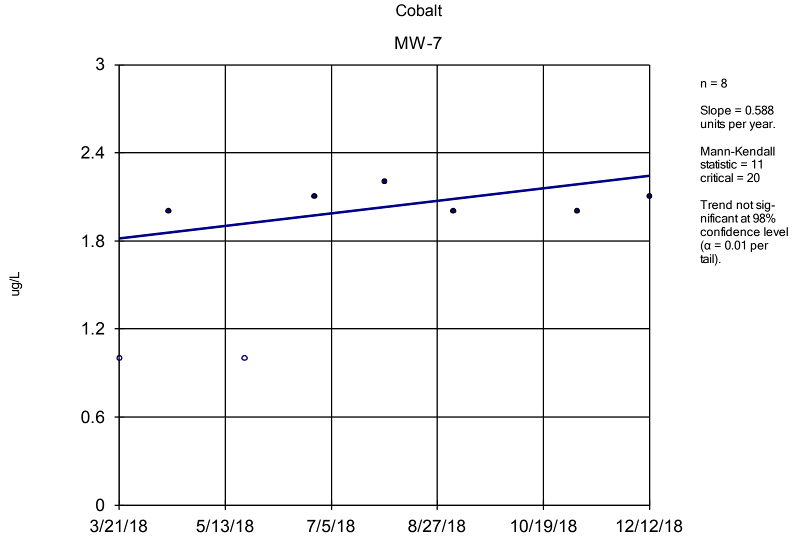

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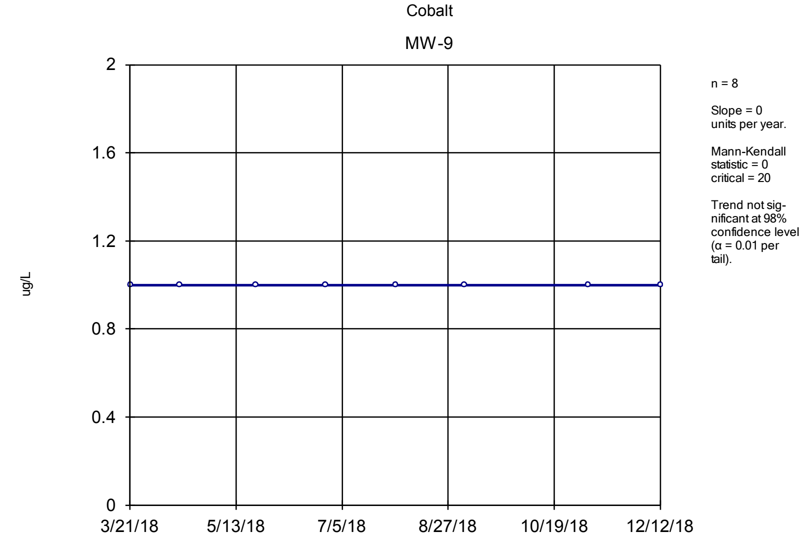

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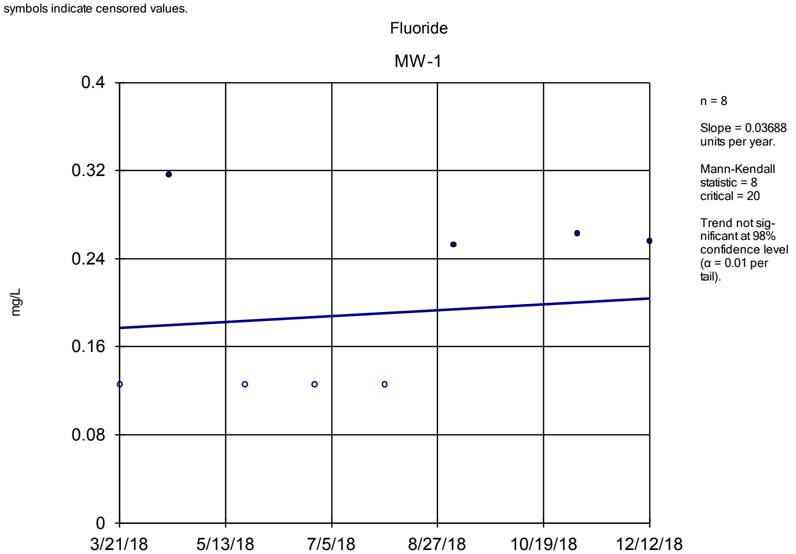

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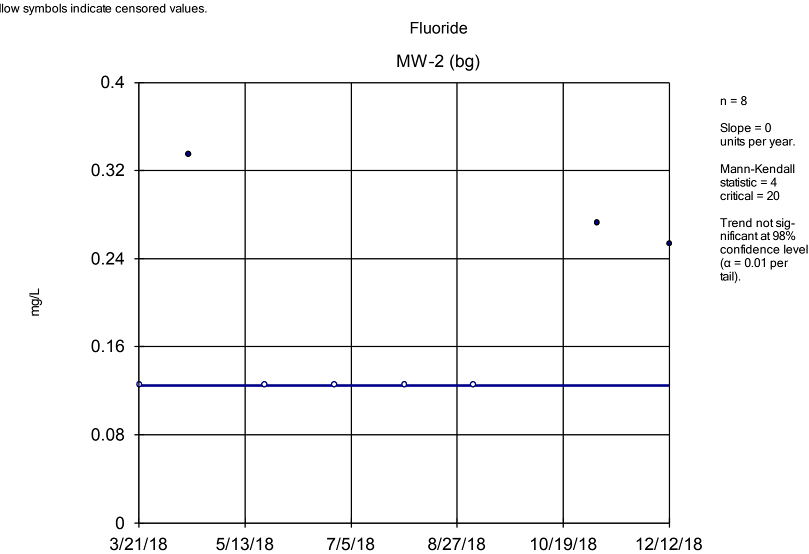

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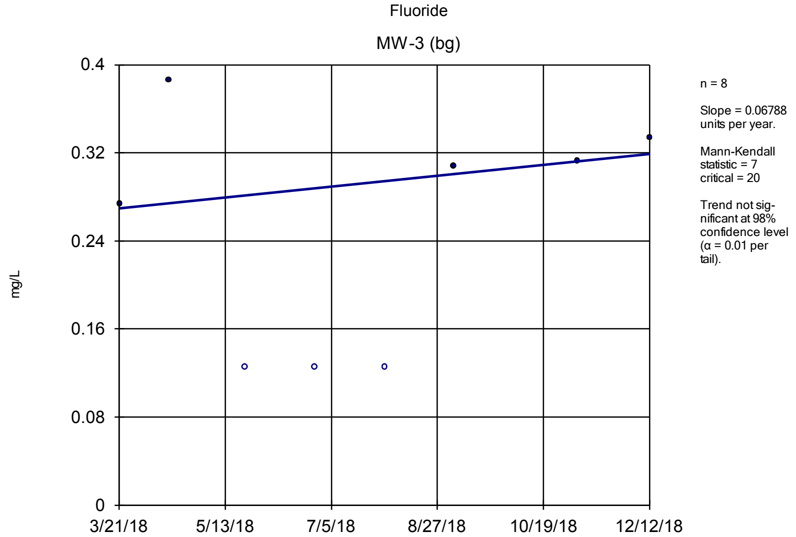

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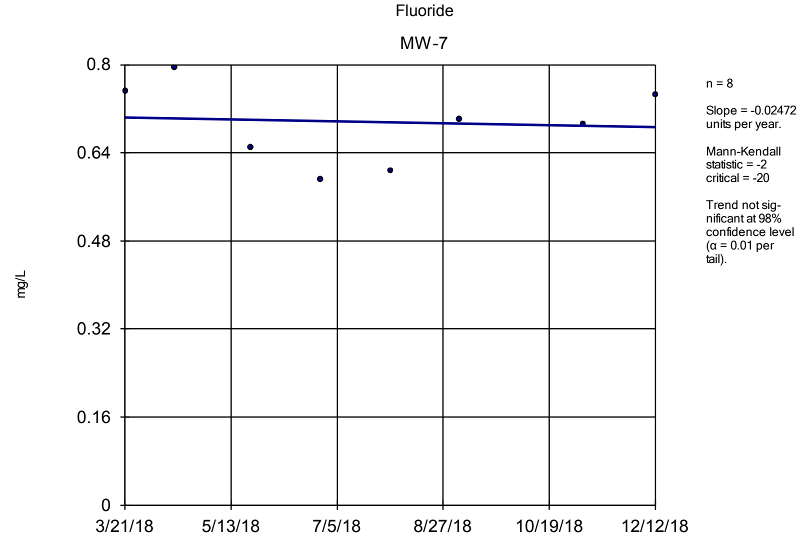

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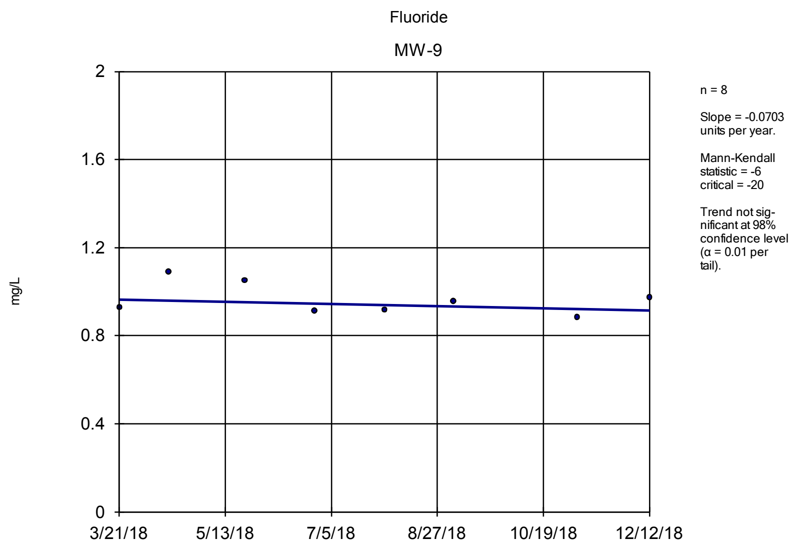

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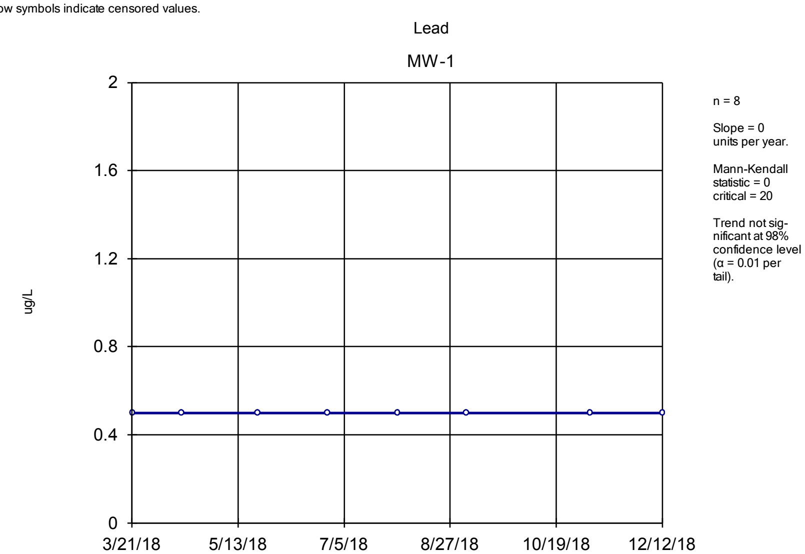

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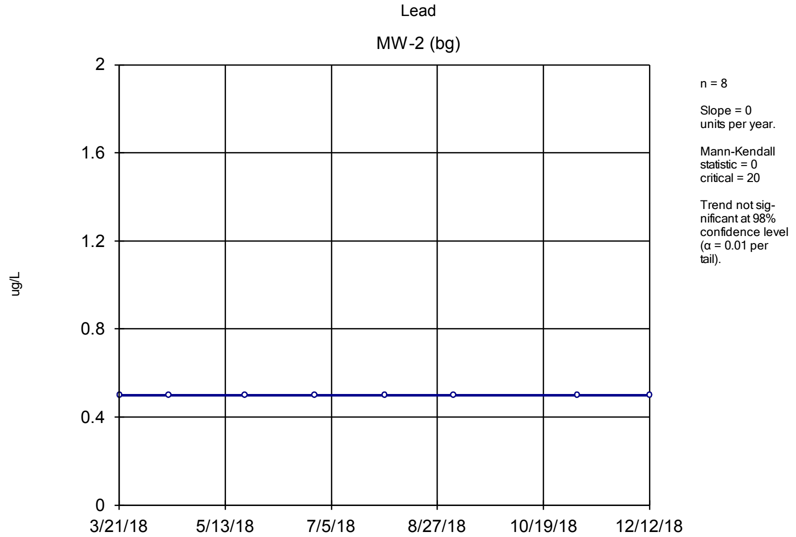

Sen's Slope Estimator   Analysis Run 3/4/2019 2:15 PM
SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

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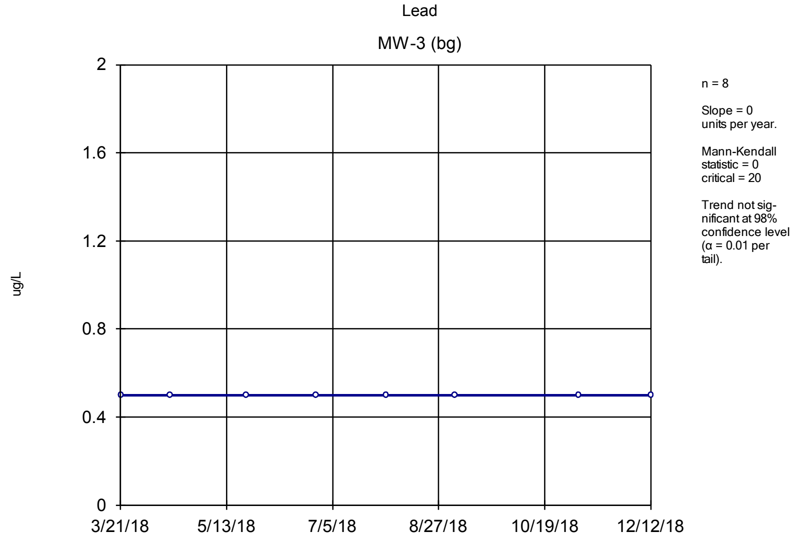

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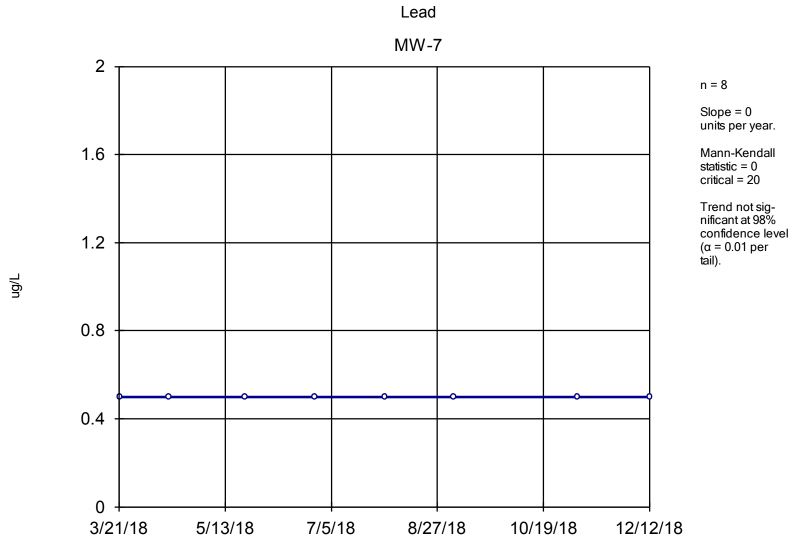

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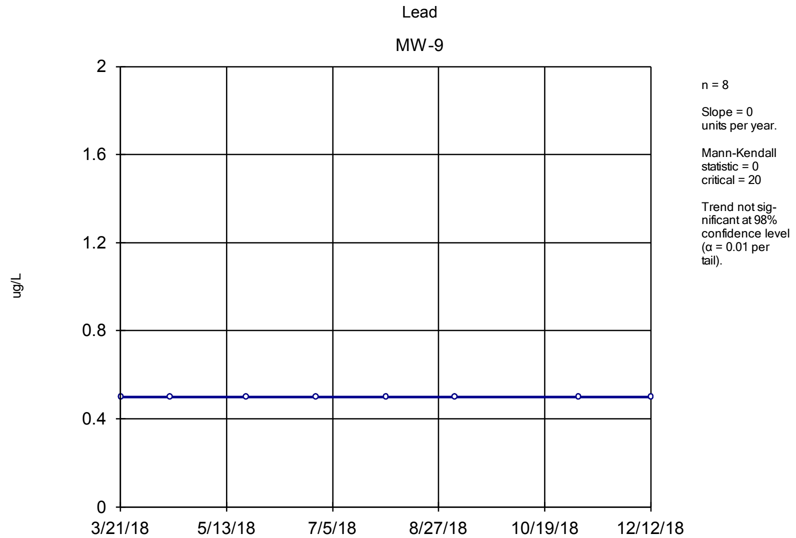

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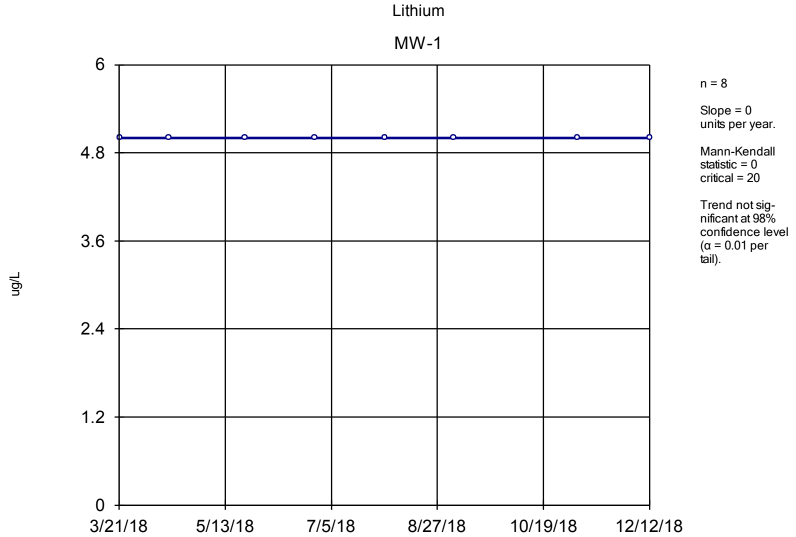

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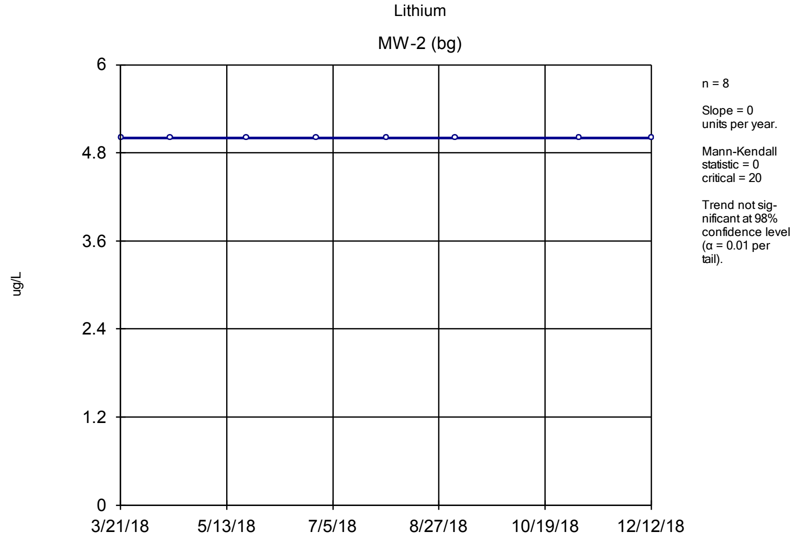

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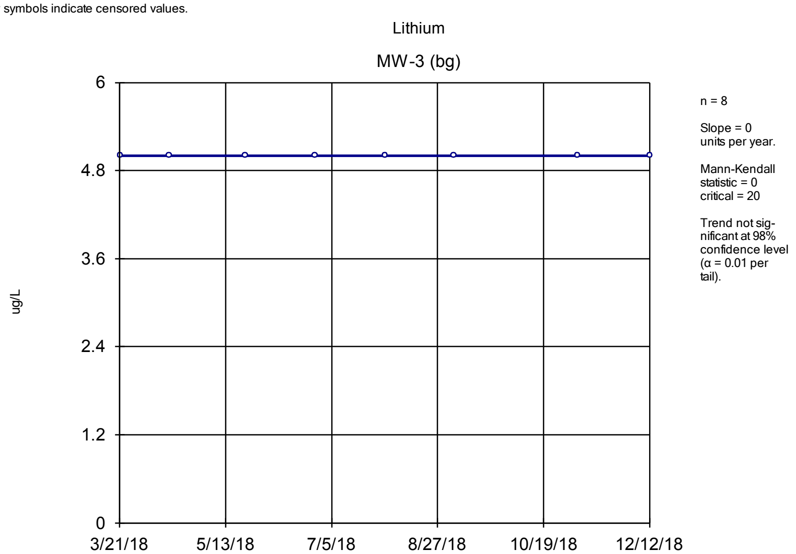

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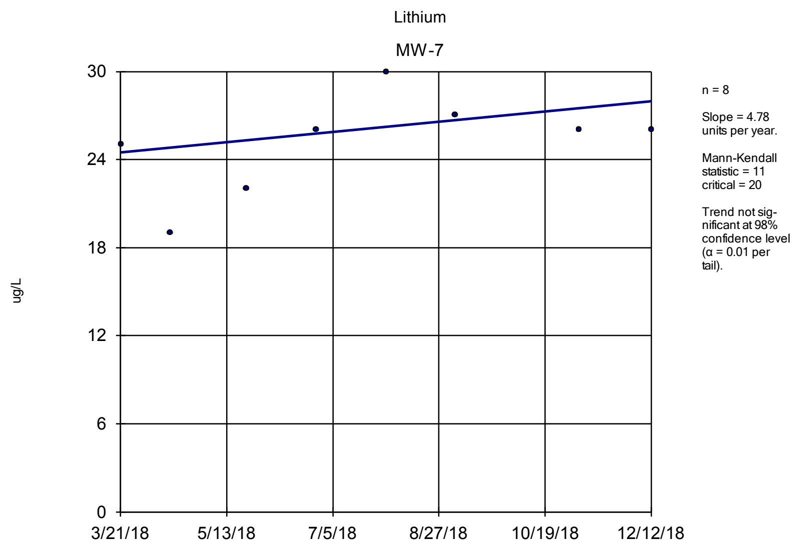
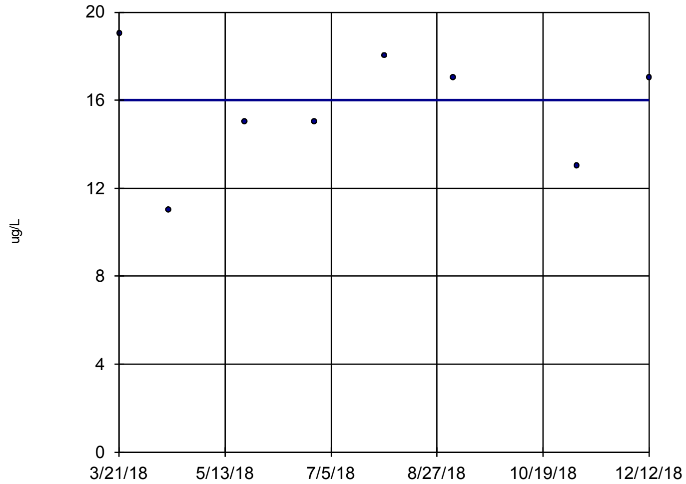


Sen's Slope Estimator Analysis Run 3/4/2019 2:15 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG

Lithium

MW-9



n = 8

Slope = 0
units per year.

Mann-Kendall
statistic = 0
critical = 20

Trend not significant at 98% confidence level (α = 0.01 per tail).

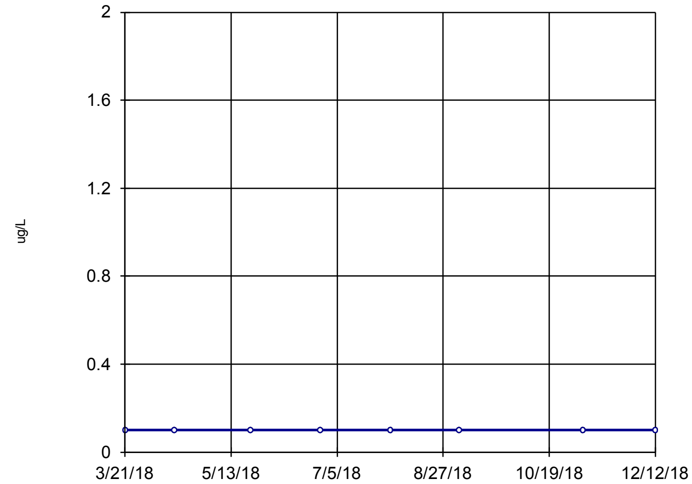
Sen's Slope Estimator   Analysis Run 3/4/2019 2:15 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.

Mercury

MW-1



n = 8

Slope = 0
units per year.

Mann-Kendall
statistic = 0
critical = 20

Trend not significant at 98% confidence level (α = 0.01 per tail).

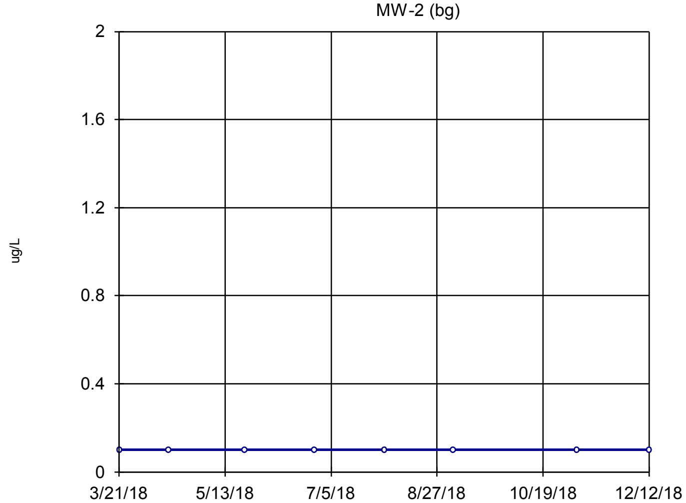
Sen's Slope Estimator   Analysis Run 3/4/2019 2:15 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.

Mercury

MW-2 (bg)



n = 8

Slope = 0
units per year.

Mann-Kendall
statistic = 0
critical = 20

Trend not significant at 98% confidence level (α = 0.01 per tail).

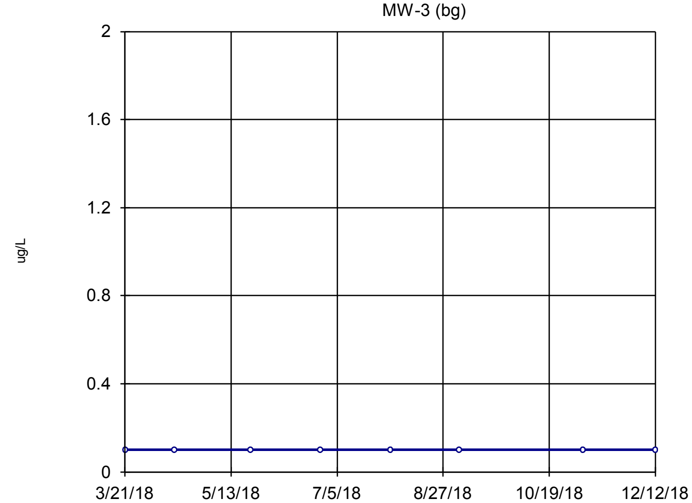
Sen's Slope Estimator   Analysis Run 3/4/2019 2:15 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.

Mercury

MW-3 (bg)



n = 8

Slope = 0
units per year.

Mann-Kendall
statistic = 0
critical = 20

Trend not significant at 98% confidence level (α = 0.01 per tail).

Sen's Slope Estimator   Analysis Run 3/4/2019 2:15 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
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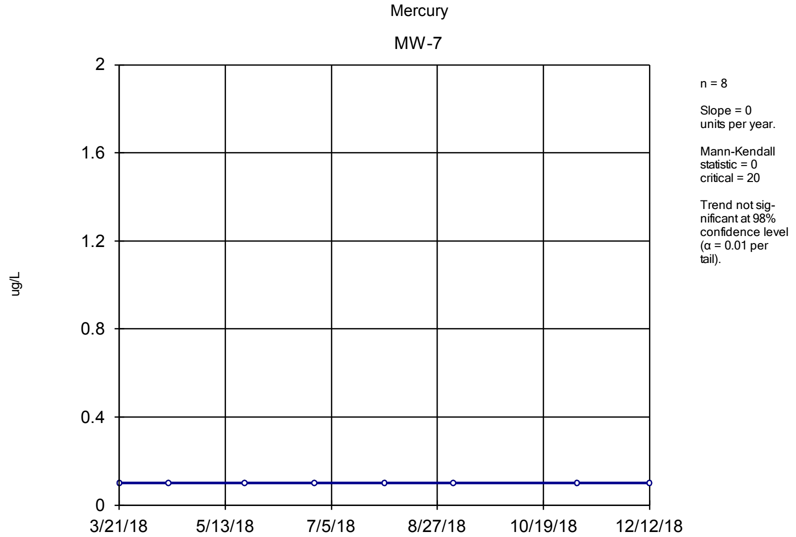

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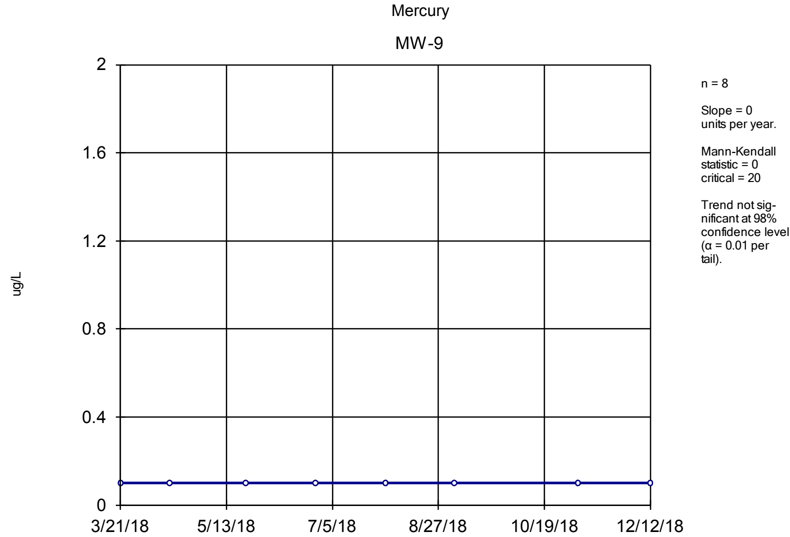
Hollow symbols indicate censored values.



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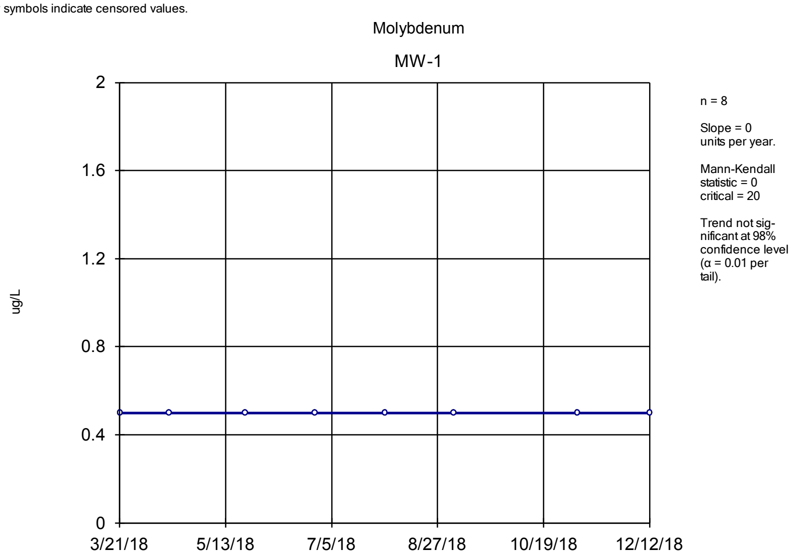

Sen's Slope Estimator Analysis Run 3/4/2019 2:15 PM
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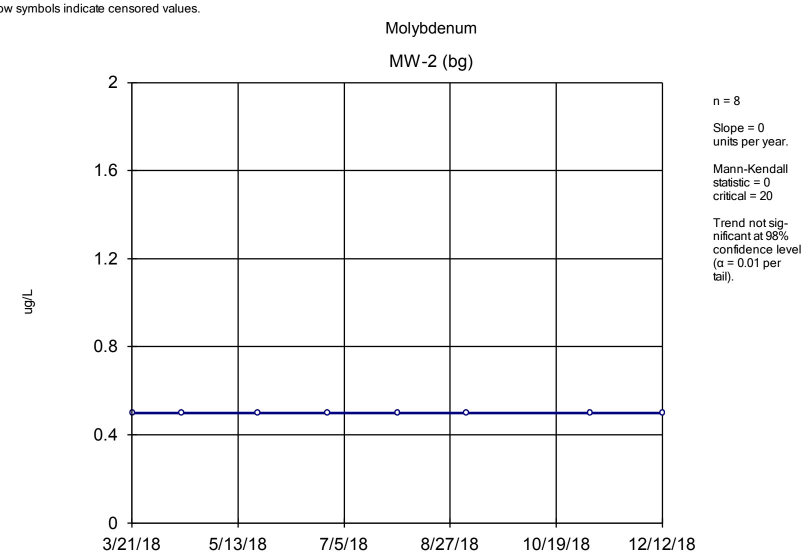
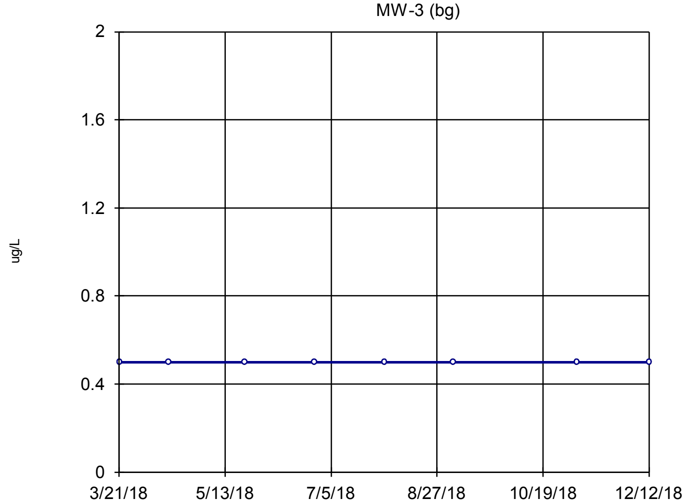


Sen's Slope Estimator Analysis Run 3/4/2019 2:15 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.

Molybdenum

MW-3 (bg)



n = 8

Slope = 0
units per year.

Mann-Kendall
statistic = 0
critical = 20

Trend not sig-
nificant at 98%
confidence level
(α = 0.01 per
tail).

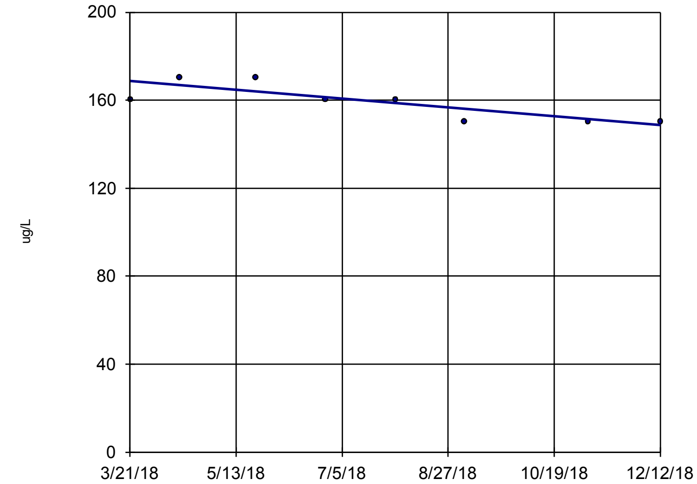
Sen's Slope Estimator   Analysis Run 3/4/2019 2:15 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG

Molybdenum

MW-7



n = 8

Slope = -27.55
units per year.

Mann-Kendall
statistic = -17
critical = -20

Trend not sig-
nificant at 98%
confidence level
(α = 0.01 per
tail).

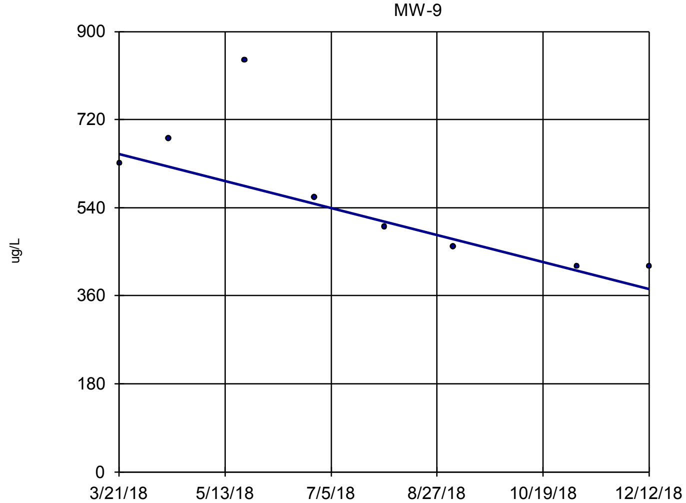
Sen's Slope Estimator   Analysis Run 3/4/2019 2:15 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG

Molybdenum

MW-9



n = 8

Slope = -378.2
units per year.

Mann-Kendall
statistic = -21
critical = -20

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

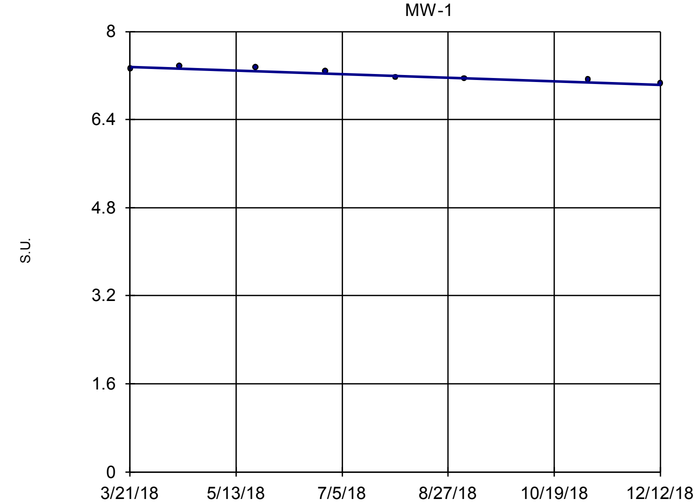
Sen's Slope Estimator   Analysis Run 3/4/2019 2:15 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG

pH

MW-1



n = 8

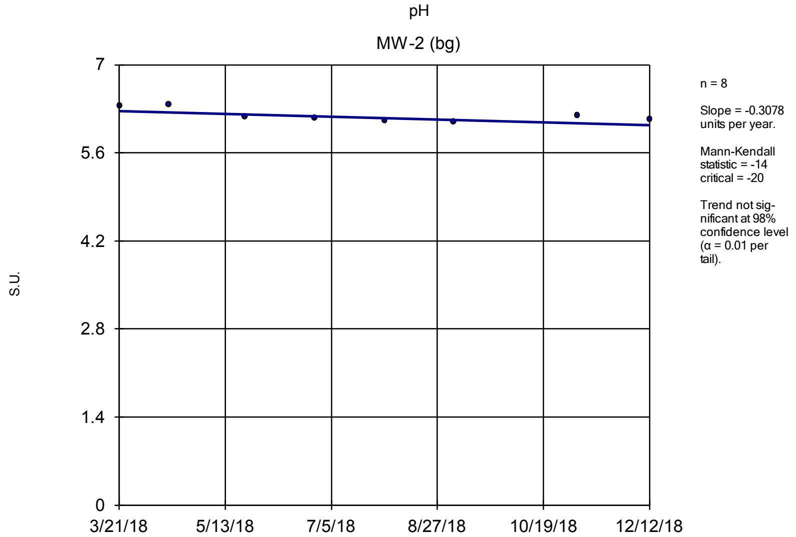
Slope = -0.4438
units per year.

Mann-Kendall
statistic = -24
critical = -20

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Sen's Slope Estimator   Analysis Run 3/4/2019 2:15 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background



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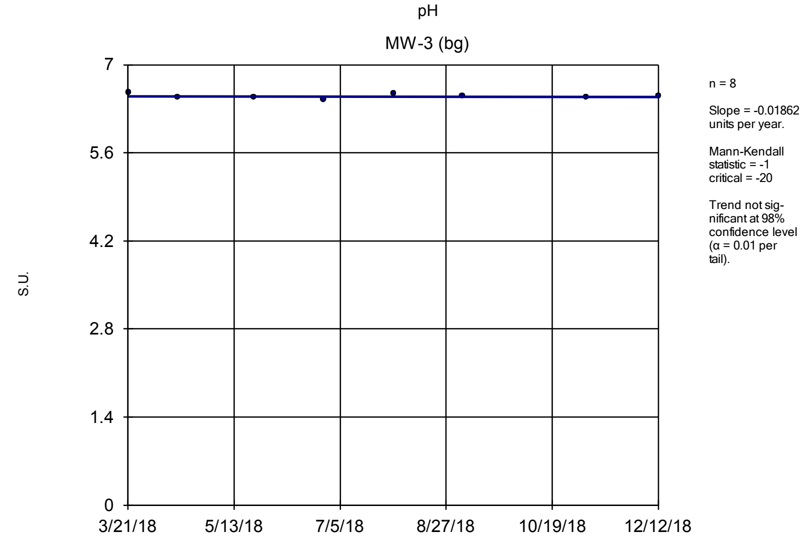

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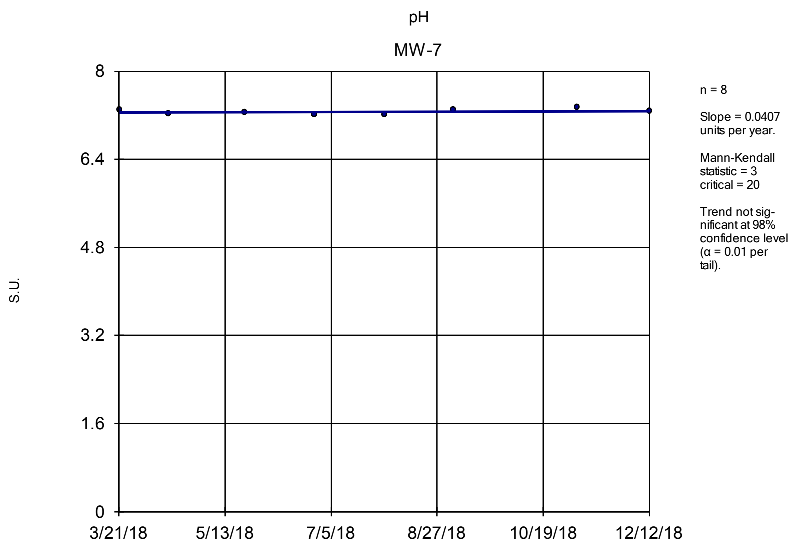

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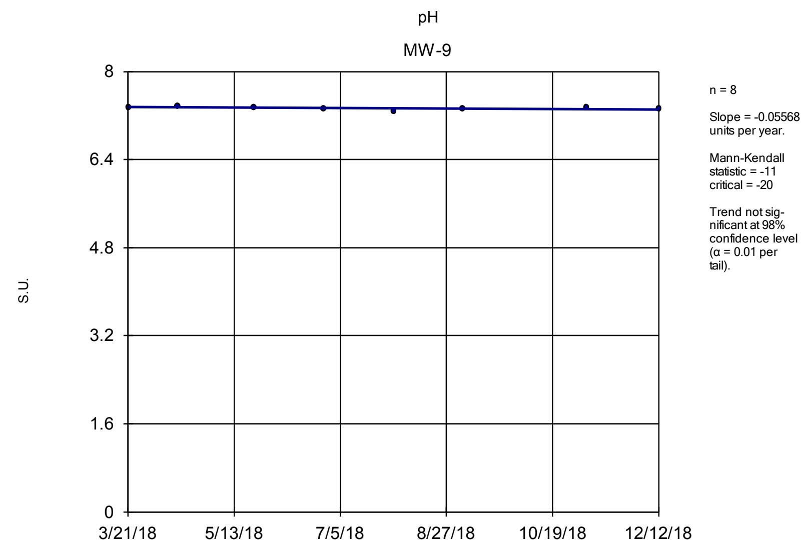
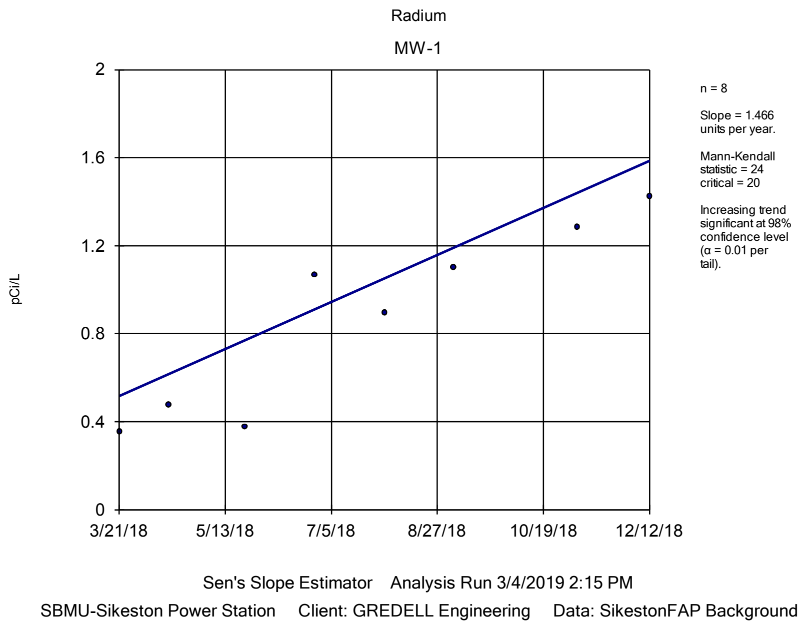
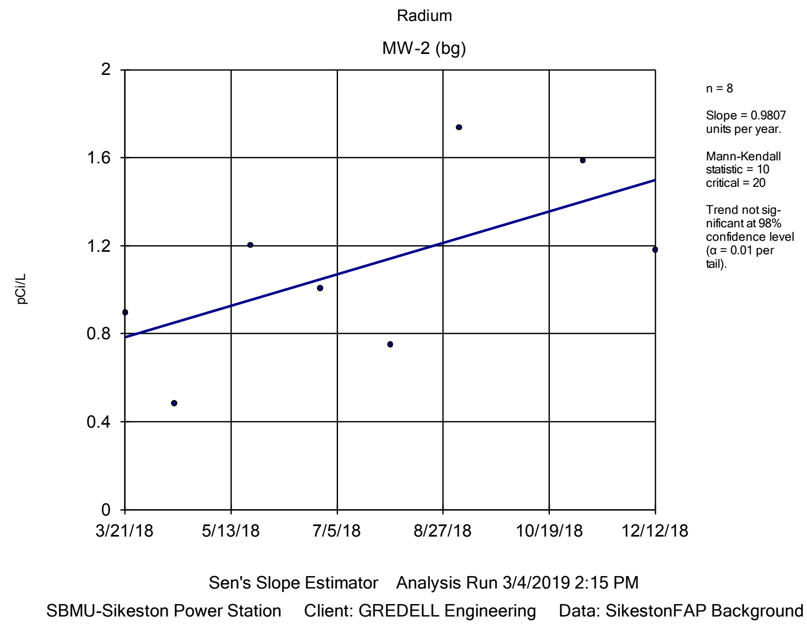
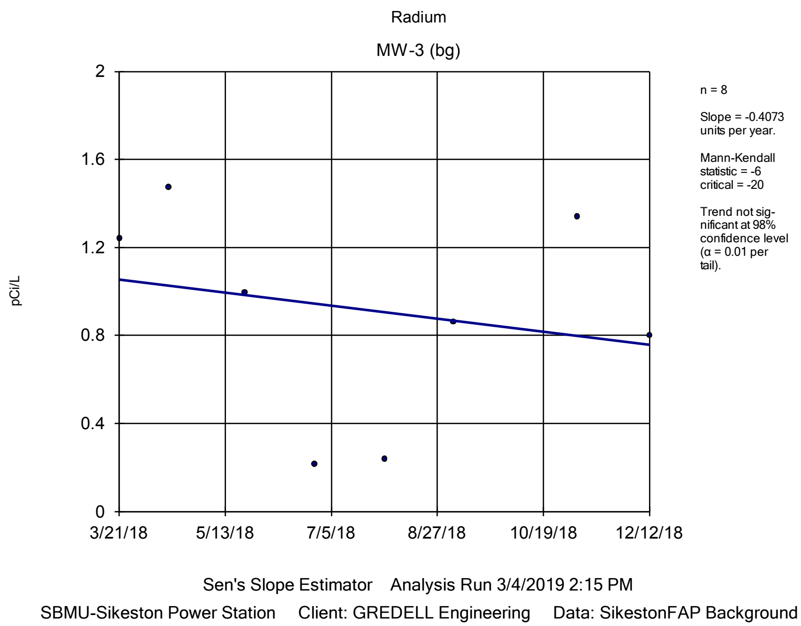
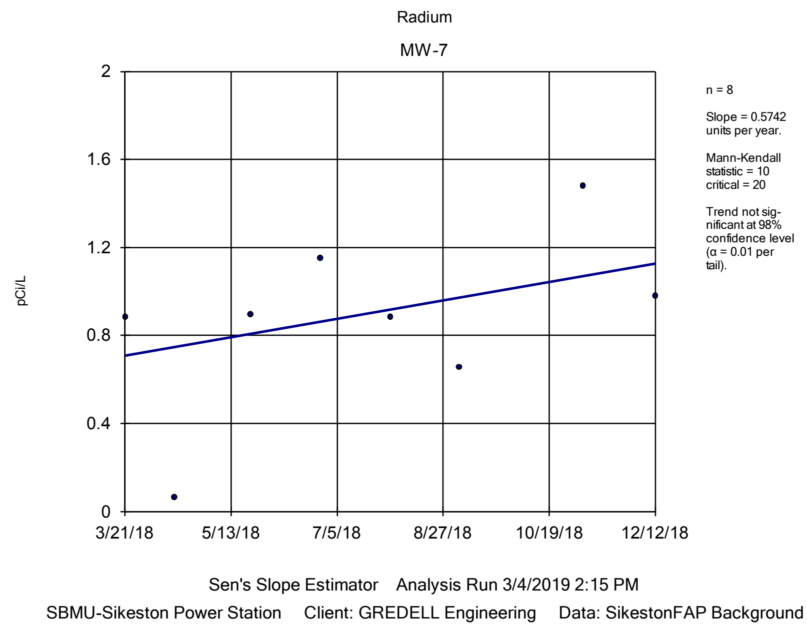


Sen's Slope Estimator   Analysis Run 3/4/2019 2:15 PM
SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background


Radium
MW-1
pCi/L
2
1.6
1.2
0.8
0.4
0
3/21/18
5/13/18
7/5/18
8/27/18
10/19/18
12/12/18
n = 8
Slope = 1.466 units per year.
Mann-Kendall statistic = 24 critical = 20
Increasing trend significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 3/4/2019 2:15 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background


Radium
MW-2 (bg)
pCi/L
2
1.6
1.2
0.8
0.4
0
3/21/18
5/13/18
7/5/18
8/27/18
10/19/18
12/12/18
n = 8
Slope = 0.9807 units per year.
Mann-Kendall statistic = 10 critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 3/4/2019 2:15 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background


Radium
MW-3 (bg)
pCi/L
2
1.6
1.2
0.8
0.4
0
3/21/18
5/13/18
7/5/18
8/27/18
10/19/18
12/12/18
n = 8
Slope = -0.4073 units per year.
Mann-Kendall statistic = -6 critical = -20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 3/4/2019 2:15 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background


Radium
MW-7
pCi/L
2
1.6
1.2
0.8
0.4
0
3/21/18
5/13/18
7/5/18
8/27/18
10/19/18
12/12/18
n = 8
Slope = 0.5742 units per year.
Mann-Kendall statistic = 10 critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 3/4/2019 2:15 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

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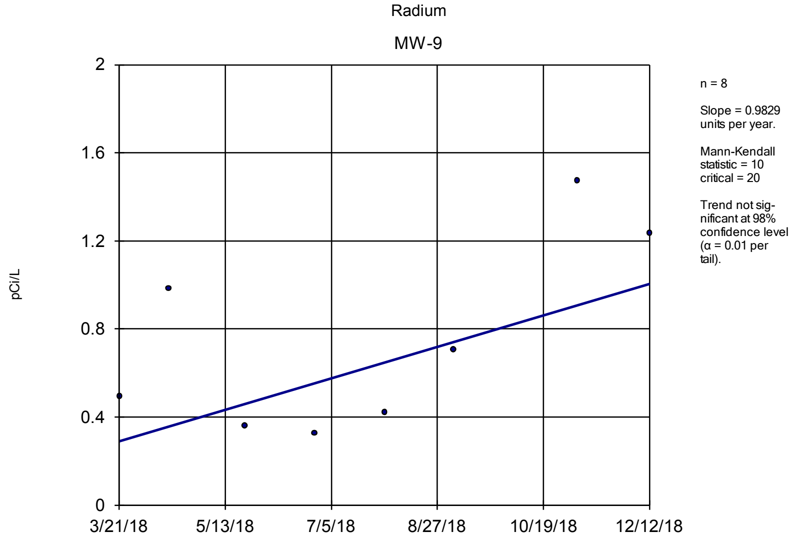
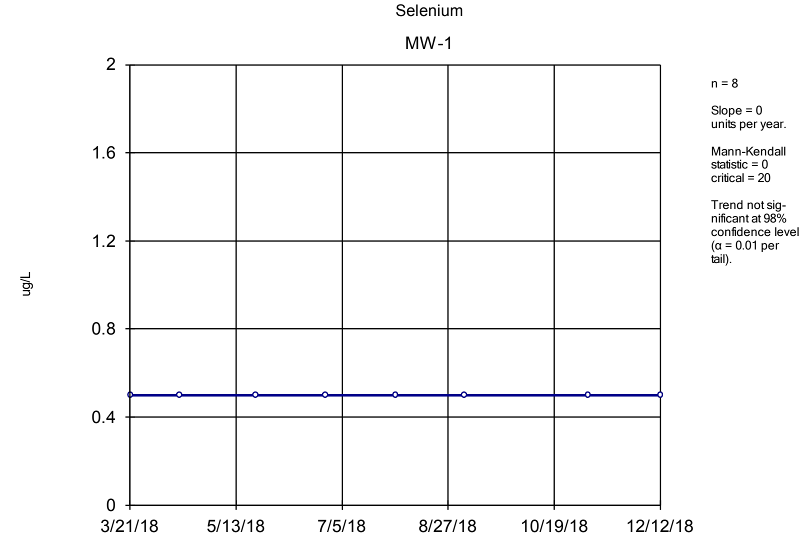


Sen's Slope Estimator Analysis Run 3/4/2019 2:15 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

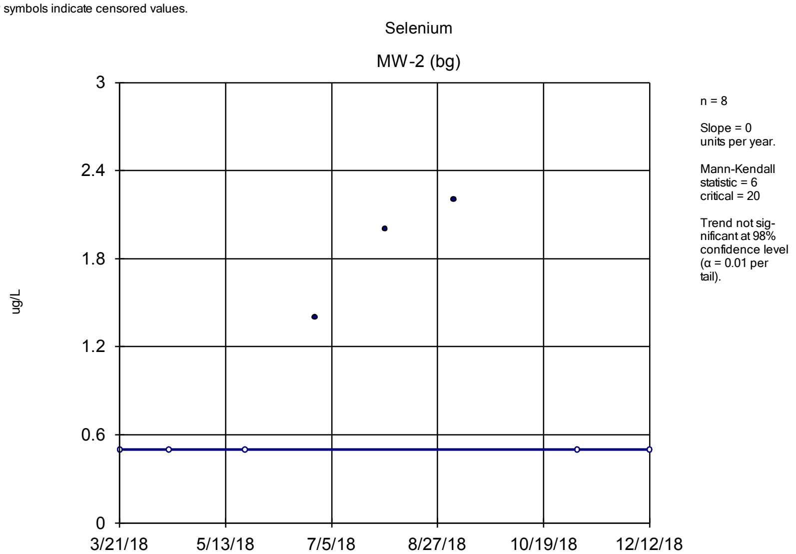
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.



Sen's Slope Estimator Analysis Run 3/4/2019 2:15 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

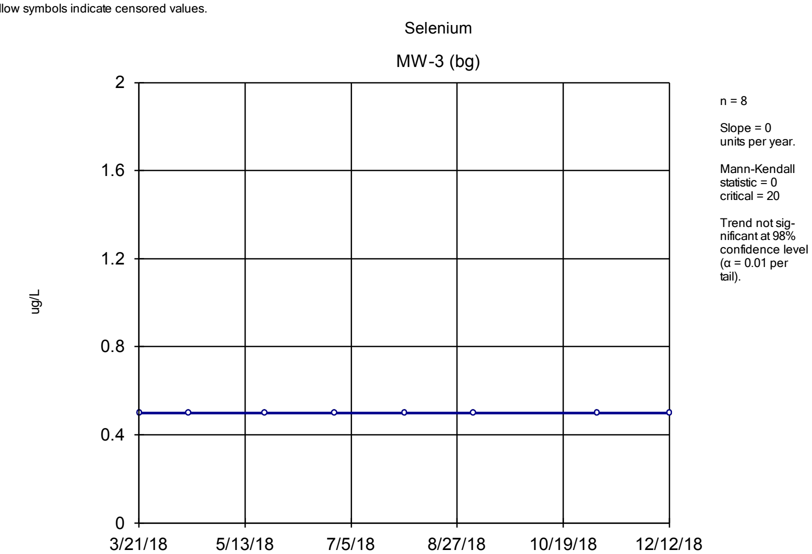
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.



Sen's Slope Estimator Analysis Run 3/4/2019 2:15 PM

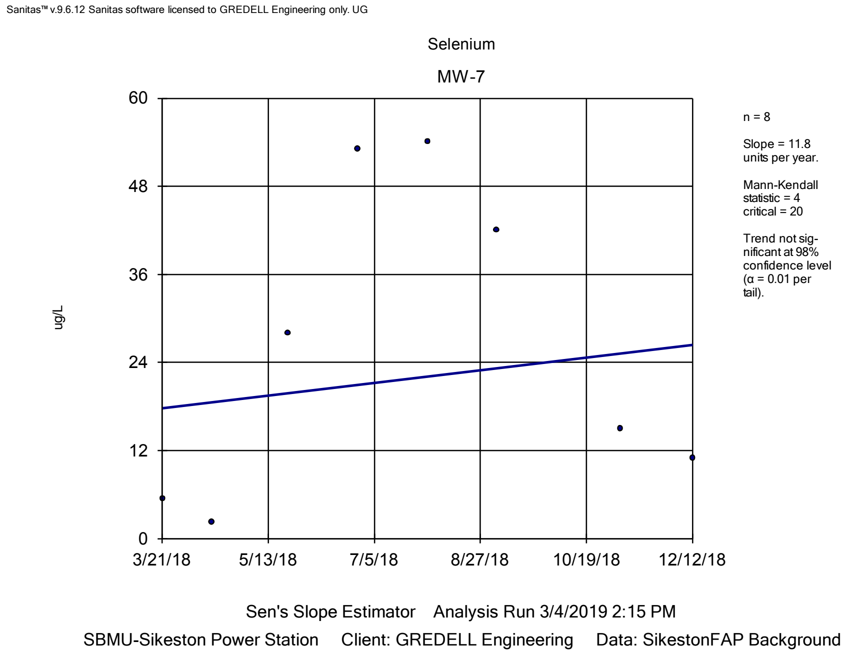
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.

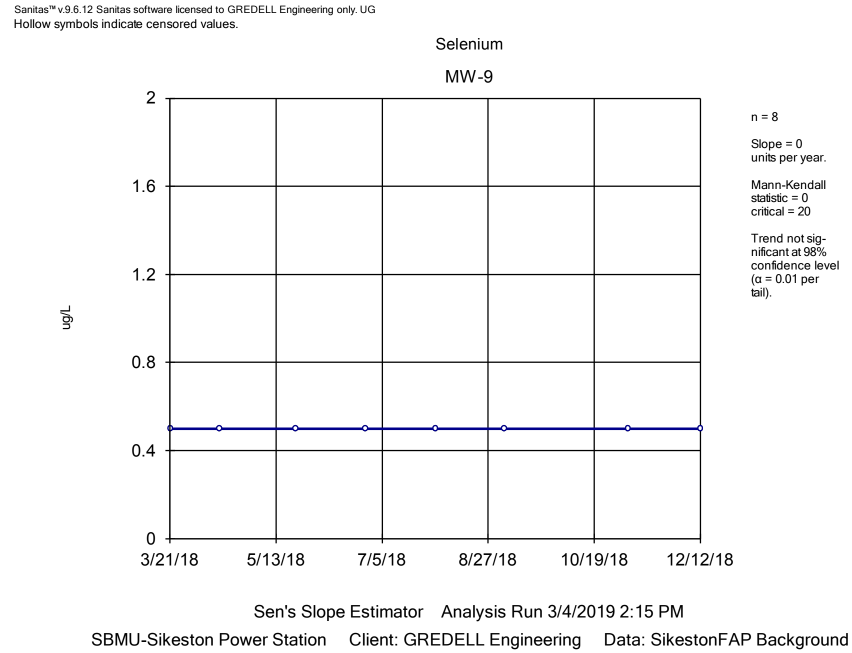


Sen's Slope Estimator Analysis Run 3/4/2019 2:15 PM

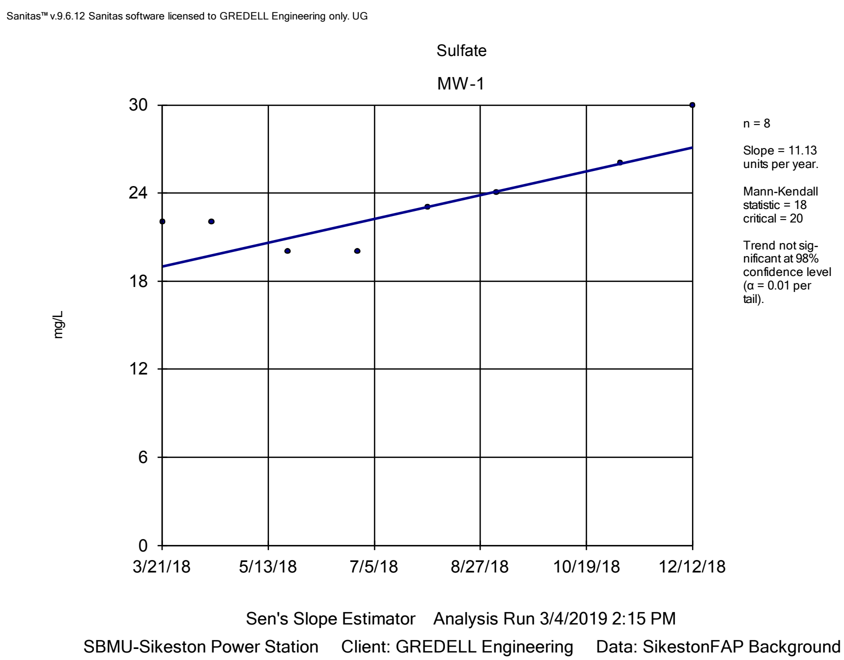
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



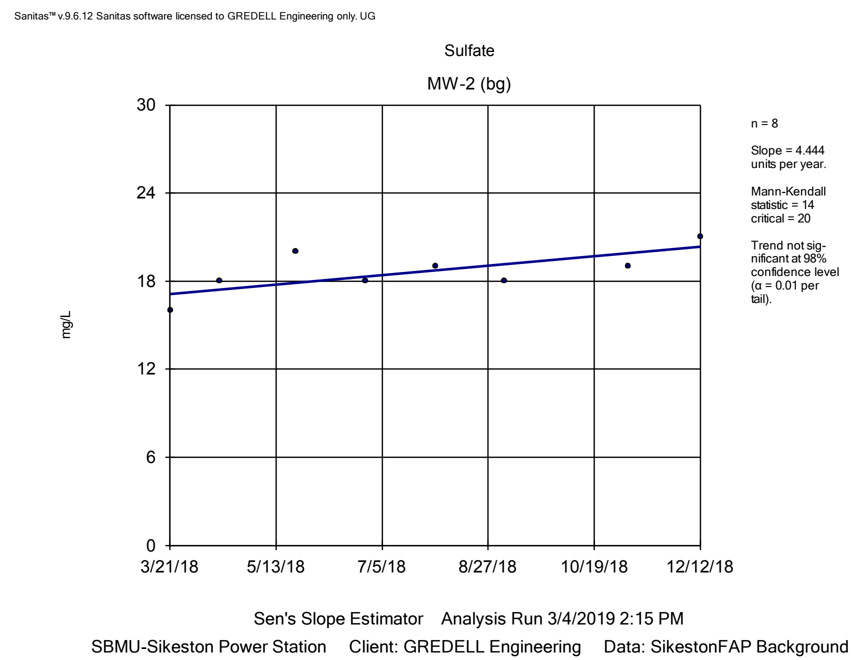
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Selenium
MW-7
ug/L
60
48
36
24
12
0
3/21/18
5/13/18
7/5/18
8/27/18
10/19/18
12/12/18
n = 8
Slope = 11.8
units per year.
Mann-Kendall
statistic = 4
critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 3/4/2019 2:15 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



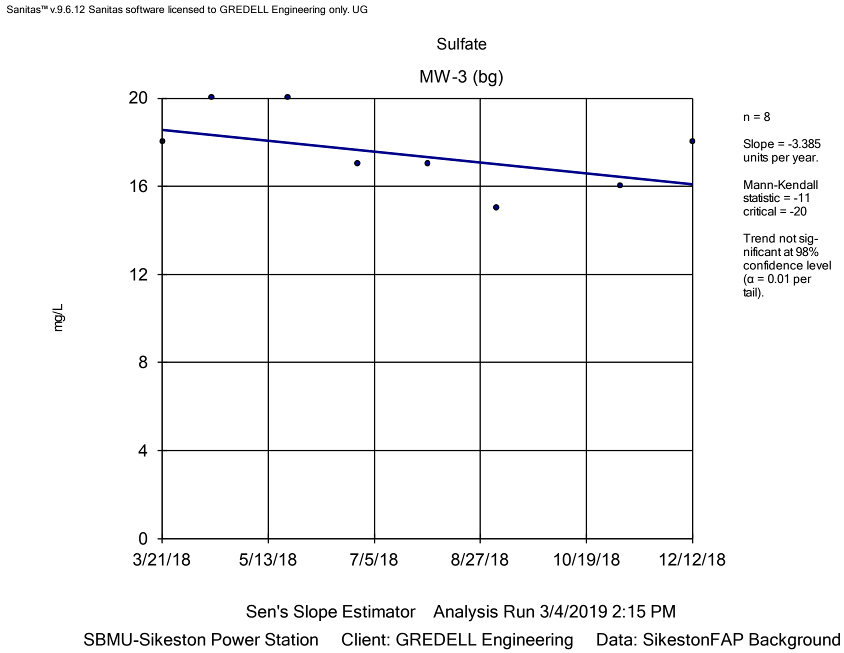
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.
Selenium
MW-9
ug/L
2
1.6
1.2
0.8
0.4
0
3/21/18
5/13/18
7/5/18
8/27/18
10/19/18
12/12/18
n = 8
Slope = 0
units per year.
Mann-Kendall
statistic = 0
critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 3/4/2019 2:15 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



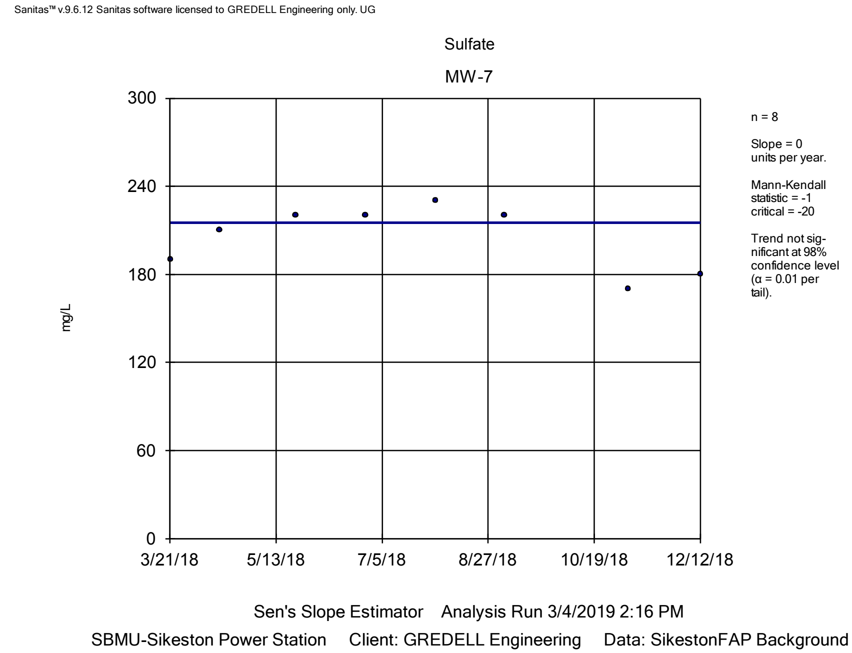
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Sulfate
MW-1
mg/L
30
24
18
12
6
0
3/21/18
5/13/18
7/5/18
8/27/18
10/19/18
12/12/18
n = 8
Slope = 11.13
units per year.
Mann-Kendall
statistic = 18
critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 3/4/2019 2:15 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



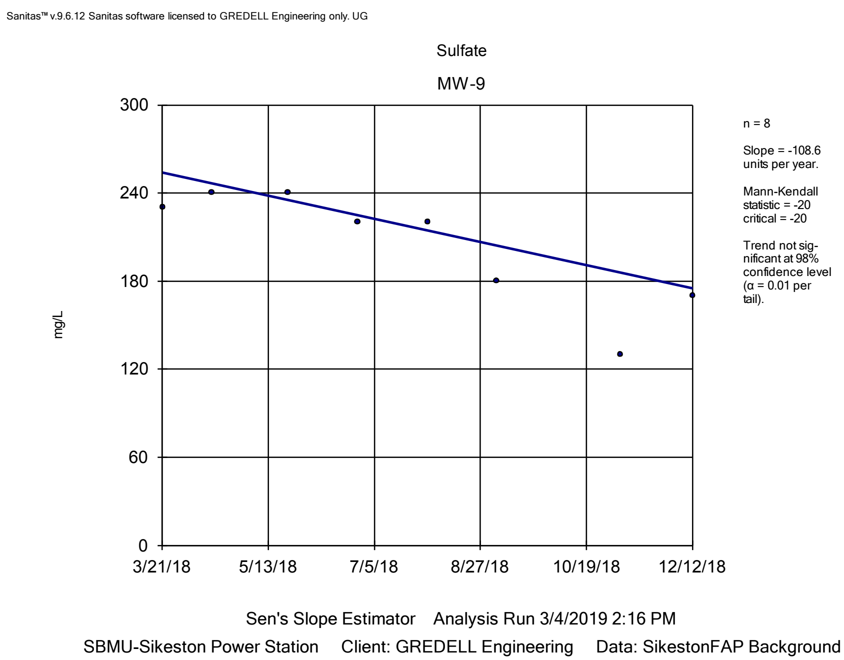
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Sulfate
MW-2 (bg)
mg/L
30
24
18
12
6
0
3/21/18
5/13/18
7/5/18
8/27/18
10/19/18
12/12/18
n = 8
Slope = 4.444
units per year.
Mann-Kendall
statistic = 14
critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 3/4/2019 2:15 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



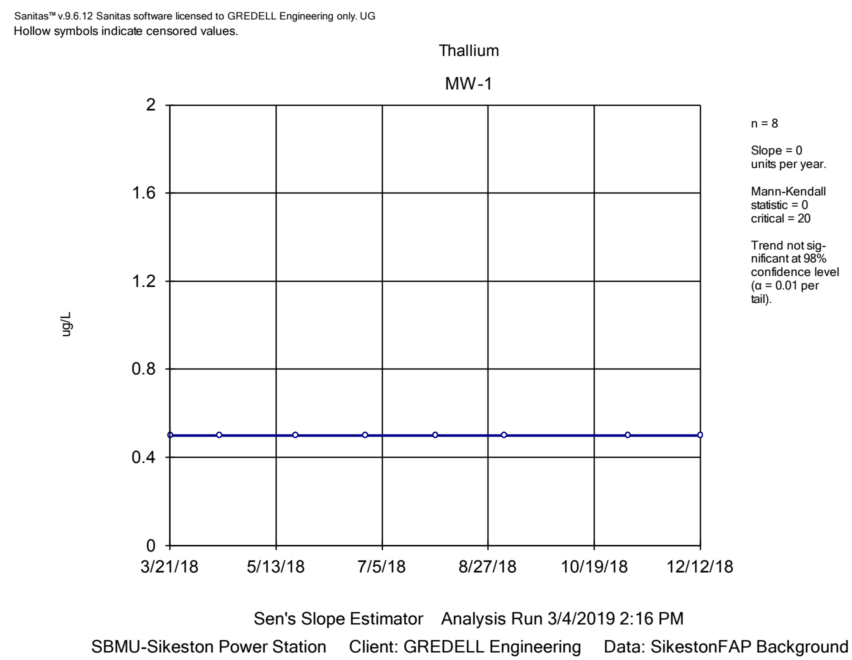
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Sulfate
MW-3 (bg)
mg/L
20
16
12
8
4
0
3/21/18
5/13/18
7/5/18
8/27/18
10/19/18
12/12/18
n = 8
Slope = -3.385 units per year.
Mann-Kendall statistic = -11 critical = -20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 3/4/2019 2:15 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Sulfate
MW-7
mg/L
300
240
180
120
60
0
3/21/18
5/13/18
7/5/18
8/27/18
10/19/18
12/12/18
n = 8
Slope = 0 units per year.
Mann-Kendall statistic = -1 critical = -20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 3/4/2019 2:16 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Sulfate
MW-9
mg/L
300
240
180
120
60
0
3/21/18
5/13/18
7/5/18
8/27/18
10/19/18
12/12/18
n = 8
Slope = -108.6 units per year.
Mann-Kendall statistic = -20 critical = -20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 3/4/2019 2:16 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.
Thallium
MW-1
ug/L
2
1.6
1.2
0.8
0.4
0
3/21/18
5/13/18
7/5/18
8/27/18
10/19/18
12/12/18
n = 8
Slope = 0 units per year.
Mann-Kendall statistic = 0 critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 3/4/2019 2:16 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.

Thallium

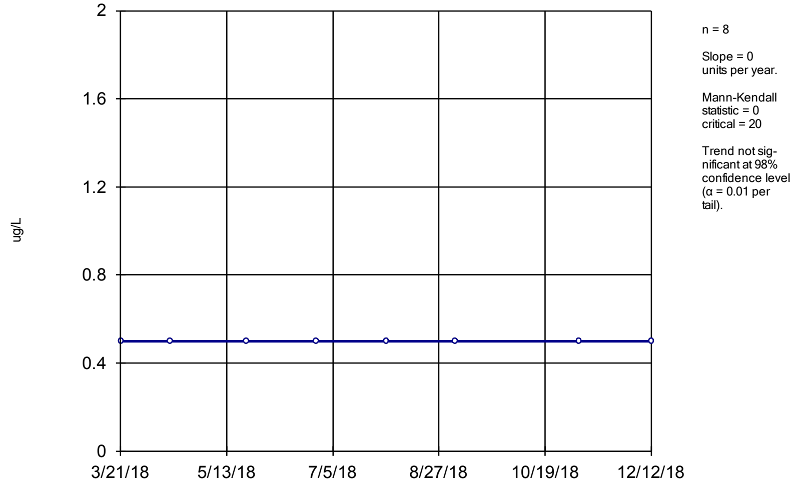
MW-2 (bg)

Sen's Slope Estimator Analysis Run 3/4/2019 2:16 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.

Thallium

MW-3 (bg)

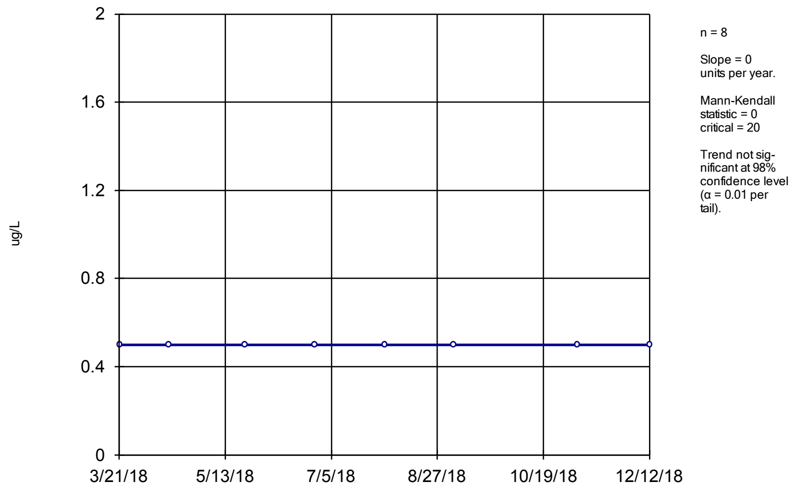


Sen's Slope Estimator Analysis Run 3/4/2019 2:16 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.

Thallium

MW-7

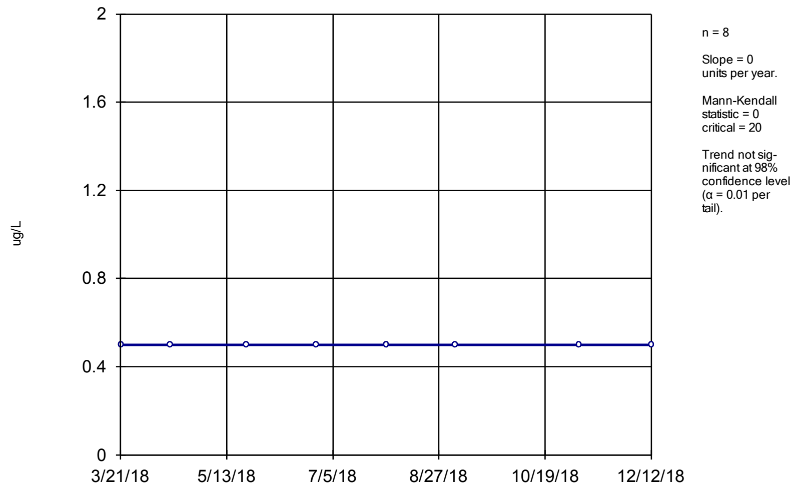


Sen's Slope Estimator Analysis Run 3/4/2019 2:16 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

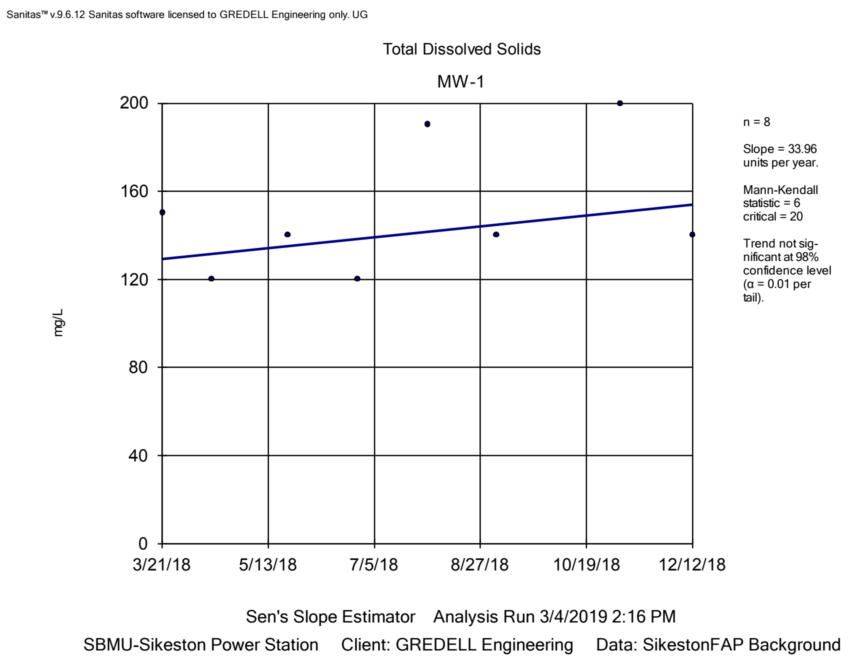
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Hollow symbols indicate censored values.

Thallium

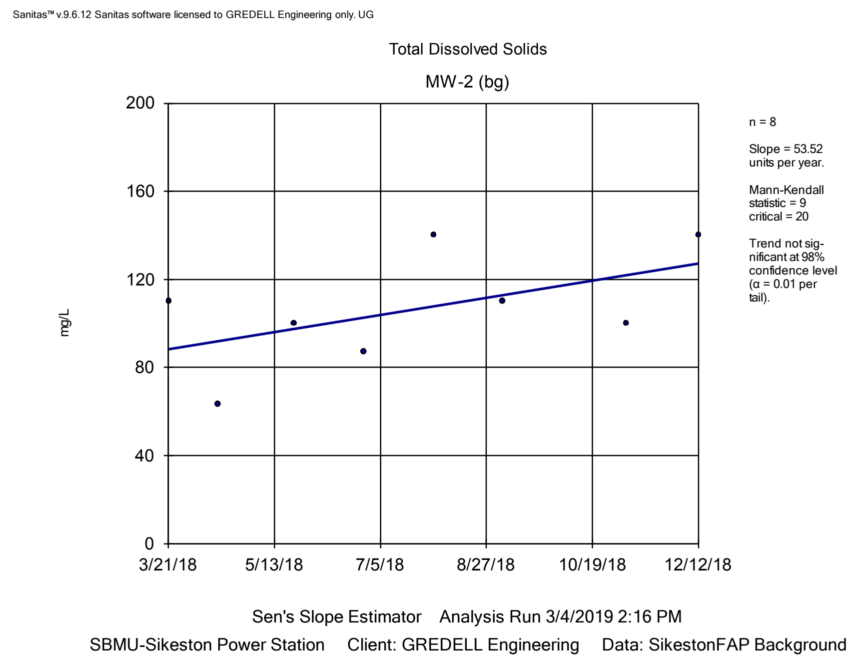
MW-9



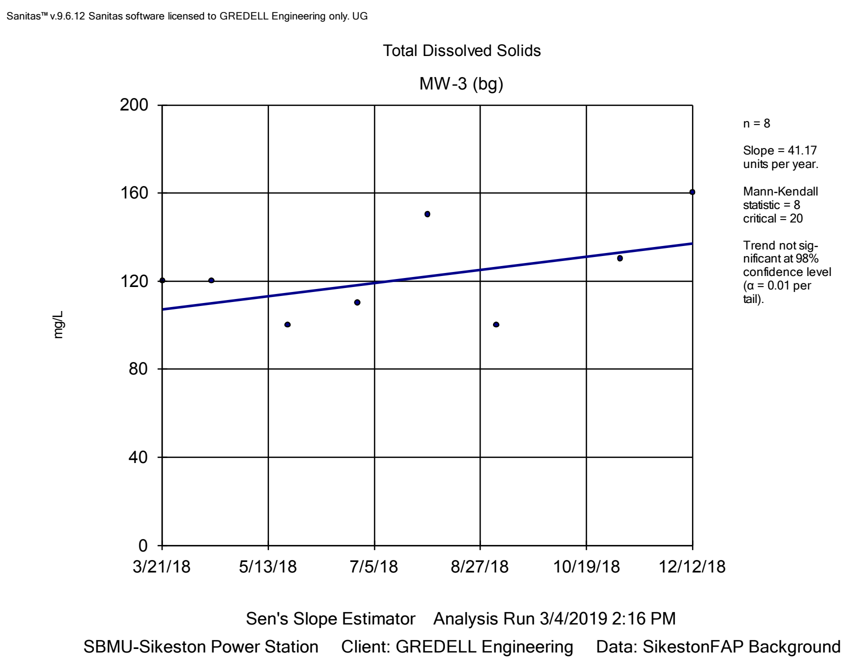
Sen's Slope Estimator Analysis Run 3/4/2019 2:16 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



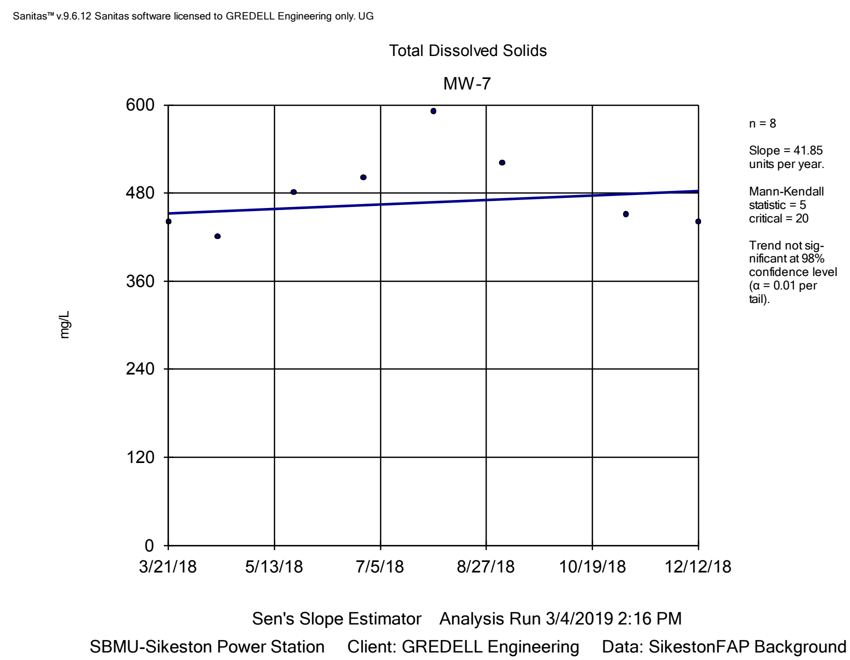
Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Total Dissolved Solids
MW-1
mg/L
200
160
120
80
40
0
3/21/18
5/13/18
7/5/18
8/27/18
10/19/18
12/12/18
n = 8
Slope = 33.96 units per year.
Mann-Kendall statistic = 6 critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 3/4/2019 2:16 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Total Dissolved Solids
MW-2 (bg)
mg/L
200
160
120
80
40
0
3/21/18
5/13/18
7/5/18
8/27/18
10/19/18
12/12/18
n = 8
Slope = 53.52 units per year.
Mann-Kendall statistic = 9 critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 3/4/2019 2:16 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

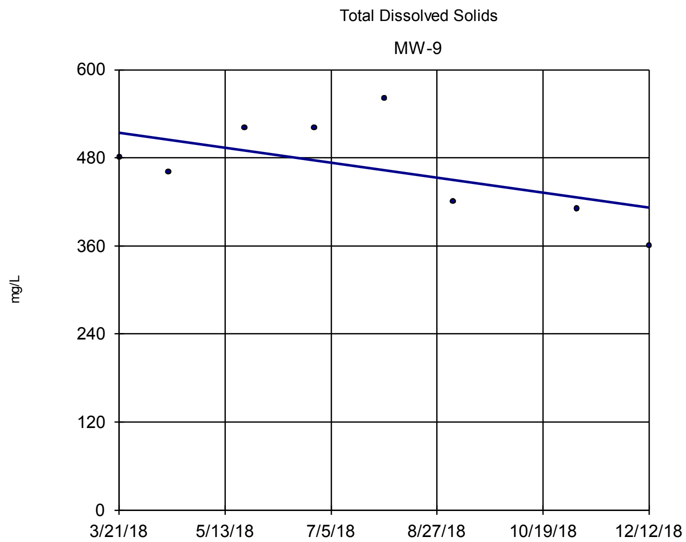


Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Total Dissolved Solids
MW-3 (bg)
mg/L
200
160
120
80
40
0
3/21/18
5/13/18
7/5/18
8/27/18
10/19/18
12/12/18
n = 8
Slope = 41.17 units per year.
Mann-Kendall statistic = 8 critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 3/4/2019 2:16 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background



Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG
Total Dissolved Solids
MW-7
mg/L
600
480
360
240
120
0
3/21/18
5/13/18
7/5/18
8/27/18
10/19/18
12/12/18
n = 8
Slope = 41.85 units per year.
Mann-Kendall statistic = 5 critical = 20
Trend not significant at 98% confidence level (α = 0.01 per tail).
Sen's Slope Estimator Analysis Run 3/4/2019 2:16 PM
SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

Sanitas™ v.9.6.12 Sanitas software licensed to GREDELL Engineering only. UG



n = 8

Slope = -140.9 units per year.

Mann-Kendall statistic = -11 critical = -20

Trend not significant at 98% confidence level (α = 0.01 per tail).

Sen's Slope Estimator   Analysis Run 3/4/2019 2:16 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

Appendix G

Analysis of Variance

Analysis of Variance

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background   Printed 3/4/2019, 2:19 PM

Constituent	Well	Calc.	Crit.	Sig.	Alpha	Transform	ANOVA Sig.	Alpha	Method
Barium (ug/L)	n/a	n/a	n/a	n/a	n/a	No	Yes	0.05	NP (normality)
Boron (ug/L)	n/a	n/a	n/a	n/a	n/a	sqrt(x)	Yes	0.05	Param.
Calcium (mg/L)	n/a	n/a	n/a	n/a	n/a	No	No	0.05	NP (eq. var.)
Chloride (mg/L)	n/a	n/a	n/a	n/a	n/a	No	Yes	0.05	NP (eq. var.)
Cobalt (ug/L)	n/a	n/a	n/a	n/a	n/a	No	No	0.05	NP (NDs)
Fluoride (mg/L)	n/a	n/a	n/a	n/a	n/a	No	No	0.05	Param.
pH (S.U.)	n/a	n/a	n/a	n/a	n/a	x^3	Yes	0.05	Param.
Radium (pCi/L)	n/a	n/a	n/a	n/a	n/a	No	No	0.05	Param.
Selenium (ug/L)	n/a	n/a	n/a	n/a	n/a	No	No	0.05	NP (NDs)
Sulfate (mg/L)	n/a	n/a	n/a	n/a	n/a	No	No	0.05	Param.
Total Dissolved Solids (mg/L)	n/a	n/a	n/a	n/a	n/a	No	No	0.05	Param.

Non-Parametric ANOVA

Constituent: Barium   Analysis Run 3/4/2019 2:19 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

For observations made between 3/21/2018 and 12/12/2018, the non-parametric analysis of variance test indicates a DIFFERENCE between the medians of the groups tested at the 5% significance level. Because the calculated Kruskal-Wallis statistic is greater than the Chi-squared value, we conclude that at least one group has a significantly different median concentration of this constituent when compared to another group.

Calculated Kruskal-Wallis statistic = 11.48

Tabulated Chi-Squared value = 3.841 with 1 degree of freedom at the 5% significance level.

There were 2 groups of ties in the data, consequently the Kruskal-Wallis statistic (H) was adjusted. The adjusted statistic (H') was utilized to determine if the medians were equal.
Kruskal-Wallis statistic (H) = 11.29
Adjusted Kruskal-Wallis statistic (H') = 11.48

Parametric ANOVA

Constituent: Boron   Analysis Run 3/4/2019 2:19 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

For observations made between 3/21/2018 and 12/12/2018 the parametric analysis of variance test (after square root transformation) indicates VARIATION at the 5% significance level. Because the calculated F statistic is greater than the tabulated F statistic, the hypothesis of a single homogeneous population is rejected.

Calculated F statistic = 20.18

Tabulated F statistic = 4.6 with 1 and 14 degrees of freedom at the 5% significance level.

ONE-WAY PARAMETRIC ANOVA TABLE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
Between Groups	1225	1	1225	2.14
Error Within Groups	8013	14	572.4	
Total	9238	15		

The Shapiro Wilk normality test on the residuals passed after square root transformation. Alpha = 0.05, calculated = 0.9114, critical = 0.887. Levene's Equality of Variance test passed. Calculated = 3.119, tabulated = 4.6.

Non-Parametric ANOVA

Constituent: Calcium   Analysis Run 3/4/2019 2:19 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

For observations made between 3/21/2018 and 12/12/2018, the non-parametric analysis of variance test indicates NO DIFFERENCE between the medians of the groups tested at the 5% significance level. Because the calculated Kruskal-Wallis statistic is less than or equal to the Chi-squared value, we conclude that no group has a significantly different median concentration of this constituent when compared to another group.

Calculated Kruskal-Wallis statistic = 1.792

Tabulated Chi-Squared value = 3.841 with 1 degree of freedom at the 5% significance level.

There were 4 groups of ties in the data, consequently the Kruskal-Wallis statistic (H) was adjusted. The adjusted statistic (H') was utilized to determine if the medians were equal.
Kruskal-Wallis statistic (H) = 1.723
Adjusted Kruskal-Wallis statistic (H') = 1.792

Non-Parametric ANOVA

Constituent: Chloride   Analysis Run 3/4/2019 2:19 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

For observations made between 3/21/2018 and 12/12/2018, the non-parametric analysis of variance test indicates a DIFFERENCE between the medians of the groups tested at the 5% significance level. Because the calculated Kruskal-Wallis statistic is greater than the Chi-squared value, we conclude that at least one group has a significantly different median concentration of this constituent when compared to another group.

Calculated Kruskal-Wallis statistic = 11.41

Tabulated Chi-Squared value = 3.841 with 1 degree of freedom at the 5% significance level.

There were 4 groups of ties in the data, consequently the Kruskal-Wallis statistic (H) was adjusted. The adjusted statistic (H') was utilized to determine if the medians were equal.
Kruskal-Wallis statistic (H) = 11.29
Adjusted Kruskal-Wallis statistic (H') = 11.41

Non-Parametric ANOVA

Constituent: Cobalt Analysis Run 3/4/2019 2:19 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

For observations made between 3/21/2018 and 12/12/2018, the non-parametric analysis of variance test indicates NO DIFFERENCE between the medians of the groups tested at the 5% significance level. Because the calculated Kruskal-Wallis statistic is less than or equal to the Chi-squared value, we conclude that no group has a significantly different median concentration of this constituent when compared to another group.

Calculated Kruskal-Wallis statistic = 1

Tabulated Chi-Squared value = 3.841 with 1 degree of freedom at the 5% significance level.

There were 1 groups of ties in the data, consequently the Kruskal-Wallis statistic (H) was adjusted. The adjusted statistic (H') was utilized to determine if the medians were equal.
Kruskal-Wallis statistic (H) = 0.1765
Adjusted Kruskal-Wallis statistic (H') = 1

Parametric ANOVA

Constituent: Fluoride   Analysis Run 3/4/2019 2:19 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

For observations made between 3/21/2018 and 12/12/2018 the parametric analysis of variance test indicates NO VARIATION at the 5% significance level. Because the calculated F statistic is less than or equal to the tabulated F statistic, the hypothesis of a single homogeneous population is accepted.

Calculated F statistic = 1.669

Tabulated F statistic = 4.6 with 1 and 14 degrees of freedom at the 5% significance level.

ONE-WAY PARAMETRIC ANOVA TABLE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
Between Groups	1225	1	1225	2.14
Error Within Groups	8013	14	572.4	
Total	9238	15		

The Shapiro Wilk normality test on the residuals passed on the raw data. Alpha = 0.05, calculated = 0.8948, critical = 0.887. Levene's Equality of Variance test passed. Calculated = 0.8809, tabulated = 4.6.

Parametric ANOVA

Constituent: pH Analysis Run 3/4/2019 2:19 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

For observations made between 3/21/2018 and 12/12/2018 the parametric analysis of variance test (after cube transformation) indicates VARIATION at the 5% significance level. Because the calculated F statistic is greater than the tabulated F statistic, the hypothesis of a single homogeneous population is rejected.

Calculated F statistic = 65.08

Tabulated F statistic = 4.6 with 1 and 14 degrees of freedom at the 5% significance level.

ONE-WAY PARAMETRIC ANOVA TABLE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
Between Groups	1225	1	1225	2.14
Error Within Groups	8013	14	572.4	
Total	9238	15		

The Shapiro Wilk normality test on the residuals passed after cube transformation. Alpha = 0.05, calculated = 0.8921, critical = 0.887. Levene's Equality of Variance test passed. Calculated = 4.508, tabulated = 4.6.

Parametric ANOVA

Constituent: Radium   Analysis Run 3/4/2019 2:19 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

For observations made between 3/21/2018 and 12/12/2018 the parametric analysis of variance test indicates NO VARIATION at the 5% significance level. Because the calculated F statistic is less than or equal to the tabulated F statistic, the hypothesis of a single homogeneous population is accepted.

Calculated F statistic = 0.8819

Tabulated F statistic = 4.6 with 1 and 14 degrees of freedom at the 5% significance level.

ONE-WAY PARAMETRIC ANOVA TABLE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
Between Groups	1225	1	1225	2.14
Error Within Groups	8013	14	572.4	
Total	9238	15		

The Shapiro Wilk normality test on the residuals passed on the raw data. Alpha = 0.05, calculated = 0.9408, critical = 0.887. Levene's Equality of Variance test passed. Calculated = 0.1408, tabulated = 4.6.

Non-Parametric ANOVA

Constituent: Selenium Analysis Run 3/4/2019 2:19 PM

SBMU-Sikeston Power Station Client: GREDELL Engineering Data: SikestonFAP Background

For observations made between 3/21/2018 and 12/12/2018, the non-parametric analysis of variance test indicates NO DIFFERENCE between the medians of the groups tested at the 5% significance level. Because the calculated Kruskal-Wallis statistic is less than or equal to the Chi-squared value, we conclude that no group has a significantly different median concentration of this constituent when compared to another group.

Calculated Kruskal-Wallis statistic = 3.418

Tabulated Chi-Squared value = 3.841 with 1 degree of freedom at the 5% significance level.

There were 1 groups of ties in the data, consequently the Kruskal-Wallis statistic (H) was adjusted. The adjusted statistic (H') was utilized to determine if the medians were equal.
Kruskal-Wallis statistic (H) = 1.588
Adjusted Kruskal-Wallis statistic (H') = 3.418

Parametric ANOVA

Constituent: Sulfate   Analysis Run 3/4/2019 2:19 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

For observations made between 3/21/2018 and 12/12/2018 the parametric analysis of variance test indicates NO VARIATION at the 5% significance level. Because the calculated F statistic is less than or equal to the tabulated F statistic, the hypothesis of a single homogeneous population is accepted.

Calculated F statistic = 1.483

Tabulated F statistic = 4.6 with 1 and 14 degrees of freedom at the 5% significance level.

ONE-WAY PARAMETRIC ANOVA TABLE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
Between Groups	1225	1	1225	2.14
Error Within Groups	8013	14	572.4	
Total	9238	15		

The Shapiro Wilk normality test on the residuals passed on the raw data. Alpha = 0.05, calculated = 0.92, critical = 0.887. Levene's Equality of Variance test passed. Calculated = 0.28, tabulated = 4.6.

Parametric ANOVA

Constituent: Total Dissolved Solids   Analysis Run 3/4/2019 2:19 PM

SBMU-Sikeston Power Station   Client: GREDELL Engineering   Data: SikestonFAP Background

For observations made between 3/21/2018 and 12/12/2018 the parametric analysis of variance test indicates NO VARIATION at the 5% significance level. Because the calculated F statistic is less than or equal to the tabulated F statistic, the hypothesis of a single homogeneous population is accepted.

Calculated F statistic = 2.14

Tabulated F statistic = 4.6 with 1 and 14 degrees of freedom at the 5% significance level.

ONE-WAY PARAMETRIC ANOVA TABLE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
Between Groups	1225	1	1225	2.14
Error Within Groups	8013	14	572.4	
Total	9238	15		

The Shapiro Wilk normality test on the residuals passed on the raw data. Alpha = 0.05, calculated = 0.9429, critical = 0.887. Levene's Equality of Variance test passed. Calculated = 0.04819, tabulated = 4.6.

ATTACHMENT D6 – 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	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-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 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-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

Appendix 6
Prepared by: KAE
Checked by: MCC

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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

STATE OF MISSOURI
THOMAS R. GREDELL
08-06-2020
NUMBER PE-021137
PROFESSIONAL ENGINEER

STATE OF MISSOURI
MIKEL C. CARLSON
8-6-20
RG 0126
REGISTERED GEOLOGIST

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

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

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

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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:

- <u>February 18, 2020:</u> 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.
- <u>March 30, 2020:</u> 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%).

<u>April 8, 2020:</u> 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.

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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.

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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

N

SCALE: 1" = 500'
0 250 500

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

BOTTOM ASH POND GROUNDWATER MONITORING WELL SYSTEM

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

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

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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

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

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

REPORT OF LABORATORY ANALYSIS

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

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

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

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:

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

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:

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

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.

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

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) 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) 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) 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) 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) 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) 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) 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) 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) 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) C:74% T:88%**	pCi/L	03/10/20 14:47	15262-20-1	

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

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) 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) 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) 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) 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	

REPORT OF LABORATORY ANALYSIS

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

QUALITY CONTROL - RADIOCHEMISTRY

Project: 0023536
Pace Project No.: 30351798

QC Batch: 385636 Analysis Method: EPA 903.1
QC Batch 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.

REPORT OF LABORATORY ANALYSIS

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

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.

REPORT OF LABORATORY ANALYSIS

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

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

SUBCONTRACT ORDER
Transfer Chain of Custody

PDC Laboratories, Inc.

0023536

WO# : 30351798

30351798

SENDING LABORATORY	**RECEIVING LABORATORY**
PDC Laboratories, Inc. 2231 W Altorfer Dr Peoria, IL 61615 (800) 752-6651	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	**RECEIVING LABORATORY**
PDC Laboratories, Inc. 2231 W Altorfer Dr Peoria, IL 61615 (800) 752-6651	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 #: L41026

Turn-Around Time Requested [x] NORMAL [ ] RUSH Date Results Needed: ______

Relinquished By	Date/Time	Received By	Date/Time
[signature]	2-21-20 11:30	[signature]	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 #: 7778 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.	✓			16. pH < 2
exceptions: VOA, coliform, TOC, O&G, Phenolics, Radon, Non-aqueous matrix				
All containers meet method preservation requirements.	✓			Initial when completed: NG Date/time of preservation:
				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 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.

PDC LABORATORIES, INC.
WWW.PDCLAB.COM

REGULATORY PROGRAM (CIRCLE):	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 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: [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 # 0023536-7
LOGGED BY: [initials]
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)
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 02-19-20 TIME 0830		DATE TIME
RELINQUISHED BY: (SIGNATURE)	DATE TIME	RECEIVED BY: (SIGNATURE)	DATE TIME
RELINQUISHED BY: (SIGNATURE)	DATE TIME	RECEIVED BY: (SIGNATURE) [signature]	DATE 2/20/20 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 (Y circled)
SAMPLE(S) RECEIVED ON ICE Y OR N (Y circled)
SAMPLE ACCEPTANCE NONCONFORMANT REPORT IS NEEDED Y OR N (N circled)
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
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

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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:  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
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 # 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)	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
Ashton Fader	DATE 3-31-2020 TIME 0730		DATE TIME
RELINQUISHED BY: (SIGNATURE)	DATE TIME	RECEIVED BY: (SIGNATURE)	DATE TIME
RELINQUISHED BY: (SIGNATURE)	DATE TIME	RECEIVED BY: (SIGNATURE) [signature]	DATE 4/1/20 TIME 1100

(8) COMMENTS: (FOR LAB USE ONLY)
SAMPLE TEMPERATURE UPON RECEIPT 1.7 °C
CHILL PROCESS STARTED PRIOR TO RECEIPT Y OR N (Y circled)
SAMPLE(S) RECEIVED ON ICE Y OR N (Y circled)
SAMPLE ACCEPTANCE NONCONFORMANT REPORT IS NEEDED Y OR N (N circled)
DATE AND TIME TAKEN FROM SAMPLE BOTTLE ______

Appendix 3

Laboratory Analytical Results and
Quality Control Reports – April 2020

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

ACCREDITED IN ACCORDANCE WITH nelac

DATA PACKAGE

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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: 

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	PROJECT NUMBER	PROJECT LOCATION	PURCHASE ORDER #
SIKESTON BMU POWER STATION		BOTTOM ASH TDS ONLY	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		MATRIX TYPES: WW- WASTEWATER, DW- DRINKING WATER, GW- GROUND WATER, WWSL- SLUDGE, NAS- NON AQUEOUS SOLID, LCHT-LEACHATE, OIL-OIL, SO-SOIL, SOL-SOLID
CONTACT PERSON: LUKE ST MARY	SAMPLER'S SIGNATURE: [signature]		

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 / TIME	RECEIVED BY: (SIGNATURE)	DATE / TIME
[signature]	DATE 4-9-2020 TIME 0800		DATE TIME
RELINQUISHED BY: (SIGNATURE)	DATE TIME	RECEIVED BY: (SIGNATURE)	DATE TIME
RELINQUISHED BY: (SIGNATURE)	DATE TIME	RECEIVED BY: (SIGNATURE) [signature]	DATE 4/10/20 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 ____________

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																

Appendix 6
Prepared by: KAE
Checked by: MCC

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.

Appendix 6
Prepared by: KAE
Checked by: MCC

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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:

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

<u>40 CFR 257.94(e)(2) Alternate Source Demonstration</u>

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: ____________________

Date: 9-11-2020

Registration Number: PE-021137
State of Registration: Missouri

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

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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™ 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.

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Figures

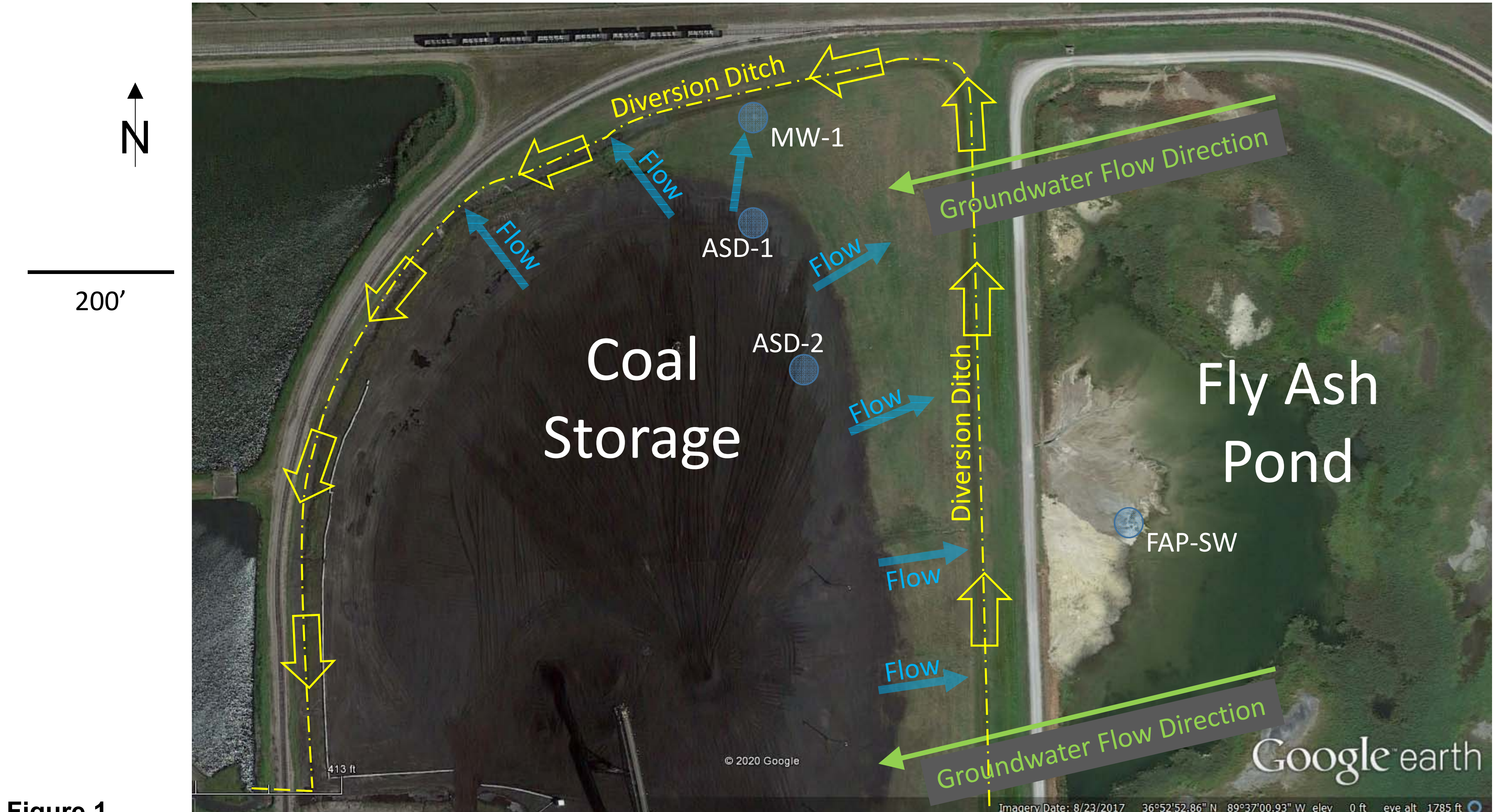


Figure 1
Site Map and Sampling Locations

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.

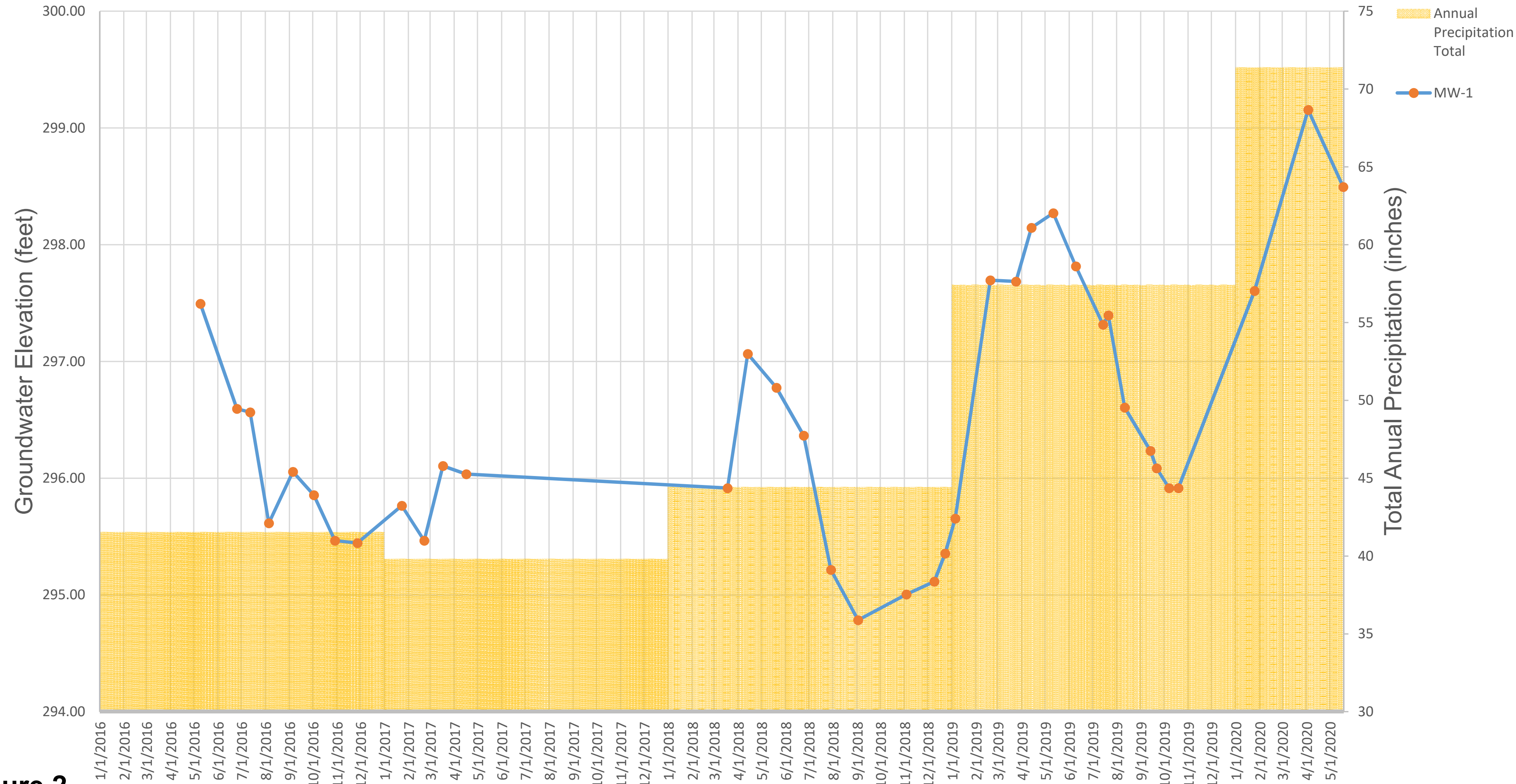


Figure 2
MW-1 Hydrograph and Annual Precipitation

Prepared by: GREDELL Engineering Resources, Inc.

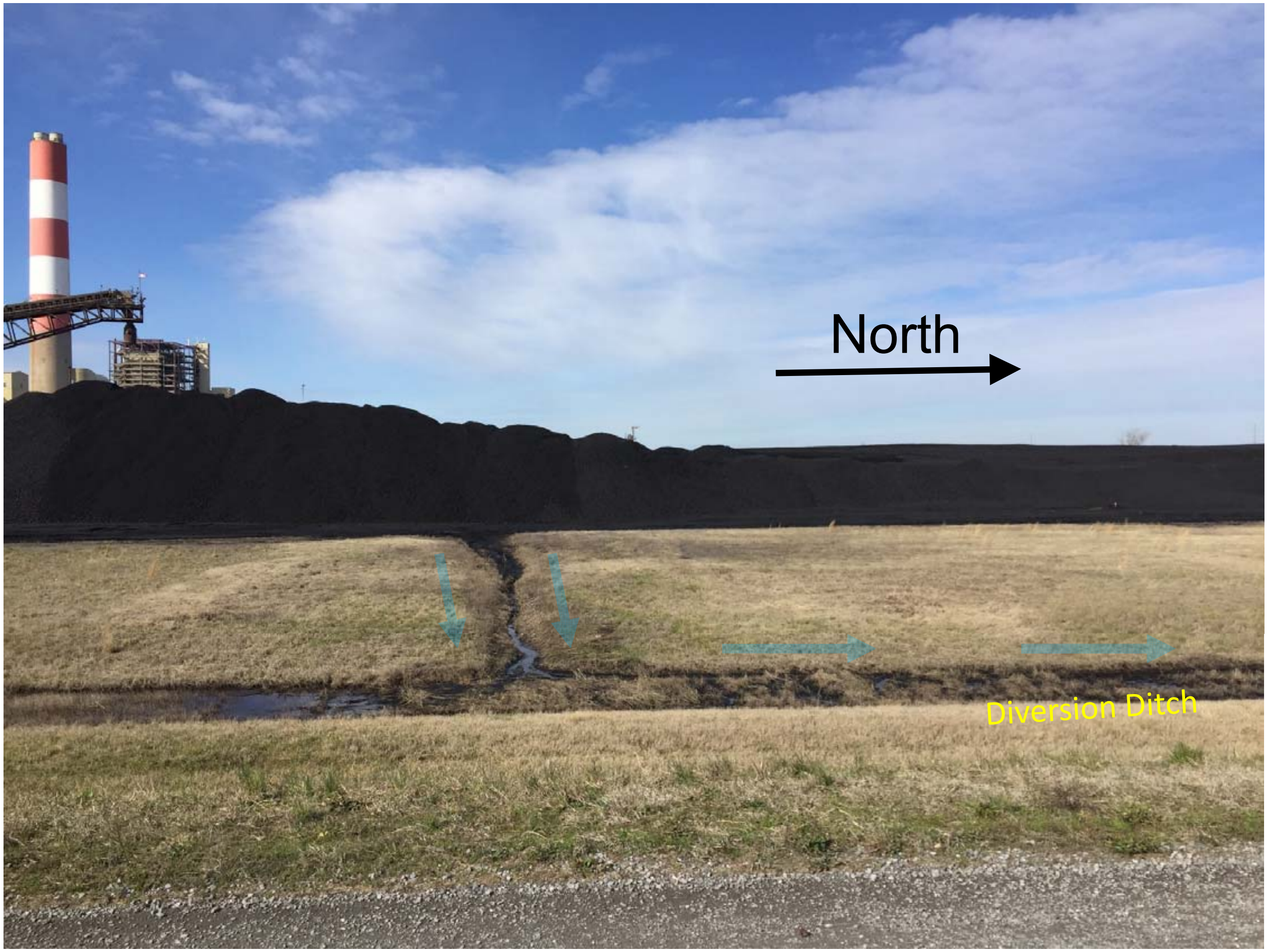


Figure 3
Diversion Ditch Photo February 2020 - Looking West

Prepared by: GREDELL Engineering Resources, Inc.

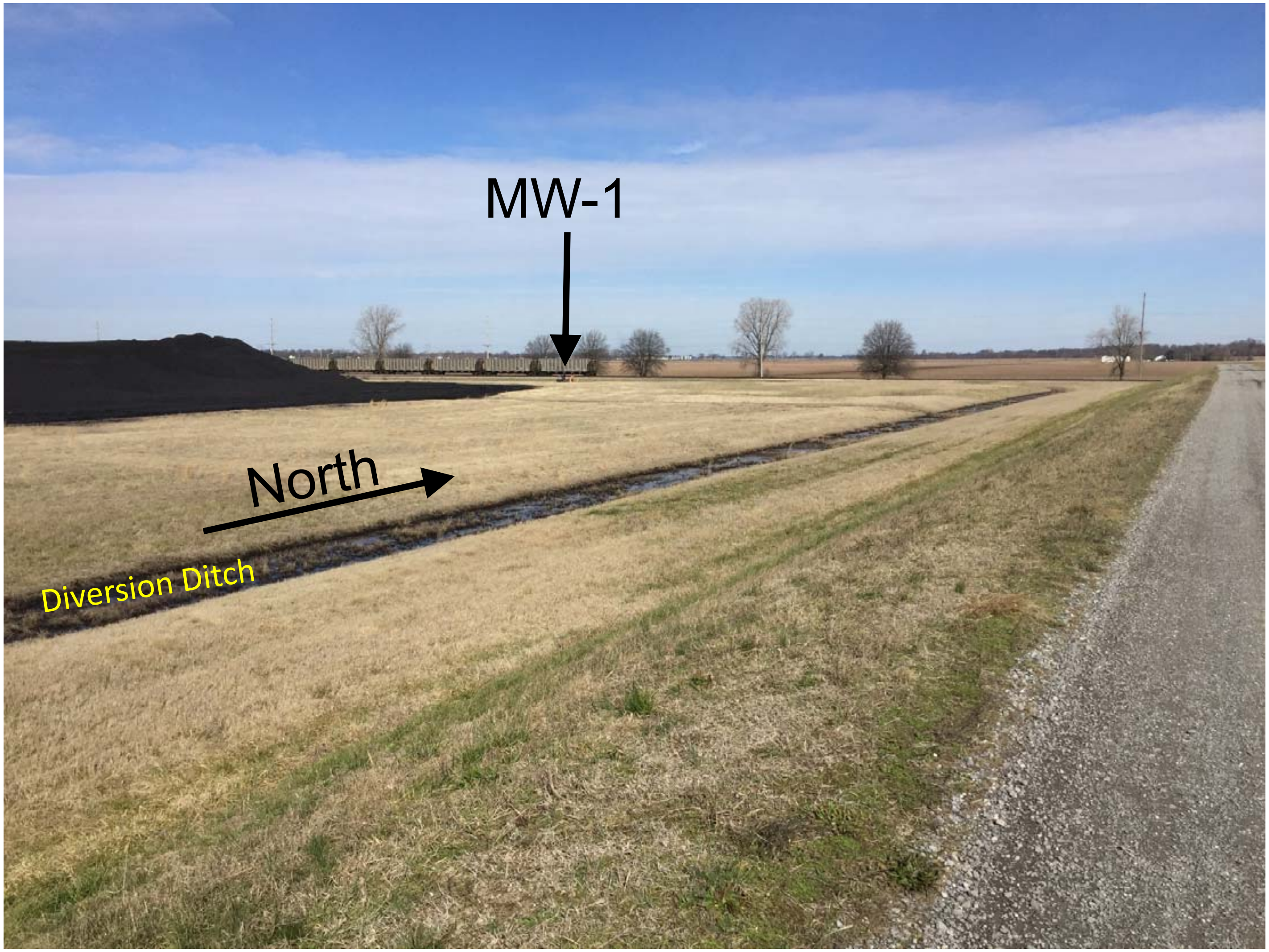
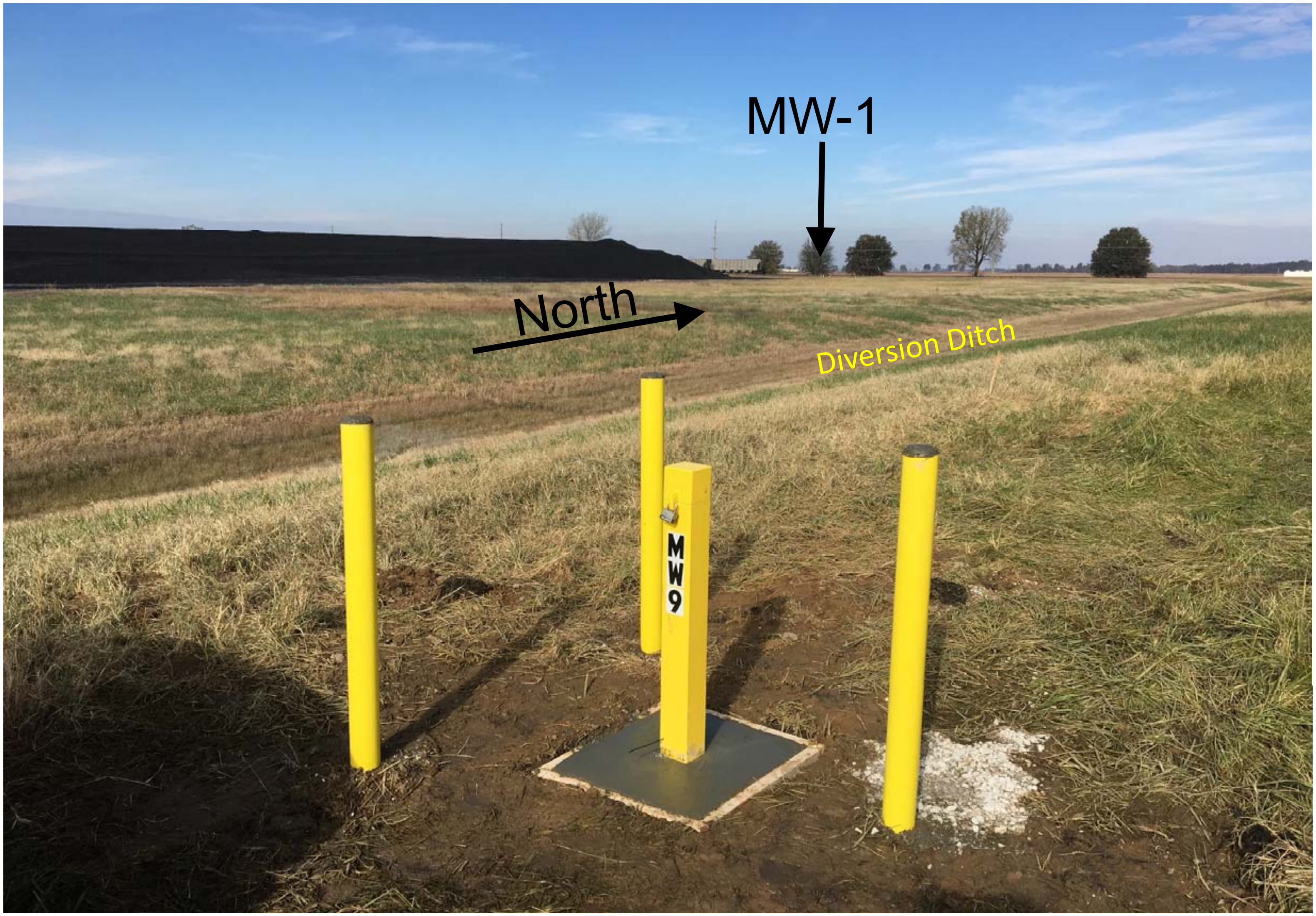


Figure 4
Diversion Ditch Photo February 2020 - Looking Northwest

Prepared by: GREDELL Engineering Resources, Inc.



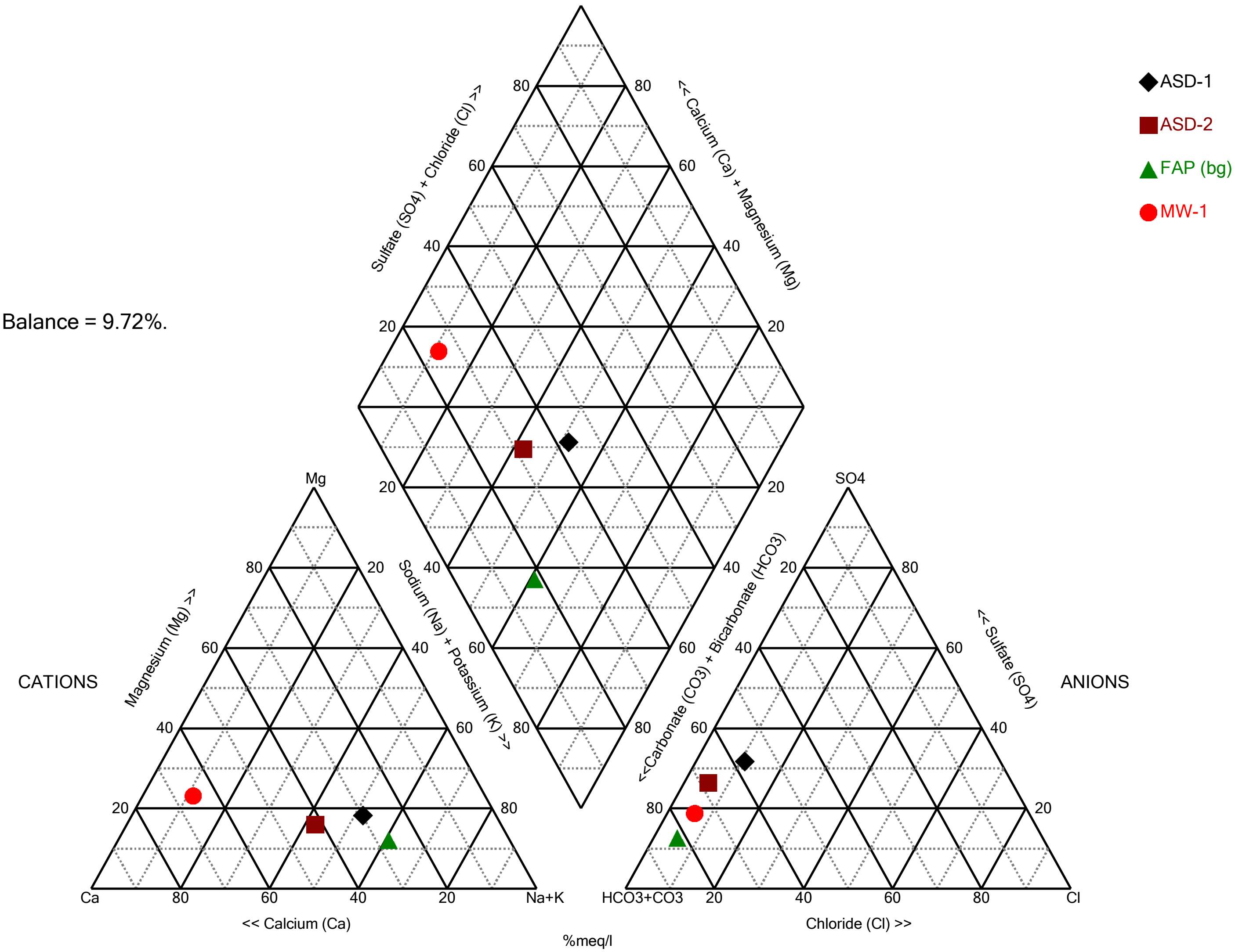
11-13-2017

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

Cation-Anion Balance = 9.72%.



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.

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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

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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: [signature]

Date: 9-11-2020

Registration Number: PE-021137
State of Registration: Missouri

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

Sikeston Board of Municipal Utilities
Sikeston Power Station
Detection Monitoring Program for
Fly Ash Pond - Fluoride in MW-2
Alternate Source Demonstration
September 2020

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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.

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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

N

SCALE: 1" = 400'

0 200 400

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:\CADDFiles\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.

Prepared by: GREDELL Engineering Resources, Inc.

Prepared by: KAE
Checked by: MCC

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:

(yellow)	Maximum groundwater elevation.
(blue)	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: GREDELL Engineering Resources, Inc.

Prepared by: KAE
Checked by: MCC

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.

Appendices

Appendix 1a

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

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.

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

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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:  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	PROJECT NUMBER	PROJECT LOCATION	PURCHASE ORDER #
SIKESTON BMU POWER STATION		FLYASH APP III ONLY	23574
ADDRESS	PHONE NUMBER	E-MAIL	DATE SHIPPED
1551 W WAKEFIELD	573.475.3131	LSTMARY@SBMU.NET	4-7-2020
CITY STATE ZIP	SAMPLER (PLEASE PRINT)		MATRIX TYPES:
SIKESTON, MO 63801	Daniel Dillingham		WW- WASTEWATER DW- DRINKING WATER GW- GROUND WATER WWSL- SLUDGE NAS- NON AQUEOUS SOLID LCHT-LEACHATE OIL-OIL SO-SOIL SOL-SOLID
CONTACT PERSON	SAMPLER'S SIGNATURE		
LUKE ST MARY	Daniel a. Dillingham		

3 ANALYSIS REQUESTED

4 (FOR LAB USE ONLY)
LOGIN # 0048811
LOGGED BY: [signature]
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: 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
[signature]	DATE 4-7-2020 TIME 0730		DATE TIME
RELINQUISHED BY: (SIGNATURE)	DATE TIME	RECEIVED BY: (SIGNATURE)	DATE TIME
RELINQUISHED BY: (SIGNATURE)	DATE TIME	RECEIVED BY: (SIGNATURE) [signature]	DATE 4/8/20 TIME [illegible]

8 COMMENTS: (FOR LAB USE ONLY)

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

Page 11 of 11

Appendix 1b

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

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

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
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

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
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

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
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

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
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

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
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

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Illinois Department of Public Health Bacterial Analysis in Drinking Water Approved Laboratory Registry No. 17553
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Wastewater Certifications/Accreditations: Arkansas (88-0677); Iowa (240); Kansas (E-10338)
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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.

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

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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 Stepping (signed)   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: 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 # 054242
LOGGED BY: [signature]
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)

SAMPLE DESCRIPTION	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) (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) Ashish Patel — DATE 5-22-2020 TIME 0700 — RECEIVED BY: (SIGNATURE) — DATE — TIME
RELINQUISHED BY: (SIGNATURE) — DATE — TIME — RECEIVED BY: (SIGNATURE) — DATE — TIME
RELINQUISHED BY: (SIGNATURE) — DATE — TIME — RECEIVED BY: (SIGNATURE) [signature] — DATE 5/26/20 — 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 ________

Page 10 of 10

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 informaciön 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.

Appendix 3a

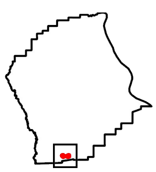
2020 Sikeston Public Well
Assessment Reports (CARES)

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	 

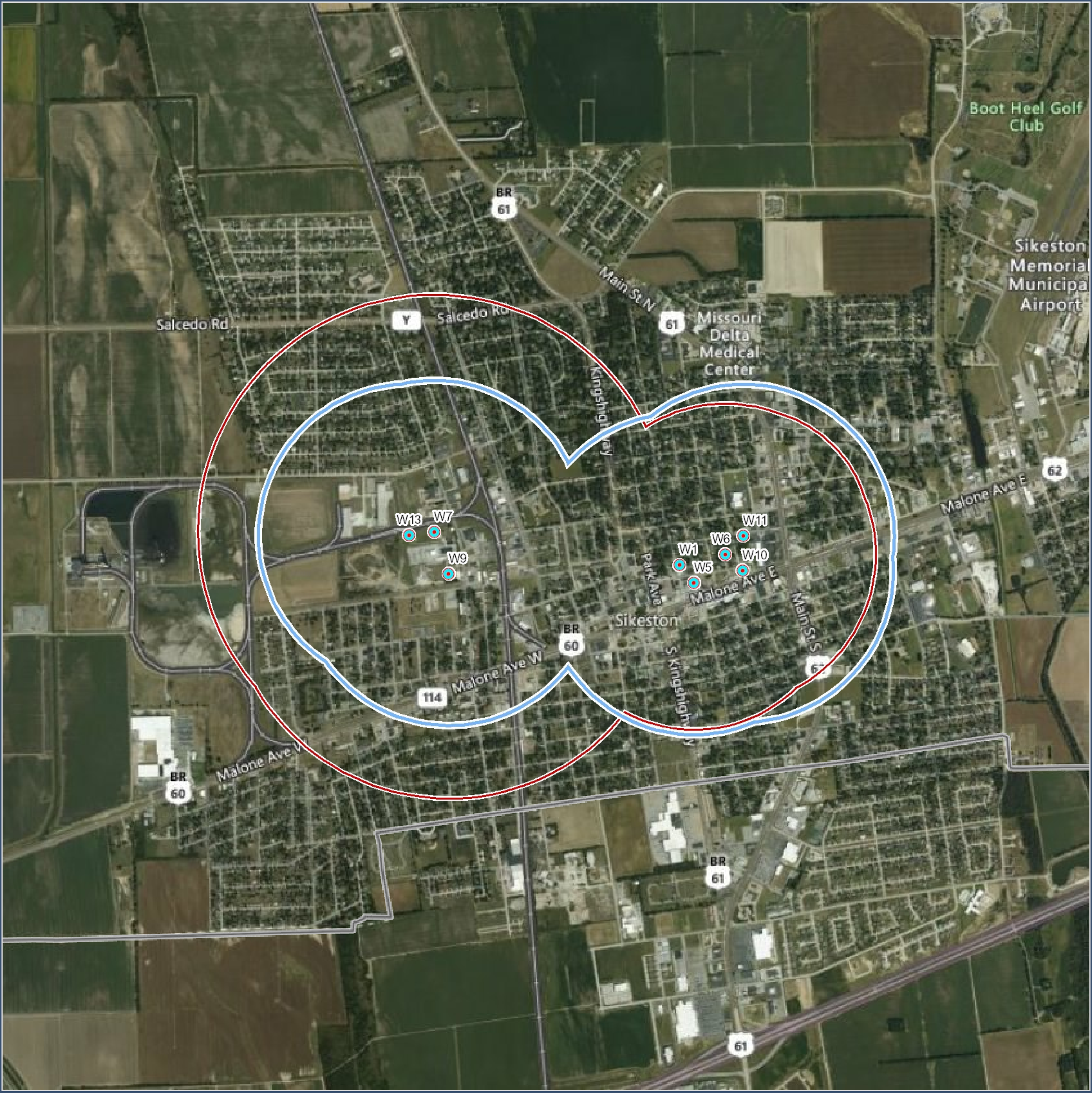
Sikeston

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

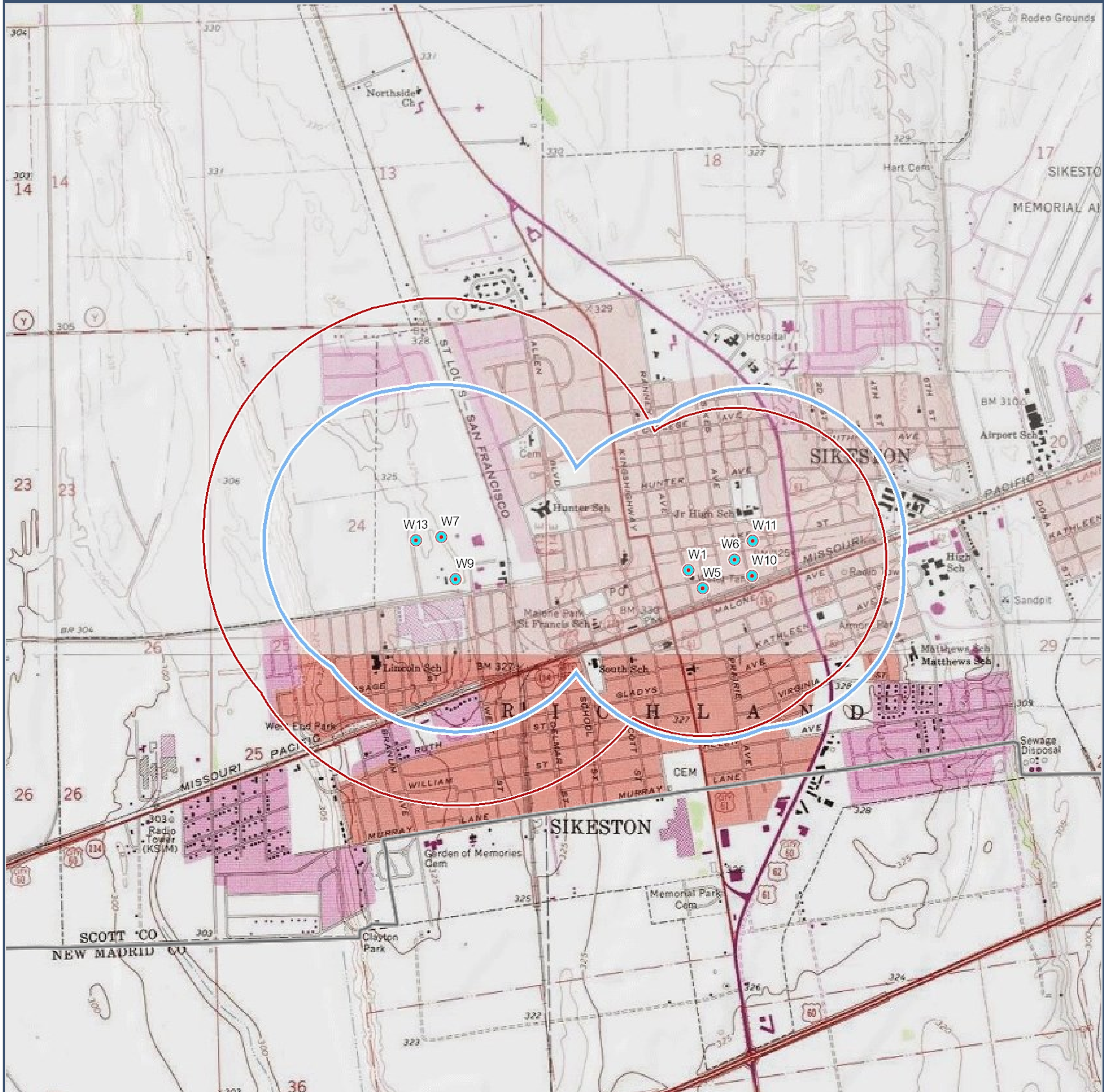
SWAP - Source Water Assessment Plan -
http://drinkingwater.missouri.edu/swap
Aerial Photos: Bing Maps, Microsoft. Jun 11, 2020.

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.

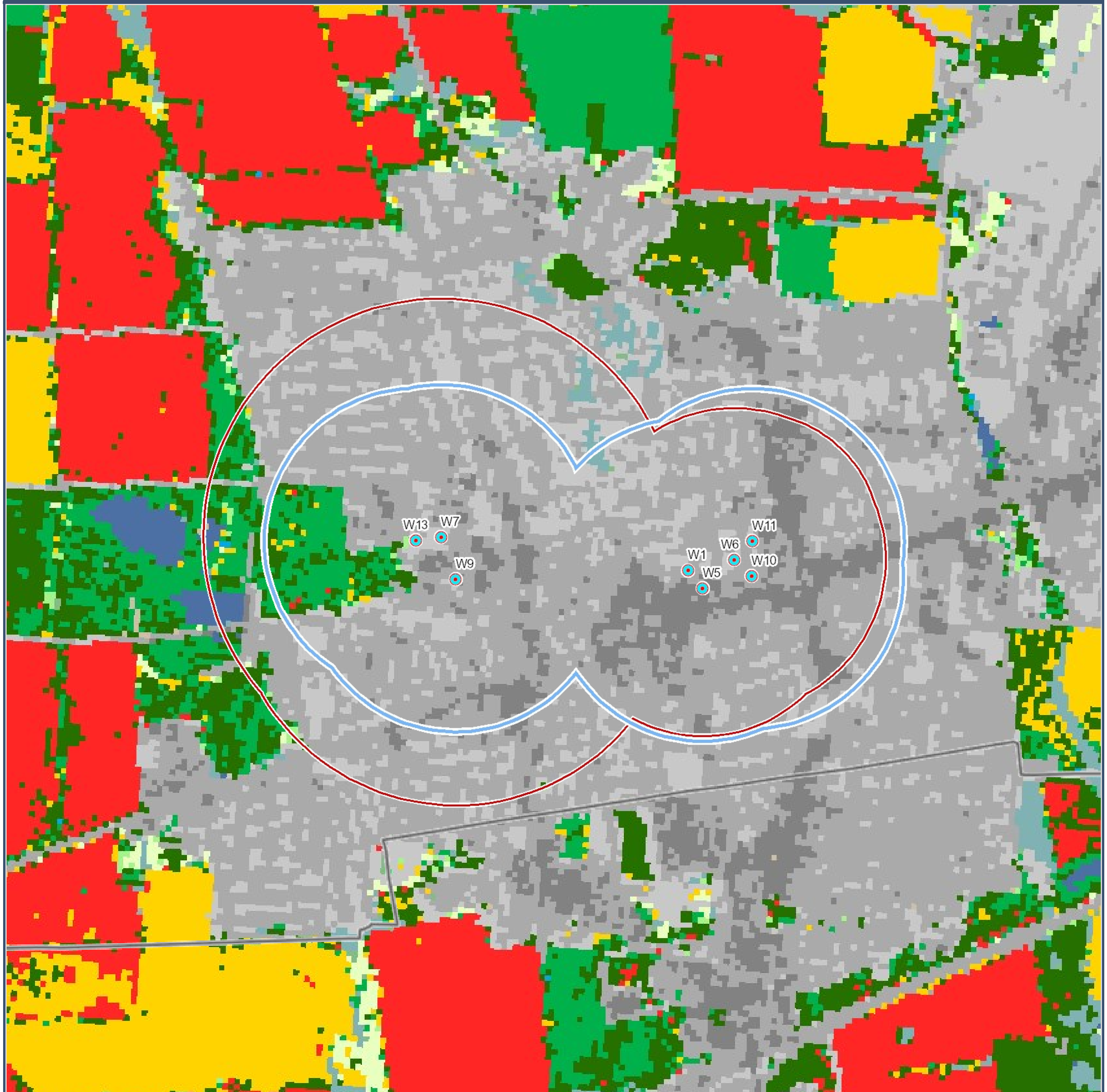
Although the data in this data set have been compiled, in part or in whole, by the Missouri Department of Natural Resources, no warranty, expressed or implied, is made by the department as to the accuracy of the data or related materials. The act of distribution shall not constitute any such warranty, and no responsibility is assumed by the department in the use of these data or related materials. This map and related information are subject to change as additional information is acquired. For additional information, please contact the Department's Drinking Water Branch (Water Protection Program).

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



Groundwater System
System Well

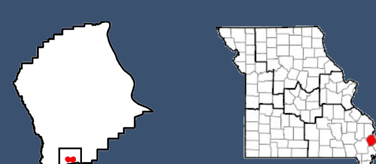
Source Water Protection Boundary
20-Year Time of Travel
Half-Mile Buffer

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

SWAP - Source Water Assessment Plan - http://drinkingwater.missouri.edu/swap
Aerial Photos: Bing Maps, Microsoft. Jun 11, 2020.

0 0.5 1
Miles



Sikeston

Land Use Statistics
PWSS No. 4010743

Map Prepared: Jun 11, 2020
Data Release: May 4, 2020

MISSOURI DEPARTMENT OF NATURAL RESOURCES
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 Sheet Prepared: Jun 11, 2020
Scott County, Sheet 1 of 2

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

MISSOURI DEPARTMENT OF NATURAL RESOURCES
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

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)
	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)
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

Prepared by CARES, University of Missouri Extension

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.

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
Missouri Department of Natural Resources

Map Update: Jun 06, 2014

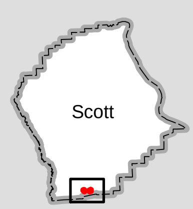
Well System

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

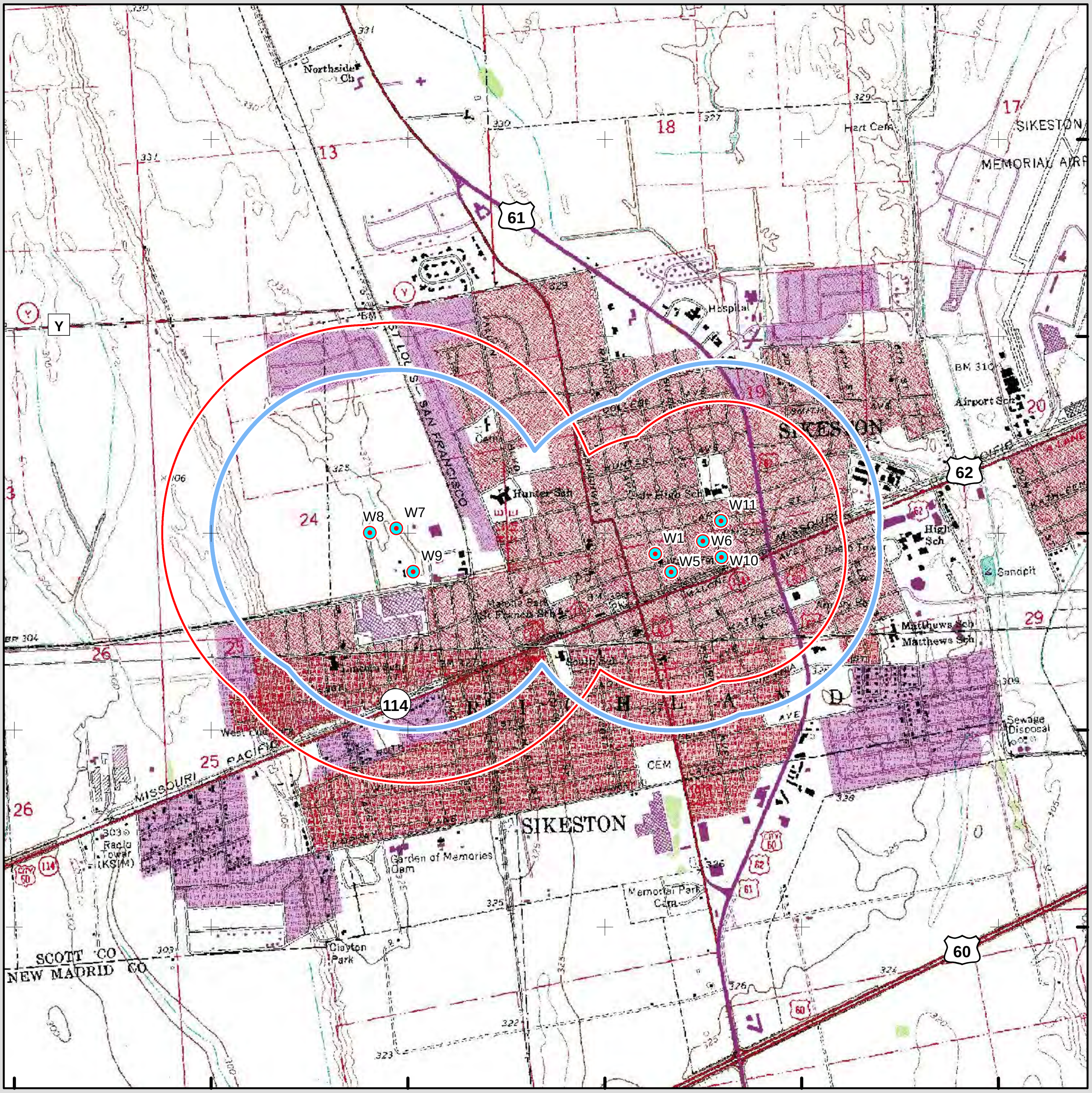
PWSS No. 4010743

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



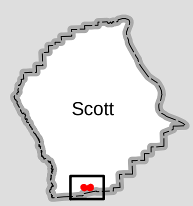
Well System

System Well

SWAP Delineation Boundary

20-year time of travel

Half-mile buffer



N

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

Prepared by: CARES Center for Applied Research and Environmental Systems, University of Missouri

Sheet Update: Jun 09, 2014

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

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
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	Census - 1990
C1	Block Centroid
C2	Block/Group Centroid
C3	Tract Centroid

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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
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Code	Other
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S2	Quarter Description
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Location Codes

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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

Sikeston

PWSS No. 4010743

Scott County, sheet 4 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
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

Code	Description
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:

Count	Database	Count	Database
	AFS (EPA AIRS Facility Sites)		Perchlo (MoDNR Perchlorate Sites in Missouri)
16	APCP (MoDNR Air Pollution Control Program Sites)		Pest Ap (MDA Licensed Pesticide Applicators)
	APF (MoDNR Active Permitted Landfills & Transfer Stations)		RCRIS (EPA Resource Conservation and Recovery Information System)
2	CERCLIS (EPA CERCLIS)		Silos (USGS Minuteman II Missile Silos)
3	Chemcov (VA Selected Chemical Sites)	1	SMARS (MoDNR Superfund Management and Registry System)
1	Dealcov (MDA Pesticide Dealer Locations)	48	Tanks (MoDNR Petroleum Tank Database)
	Dioxin (MoDNR Confirmed Dioxin List)		Tier 2 (MERC Tier II Reports)
	Grain B (USDA Former Grain Bin Sites)		Tire D (MoDNR Resolved and Unresolved Waste Tire Dumps)
31	HW Gen (MoDNR Hazardous Waste Generators)		TRI (EPA Toxic Release Inventory)
	HW Tran (MoDNR Hazardous Waste Transporters)		VCP (MoDNR Voluntary Cleanup Program Sites)
	LUST (MoDNR Leaking Underground Storage Tanks)		WQIS (MoDNR Water Quality Information System)
	MoDOT (MoDOT Highway Maintenance Facilities)		
	PADS (EPA PCB Activity Data Base System)	60	SWIP Field Inventory (see below)

60 Potential Contaminant Sources in the SWIP Field Inventory:

Count	Source	Count	Source
0	Airport or abandoned airfield	0	Machine or metalworking shop
0	Animal feedlot	2	Manufacturing (general)
0	Apartments and condominiums	0	Material stockpile (industrial)
0	Asphalt plant	0	Medical institution
6	Auto repair shop	0	Metal production facility
8	Automotive dealership	0	Mining operation
0	Barber and beauty shop	7	Other
0	Boat yard and marina	1	Paint store
0	CAFO	0	Park land
0	Campground	0	Parking lot
2	Car wash	1	Petroleum production or storage
0	Cement Plant	0	Pharmacies
0	Cemetery	0	Photography shop or processing lab
0	Communication equipment mfg	0	Pit toilet
0	Country club	0	Plastic material and synthetic mfg
3	Dry cleaner	1	Print shop
1	Dumping and/or burning site	0	Railroad yard
0	Electric equipment mfg or storage	0	Recycling/reduction facility
0	Electric substation	0	Research lab
0	Farm machinery storage	0	Restaurant
3	Feed/Fertilizer/Co-op	1	Sawdust pile
2	Fire station	0	School
2	Funeral service and crematory	0	Sports and hobby shop
1	Furniture manufacturer	0	Swimming pool
0	Furniture repair or finishing shop	0	Tailing pond
0	Garden and/or nursery	5	Tank (above-ground fuel)
0	Garden, nursery, and/or florist	0	Tank (other)
0	Gasoline service station	0	Tank (pesticide)
0	Golf courses	6	Tank (underground fuel)
0	Government office	0	Trucking terminal
0	Grain bin	1	Veterinary service
3	Hardware and lumber store	0	Wastewater treatment facility
0	Hazardous waste (Federal facility)	2	Well (abandoned)
1	Highway maintenance facility	1	Well (domestic)
0	Jewelry or metal plating shop	0	Well (irrigation)
0	Junk yard or salvage yard	0	Well (livestock)
0	Lagoon (commercial)	0	Well (monitoring)
0	Lagoon (industrial)	0	Well (public water supply)
0	Lagoon (municipal)	0	Well (unknown)
0	Lagoon (residential)		
0	Landfill (municipal)		
0	Laundromat		
0	Livestock auction		

Sikeston

PWSS No. 4010743

Susceptibility Determination Sheet

8 wells

Prepared by: Center for Applied Research and Environmental Systems, University of Missouri

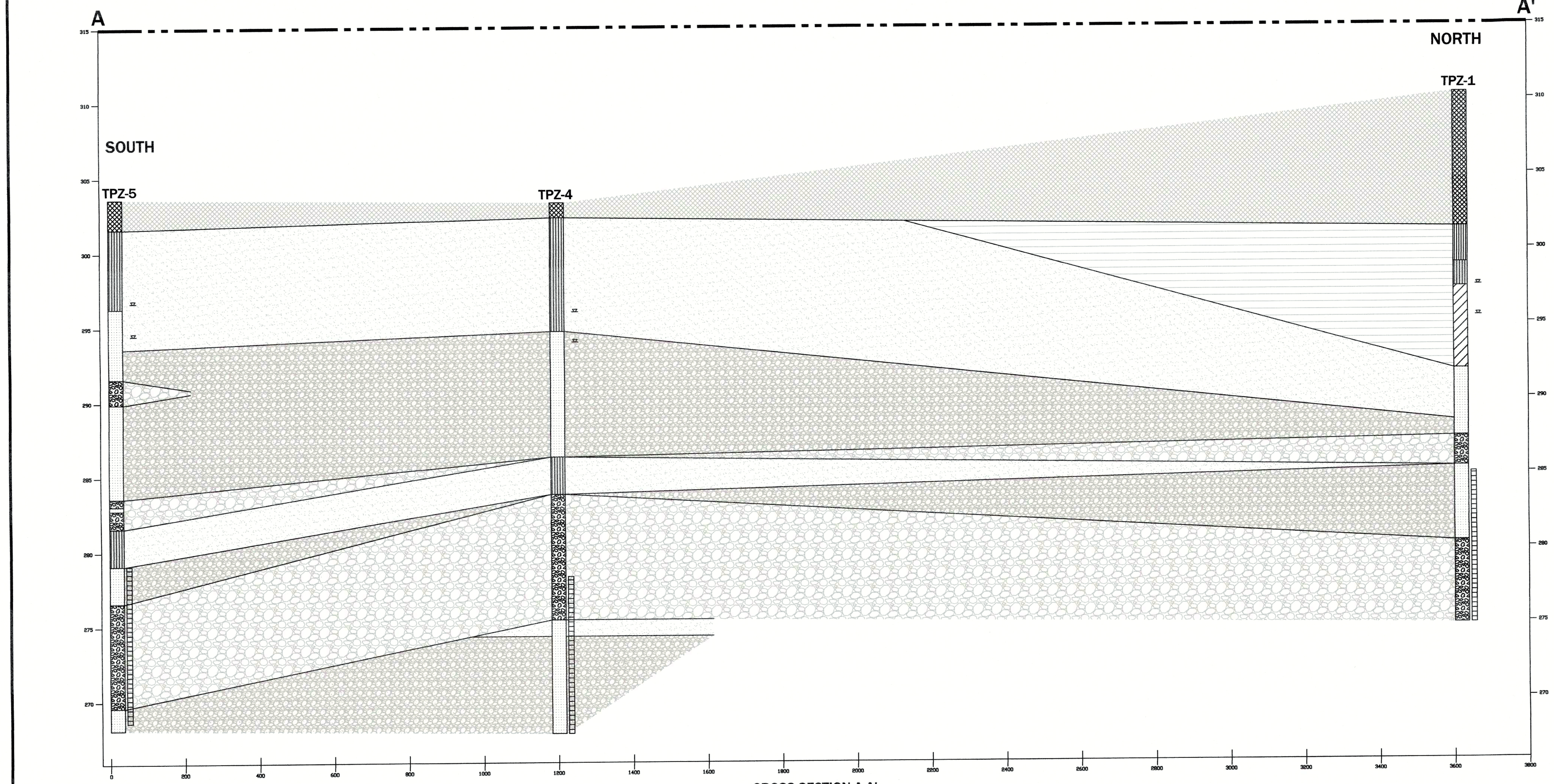
Missouri Department of Natural Resources

Sheet Update: Mar 14, 2014

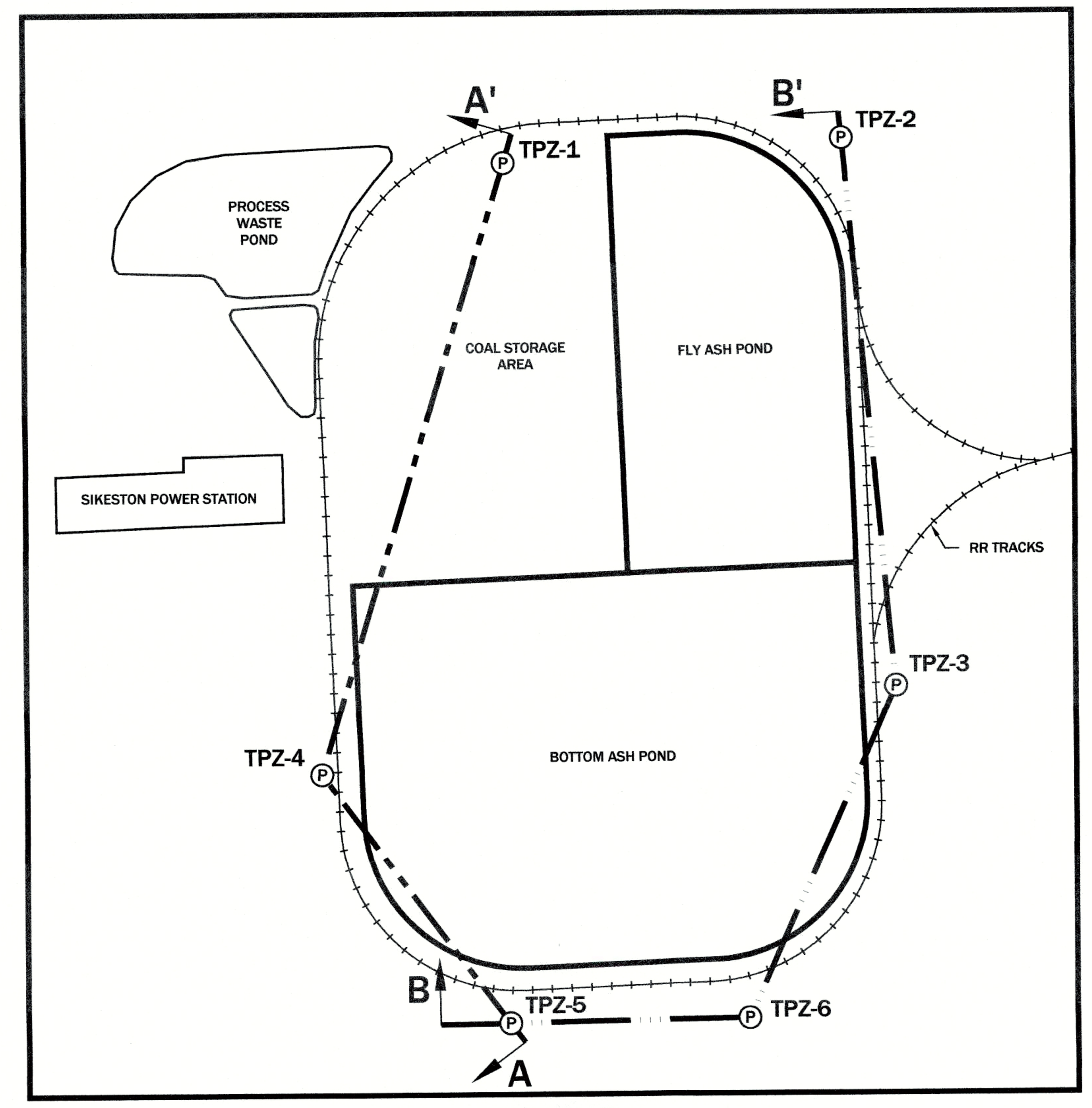
The Missouri Department of Natural Resources (MoDNR) has assembled this information to assess the susceptibility of drinking water sources to contamination. There are many unforseen and unpredictable factors that may cause a source to be contaminated. MoDNR routinely monitors all public supplies to ensure 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 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.

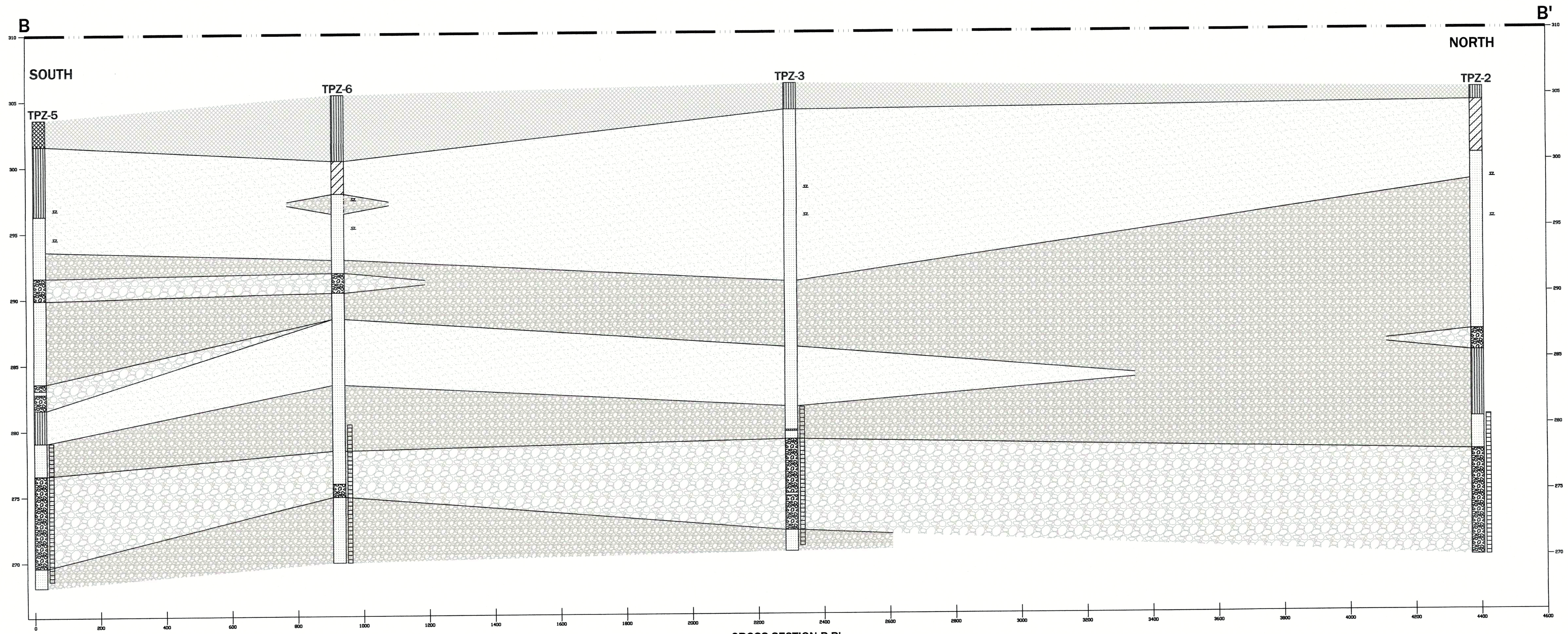
ATTACHMENT D7 – SITE HYDROGEOLOGY



CROSS SECTION A-A'
SCALE:
HORIZONTAL - 1"=200'
VERTICAL - 1"=5'



INSET MAP
SCALE: 1"=500'



CROSS SECTION B-B'
SCALE:
HORIZONTAL - 1"=200'
VERTICAL - 1"=5'

LEGEND

- FILL
- CLAY
- SANDY CLAY
- SILT
- SILTY SAND
- SAND
- SAND AND GRAVEL
- PIEZOMETER SCREEN
- FILL/SOIL
- BACKSWAMP DEPOSITS
- FLOODPLAIN DEPOSITS
- TRANSITIONAL DEPOSITS
- CHANNEL/CHANNEL BAR DEPOSITS
- 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.

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 5
GEOLOGIC CROSS SECTIONS

PROJECT NAME	FILE NAME	SHEET #
SIKESTON/NPDES	GEOLOGIC X SECS	1 OF 1

SIKESTON POWER STATION
SITE CHARACTERIZATION

SURVEYED	DESIGNED	DRAWN	CHECKED	APPROVED	DATE	SCALE
NA	KE	AJK	KE	MCC	5/2017	AS NOTED

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

ATTACHMENT D8 – 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 BMU
Board of Municipal Utilities

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: [signature]

Date: 10-17-2016

Registration Number: PE-021137
State of Registration: Missouri

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

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.”

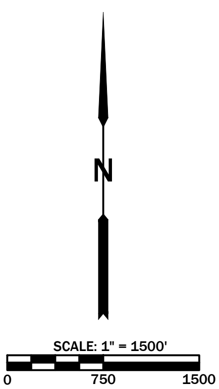
Gredell Engineering Resources, Inc., 2016b. “Sikeston Board of Municipal Utilities Sikeston Power Station Bottom Ash Pond Inflow Design Flood Control System Plan.”

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

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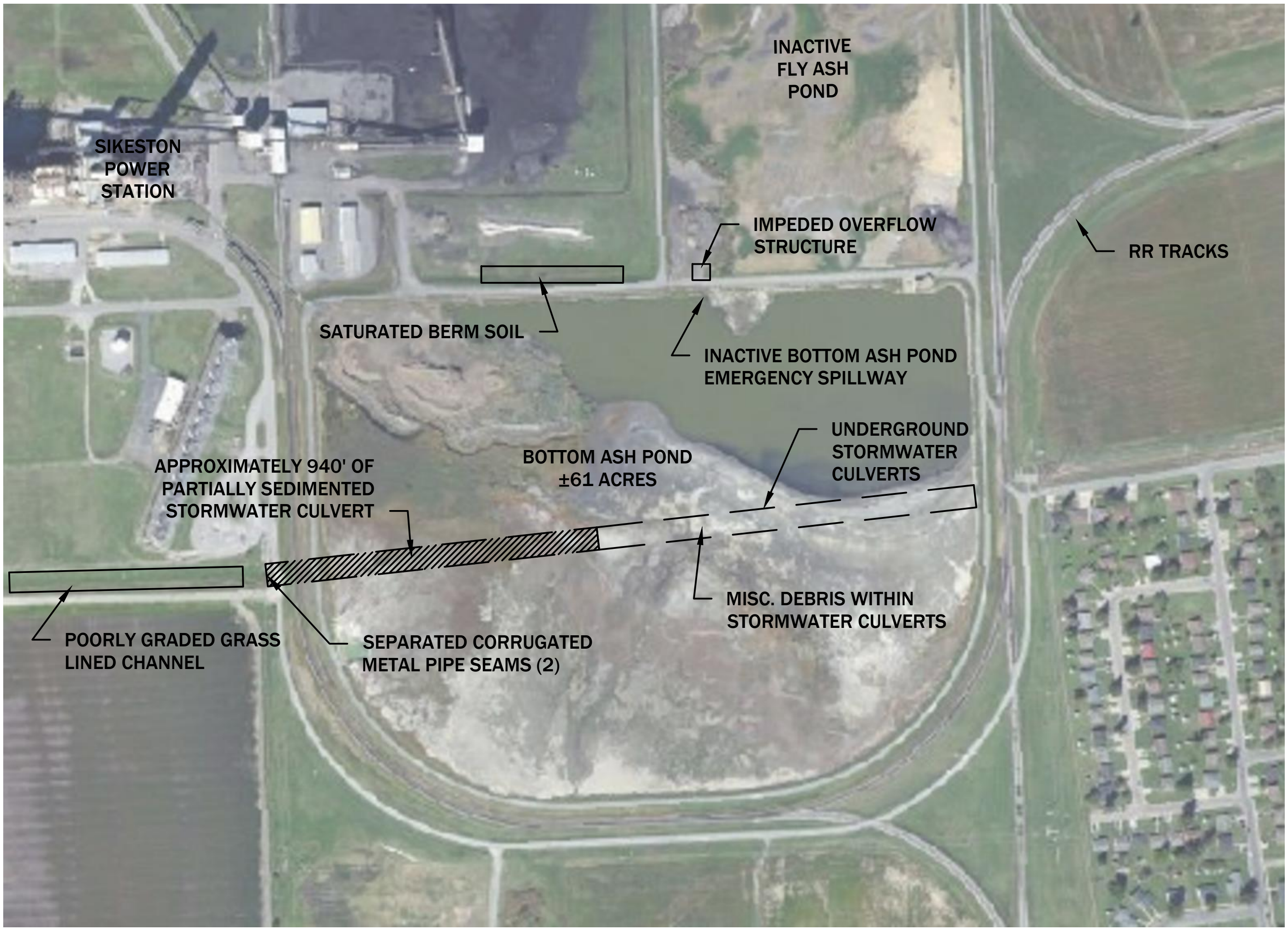

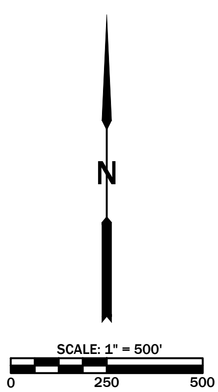

STRUCTURAL STABILITY ASSESSMENT
BOTTOM ASH POND
SIKESTON POWER STATION

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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

1505 East High Street
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GREDELL Engineering Resources, Inc.

Sikeston Board of Municipal Utilities
Sikeston Power Station
Fly Ash Pond
Structural Stability Assessment

Prepared for:

Board of Municipal Utilities

Sikeston Power Station
1551 West Wakefield Avenue
Sikeston, MO 63801

April 2018

Sikeston Board of Municipal Utilities
Sikeston Power Station
Fly Ash Pond
Structural Stability Assessment

April 2018

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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, Fly 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: 04-17-2018

Registration Number: PE-021137
State of Registration: Missouri

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

1.0 INTRODUCTION

In accordance with the scope of services outlined in the Sikeston Board of Municipal Utilities (SBMU) Work Order No. 15 dated January 3, 2018, GREDELL Engineering Resources, Inc. (Gredell Engineering) conducted an initial structural stability assessment for the SBMU Sikeston Power Station (SPS) Fly Ash Pond, a coal combustion residual (CCR) surface impoundment. The purpose of this assessment was to determine if the Fly 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 Fly 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*~~ (Remanded June 14, 2016)*;*

(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 FLY 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 Fly Ash Pond at SPS resides to the east of SPS, and directly east of SPS's coal pile and north of the Bottom Ash Pond. The Fly Ash Pond occupies approximately 30 acres with a minimum and consistent berm elevation of 322 feet.

SPS and the Fly Ash Pond are located at a transition between agricultural and urban areas. The Fly Ash Pond is surrounded by agricultural, commercial, and residential areas. Residential areas are located approximately 700 feet southeast of the Fly Ash Pond. Commercial areas are located approximately 1,700 feet east of the Fly Ash Pond. The remaining area around the Fly Ash Pond is agricultural land. There is City-owned property to the east, south, and west of the Fly Ash Pond. See Appendix A, Figure 1 – Aerial View, for a depiction of the Fly Ash Pond and Figure 2 – Fly Ash Pond Identified Deficiencies, for details of the Fly 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 Fly Ash Pond consist of existing soils or fills compacted to support the finished construction of the Fly 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 Fly 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 percent (%) maximum density at optimum moisture for silty sands and 70% relative density for sands prior to the construction of any features of the Fly Ash Pond. The construction specifications may be found in the Sikeston Board of Municipal Utilities, Sikeston Power Station, Fly Ash Pond, History of Construction, Appendix C – Historical Construction Specifications.

No deficiencies were found during the assessment of the foundations and abutments of the Fly Ash Pond, therefore, no corrective measures are recommended.

3.2 Slope Protection

The Fly 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 Fly Ash Pond. The interior slopes of the bottom ash are protected from surface erosion and wave action by vegetative growth. Additionally, aerial photography obtained by Surdex Corporation on May 06, 2016 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 Fly Ash Pond, therefore, no corrective measures are recommended.

3.3 Berm Stability

The berms of the Fly 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 Fly 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 Fly 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 Fly Ash Pond. The evaluation was conducted for steady state seepage at normal pool (elevation 315.5 feet), steady state seepage at maximum pool (elevation 317 feet), and pseudo-static conductions for seismic loading (elevation 315.5 feet). The calculated factors of safety for each condition were determined to be 1.6 (steady state, normal pool) and 1.5 (steady state, maximum pool), and 1.2 (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 Fly Ash Pond, it is determined the berms of the Fly 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 Fly Ash Pond identified a small area of saturated soil along the southeastern berm of the Fly Ash Pond and north 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.

The presence of hydric plants indicate that the wet condition of the soil may be the result of seepage through the southeastern berm from the Fly Ash Pond. However, no visible flow was observed and stability analysis of critical sections of Fly Ash Pond berms by Reitz & Jens, as a sub-consultant to Gredell Engineering, 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

The maximum vegetative height requirement specified in §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 Fly Ash Pond is not currently subject to this requirement.

3.5 Spillway Design and Capacity

The Fly Ash Pond was constructed with an outlet structure in the northwest corner of pond with discharge pipes through the Fly Ash Pond's northern and western berms. The outlet structure consisted of a concrete structure with the water level controlled by stop logs. The overflow water can be diverted to the Process Waste Pond through Outlet #2.

Outlet #1 is a 24-inch steel pipe which discharges from an approximate 6-feet by 17-feet concrete fault. The discharge from the concrete vault is through a 24-inch steel pipe which discharges onto an 18-inch rip rap lined, 6-foot flat bottom ditch prior to the stormwater ditch along West Wakefield Avenue. The overall length of Outlet #1 is 62 feet.

Outlet #2 is a 24-inch corrugated metal pipe (CMP) (inlet and discharge elevations of 316.75 feet and 307.0 feet) with an overall length of 916 feet. Outlet #2 discharges onto a 10-foot wide concrete spillway into the Process Waste Pond.

The hazard potential classification for the Fly Ash Pond was determined by modeling a worst-case probable scenario breach of the Fly Ash Pond Berms and its resulting flood waters impact on the surrounding land using HydroCAD. Based on the HydroCAD model, the Fly Ash Pond at SPS was classified as Low. As stated above, §257.73(d)(1)(v)(B)(2) requires the inflow design flood for CCR surface impoundments with low hazard potential classifications to be the 100-year flood (Gredell Engineering Resources, 2018a). The 100-year flood is the volume of runoff generated by the 100 year rainfall event for a given location. The 100-year, 24 hour rainfall event was modeled to determine if the existing Fly Ash Pond and its associated discharge structures are negatively impacted by the discharge from the Fly Ash Pond. From the National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Volume 8, Version 2, the 100-year, 24-hour precipitation event for Sikeston, Missouri is 8.44 inches of rainfall.

The peak discharge from the 100-year flood was determined to be 146 cubic feet per second (CFS) with a total influent volume of 715,373 ft^3 (5.4 MG). During the peak flow of the 100-year 24-hour storm event, the maximum elevation from the influents was determined to be 320.1 feet, which is 1.9 feet below the top of the Fly Ash Pond berms (elevation 322 feet). Also during the peak flow the remaining storage capacity of the Fly Ash pond was determined to be approximately 638,000 ft^3. Therefore, the Fly Ash Pond 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, 2018b).

One hydraulic deficiencies were found during the assessment of the Fly 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 between the two ponds. 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 (i.e., emergency spillway) 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 Fly Ash Pond has three hydraulic structures pass through the berms, but no hydraulic structures passing beneath the CCR surface impoundment. Hydraulic structures passing through the berms of the Fly Ash Pond Include:

- Outlet Structure #1: 24-inch steel pipe passing through the northern berm to a ditch adjacent to West Wakefield Avenue (approximate 316.42 feet invert elevation) is permanently closed.
- Outlet Structure #2: 24-inch corrugated metal pipe passing through the western berm of the Fly Ash Pond, discharging into the Process Waste Pond (approximate 316.75 feet invert elevation) is closed, but it is understood that it is capable to be opened.
- Emergency Spillway: 30-inch corrugated metal pipe passing through the southern berm of the Fly ash Pond, discharging stormwater to the Bottom Ash Pond is impeded by built up CCR material.

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 Fly 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.

- Outlet Structure #1: The inlet of the 24-inch steel pipe was not identified due to the valve being closed. 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 100-year flood).
- Outlet Structure #2: The concrete discharge structure serving the 24-inch steel and CMP pipes appeared in good condition with no visual signs of deterioration. The inlet of the 24-inch CMP pipe was behind a closed valve and therefore, not directly observed. The control valve serving the discharge was observed to be in poor condition and was reported to have not been recently operated per plant personnel.
- Emergency spillway: The 30-inch CMP between the Fly Ash Pond and Bottom Ash Pond is not used due to the adequate hydraulic capacity of the Fly Ash Pond. The emergency spillway needs maintenance to remove accumulated CCR in the event it is desired to use the structure in the future. The CMP is in good condition and serves as an interior overflow.

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:

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 inlet 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 Fly 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 Fly Ash Pond berms are not subject to inundation by an adjacent water body in accordance with the Federal Emergency Management Agency (FEMA) Floodplain Map (FM) 29201C0315D. Therefore, the structural integrity of the Fly Ash Pond was not assessed for low pool or sudden drawdown of an adjacent water body.

3.8 Miscellaneous Assessed Site Features

There is one site feature is present in or near the Fly Ash Pond to be assessed for impact on the structural stability of the Fly Ash Pond. Electrical manholes were identified on the southern berm of the Fly 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 Fly Ash Pond Berms.

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:

- A small area of wet/saturated soil was identified along the exterior of the eastern berm of the Fly Ash Pond. The wet area was observed a few feet above the toe of the exterior slope of the berm above the railroad track. The small area was manifested as a patch of hydrophilic plants (e.g., cattails). Therefore, Gredell Engineering has identified this condition as a potential CCR rule deficiency.
- Gredell Engineering recommends further investigation of the wet area along the eastern berm of the Fly Ash Pond. If the wet area is confirmed to be caused by seepage from the Fly 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 eastern berm of the Fly Ash Pond.
- Gredell Engineering recommends repair of Outlet Structure #2 valves. The valves should be operable for future large rainfall events.

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 Fly Ash Pond has no emergency discharge structures. The overflow structure between the Bottom Ash Pond and the Fly Ash Pond is currently inoperable due to excess CCR accumulation at the discharge and lack of exercise of the valve. The inoperable overflow structure was not determined to be a deficiency because Gredell Engineering's hydrologic and hydraulic evaluation determined that the no discharge structure is required to manage the anticipated flow during, and following, the peak discharge from the design flood event (the 100-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 Fly Ash Pond berm at least 100 feet south of northwest outlet 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., 2018a. "Sikeston Board of Municipal Utilities Sikeston Power Station Bottom Ash Pond Hazard Potential Classification Assessment."

Gredell Engineering Resources, Inc., 2018b. "Sikeston Board of Municipal Utilities Sikeston Power Station Bottom Ash Pond Inflow Design Flood Control System Plan."

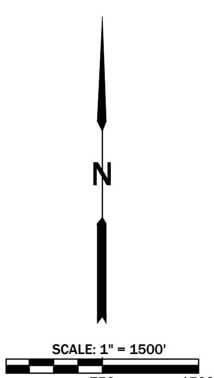
Gredell Engineering Resources, Inc., 2018c. "Sikeston Board of Municipal Utilities Sikeston Power Station Bottom Ash Pond History of Construction."

Gredell Engineering Resources, Inc. January 2018. "2017 Initial Annual P.E. Inspection of Fly Ash Pond."

Sikeston Board of Municipal Utilities, 2015. "Sikeston Power Station Missouri State Operating Permit, MO-0095575."

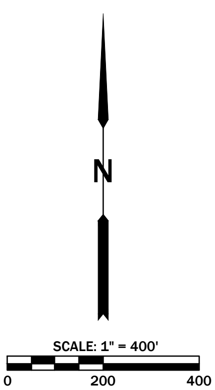
APPENDIX A

Figures



M:\Share\CADDFiles\SIKESTON\FLY AS POND APRIL EDITS\STRUC STAB ASSMNT.dwg, FIGURE 1 - AERIAL VIEW, 4/5/2018 4:06:57 PM

STRUCTURAL STABILITY ASSESSMENT FLY ASH POND 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			
FIGURE 1 - AERIAL VIEW	DATE 4/2018	SCALE AS NOTED	PROJECT NAME SIKESTON	REVISION
	DRAWN CP	APPROVED JB	FILE NAME STRUC STAB ASSMNT	SHEET # 1 OF 1



STRUCTURAL STABILITY ASSESSMENT
FLY 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 - FLY ASH POND IDENTIFIED DEFICIENCIES

DATE	SCALE	PROJECT NAME	REVISION
04/2018	AS NOTED	SIKESTON	
DRAWN	APPROVED	FILE NAME	SHEET #
CP	TG	STRUC STAB ASSMNT	1 OF 1

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ATTACHMENT D9 – SAFETY FACTOR ASSESSMENT

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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.

Derrick A. Shelton
Geotechnical Program Manager | Senior Associate

Steven F. Putrich, P.E.
Project Principal

Enclosures

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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 ($FS \geq 1.0$) 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:

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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							

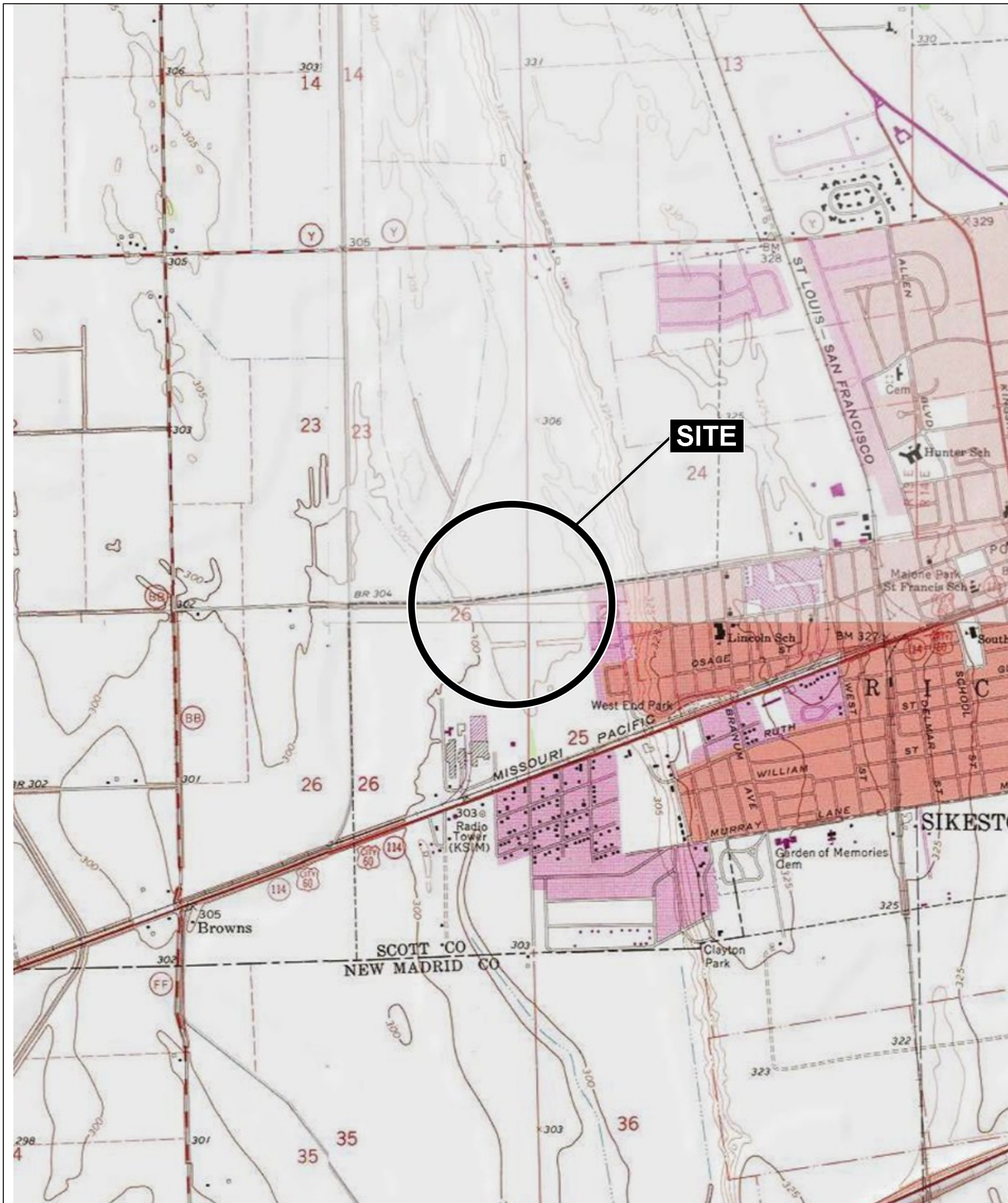
TABLE IV

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	

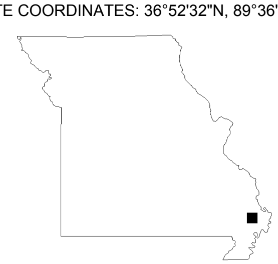
Notes:
1. Top of casing elevation of P-8 was reported by Geotechnology, Inc. and top of casing elevation of TPZ-3 was provided by Sikeston BMU.
2. Depth to water level readings were provided by Sikeston BMU.
3. Water level readings have been made in the wells at times and under conditions discussed herein. 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

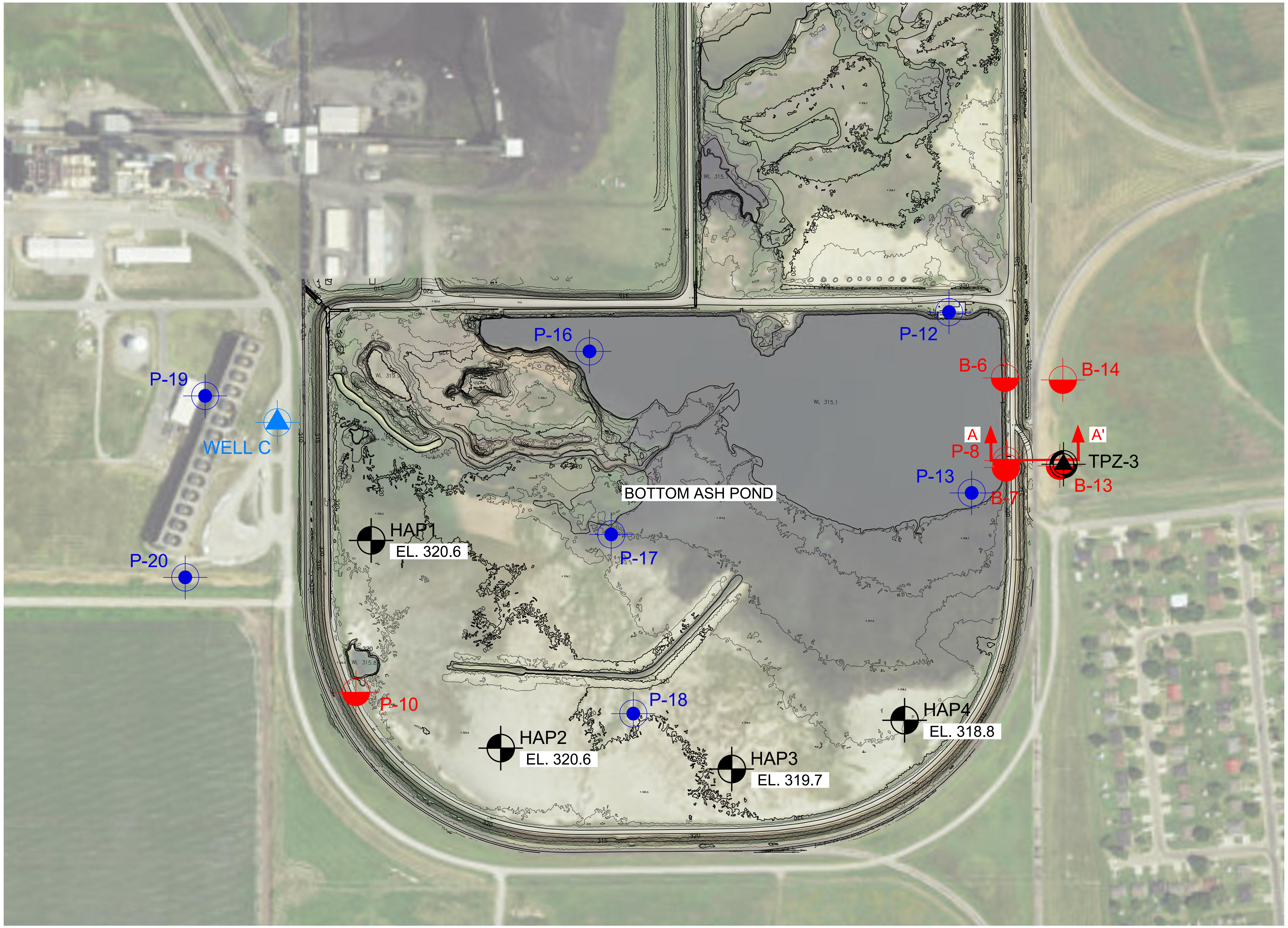
SIKESTON POWER STATION
BOTTOM ASH IMPOUNDMENT
SIKESTON, MISSOURI

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.

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

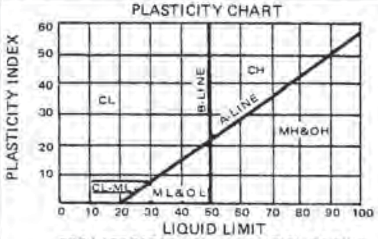
APPENDIX A

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	GW	WELL-GRADED GRAVEL, GRAVEL-SAND MIXTURE
		LITTLE OR NO FINES	GP	POORLY-GRADED GRAVEL, GRAVEL—SAND MIXTURE
		GRAVELS WITH FINES	GM	SILTY GRAVEL, GRAVEL-SAND-SILT MIXTURE
		APPRECIABLE FINES	GC	CLAYEY-GRAVEL, GRAVEL-SAND-CLAY MIXTURE
	SAND AND SANDY SOILS	CLEAN SANDS	SW	WELL-GRADED SAND, GRAVELLY SAND
		LITTLE OR NO FINES	SP	POORLY-GRADED SAND, GRAVELLY SAND
		SANDS WITH FINES	SM	SILTY SAND, SAND-SILT MIXTURE
		APPRECIABLE FINES	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)

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'						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						dry
3	Lt. Brown, pred. fine sand, some med. sand, trace silt, tan + rust colouring, subrounded, trace lignite, med. density, damp to moist.					damp
4		SP	4/5/7	15" Recov.	D-1	
5						
6						moist wet
7						
8	Brown, fine to med. sand, trace coarse sand, trace silt, lignite part., subrounded, med. density, sat.					
9		SP	5/5/7	10" Recov.	D-2	water @ 9'
10						
11						
12						
13						

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
14–15	Gray-brown, pred. fine sand, w/ med. sand, trace coarse sand + fine gravel, trace silt, subrounded to occas. subangular, loose, sat., lignite part.	SP	3/3/5	11" Recov.	D-3	3/4" lignite part. in sluff mat'l.
18–20	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	
23–25	Gray, fine sand, w/ med. sand, trace silt, lignite, subrounded to subangular, dense, sat.	SP	11/17/23	10½" Recov.	D-5	
28–30	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
33–35	Similar to previous; becoming pred. finer sand toward bottom with several successive lignite seams, (trace chert)	SP/(SW)	11/12/14	10½" Recov.	D-7	
38–41	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
43–46	Brown-gray, well graded sand, some fine gravel, lignite part., subrounded to subangular, med. density, sat.; slightly finer towards tip.	SW/SP	8/10/12	7" Recov.	D-9	
48–49	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
53–55	Similar to previous; becoming slightly finner & milky toward tip, dense, red-tint.	SP/SW	13/15/21	9" Recov.	D-11	
58–60	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
0–3						Yellow-Lt. Brown, silty fine sand, dry, organics. (SM-SP) Bag #1
3–5	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	
5–8						Yellow-Lt. Brown, fine sand, w/ silt, damp. (SP-SM) Bag #2
8–10	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'

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
14–15	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 Tube.
16–17						Use of Fiber Tex + Mica Tex for drilling water with mud
18–21	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	
23–24	Dark- Brown, same as previous, except becoming occas. subangular, med. dense.	SP	5/6/7	7" Recov.	D-5	
28–30	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
33–36	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; Driller noted coal seam @ ±36½'
38–40	Gray, fine to med. sand, similar to previous, less milky, w/ fine + coarse gravel encountered @ tip.	SP	7/10/8	8" Recov.	D-8	
42–45	Gray, well graded sand, trace gravel, trace silt, lignite, subrounded to subangular, med. density, sat.	SP/SW	6/11/13	7" Recov.	D-9	
48–50	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
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
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	
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	

BURNS & McDONNELL ENGINEERING COMPANY

DRILLING LOG

Project: PHSIKEMO — Hole No. P-13 — Sheet 5 of 6

Depth	Description	Log or Class	No. Blows	Core Recov. & Loss	Box or Sample No.	Remarks
69 (** →, Intermediate Sample)	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	
74	Same as previous w/ red milky tint.	SW/SP	11/13/14	6½" Recov.	D-15	
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	
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

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
87–89	Same as previous; becoming slightly coarser ~~& more toward well graded~~	SP/ ~~(SW)~~	11/14/15	7" Recov.	D-18	
93–94	Similar to previous; only well graded; (trace chert)	SW/(SP)	13/14/16	7" Recov.	D-19	
98–100	Red-brown, fine to med. sand, trace coarse sand & gravel, milky, subrounded to subangular, lignite, very dense, sat.	SP	50/1½"	6" pen. Recov.	D-20	
	T.D. 100'					

Margin note: * Coarse Gravel

11/27/63 — BURNS & McDONNELL ENGINEERING COMPANY — FORM J-2-1-1a

DRILLING LOG

JOB NO. 76-076-1	PROJECT PHSIKEMO		HOLE NO. P-16
GROUND ELEV. 307.11	LOCATION 500' East 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
3.5–5	~~Yellow~~ Lt. Brown, silty fine sand, subrounded, trace lignite, loose, damp to dry.	SM/SP	2/3/4	15" Recov.	D-1	
5.7						change
8.5–10	Brown, fine sand, trace med. sand, some silt, lignite, subrounded, med. density, wet.	SP/(SM)	3/6/7	10" Recov.	D-2	
11						Water @ 11'

122673 — Burns & McDonnell Engineers-Architects-Consultants — Form J-2-1-1A

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
14–15	Brown, prd. med. to fine sand, trace coarse sand, trace silt, lignite, subrounded to occass. subangular, loose, sat.	SP	2/3/4	13" Recov	D-3	
16–18	↕					
18–20	Brown, same as previous.	SP	4/3/5	3" Recov	D-4	fine gravel in sluff mat'l
23–27	Dark brown, prd. 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	
28–30	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	

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'
* 33–37	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; more lignite seams noted in wash
38–40	Gray, very fine sand, trace silt, lignite part., subrounded to subangular, med. density, sat.	SP	10/14/14	7" Recov	D-3	
43–46	Gray, prd. 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	
48–50	Similar to previous, milky slightly coarser & more well graded, dense, lignite seam @ tip.	SP/(SW)	15/16/17	5½" Recov	D-10	

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	Gray, fine to med. sand, some coarse sand, trace fine gravel, very silty, lignite part., subrounded to subangular, dense, sat.	SP/(SW)	17/18/18	2½" Recov	D-11	Between 50² & 55², some caving of gravelly mat'l occurred
58	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. 60²					

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	85²						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						Lt. Yellow-brown silty fine sand, damp, organics (SM-SP) Bag #1
4	Lt. Rust-brown, fine sand, trace med. sand, w/silt, subrounded, trace lignite, loose, damp to dry.	SP/SM	2/4/4	13½" Recov	D-1	
6						Lt. Yellow-brown, fine sand, trace med. sand, w/ silt, damp to moist. (SP-SM) Bag #2
9	Brown, fine sand, trace med. sand, w/ silt, trace lignite, very loose, wet to sat.	SP/(SM)	2/1/1	10½" Recov	D-2	water @ 9²

BURNS & McDONNELL ENGINEERING COMPANY

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
14–15	Brown, fine sand, trace med. sand, trace silt, lignite part., subrounded, med. density, sat.	SP	7/9/11	Full Recov.	D-3	
16						
17						
18–21	Brown, pred. 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	$9\frac{1}{2}$" Recov.	D-4	
22						
23–26	Brown, pred. 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	$9\frac{1}{2}$" Recov.	D-5	
27						Drilled to 28± wed. - end drill
28–30	Brown, pred. 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	$10\frac{1}{2}$" Recov.	D-6	

11/27/63 BURNS & McDONNELL ENGINEERING COMPANY FORM J-2-1-13

BURNS & McDONNELL ENGINEERING COMPANY

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
33–36	Upper 6" pea gravel, subrounded; remaining 3" gray, pred. 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 water gravel from 33' to 34'
37						
38–40	Gray, fine sand, some med sand, trace coarse sand, trace silt, lignite part. & seams, subrounded to subangular, med. density, sat.	SP	3/11/13	6" Recov.	D-8	
41–43						
44–45	Same; becoming dense, trace fine gravel.	SP	12/19/21	$7\frac{1}{2}$" Recov.	D-9	
46						
47–50	Gray, pred. 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	$6\frac{1}{2}$" Recov.	D-10	

11/27/63 BURNS & McDONNELL ENGINEERING COMPANY FORM J-2-1-13

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						
* 53–55	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)
56						
57						
58–61	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.
62						
63–66	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	
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
69–71	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	
72–73	↓ similar - finer					
74–75	Similar to previous; more uniform sand, finer, very dense.	SP/(SW)	15/50/8½" pen.	8" Recov.	D-15	
76–77	↓ similar - finer					
78–81	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	— end Fri.
82						
83–85	Brown-gray, same as previous; med. density, milky.	SP	8/12/16	11" Recov.	D-17	Hole caved to 30' casing - rate plugged. End hole
	TD 85.2					

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
3	Yellow- Brown, prd. 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	
7						Water @ 7±
8	Dk. brown, prd. 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	11½" Recov.	D-2	

122673 | Burns & McDonnell | Form J-2-1-1A

BURNS & McDONNELL ENGINEERING COMPANY

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, prd. med. to fine sand, trace coarse sand, trace silt, trace lignite, subrounded, med. density, sat.	SP	4/7/8	13" Recov.	D-3	
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 mud
23	Brown, well graded sand, some fine gravel, trace silt, lignite part. (¼"), subrounded to occass. subangular, med. density, sat.	SW/(SP)	6/8/9	9" Recov.	D-5	
28	Gray, prd. fine to med. sand, trace coarse sand & fine gravel, lignite part. & seams, subrounded to subangular, med. density, sat.	SP/(SW)	8/7/10	9½" Recov.	D-6	

11/27/63 | BURNS & McDONNELL ENGINEERING COMPANY | Form J-2-1-1B

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
33–35	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
38–40	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	
43–45	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
48–50	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	

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
53–56	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 / SM	13/50/10" pen.	10" Recov.	D-11	
58–60	Brown-gray, fine to med. sand, trace coarse sand + fine gravel, lignite part., subrounded to subangular, dense, sat. (trace milky)	SP/(50)	13/22/22	9" Recov.	D-12	
63–66	Brown-gray, fine to med. sand, trace to some coarse sand, milky, lignite part. + seam, subrounded to subangular, dense, sat.	SP/(50)	11/15/15	10" Recov.	D-13	2" gravel seam @ 63'

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 ...
73–75	Same; dense, slight red-tint.	SP/SW	8/21/19	Recov.	D-15	
76						Hole caved @ 37', plugged, end drilling
77	T.D. 75'					
79–80				Recov.	~~D-16~~	
81	~~T.D. 80'~~					
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'						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'
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
14–17	Top 4" – brown-gray, well graded sand, trace fine gravel, subrounded & occass. subangular; becoming finner, gray through color changes – brown, rust-brown, lt.-brown, lignite seam, dk. brown; tip fred. fine sand, w/ med. sand, trace coarse sand, subrounded to subangular; lignite throughout, sat.	SW / SP	5/7/13	10½" Recov.	D-3	
18–20	Lt. Yellow-brown, fine to med. sand, trace coarse sand, lignide part., subrounded to subangular, med. density, sat.	SP	6/6/8	6" Recov.	D-4	trace chert in wash §
23–25	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	
28–30	Top 1" similar to previous, finner; becoming gray silt, trace very fine sand, no plast., lignite part. & seams, moist. med. density to dense.	ML	4/8/10	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
33–35	Gray, very fine sand, trace silt, trace med. sand, lignite part., subrounded to subangular, sat., med. density.	SP/ ~~SM~~	6/8/10	1" Recov.	D-7	
38–40	Gray, similar to previous; becoming coarser w/ lignite part. & seams, subrounded to subangular, med. density, sat.	SP	6/10/12	6" Recov.	D-8	
43–46	Gray, fine to med. sand, trace coarse sand, ~~trace top~~, milky, lignite, subrounded to subangular, dense, sat.; slightly coarser toward top.	SP	10/16/23	10" Recov.	D-9	
47–49	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 — @ 50 ft 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 Rotary Wash	HOLE DEPTH 95.0	OVERBURDEN FOOTAGE	BEDROCK FOOTAGE	OVERBURDEN SAMPLES	NO. CORE BOXES	% CORE RECOVERY	WATER TABLE 3.5
DRILLING CO. RAYMOND INT. CO.				DRILLER(S) DON FERREY			
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 @ 3.5
3–6	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 / SP	2/4/10	13" Recov.	D-1	
8–10	Gray, fine to med. sand, trace coarse sand, trace silt, trace lignite, subrounded to subangular, dense, sat., lignite seams.	SP	7/14/21	16" Recov.	D-2	
11–13						

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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
14–15	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
16–17						gravel seam noted by driller @ 17±
18–19	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	
20–22						
23–25	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	
26–27						
28–29	Dk. gray, fine to med. sand, much lignite part. + seams, subrounded to subangular, med. density, sat.	SP	6/8/14	10" Recov.	D-6	
30						

11/27/63 BURNS & McDONNELL ENGINEERING COMPANY FORM J-2-1-1A

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
33–35	Gray, fine to med. sand, lignite part., subrounded to subangular, med. density, sat.	SP	8/10/15	10" Recov.	D-7	Chert in sluff
38–40	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	
43–45	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	
47–49	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

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
53–55	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	
** * 58–60	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	end Tues. caving problems.
63–67	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 / Gravel / SP	11/11/15	10" Recov.	D-13	Lignite seam located above sample D-13

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
68–71	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	
73–76	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	plugging + caving caused delay —
78–80	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	
81–83						gravel [illegible] @ 81.5 to 83.2
83–85	Red-brown, very fine sand, subrounded to subangular, lignite, dense, sat.	SP	11/14/18	1½" Recov.	D-17	Coarse gravel placed in jar — from gravel layer

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
88–90	Blue-gray, clay, very stiff to hard, mottled, high plast., high dry strength, moist. ~~[illegible]~~	CH	6/9/14	9½ Recov.	D-18	
91–92						blue-gray water return
93–95	Same	CH	7/7/9	Full Recov.	D-19	caved in @ 40.2 end drilling.
96	T.D 95.2					
98–100				~~Recov.~~	~~D-20~~	

Surface Elevation: 322.2 Datum msl	Completion Date: 8/30/11				SHEAR STRENGTH, tsf: Δ - UU/2, O - 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)
DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES	
0	FILL: brown, fine sand		3-6-8	SS1	
			3-5-14	SS2	
5	FILL: brown, clayey sand				
	FILL: brown and gray, fine sand		6-12-15	SS3	
			7-12-11	SS4	
10					
	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	
45	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: 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-6

Project No. J019302.01

Surface Elevation: 322.1 | Completion Date: 8/30/11

Datum msl

SHEAR STRENGTH, tsf

Δ - UU/2 | O - QU/2 | ▯ - SV

0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE (ASTM D 1586)

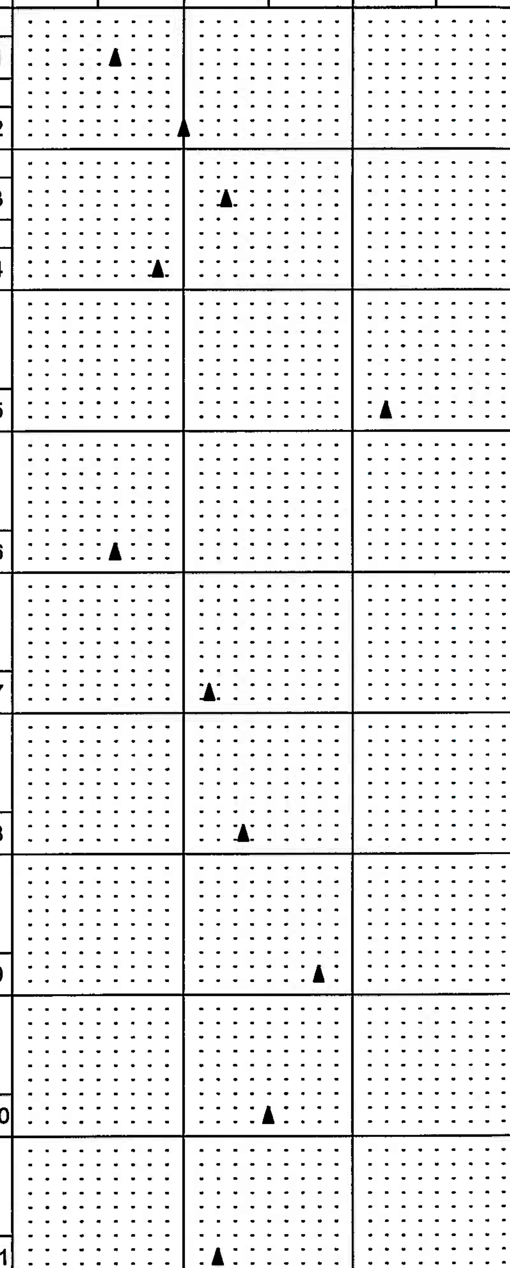
▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL ⊢—●—⊣ LL

10 20 30 40 50

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
0	FILL: brown, fine sand			
			4-5-7	SS1
5			5-9-11	SS2
			7-12-13	SS3
7	FILL: brown and gray, clayey SAND - SC			
			7-6-11	SS4
10				
12	Medium dense to dense, brown, fine to coarse SAND - SP			
15			11-19-25	SS5
20			4-5-7	SS6
25			7-10-13	SS7
30			12-12-15	SS8
35			13-15-21	SS9
40			10-14-16	SS10
45	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.

LOG OF BORING 2002 WL J019302.01 - SIKESTON.GPJ GTINC 0638301.GPJ 10/3/11

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: SZL	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

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	N-VALUE (BLOWS PER FOOT)
0	FILL: brown, fine sand				
5			4-11-14	SS1	
7	FILL: brown, silty sand				
10			9-12-14	SS2	
15			18-36-26	SS3	62
15	Medium dense, brown, silty SAND - (SM)				
20			9-8-8	SS4	
22	Medium dense, brown, fine to medium SAND - SP				
25			6-8-9	SS5	
25	Boring terminated at 25 feet.				

SHEAR STRENGTH, tsf

Δ - UU/2 O - 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

SHEAR STRENGTH, tsf: Δ - UU/2, O - 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)

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			2-3-5	SS1
9			8-22-23	SS2
14	Coal debris		12-14-17	SS3
17	Medium dense, brown and gray, fine to medium SAND -SP	∇		
19			8-11-14	SS4
20	Boring terminated at 20 feet.			

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: NHM
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   Completion Date: 9/1/11

Datum msl

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
0	Medium dense, gray, silty SAND - SM	5-8-9	SS1
3	Loose to medium dense, brown and gray, fine to medium SAND - (SP)	3-4-4	SS2
		4-6-6	SS3
		3-4-6	SS4
		4-6-9	SS5
		8-8-9	SS6
		9-8-8	SS7
26.5	Medium dense, brown and gray, fine to coarse SAND with gravel - SP	5-6-7	SS8
		6-6-6	SS9
35	Boring terminated at 35 feet.		

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 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 Date: 9/7/11 | Checked by: SLC Date: 10/3/11 | App'vd. by: MHM 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 | Completion Date: 9/1/11

Datum msl

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) / SPT BLOW COUNTS / CORE RECOVERY/RQD	SAMPLES	N-VALUE (BLOWS PER FOOT)
0–3	Hard, gray SILT - ML	14-24-14	SS1	
3–35	Loose to medium dense, brown to gray, fine to medium SAND - (SP)	3-5-5	SS2	
		4-4-5	SS3	
		4-6-8	SS4	
11.5	▽			
		3-5-9	SS5	
		9-10-12	SS6	
		8-6-5	SS7	
28	with gravel	6-9-14	SS8	
		6-9-12	SS9	
35	Boring terminated at 35 feet.			

SHEAR STRENGTH, tsf: Δ - UU/2, O - 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 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 THICK-NESS IN.	MATERIAL	TYPE	NO.
Screen	43	18			Stainless Steel	Cook / ~~Shutter~~ ~~Keystone~~	0.060 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"

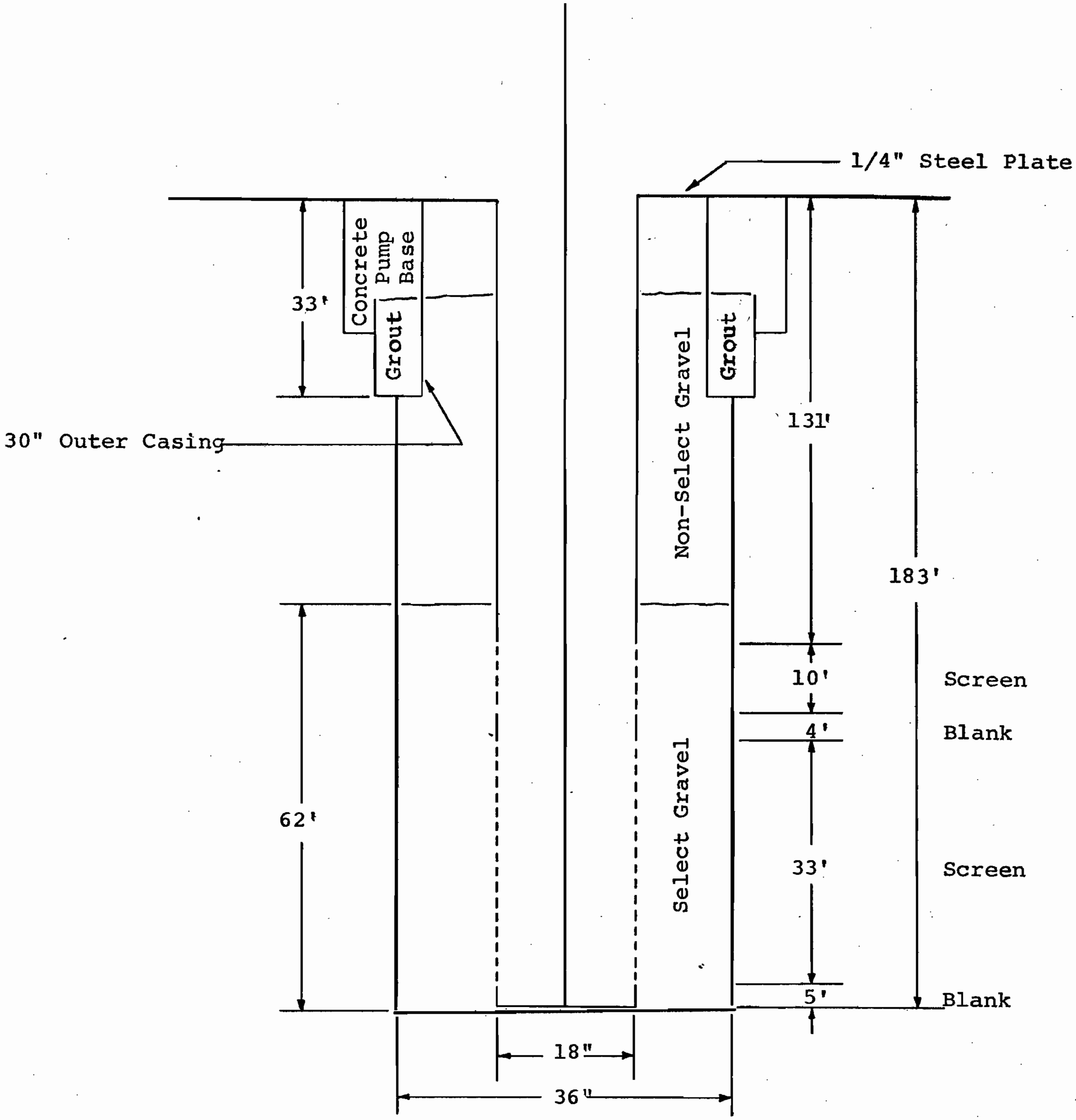
    Comments

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	DATE RECEIVED
00517353	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
OWNER ADDRESS: 1551 WEST WAKEFIELD STREET	CITY: SIKESTON	STATE: MO	ZIP: 63801	NUMBER ________
SITE NAME: SIKESTON POWER STATION		WELL NUMBER: TPZ3		COUNTY: SCOTT
SITE ADDRESS		CITY		STATIC WATER LEVEL: 10.09 FT

SURFACE COMPLETION

TYPE: [X] 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.

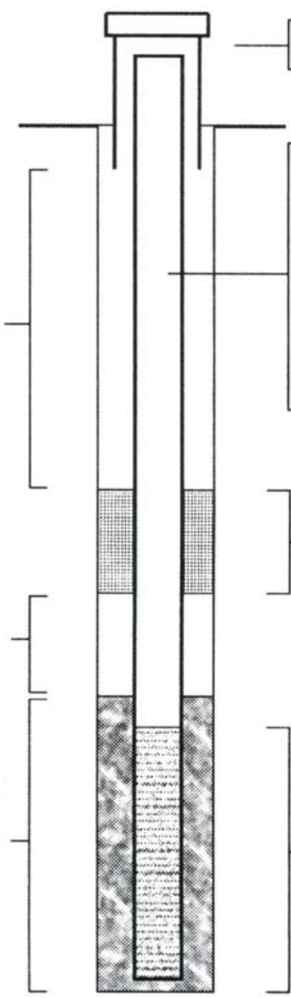
SURFACE COMPLETION GROUT: [X] CONCRETE [ ] OTHER

LOCATION OF WELL: LAT. 36 ° 52' 37.11" LONG. 89 ° 36' 43.07"

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

SEC. 24 TWN. 26 NORTH RANGE 13 Direction E

[ ] LOCKING CAP
[ ] WEEP HOLE



ELEVATION ______ FT.

ANNULAR SEAL
LENGTH 16.5 FT.
[ ] SLURRY [ ] CHIPS [ ] PELLETS [ ] GRANULAR [ ] CEMENT/SLURRY

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

SECONDARY FILTER PACK
LENGTH: 0.0 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK: 22.1 FT.

LENGTH OF PRIMARY FILTER PACK: 13.4 FT.

SURFACE COMPLETTION
[X] STEEL [ ] ALUMINUM [ ] PLASTIC

RISER
RISER PIPE DIAMETER 2.0 IN.
RISER PIPE LENGTH 27.1 FT.
HOLE DIAMETER 8.5 IN.
WEIGHT OR SDR# SCH40

MATERIAL
[ ] STEEL [X] THERMOPLASTIC (PVC) [ ] OTHER ______

BENTONITE SEAL
LENGTH: 3.1
[ ] CHIPS [ ] PELLETS [ ] GRANULAR [ ] SLURRY [ ] SATURATED ZONE [ ] HYDRATED

SCREEN
SCREEN DIAMETER: 2.0 IN.
SCREEN LENGTH: 10.0 FT.
DIAMETER OF DRILL HOLE: 8.5 IN.
DEPTH TO TOP 25.5 FT.

SCREEN MATERIAL
[ ] STEEL [X] THERMOPLASTIC (PVC) [ ] OTHER

MONITORING FOR:
[ ] RADIONUCLIDES [ ] PETROLEUM PRODUCTS ONLY [ ] EXPLOSIVES [ ] METALS [ ] VOC [ ] SVOCS [ ] PESTICIDES/HERBICIDES

PROPOSED USE OF WELL:
[ ] GAS MIGRATION WELL [ ] OBSERVATION [ ] EXTRACTION WELL [ ] OPEN HOLE [X] PIEZOMETERS [ ] DIRECT PUSH

DEPTH FROM	DEPTH TO	FORMATION 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.

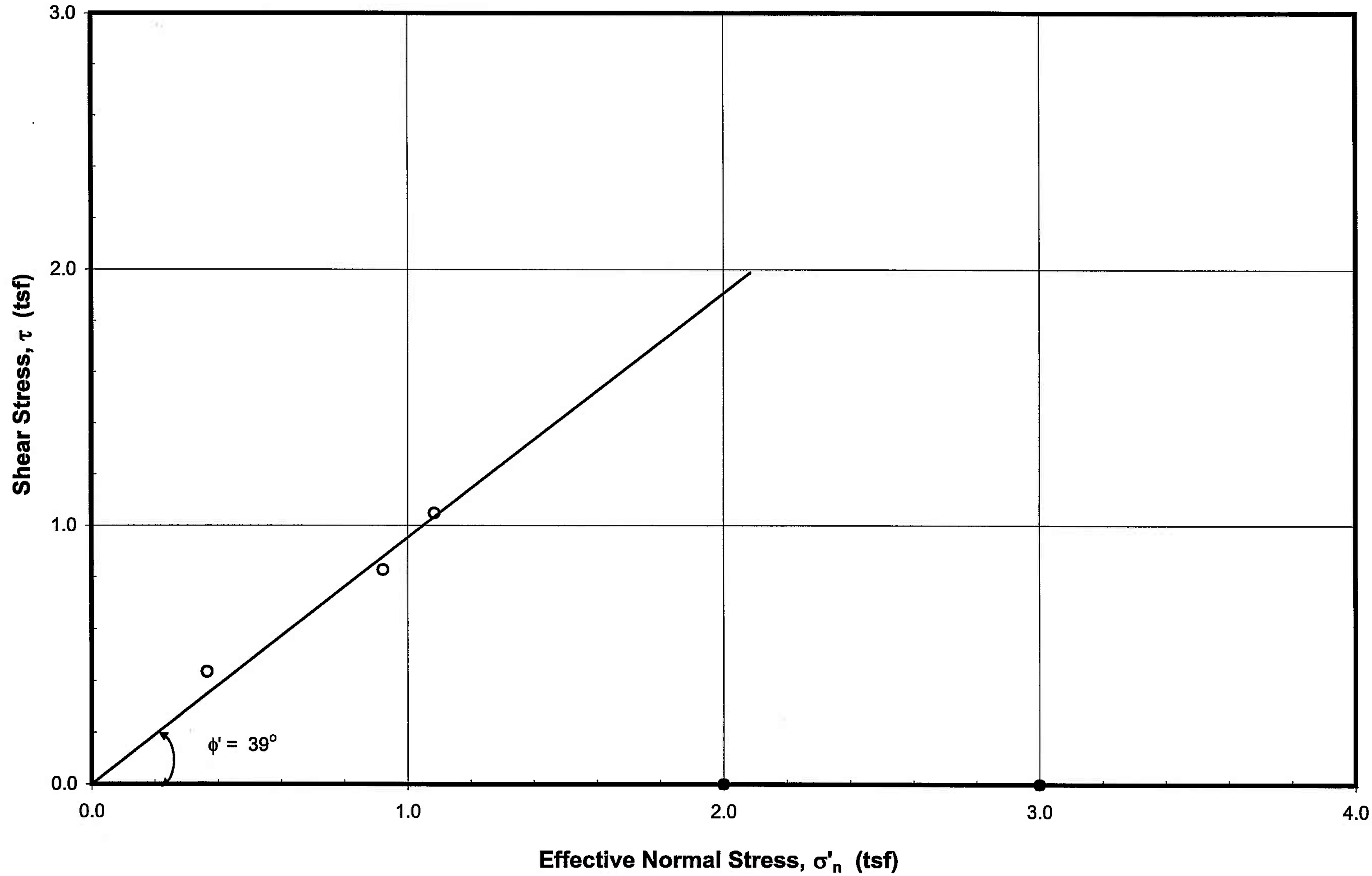
SIGNATURE (PRIMARY COUNTRACTOR) x KEN EWERS	PERMIT NUMBER 006218	DATE WELL DRILLING WAS COMPLETED 05/13/2016

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

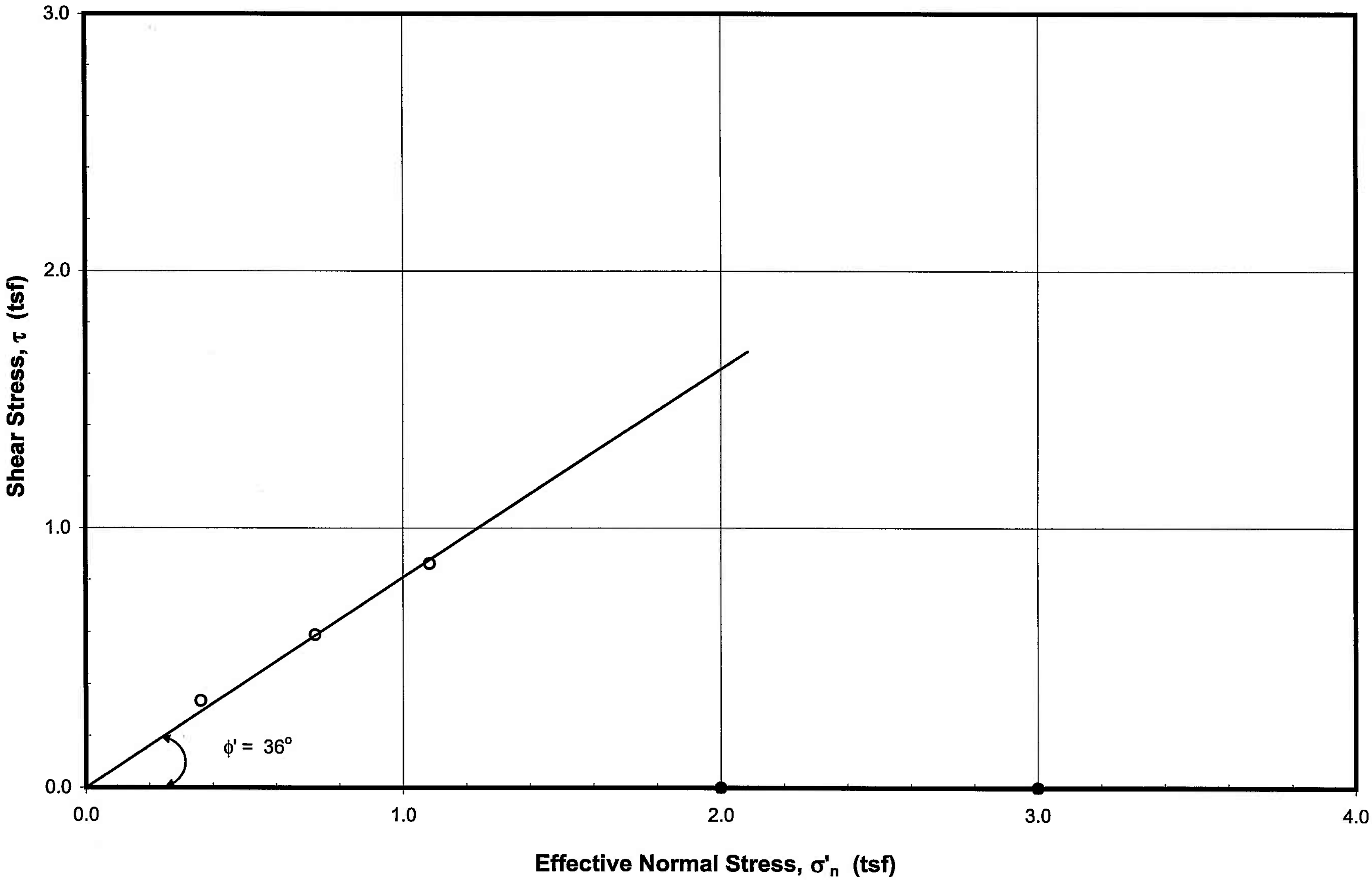


DRAINED DIRECT SHEAR TEST

ASTM D 3080

Boring: Composite B-1 & 2 (From auger cuttings 0-20 ft)

GEOTECHNOLOGY INC
FROM THE GROUND UP

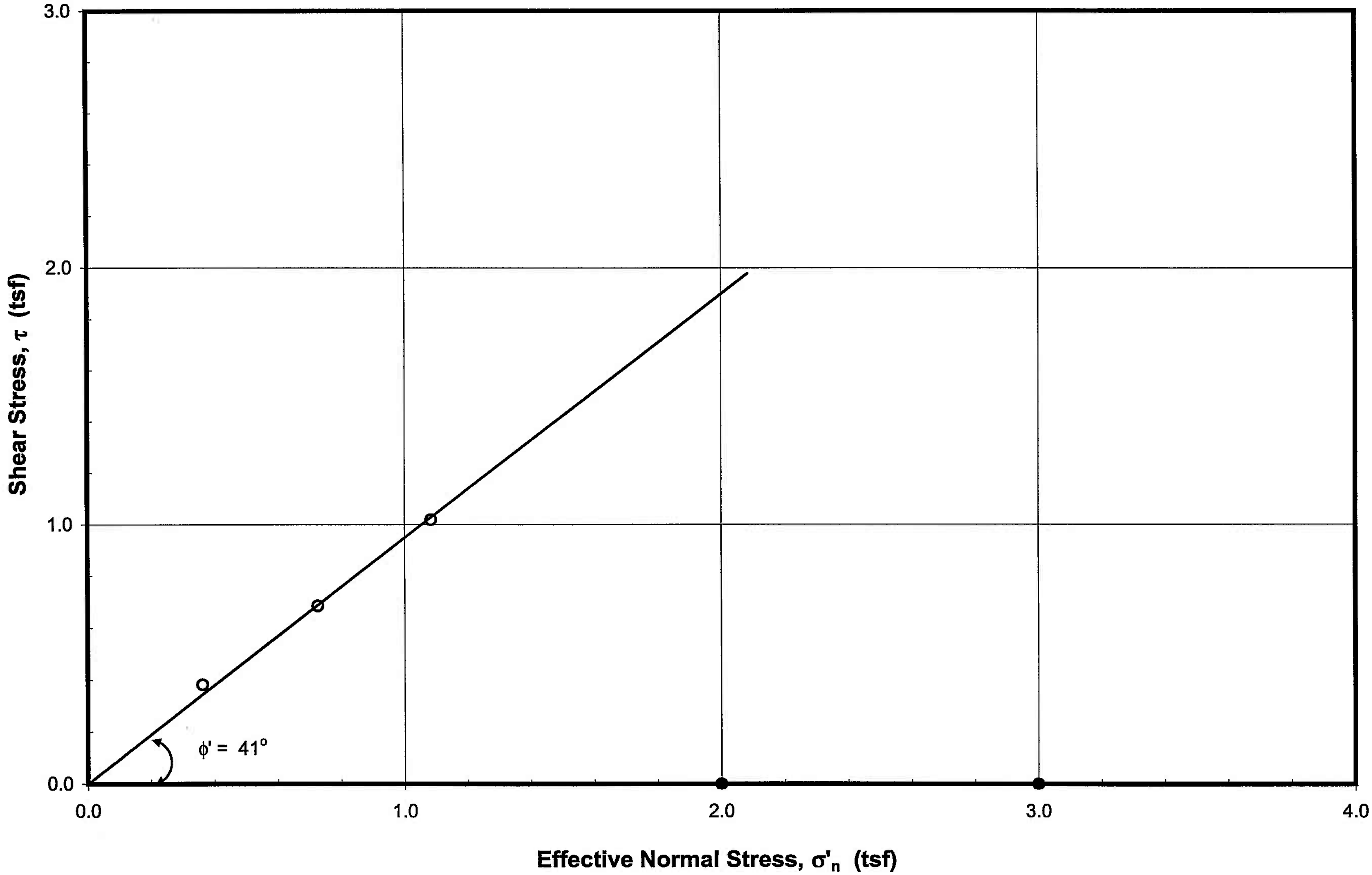


DRAINED DIRECT SHEAR TEST

ASTM D 3080

Boring: Composite B-6 & 7 (From auger cuttings 0-20 ft)

GEOTECHNOLOGY INC
FROM THE GROUND UP

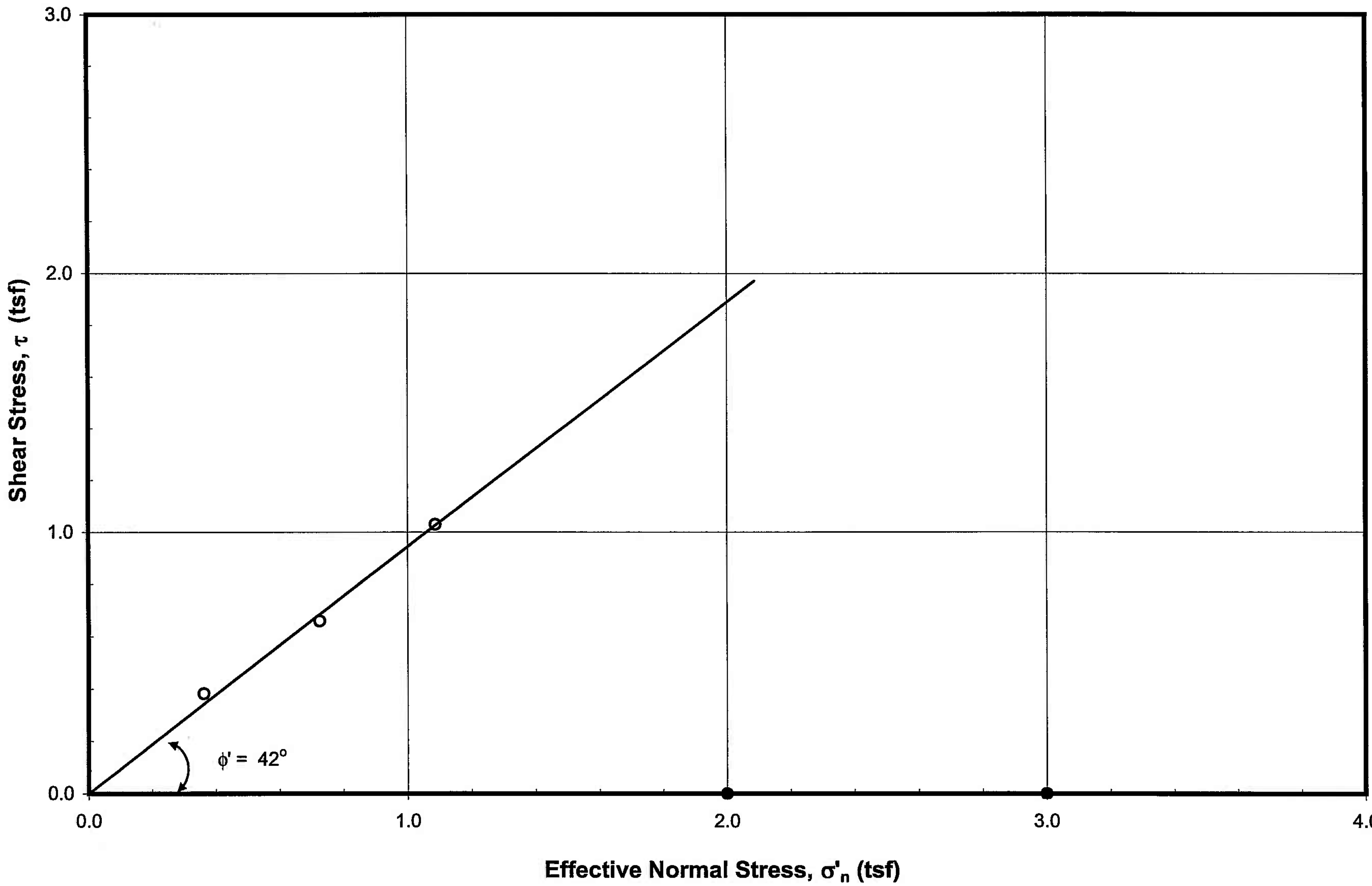


DRAINED DIRECT SHEAR TEST

ASTM D 3080

Boring: Composite B-11 & 12 (From auger cuttings 0-15 ft)

GEOTECHNOLOGY INC
FROM THE GROUND UP



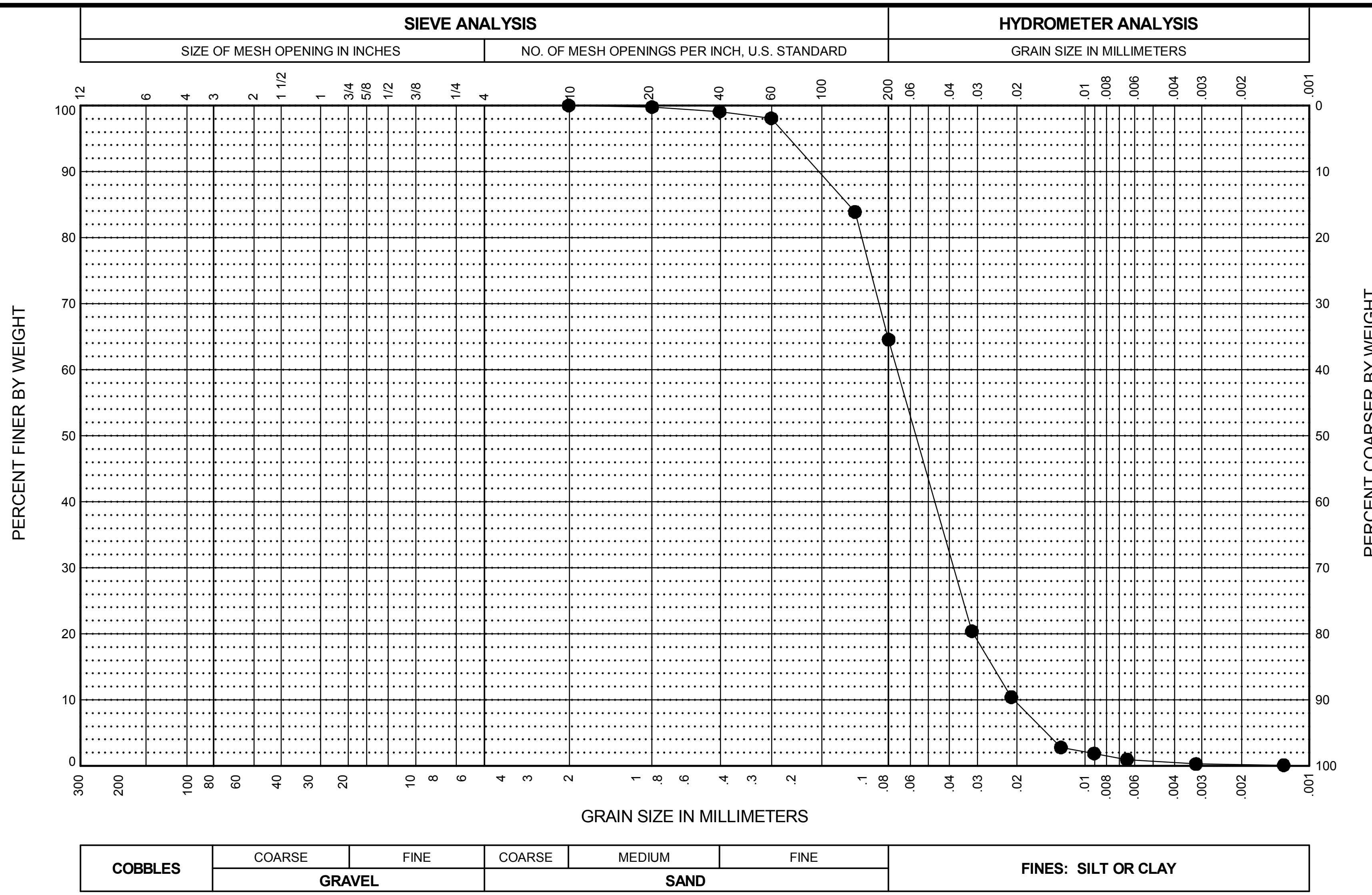
DRAINED DIRECT SHEAR TEST

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

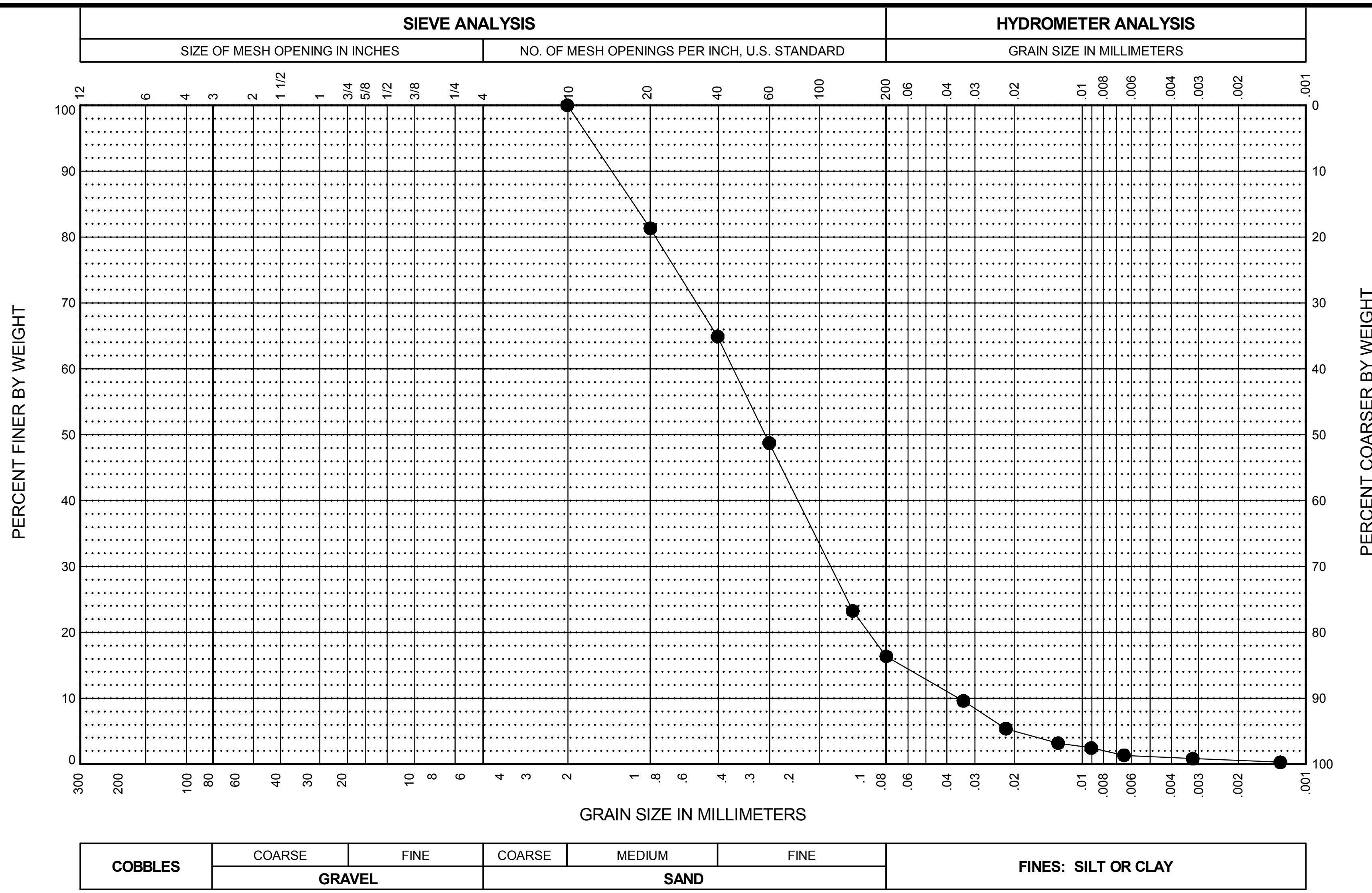
41-1-37431-005

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG.

FIG.

HAL 41-1-37431-005 LAB DATA.GPJ SHAN_WIL.GDT 8/5/16



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

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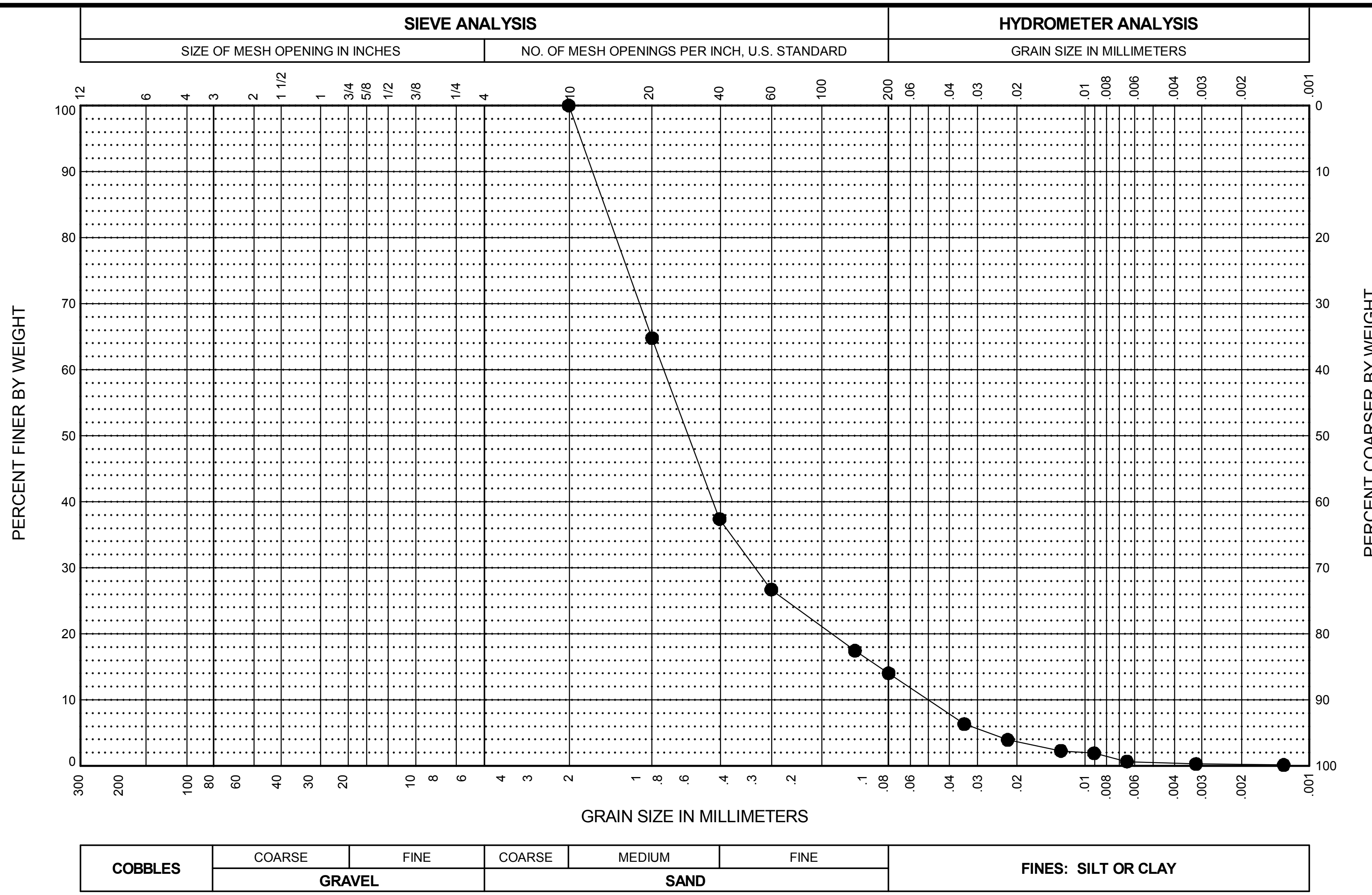
FIG.

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

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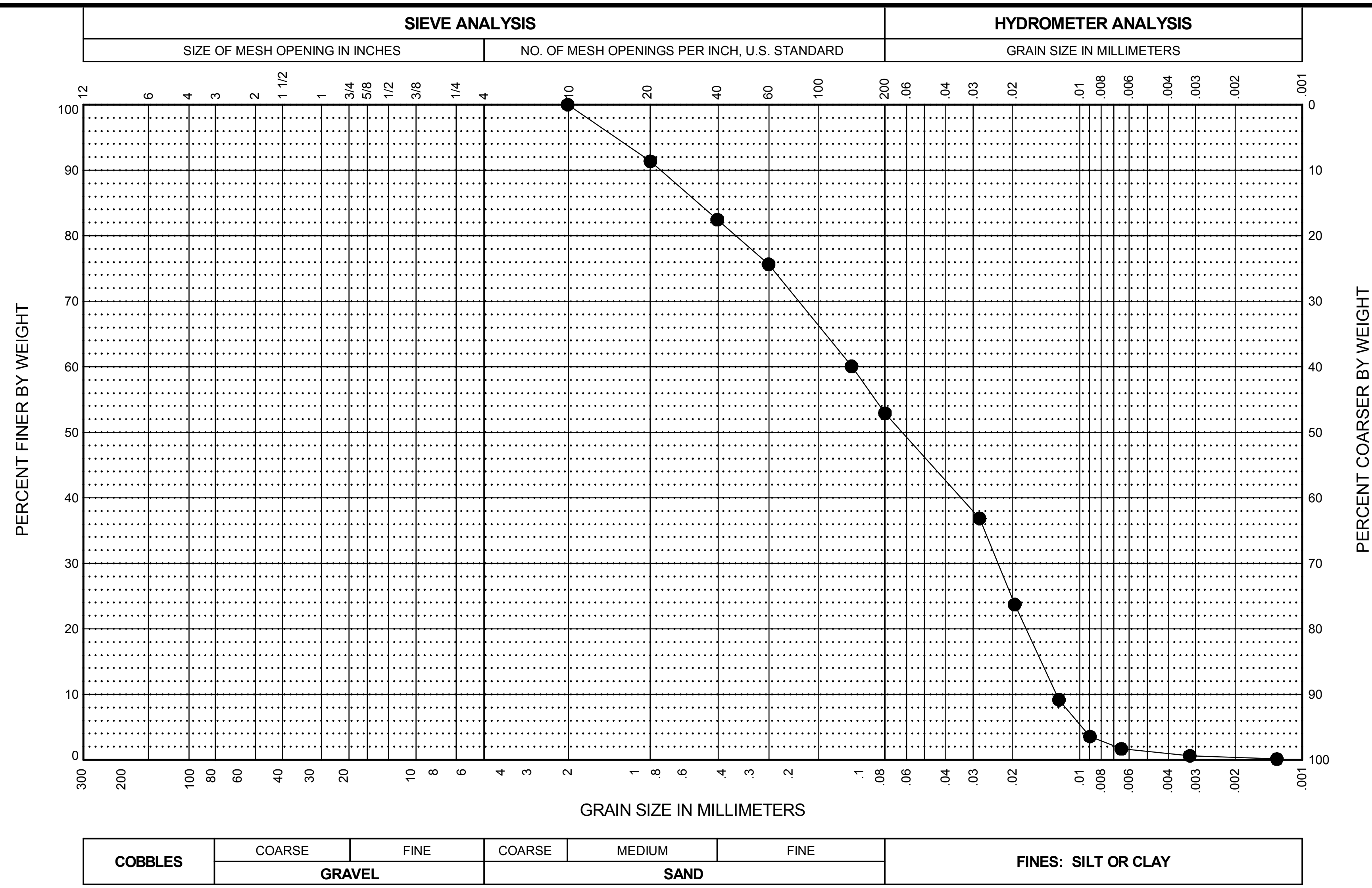
FIG.

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-4	ML	Light tan and gray, Sandy Silt.	52.9	54.1			

Sikeston Project
Sikeston, Missouri

GRAIN SIZE DISTRIBUTION

41-1-37431-005

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Geotechnical and Environmental Consultants

FIG.

FIG.

HAL 41-1-37431-005 LAB DATA.GPJ SHAN_WIL.GDT 8/5/16

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

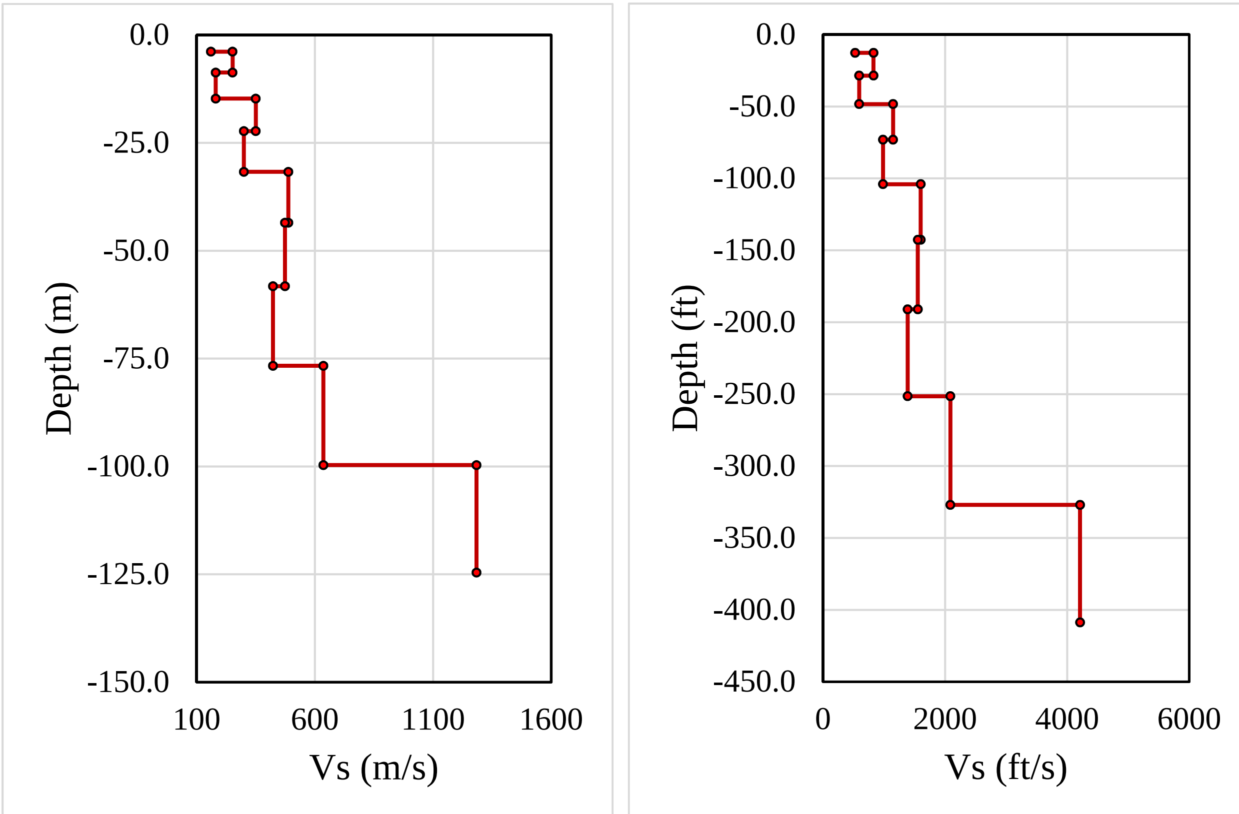

Figure 4: Graph of shallow V_s profile in meters (left) and feet (right).

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).

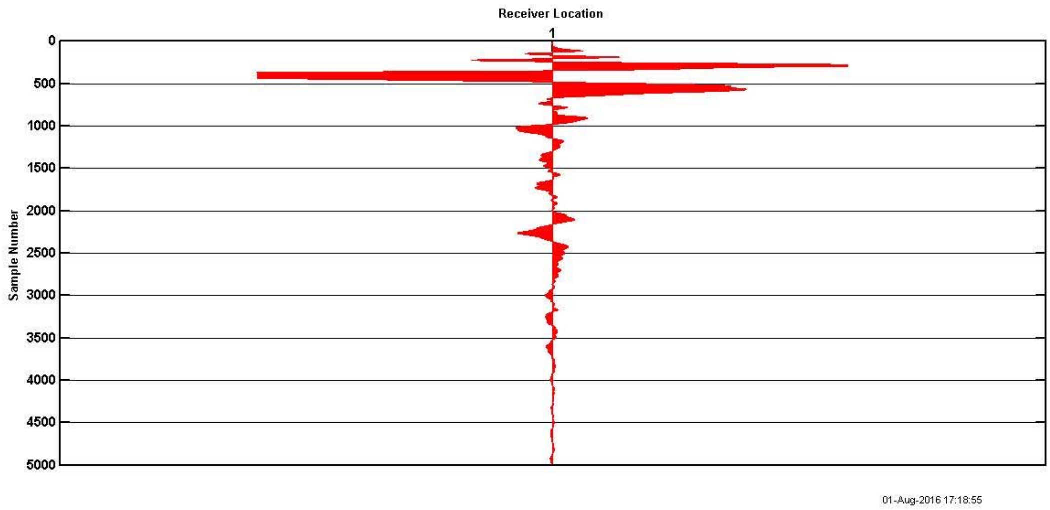

Figure 5: Single 450 lb. weight-drop shot record from the geophone nearest the shot. Two reflections are located near sample 1000 and 2200 (breaking to the left). The reflection amplitudes are greater than the shot noise on either side of them. Adjacent geophone records suggest that these reflections have normal moveout (confirming them as reflections).

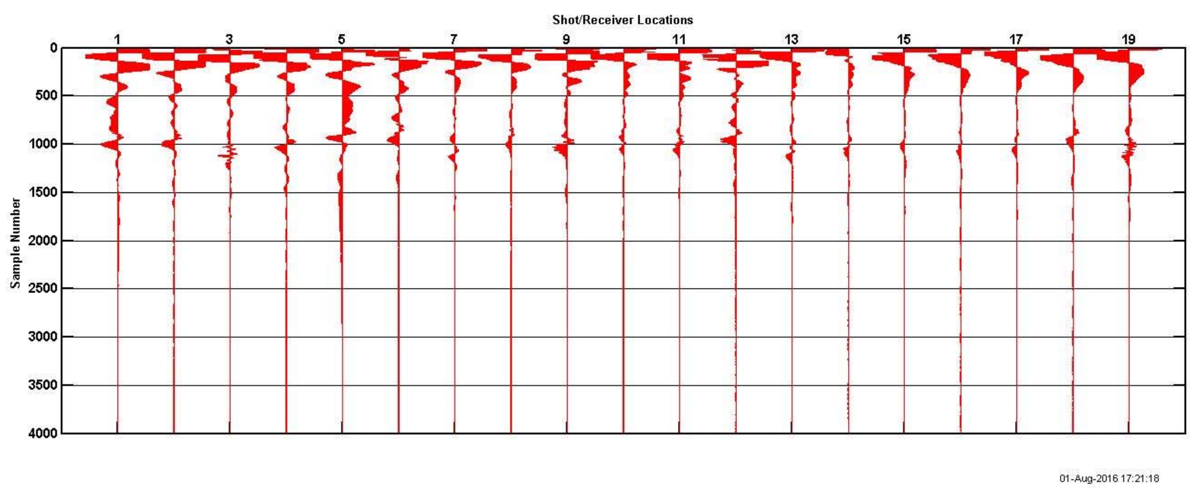

Figure 6: 19 at shot point geophone records (3 stacked records per shot point) from the MASW survey. The shot points are spaced 4 m apart along the spread. The shallow reflector in Figure 5 also appears on these records near sample 1000. There is variation in the arrival time along this profile likely from variations in the first layer (above water table) thickness and shear-wave velocity.

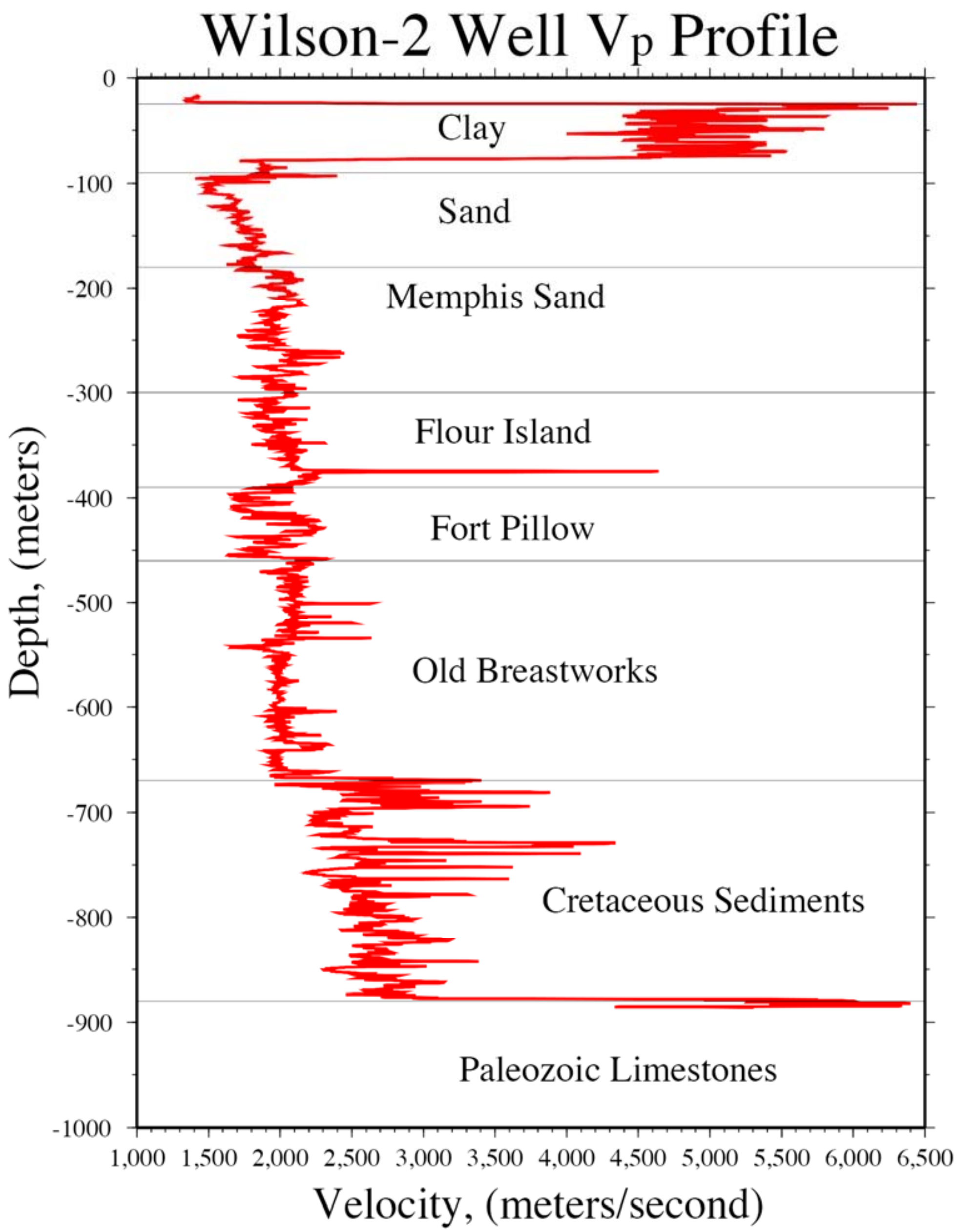

Figure 7: Wilson-2 V_P log with geology (Cramer et al., 2004, Figure 6).

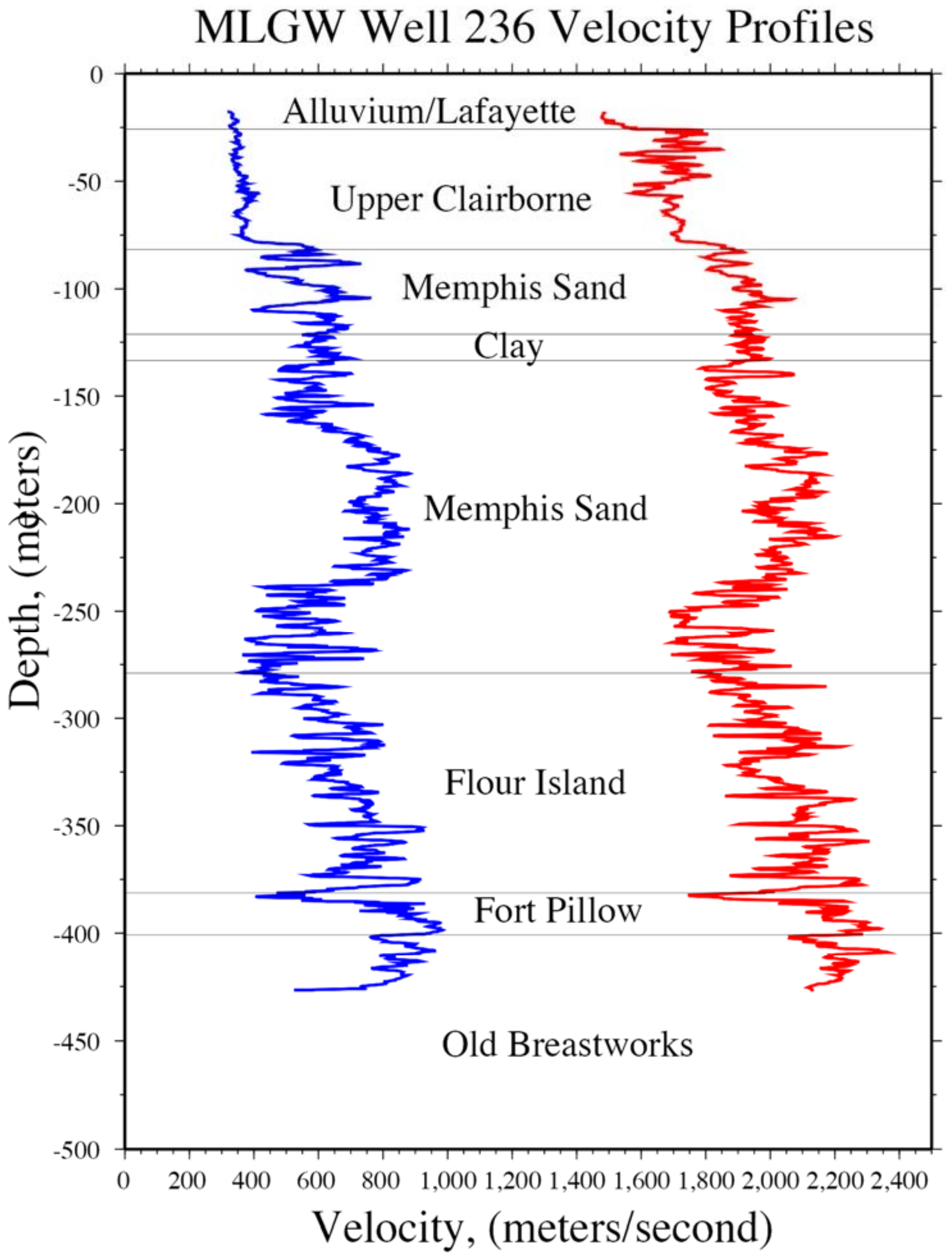

Figure 8: MLGW well 236 V_p and V_s logs with geology (Cramer et al., 2004, Figure 5).

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.

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APPENDIX D

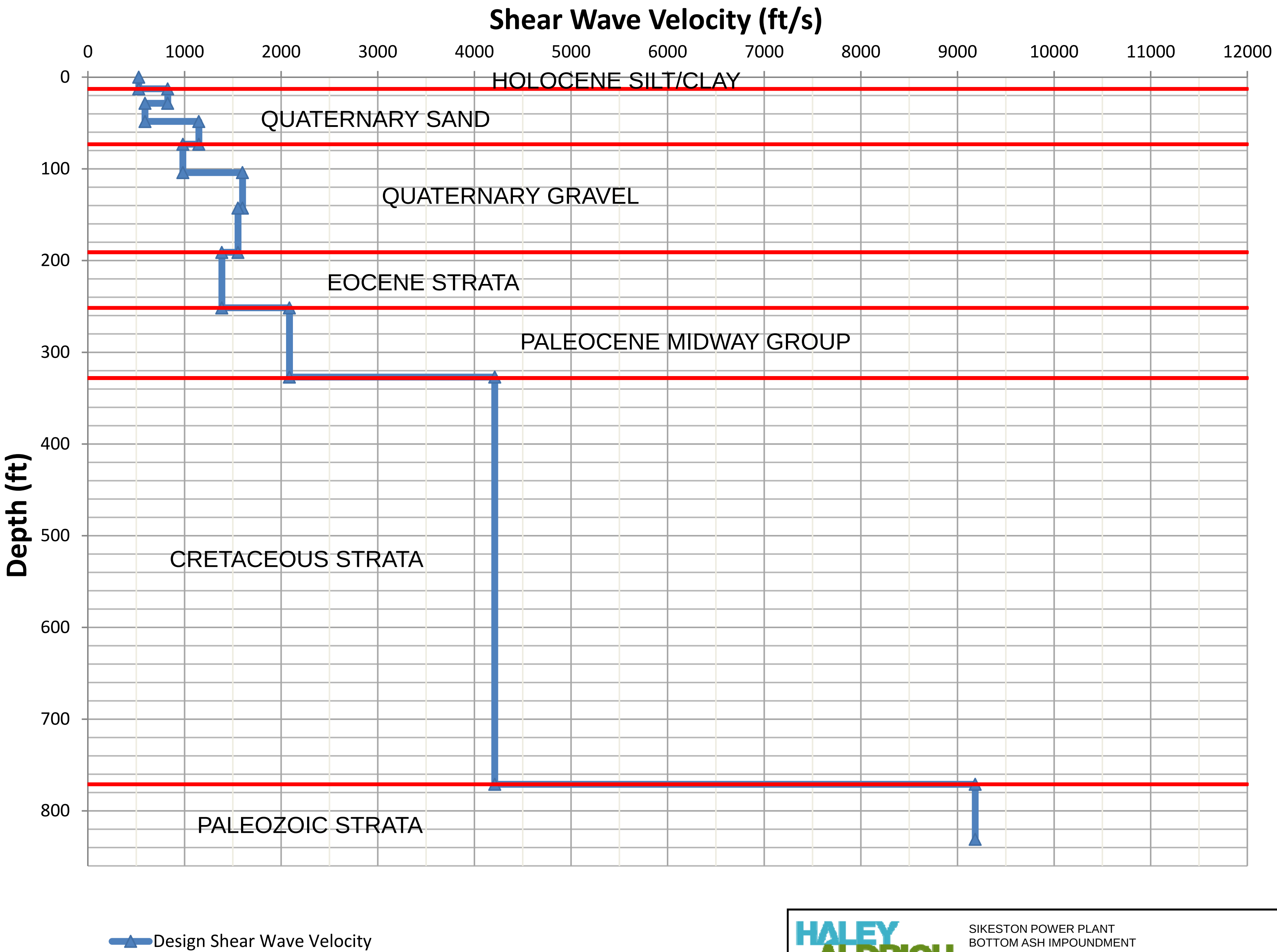
Analyses

Design Soil Properties

SOIL PROPERTY CHARACTERIZATION - SIKESTON BOTTOM ASH POND

Material	Total Unit Weight, γ_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.					
	γ_T	γ_T	γ_T		γ_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.



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 84^{th}-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

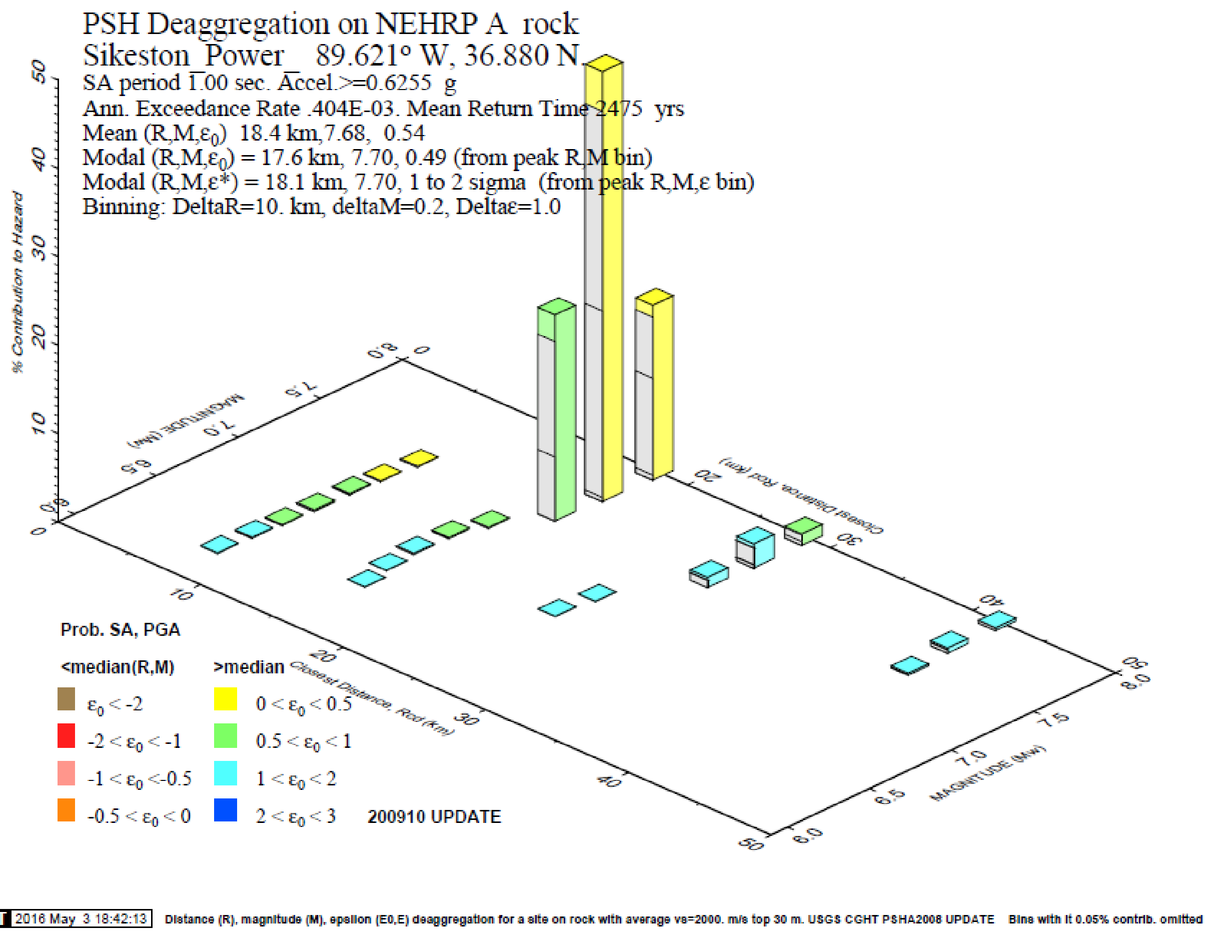


Figure 1: Deaggregation Plot for Sikeston at T = 1.0 s

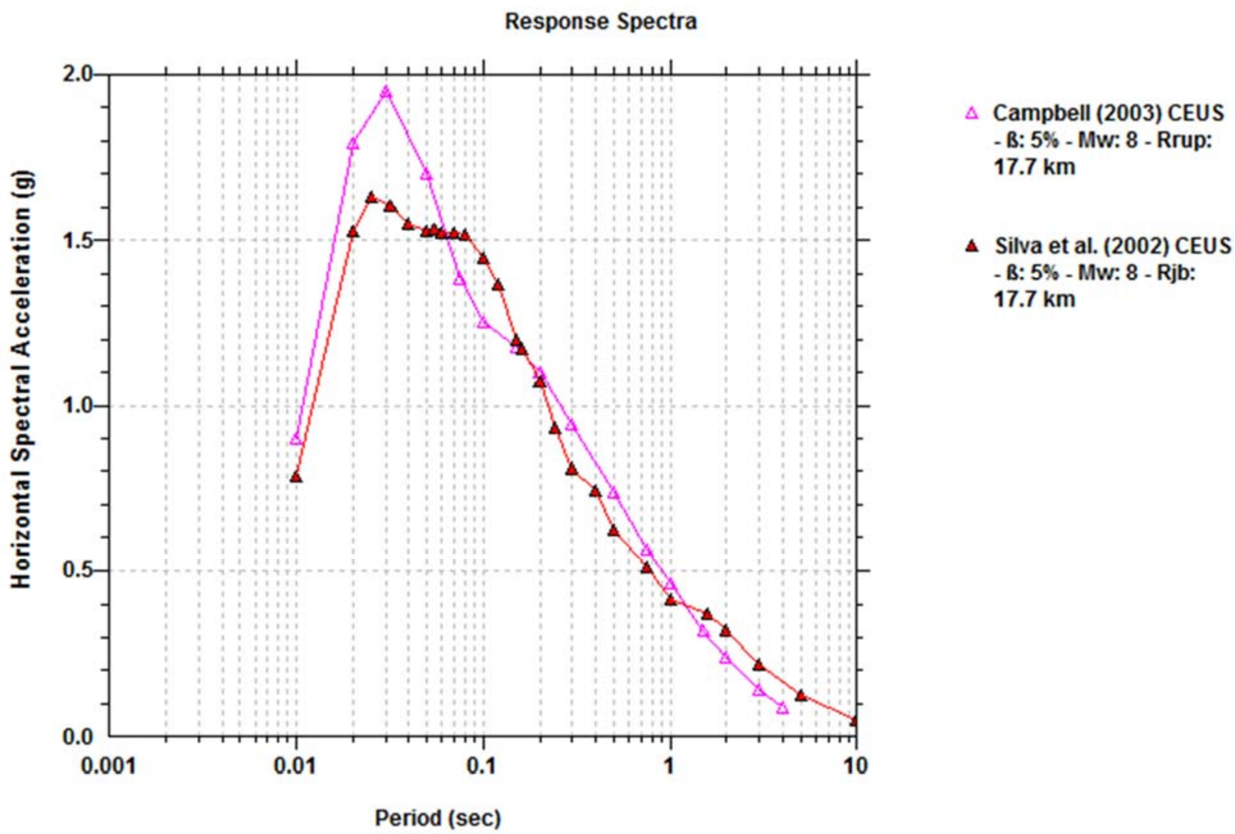


Figure 2: GMPE's -Attenuation models for Sikeston

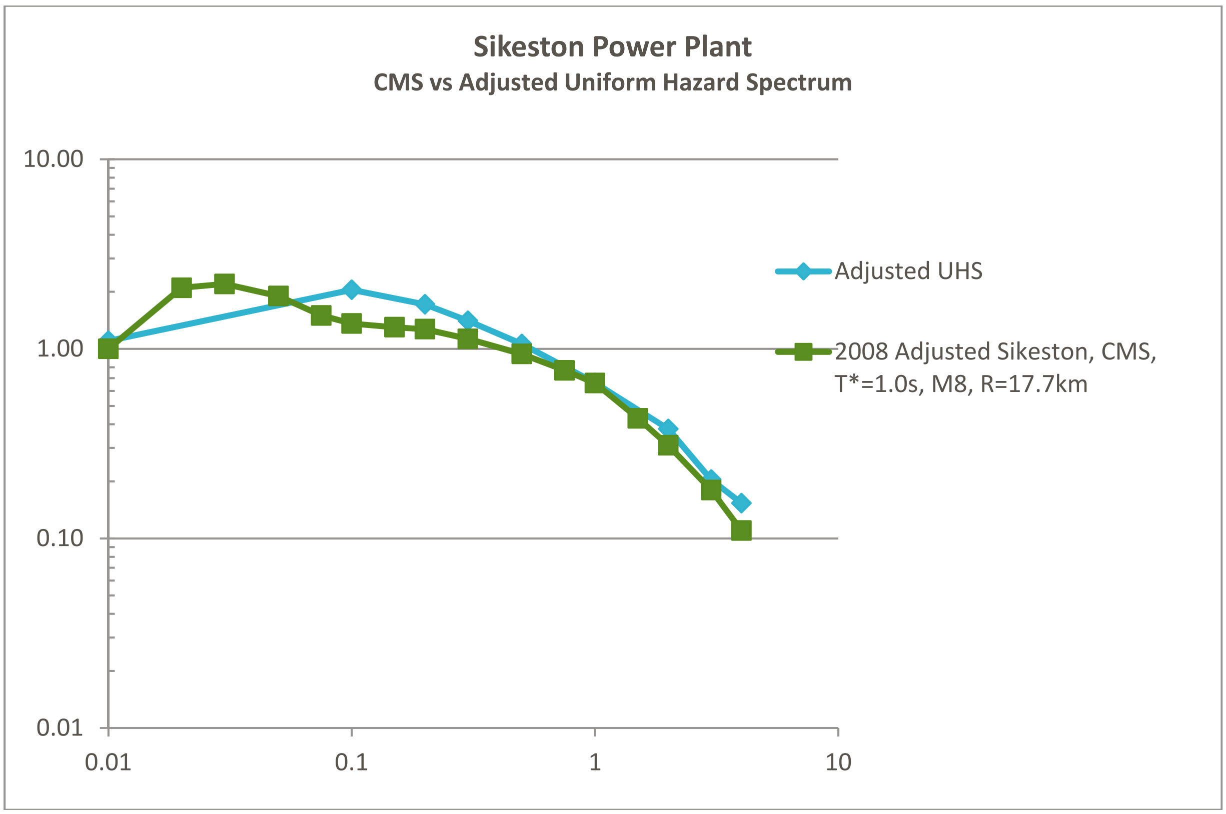


Figure 3: 2008 Uniform Hazard Spectrum and Conditional Mean Spectrum for Sikeston Power Plant

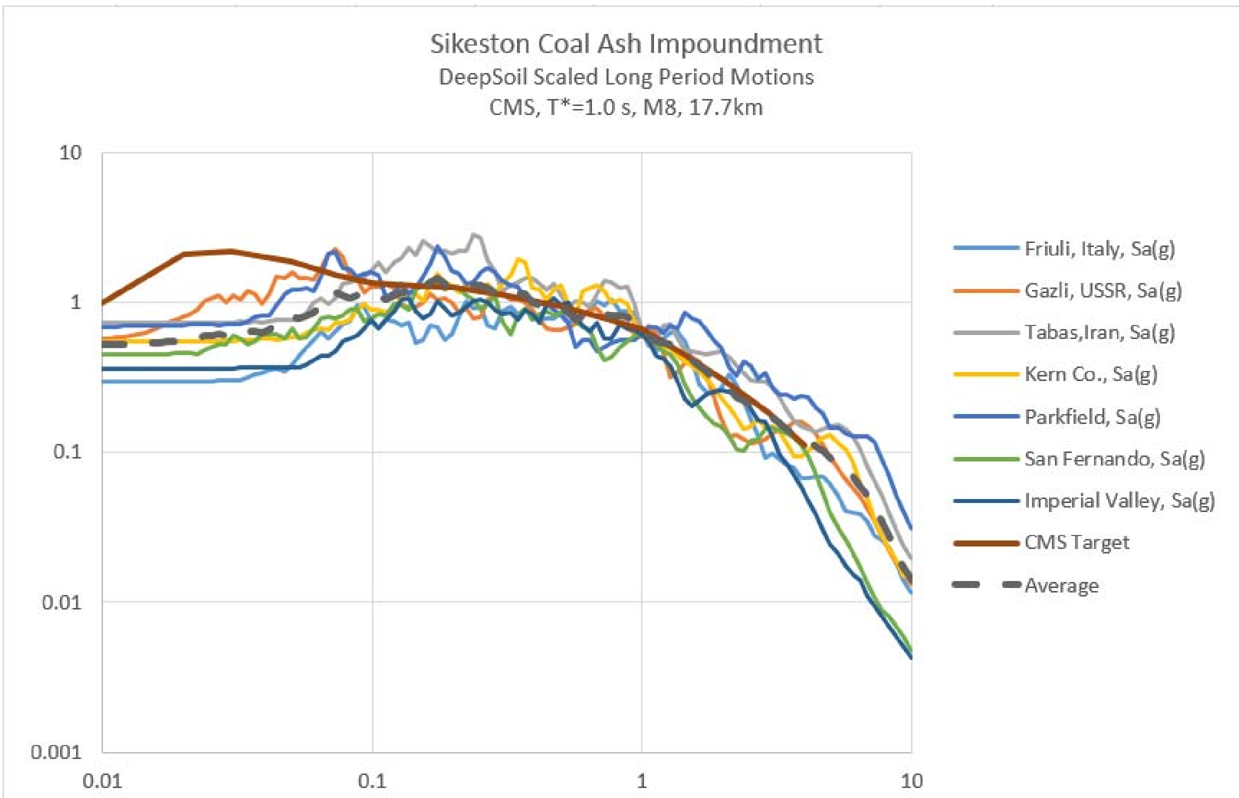
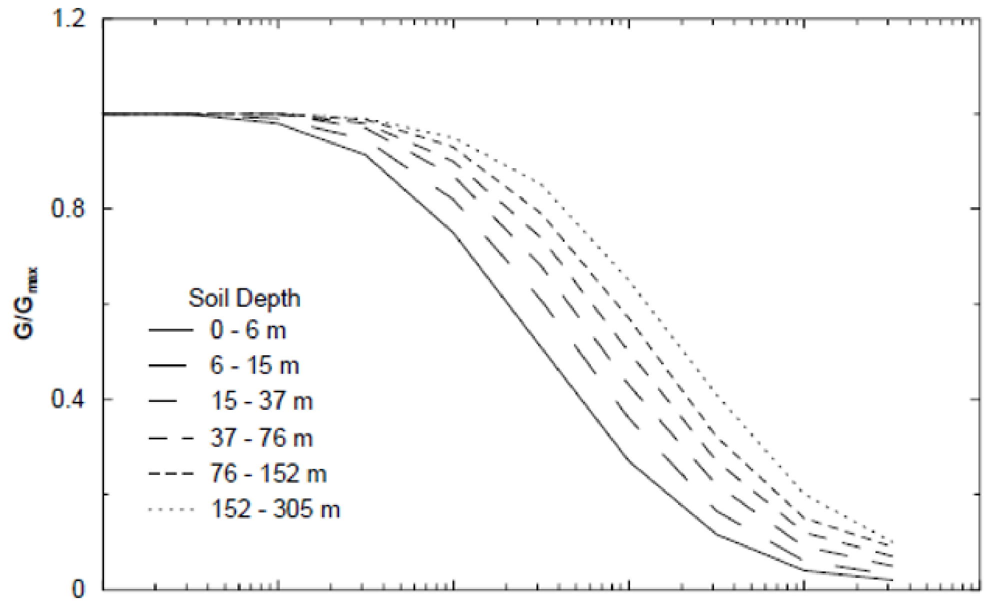


Figure 4: Ground motions scaled to CMS at target T*=1.0s



(a) Modulus reduction curves

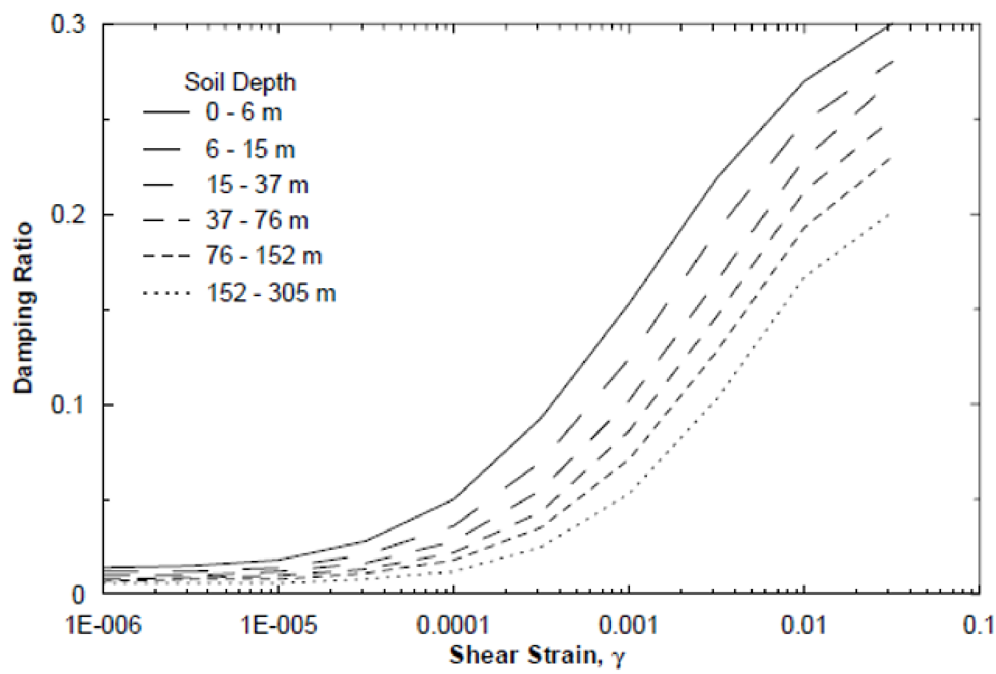


Figure 5: EPRI (1993) (a) modulus reduction and (b) damping curves

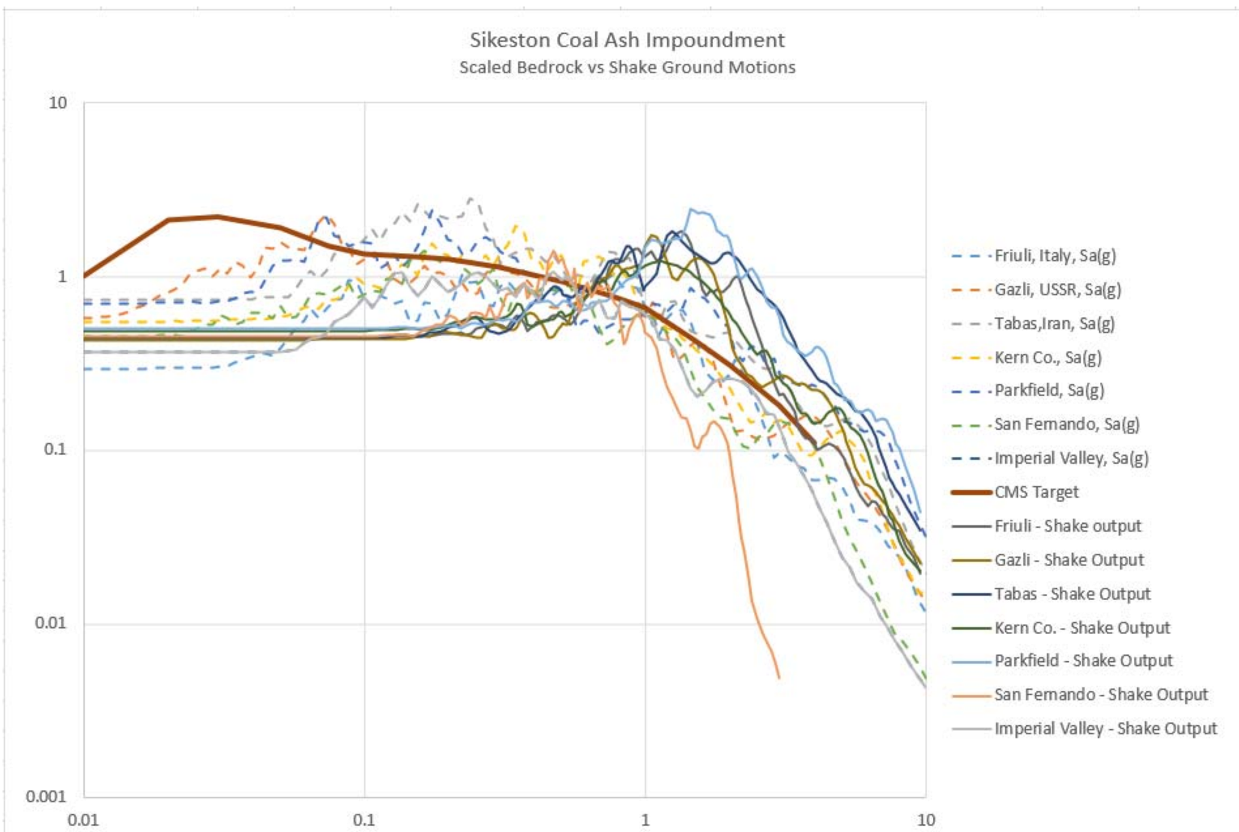


Figure 6: Comparison between input motions to Shake and output. Note that spectral response has shifted to longer periods

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 displacement (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)** Min (in)	Avg (in)	Maximum (in)	Adjusted Newmark Displacement (Inches) 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

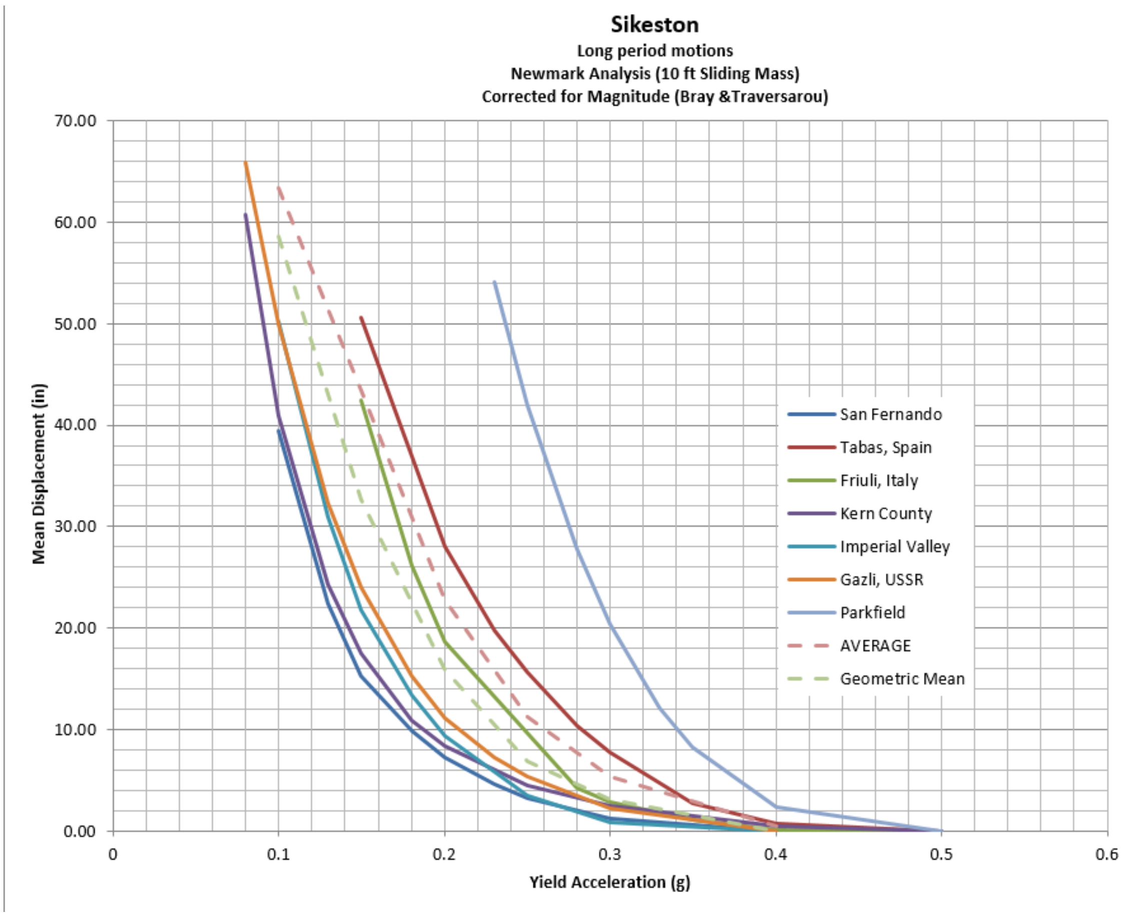
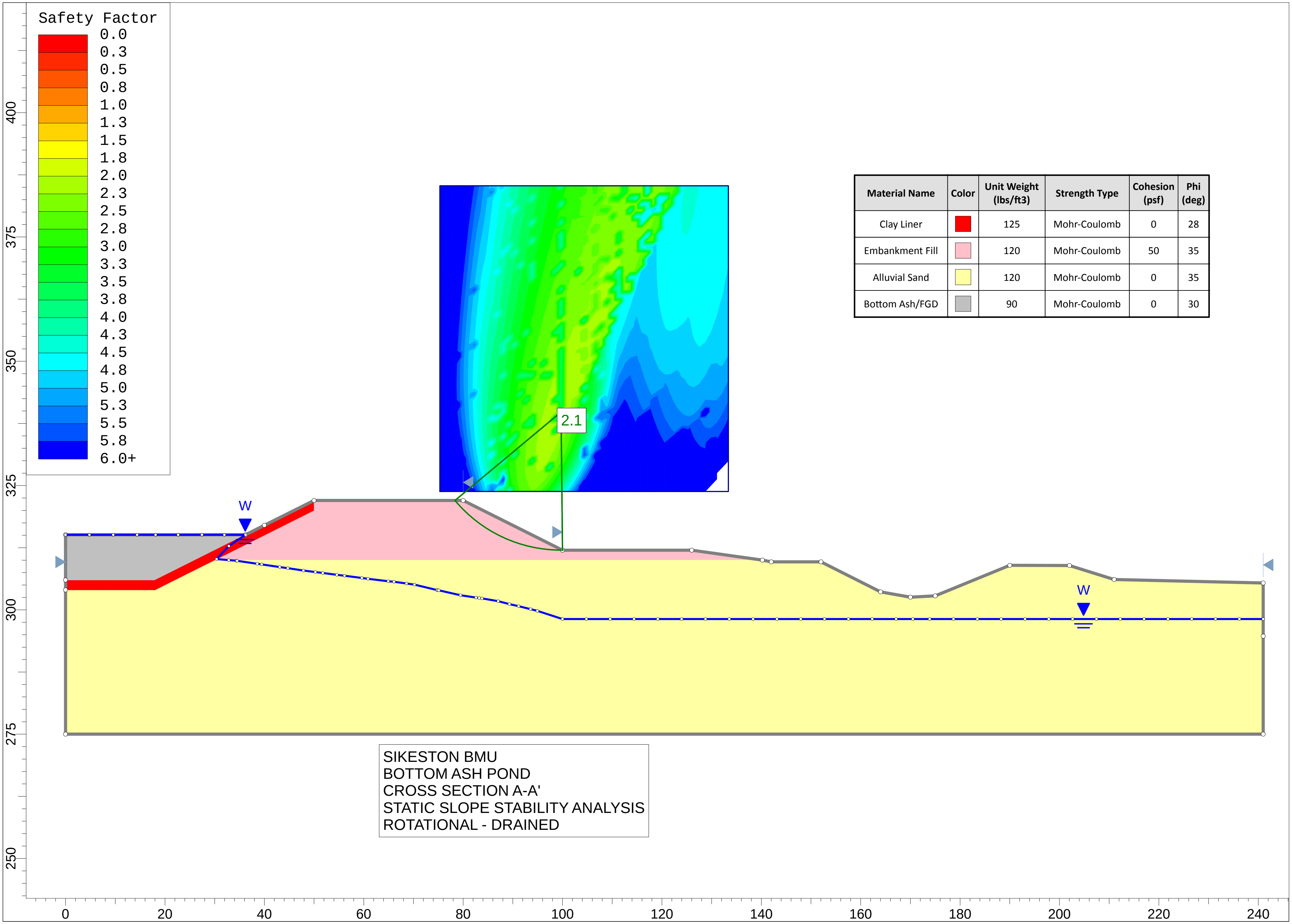
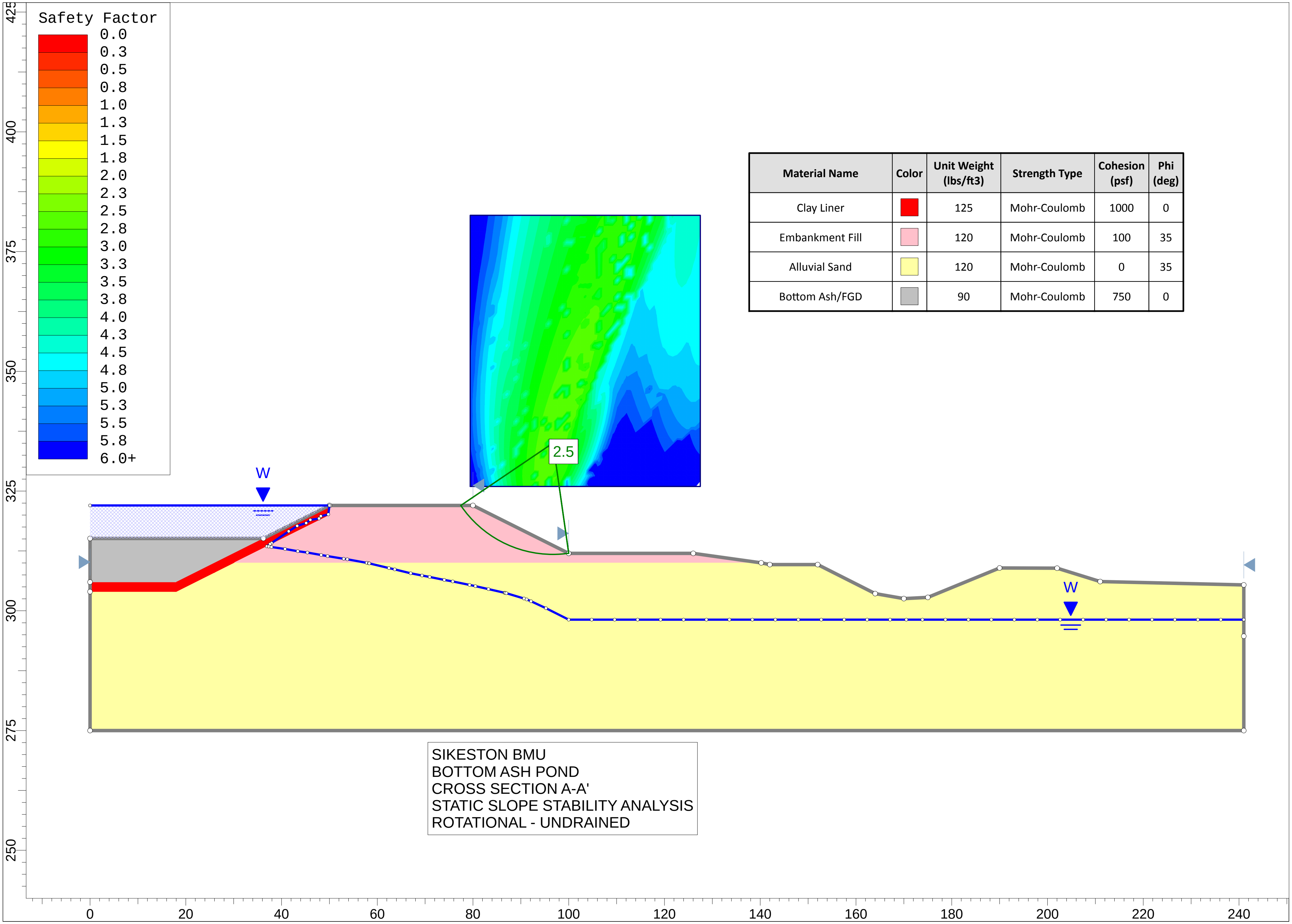


Figure 8: Newmark Block Displacement Analysis for Sikeston

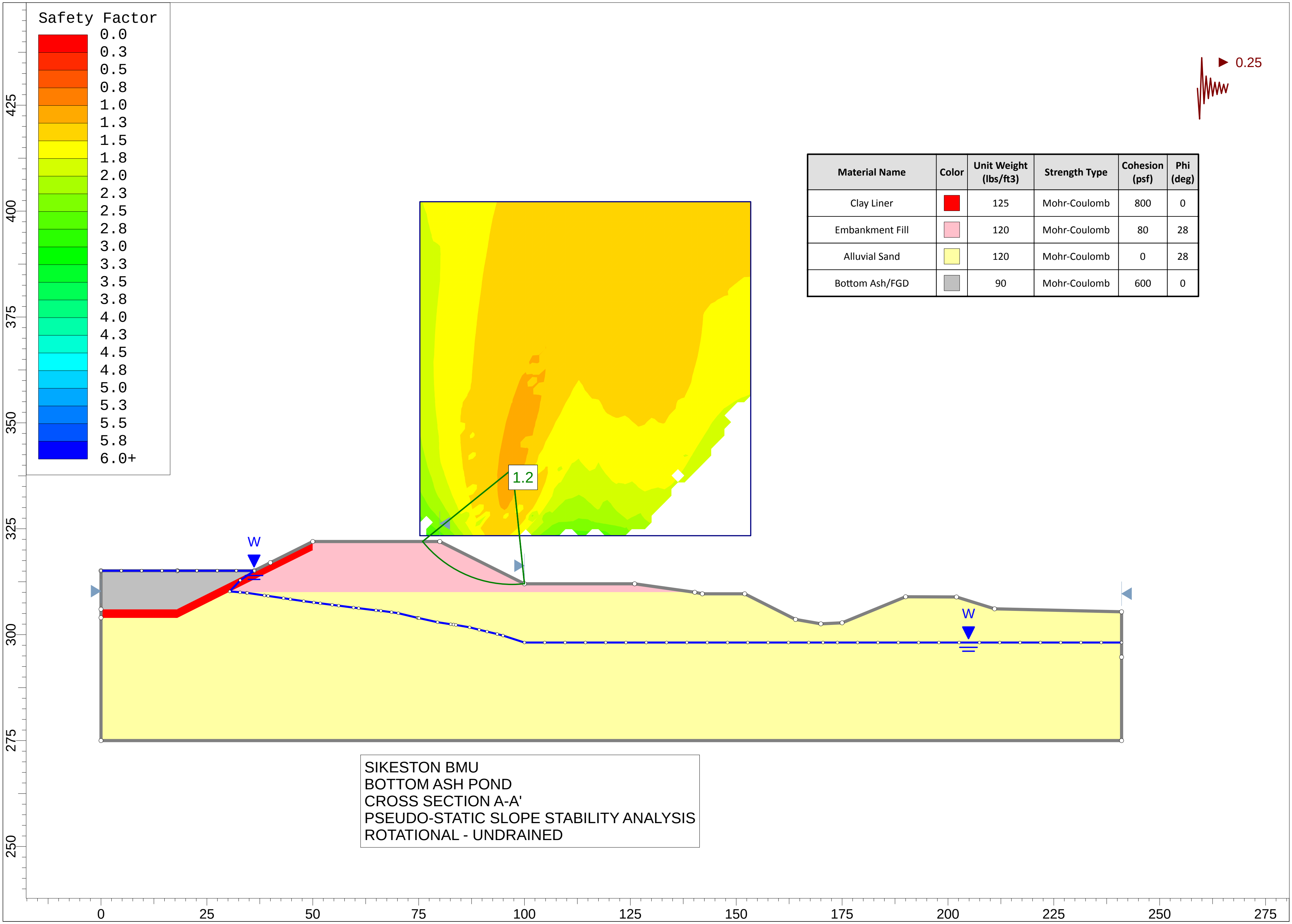
Slope Stability



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



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



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

REPORT
2018120907

SAFETY FACTOR ASSESSMENT FOR SIKESTON POWER STATION FLY ASH POND SIKESTON, MISSOURI

Prepared for

GREDELL ENGINEERING RESOURCES, INC.
Jefferson City, Missouri

and

SIKESTON BOARD OF MUNICIPAL UTILITIES
Sikeston, Missouri

Prepared by

REITZ & JENS, INC.
CONSULTING ENGINEERS

STATE OF MISSOURI
JEFFREY LYNN FOUSE
NUMBER E-21043
REGISTERED PROFESSIONAL ENGINEER

3/12/2018

March 12, 2018

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

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March 12, 2018

GREDELL Engineering Resources, Inc.
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Attention: Mr. Mikel C. Carlson, R.G.
Senior Geologist

RE: Report of Safety Factor Assessment for
Sikeston BMU / Sikeston Power Station Fly Ash Pond
Sikeston, Missouri

Introduction

This report presents our findings from our safety factor assessment for the fly ash pond at the Sikeston Board of Municipal Utilities (BMU) Sikeston Power Station, which is located on West Wakefield Avenue in Sikeston, Missouri. Our analyses were done to satisfy the requirements of 40 CFR Part 257.73(e) "Periodic Safety Factor Assessments" for an existing Coal Combustion Residuals (CCR) surface impoundment that was published on April 17, 2015 (U.S. EPA "CCR Rule"). This is the initial safety factor assessment for the fly ash pond. This work was done in general accordance with our proposal to GREDELL Engineering Resources, Inc. (GREDELL), dated January 2, 2018.

The safety factor assessment requires the calculation of the factor of safety against slope failure of the dike of the CCR unit at the critical cross-section for four loading conditions:

1. Static load condition under the long-term, maximum storage pool;
2. Static load condition under the maximum surcharge;
3. Seismic load condition; and
4. For dikes constructed of soils that have susceptibility to liquefaction, the static load condition with reduced soil shear strengths to take into account liquefaction.

Previous Investigations

We reviewed reports of previous investigations and safety factor assessments by others that were furnished to us by GREDELL and Sikeston BMU. These were:

- Burns & McDonnell (1977). *Report of Preliminary Subsurface Investigation for Board of Municipal Utilities, Sikeston, Missouri,* 76-076-1. (This is the original investigation for construction of the power station.)

- O'Brien & Gere Engineers (2010). *Dam Safety Assessment of CCW Impoundments, Sikeston Power Station,* a report to the U.S. EPA.
- Geotechnology (2011). *Global Stability Evaluation, Fly Ash and Bottom Ash Ponds, Sikeston Power Station, Sikeston, Missouri*, a report for Sikeston BMU. (This evaluation was done in accordance with the Missouri Department of Natural Resources (MDNR) Dam Safety Program, which is not the same as the 2015 EPA CCR Rule.)
- Haley & Aldrich (2016). *Detailed Initial Safety Factor Assessment, Sikeston Power Station, Bottom Ash Pond, Sikeston, Missouri*, a report for Sikeston BMU.

An investigation of the shear-wave velocity profile at the Sikeston Power Station was done by the University of Memphis as part of the safety factor assessment by Haley & Aldrich (Appendix C in the above report). The findings from the measurement of the shear wave velocity profile by the University of Memphis were used in this safety factor assessment with permission from Sikeston BMU.

General Description of Fly Ash Pond

The plan of the fly ash pond is shown in Figure 1. The fly ash pond is a combination of incised and diked surface impoundment. The dike is about 4800 feet long and encloses about 30 acres. The southern dike separates the fly ash pond from the active bottom ash pond. The top of the dike is at el. 322 to el. 322.6. Based upon the 2016 topographic survey by Surdex Corp., the height of the dikes is about 11 to 12 feet. The report by O'Brien & Gere states that the pond is incised a depth of 4 feet below the outside toe of the dike. The top of the CCR in the fly ash pond is a maximum of el. 319.6 to 321.6. Two areas of free water on the west side of the fly ash pond were at el. 315.7 and el. 316.5 when photo surveyed by Surdex. The topographic survey showed that the exterior slope of the dike is about 2.1(H)-to-1(V). The interior slope of the dike is reportedly about 2(H)-to-1(V). The 2011 borings by Geotechnology confirmed that the dike is composed of compacted silty sands and fine sands with some layers of clayey sand. An outlet structure at the northwest corner of the fly ash pond controls the height of the water. The weir on the outlet structure is at el. 318.

Field Investigation

Borings had been made by Geotechnology in 2011 in the dike on the west and northwest corner sides of the fly ash pond. However, there were no data on the subsurface soil strata on the north and east sides. We planned four Cone Penetrometer Test (CPT) soundings on the north, northeast and east sides of the fly ash pond, approximately 25 to 30 feet beyond the railroad track that runs along the outside toe of the dike. The purpose of the CPT soundings was to obtain data on the natural soil strata beyond the influence of the fly ash pond and dike. The soil strata beneath the pond and dike have been consolidated or densified by the weight of the CCR and dike, and therefore would have greater shear strength properties. The shear strength properties of the unconsolidated soil strata beyond the dike would be critical to the stability assessment.

The CPT soundings were performed by Bulldog Drilling, Inc. using an AMS-probe rig, under a subcontract with Reitz & Jens. Reitz & Jens owns and operates the CPT equipment. Reitz & Jens' geologist, the drill crew and rig mobilized to the site on February 14, 2018. After obtaining the excavation permit from the Sikeston Power Station, we began CPT-2. The first sounding met refusal at 15 feet. So, we moved about 10 feet further from the railroad track and completed CPT-2A to 51.6 feet.

We moved to CPT-3, and began that sounding on February 15. We lost the signal from the CPT probe at about 8 feet. We extracted the probe and re-set a new CPT probe in the original hole. We lost the signal from the new CPT probe at about 40.2 feet. We found that a circuit board in the CPT equipment was bad. We demobilized on February 15. We processed the data from CPT-2A and CPT-3. The data were very similar, and were consistent with the findings from previous borings by others. Therefore, we judged that it was not necessary to re-mobilize to do soundings CPT-1 and CPT-4 to complete our safety factor assessment.

The cone penetrometer is a 1.5-inch diameter, 100-MPa capacity, electronic piezocone (CPTu), which continuously records tip pressure, sleeve friction and porewater pressure as it is hydraulically pushed into the ground. The CPT soundings were done in general accordance with ASTM D5778. The holes were backfilled with Bentonite crumbles. The CPT soundings were performed under the direction of a Reitz & Jens' geologist, who set up and operated the CPT equipment, monitored data collection, and determined the termination depths of the soundings. The CPT logs are shown in Figures 2-1 and 2-2, with symbol key and notes in Figure 2-0.

CPT Calculations

The field data were analyzed in our office using the program CPT-Pro, Ver. 5.49 by Geosoft. The program automatically applies corrections for depth, and post/pre-data collection baseline readings. These corrected field data are plotted in the CPT logs, which are: field tip resistance (q_c), sleeve friction (f_s) and pore water pressure (u2). Soil types were determined based upon the Robertson (1986) method (see Figure 2-0 for references). Undrained shear strengths (s_u) were calculated for cohesive materials based upon the Lunne (1997) method. Equivalent Standard Penetration Test (SPT) N_{60}–values were calculated by CPT-Pro, with empirical corrections developed by Reitz & Jens. The estimates of internal friction angle (ϕ) in coarse-grain soil were based upon the measured q_c values using Bowles (1996). The computed parameters N_{60}, s_u and ϕ are also plotted in the CPT logs.

Summary of Subsurface Conditions

The two CPT soundings revealed generally silty sands to about 4.5 to 5 feet, followed by sands and gravelly sands to the depths of the soundings (40.2 and 51.6 feet). The calculated internal friction angle (ϕ) varied from 30˚ near the surface, and increased to about 36˚ to 39˚ at a depth of 10 feet. The ϕ varied between about 34˚ and 40˚ below about 10 feet to the termination depths of the soundings. Geotechnology and Haley & Aldrich had assumed a ϕ of 35˚ in their analyses. So, our findings were consistent with their previous analyses.

The groundwater level when the CPT soundings were made are calculated from the piezometric data (u2) from the CPT probe. It appears that the groundwater level was at a depth of 10 feet at the time of our field investigation. The site is located in the flood plain of the Mississippi River. Therefore, the depth of the groundwater will vary significantly with the Mississippi River level and recent precipitation. Long-term groundwater data from piezometers and monitoring wells at the Sikeston Power Station indicate that the groundwater depth at the time of our investigation is typical.

Seismic Assessment

A site-specific seismic analysis was completed using the program SHAKE2000. Whereas the other procedures use generalized parameters for the soil properties and earthquake motions, this procedure is more site-specific because it uses field data for the soils, coupled with earthquake acceleration time histories. A site-specific seismic analysis has two components – to determine the probable seismic acceleration (or "time history") for the bedrock beneath the site, and to determine the impact or amplification of the seismic acceleration at the ground surface due to the soils.

Ten pseudo bedrock acceleration time-histories developed for each of St. Louis, Carbondale, Illinois and Memphis are included in SHAKE2000. The development of these pseudo earthquakes is documented in the Chiun-Lin Wu and Y.K. Wen (1999) report "Uniform Hazard Ground Motions and Response Spectra for Mid-American Cities." Their method of simulation is based on the latest seismicity information in the region, and the most recent ground motion and simulation models that are appropriate for engineering applications in this region. The seismological data are mainly from the USGS open-file Report 96-532. The sets of ground motions were selected from a large pool of simulated ground motions such that the median of the response spectra matched those of the 10% and 2% exceedance in 50 years. We selected pseudo bedrock acceleration time-histories for Memphis because it is more similar to Sikeston geologically than St. Louis or Carbondale. We ran multiple SHAKE2000 analyses using short-duration, medium-duration, and long-duration time-histories:

Properties of Memphis Pseudo Time-Histories Selected for Analyses

Designation	Duration t, seconds	Magnitude Mw	Distance Re, km	Peak Acceleration
Short	30	8	170.4	0.26g
Medium	50	8	117.6	0.40g
Long	75	8	97.6	0.28g

We compared the response spectra accelerations for a short-period (Ss) and a 1-second period (S_1) from the USGS Seismic Hazards Design Maps website for a Site Class "B" site at Memphis and at the Sikeston Power Station, and for an earthquake with a 2% chance of exceedance in 50 years per IBC 2012/2015. We found that the accelerations at the Sikeston Power Station are about 2.5 times that at Memphis. Therefore, we scaled or multiplied the bedrock accelerations in the time-histories in the SHAKE2000 program by 2.5 to produce our bedrock accelerations at the site.

The second step in the site specific seismic analyses – determination of the impact or amplification of the seismic acceleration at the ground surface due to the soils – was completed using the SHAKE2000 computer program. We developed the input soils properties for the analyses based upon the results from the University of Memphis study (Appendix C, Table 1) to a depth of 325 feet, and with consideration of the results from our two CPT soundings. The University of Memphis reported a shear wave velocity of 2000 to 2200 m/sec (6500 to 7200 ft/sec) for the Cretaceous strata from 325 feet to 770 feet. However, the SHAKE2000 program returned an error message that a shear wave velocity greater than 4000 ft/sec is not reasonable for rock. Therefore, we made the bottom of our soil column model at 325 feet.

The results from our SHAKE2000 analyses are shown in Figures 3-1 through 3-9 for the long-, medium- and short-duration earthquakes. The response spectral accelerations are shown in Figures 3-1, 3-4 and

3-7. We included in these plots the design response spectral accelerations calculated from the USGS 2012 Seismic Hazard Design Maps for the Sikeston Power Station, for a Site Class "E", and the design earthquake (2% chance of exceedance in 50 years) for comparison. The results of the Peak Horizontal Ground Accelerations (PHGA) versus depth are plotted in Figures 3-2, 3-5 and 3-8.

Liquefaction Analyses

The CCR rule states [40 CFR Part 257.73(e)(iv)] that "For dikes constructed of soils that have susceptibility to liquefaction, the calculated liquefaction factor of safety must equal or exceed 1.20." The dikes of the fly ash pond are composed of fine sands and silty sands which might be susceptible to liquefaction except that (1) the fill is generally in a compacted state, and (2) the dike is generally above the groundwater level. If the phreatic surface (line of seepage) through the dike were elevated, then a portion of the dike would be saturated and could be subject to liquefaction. The long-term depth readings from the piezometers installed by Geotechnology in the dike in 2011 indicate that the phreatic surface is below the dike. Therefore, it is unlikely that the 4^{th} load condition is applicable if only the potential liquefaction of the dike itself is considered.

However, it is our judgement that liquefaction potential of the subsurface soil strata must be considered, not only the liquefaction potential of the dike itself. If such liquefaction could occur immediately following the design seismic event, then the dike may be susceptible to failure. Therefore, we evaluated the liquefaction potential of the subsurface soil strata for the 4^{th} load condition.

Liquefaction occurs when ground shaking is sufficient to produce cyclic particle movements that cause excess pore water pressures to build to the point that nearly all the strength of the soil is lost. After ground shaking has stopped, the soil will potentially reconsolidate to denser configuration, which results in settlement. Liquefaction is most problematic in loose sandy soils with less than about 35 percent fines (soils which are finer than standard sieve size #200) but can occur in very loose soils with up to 50 percent fines and soils up to the size of fine gravel.

Factors of Safety (FS) against liquefaction were calculated for the 2 CPT soundings using the cyclic stress approach outlined in Idriss and Boulanger (2008). The CPT soundings were analyzed using the cone tip pressure, which was corrected for overburden pressure and fines content, termed $(q_{1N})_{CS}$. The fines content in the CPT soundings were those associated with the descriptions on the CPT Logs:

CPT Log Descriptive Phrase	Fines Content (%)
Sand	1
Sand to Silty Sand	10
Silty Sand to Sandy Silt	36

The liquefaction analyses were based upon the calculated horizontal ground acceleration at the depths of each soil stratum that were derived from each of the 3 pseudo time-histories (Figures 3-2, 3-5 and 3-8). Our analyses indicate that is potential for liquefaction in several sand strata, as illustrated in Figure 4-3 for the static load condition with liquefaction.

Results of Slope Stability Analyses

We analyzed the stability of the critical embankment cross-section using the program SLIDE 7.0. This program uses the Spencer method, which resolves the static forces on each vertical slice of soil profile along a given circular or irregular assumed failure surface. The program searches for the minimum factor of safety (FS) against slope failure for each center point in the grid by incrementally varying the radius of the failure surface. The plotted results from the program show the minimum FS, the center and radius of the failure surface with the minimum FS. The output of the program also plots contours of equal FS within the grid of possible center points. The properties of the fly ash in the pond and of the dike were taken from the previous study by Geotechnology. We considered the cross-section of the dike at 4 locations, but the geometries from the typographic survey by Surdex were very similar. Also, the soil properties from the 2 CPT soundings were very similar. Therefore, we selected the cross-section at the location shown in Figure 1 as the "critical cross-section" for our slope stability analyses.

Static Load Condition

The CCR Rule stipulates 2 static load conditions: (i) long-term with maximum storage pool, and (ii) under the maximum surcharge which is presumably a short-term, temporary load condition. However, since the fly ash pond is nearly full, we judged that only the first load condition is applicable. The cross-section with the properties of the CCR, dike and soil strata are shown in Figure 4-1. The minimum FS is 1.64, which is for a surficial slide on the downstream slope, which would have little impact on the stability of the dike. Two of the other trial slope failures are also shown in Figure 4-1 which are more substantial and could jeopardize the containment of the CCR, but each of these had a FS greater than 3.6. The minimum required FS for this load condition is 1.50. Therefore, the fly ash pond is satisfactory for the long-term, maximum storage load condition.

Seismic Load Condition

The minimum required FS for the seismic load condition is 1.00. However, the CCR does not stipulate how to calculate a pseudo-static horizontal acceleration for this slope stability analyses. The peak ground acceleration (PGA) is extremely short in duration. Therefore, the full PGA is not applicable for this slope stability analyses. For the bottom ash pond, Haley & Aldrich used the recommendation from the Mine Safety and Health Administration (MSHA) 2009 *Engineering and Design Manual for Coal Refuse Disposal Facilities* which states that the maximum acceptable deformation of the dike for a surface impoundment is 25% of the freeboard. The preamble to the CCR [Unit VI.E(3)(b)(ii)(d)] states that "all CCR surface impoundments must also be capable of withstanding a design earthquake without damage to the foundation or embankment that would cause a discharge of its contents." Therefore, we understand that the common practice is to use the MSHA design criterion to determine a pseudo-static acceleration (Ks) that would produce the maximum acceptable deformation using the Newmark (1965) method of analyses. The Newmark method is part of the SHAKE2000 program. A trial Ks is input to the program. The Ks is compared to the ground accelerations in a time-history. When the ground acceleration exceeds the Ks the associated lateral displacement is calculated using the empirical relationship developed by Makdisi and Seed (1978). The lateral displacements are cumulated over the time-history assuming that all of the displacements occur in the same direction. We ran trial analyses until a Ks was found for each of the 3 pseudo time-histories that resulted in a calculated lateral deformation at the ground surface equal to about the maximum acceptable 25% of the freeboard. The current freeboard of the fly ash pond is 4.5 feet (el. 322.5 minus el. 318). Therefore, the maximum acceptable deformation is 25% of 4.5 feet or 13.5 inches. Results of the Newmark analyses are shown in Figures 3-3, 3-6 and 3-9. The Ks is 0.13g for the short-duration event, 0.17g for the medium-duration event, and 0.19g for the long-duration event.

We calculated the FS for the seismic load condition by two methods. First, the critical cross-section was analyzed using the pseudo-static acceleration Ks of 0.19g. The results are presented in Figure 4-2. The minimum FS is 1.09, which is for a surficial slide on the downstream slope, which would have little risk of allowing discharge of the CCR and water from the pond. Two of the other trial slope failures are also shown in Figure 4-2 which are more substantial and would jeopardize the containment of the CCR, but each of these had a FS greater than 1.6 and 2.7.

For the second method, we analyzed the critical cross-section to determine the yield pseudo-static acceleration (Ky) that resulted in a minimum FS of 1.0. A Ky = 0.21g resulted in a FS of 1.0 for a surficial slide in the downstream slope that would have little impact on the stability of the dike. A Ky = 0.25g resulted in a more substantial slide that involved more of the dike and the foundation strata and also had a FS of about 1.0. For this method, the FS of the seismic load case was defined as the ratio of the yield pseudo-static acceleration (Ky) to the Ks that produced the maximum acceptable deformation at the ground surface. The FS by this method = (0.25g/0.19g) = 1.32.

The minimum required FS for this load condition is 1.00. Therefore, the fly ash pond is satisfactory for the seismic load condition.

Static Load Condition with Liquefaction

For the static load condition with liquefaction, we applied a residual cohesive shear strength to those sand strata that have a potential to liquefy under the design earthquake, specifically the medium- and long-duration events. The residual shear strength is based upon published correlations. The results are presented in Figure 4-3. The minimum FS is 1.68, which is for a surficial slide on the downstream slope, which would have little risk of allowing discharge of the CCR and water from the pond. Two of the other trial slope failures are also shown in Figure 4-3 which are more substantial and would jeopardize the containment of the CCR, but each of these had a FS greater than 3.1 and 4.1.

The minimum required FS for this load condition is 1.20. Therefore, the fly ash pond is satisfactory for the static load condition with liquefaction of the foundation soil strata.

Closure

Based upon our field investigation and analyses, we judge that the existing condition of the Sikeston Power Station's fly ash pond meets or exceeds the minimum factor of safety criteria of 40 CFR Part 257.73(e).

We welcome any questions or comments that GREDELL or Sikeston BMU may have regarding this report. We appreciate the opportunity to continue our working relationship with GREDELL and Sikeston BMU.

Sincerely,
REITZ & JENS, Inc.

Jeffrey L. Fouse, P.E.
Principal
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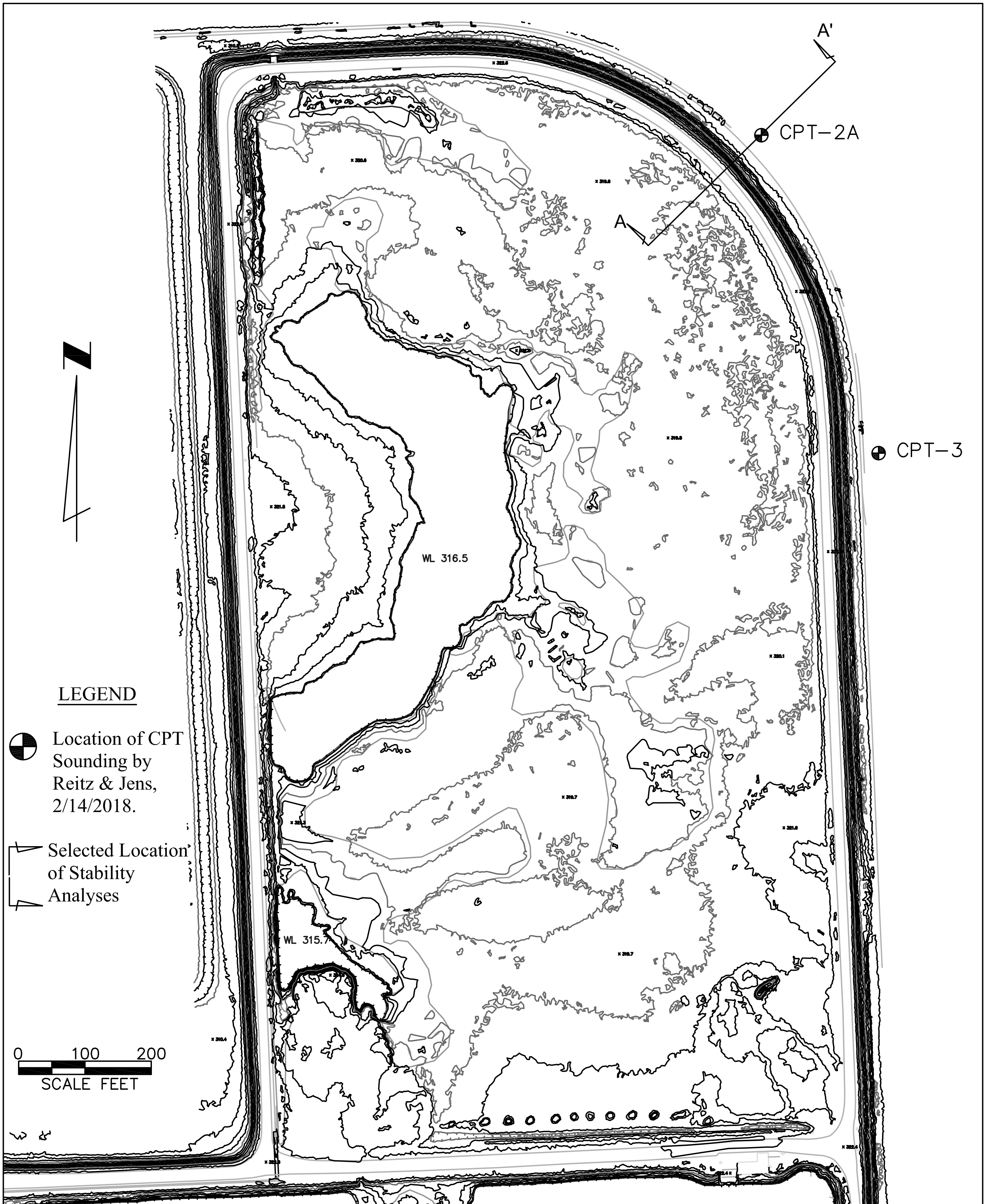
Cell phone: 314-852-1110

Cc: Mr. Mark E. McGill, Sikeston BMU / Sikeston Power Station

The following attachments complete this report:

Figure 1	Plan of Fly Ash Pond and Locations of CPT Soundings
Figure 2-0	Key to CPT Sounding Log
Figures 2-1 and 2-2	Individual CPT Sounding Logs
Figures 3-1 to 3-9	Results of Analyses from SHAKE2000
Figures 4-1 to 4-3	Results of Slope Stability Analyses

Copies submitted: 1 bound, emailed PDF



Note: figure based upon orthophotographic map by Surdex Corp. for GREDELL Engineering Resources. Photo dated May 6, 2016.

Sikeston BMU / Sikeston Power Station
Safety Factor Assessment of Fly Ash Pond
PLAN OF FLY ASH POND AND
LOCATIONS OF CPT SOUNDINGS

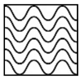
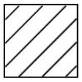
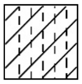
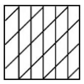
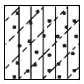
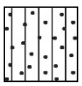
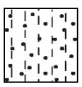
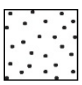
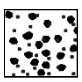
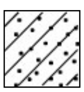
REITZ & JENS, INC.

Figure 1

LEGEND

Symbol Description

<u>KEY TO SOIL SYMBOLS</u>

Symbol	Description
	Organic Material
	Clay
	Silty Clay to Clay
	Clayey Silt to Silty Clay
	Sandy Silt to Clayey Silt
	Silty Sand to Sandy Silt
	Sand to Silty Sand
	Sand
	Gravelly Sand to Sand
	Sand to Clayey Sand

qc = Cone Tip Pressure, tons/sq. ft.

fs = Skin Friction, tons/sq. ft.

Rf = Friction ratio (fs/qc) in %

u2 = Porewater Pressure, psi

N60 = Calculated Equivalent N-value, blows/foot, (Standard Penetration Test)

Su = Calculated Undrained Shear Strength, ksf

Phi = Friction Angle, degrees

TA = Tilt Angle, degrees

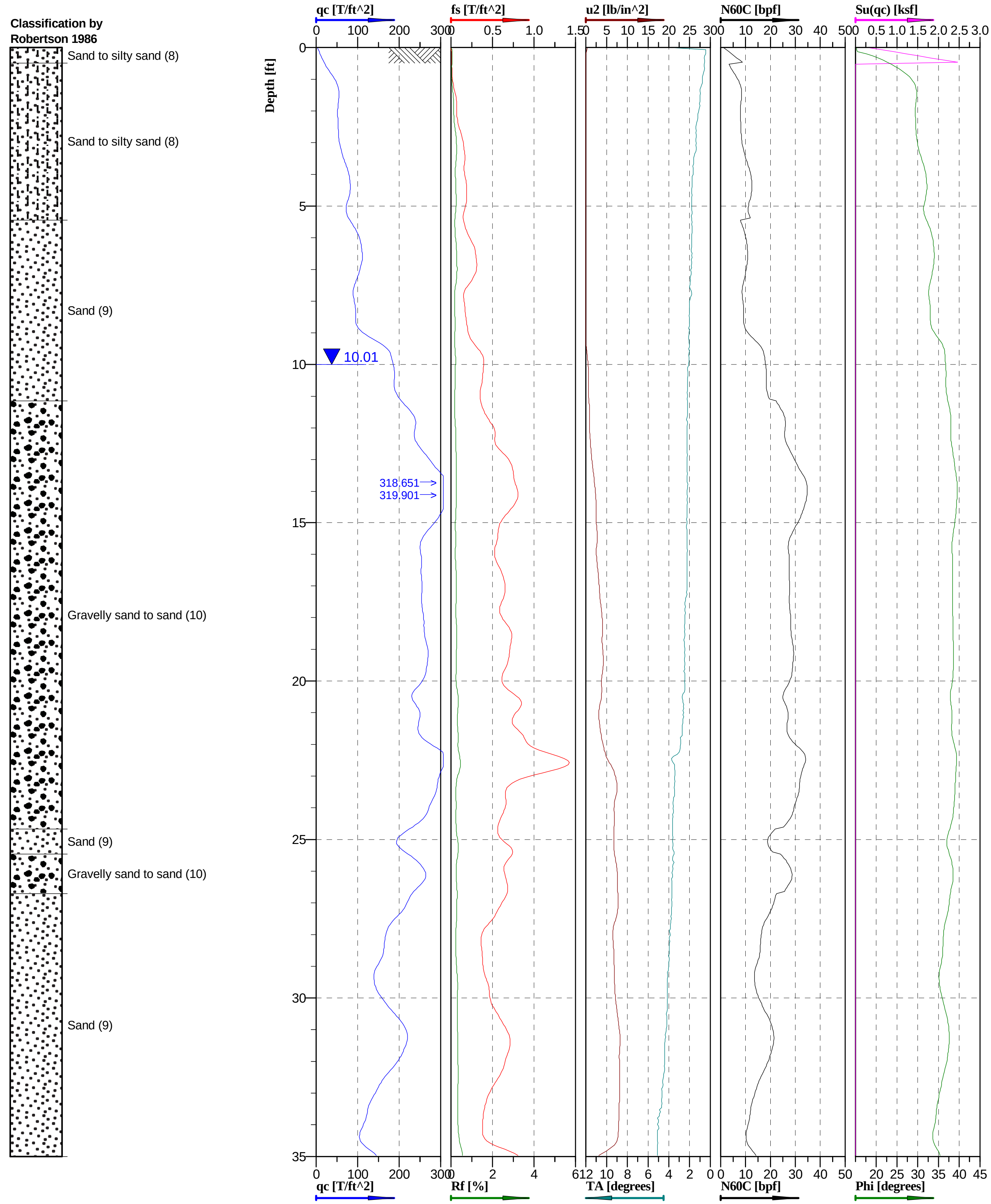
<u>Notes:</u>

1. Soundings were made on February 14 and 15, 2018, by Bulldog Drilling, Inc. using 1.5” diameter cone penetrometer with pore pressure measurements (CPTu) owned and operated by Reitz & Jens. Soundings were backfilled the same day with Bentonite crumbles.
2. Soundings were located by Reitz & Jens, and were staked after drilling. Elevations at the CPT locations were not provided; thus, elevations are not shown on the logs.
3. Soundings were logged in the field by Reitz & Jens’ geologist who monitored and conducted all CPT related work.
4. Soil classification and equivalent N_{60} were based upon Robertson 1986[1].
5. Undrained shear strength (Su) is based on Lunne, Robertson, Powell (1997)[2]. Internal friction Angle (Phi or Ø) is based on Bowles (1996)[3].
6. Stratification lines shown on the log represent approximate soil boundaries; actual changes in strata may be gradual.

---

[1] Robertson et al. (1986) *Use of piezometer cone data.* Proceedings of the ASCE Specialty Conference: In Situ 86: Use of In Situ Tests in Geotechnical Engineering. ASCE 1986
[2] Lunne, T. Robertson, P.K. and Powell, J.J.M. (1997) <u>Cone Penetration Testing in Geotechnical Practice</u>, Published by Blackie Academic & Professional.
[3] Bowles, Joseph E. (1996) <u>Foundation Analysis and Design</u>. McGraw-Hill. 5th ed. Page 180.

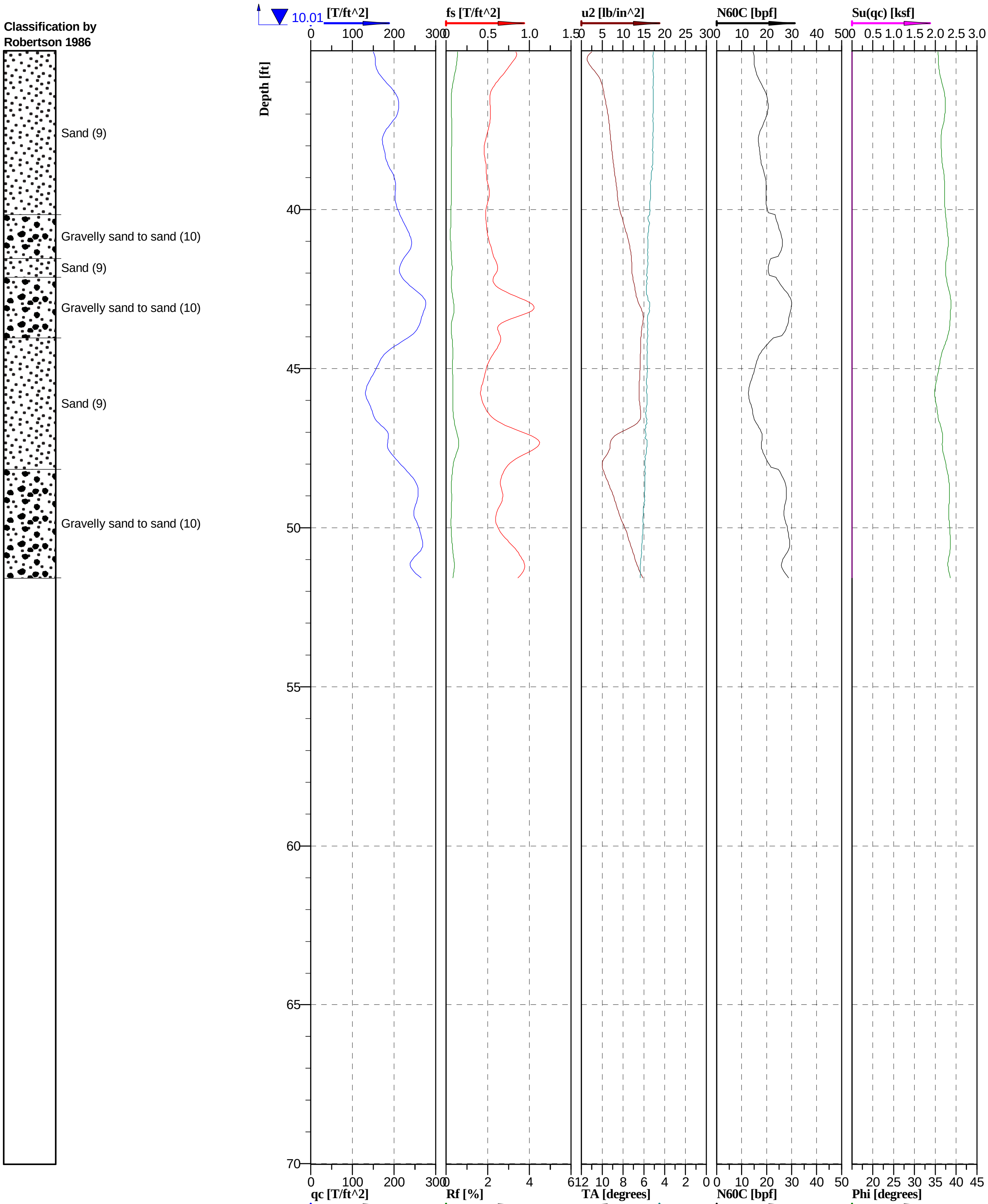
Figure 2-0



U2

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

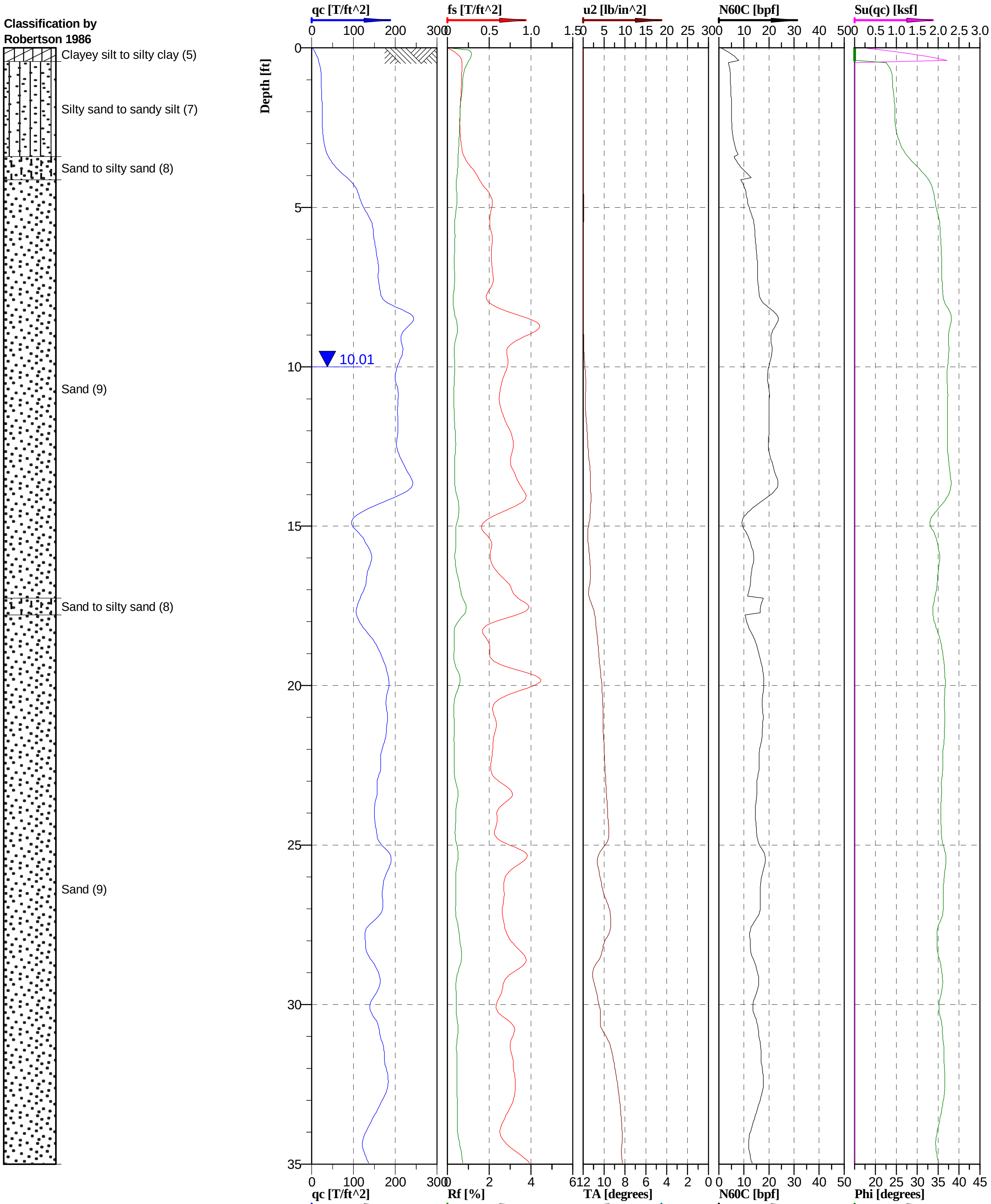
Location: Sikeston, MO	Position: X: 0.00 ft, Y: 0.00 ft	Ground level: 0.00	Test no: CPT-2A
Project ID: 2018120907	Client: Gredell Engineering Resources, Inc.	Date: 2/14/2018	Scale: 1 : 50
Project: BMU Sikeston Power Station Fly Ash Pond Stabilit		Page: 1/2	Fig: 2-1
		File: cpt-2a.cpt	



U2

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

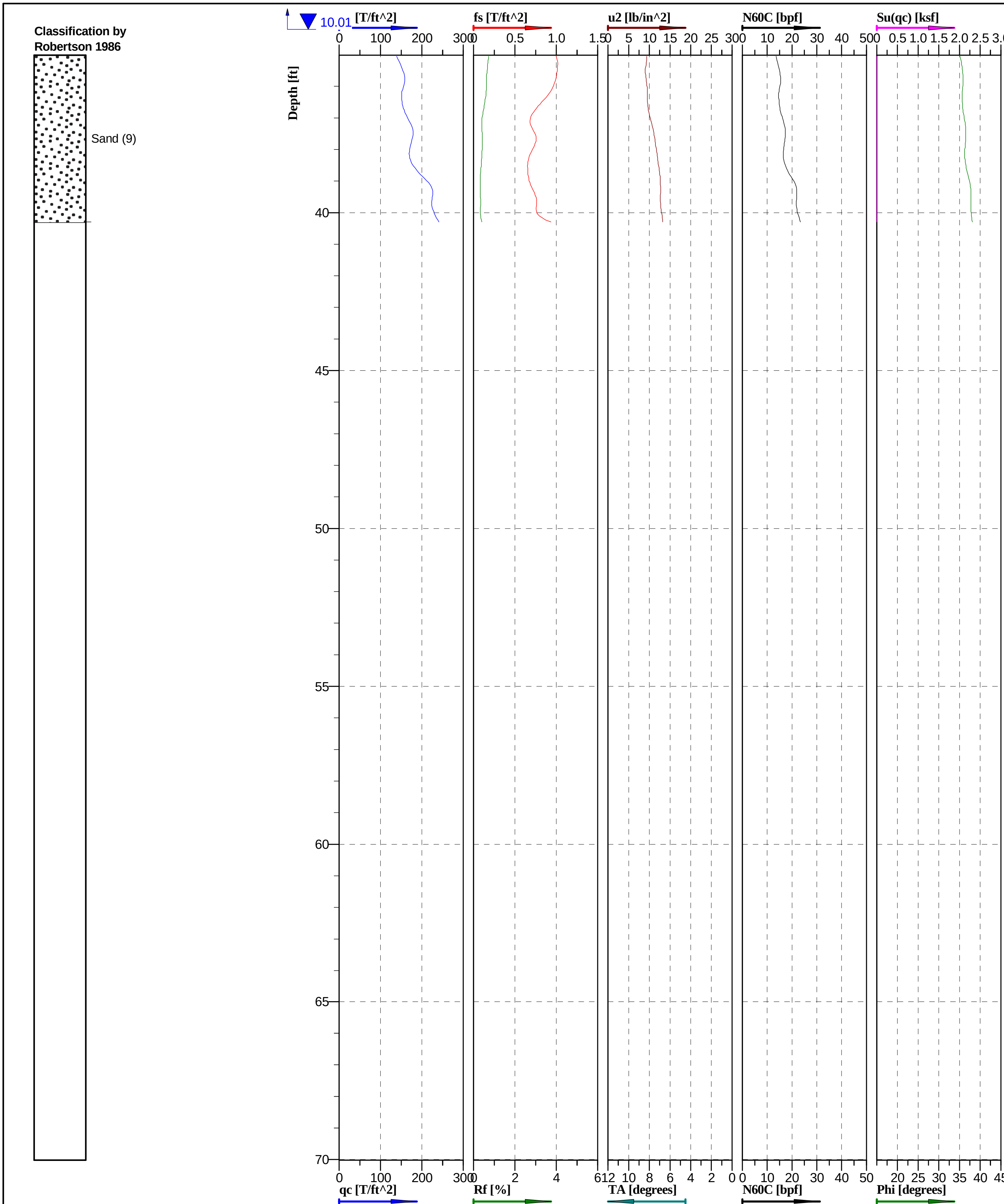
Location: Sikeston, MO	Position: X: 0.00 ft, Y: 0.00 ft	Ground level: 0.00	Test no: CPT-2A
Project ID: 2018120907	Client: Gredell Engineering Resources, Inc.	Date: 2/14/2018	Scale: 1 : 50
Project: BMU Sikeston Power Station Fly Ash Pond Stabilit		Page: 2/2	Fig: 2-1
		File: cpt-2a.cpt	



U2

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Sikeston, MO	Position: X: 0.00 ft, Y: 0.00 ft	Ground level: 0.00	Test no: CPT-3
Project ID: 2018120907	Client: Gredell Engineering Resources, Inc.	Date: 2/15/2018	Scale: 1 : 50
Project: BMU Sikeston Power Station Fly Ash Stability		Page: 1/2	Fig: 2-2
		File: cpt-3_corr.csv	



U2

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Sikeston, MO	Position: X: 0.00 ft, Y: 0.00 ft	Ground level: 0.00	Test no: CPT-3
Project ID: 2018120907	Client: Gredell Engineering Resources, Inc.	Date: 2/15/2018	Scale: 1 : 50
Project: BMU Sikeston Power Station Fly Ash Stability		Page: 2/2	Fig: 2-2
		File: cpt-3_corr.csv	

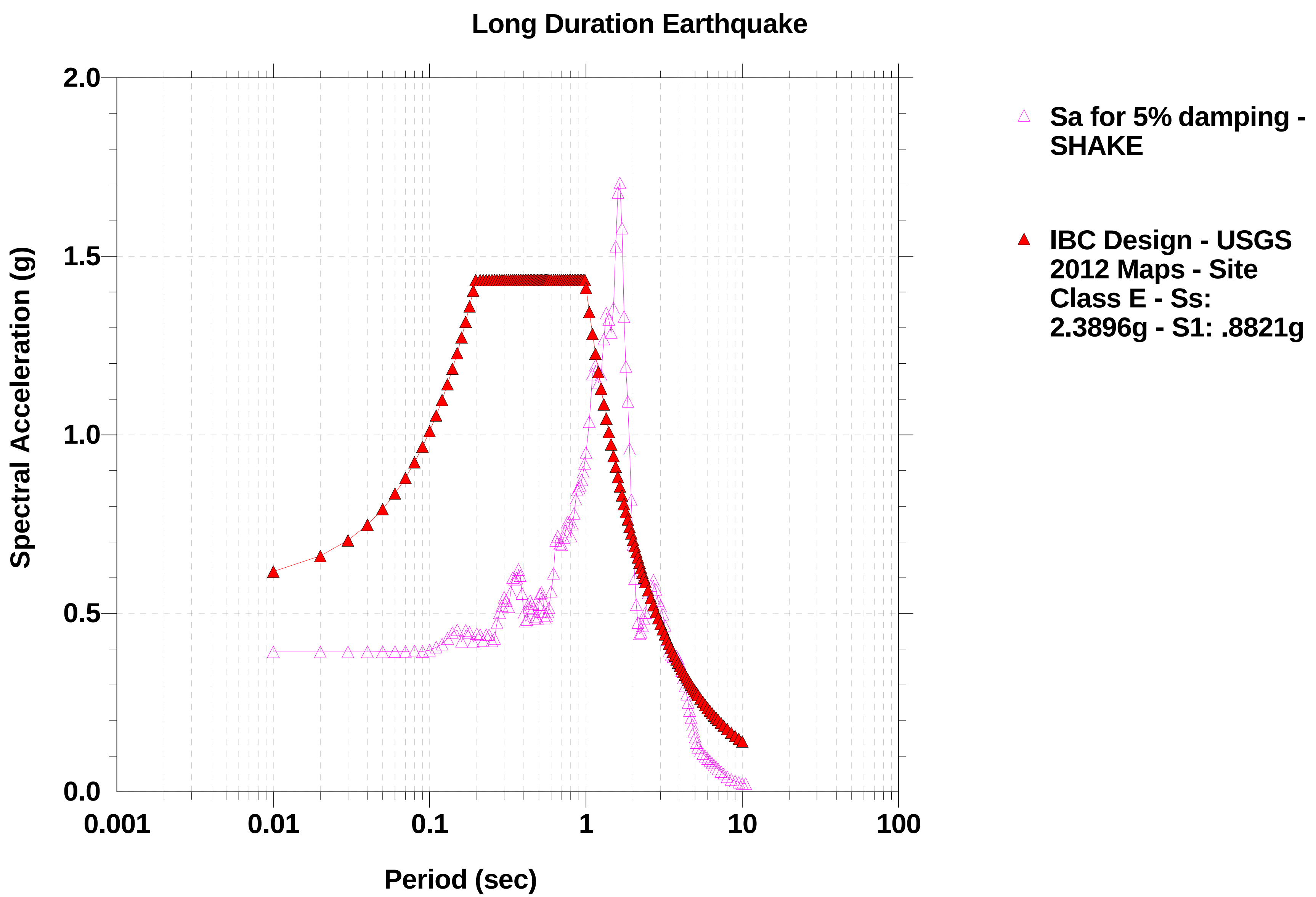


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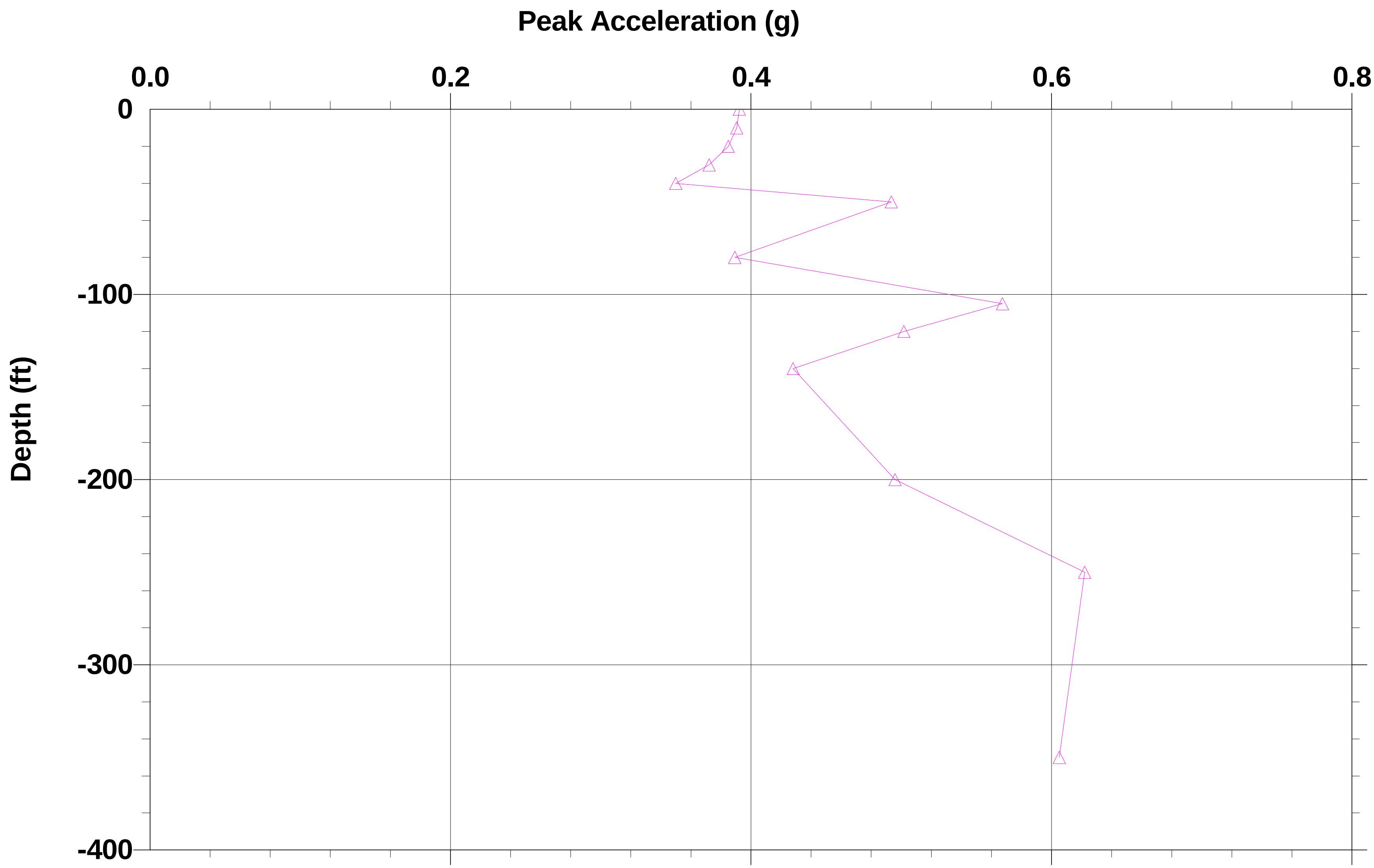
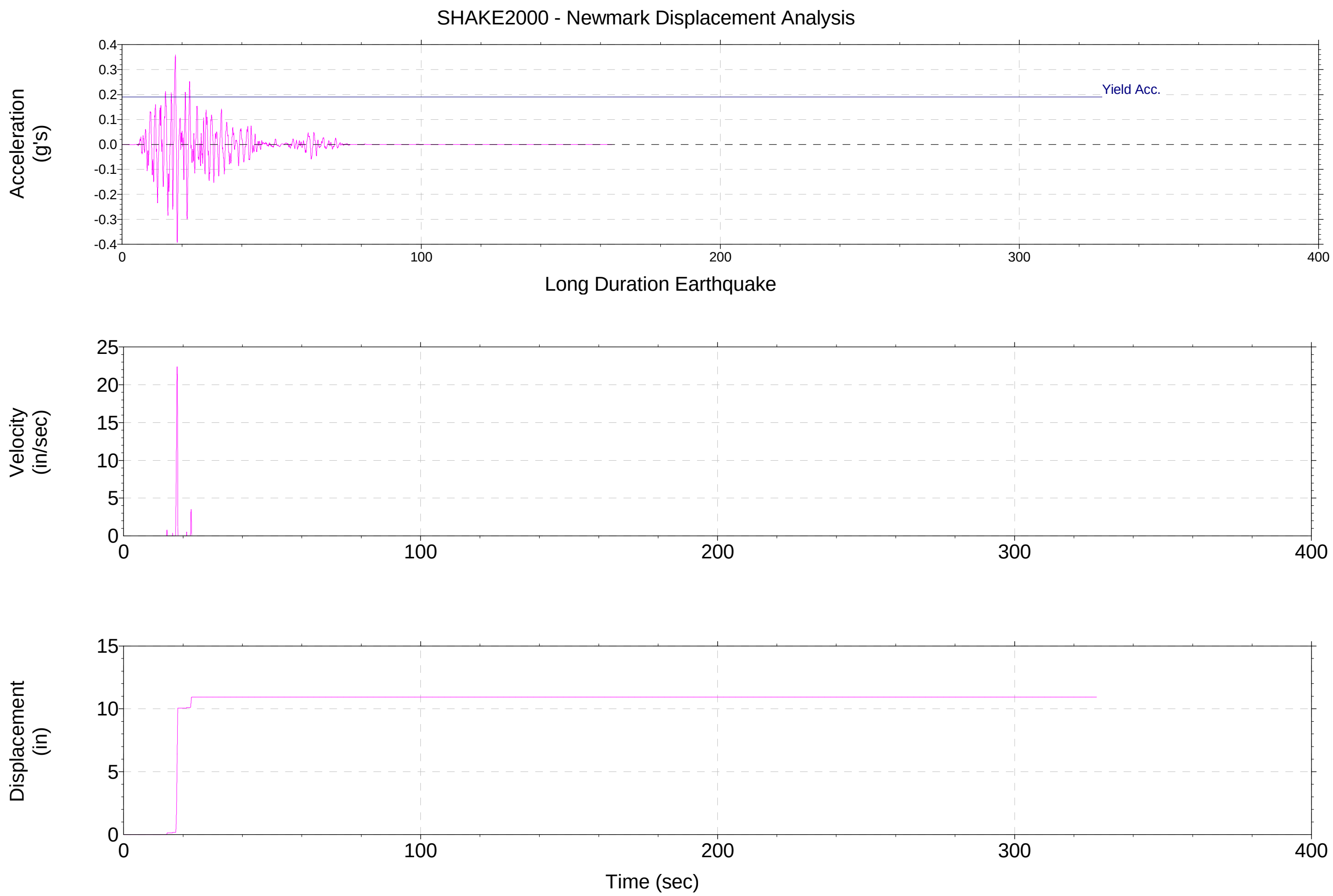
Figure 3-1



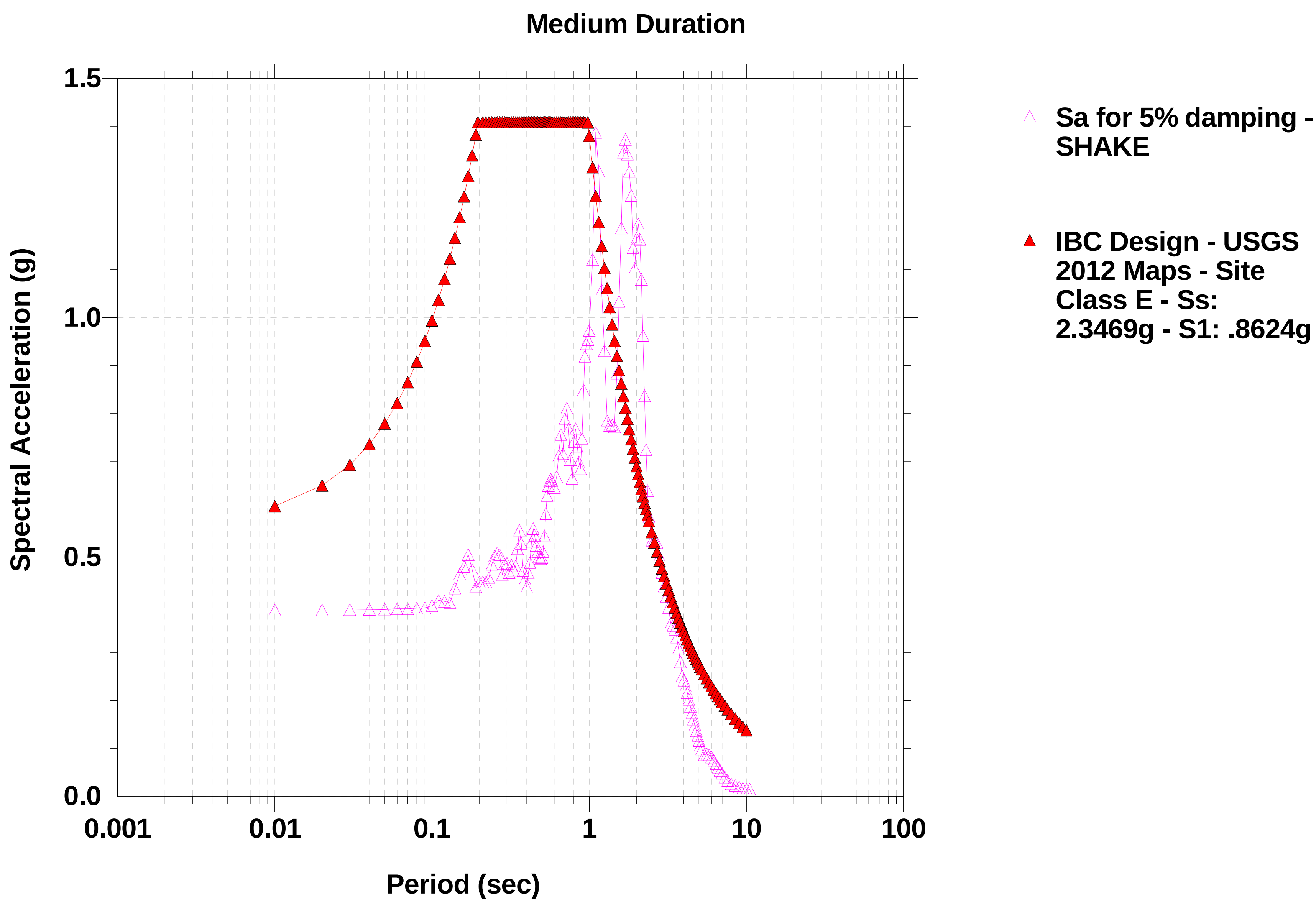
Long Duration Earthquake

REITZ & JENS, INC.

Figure 3-2

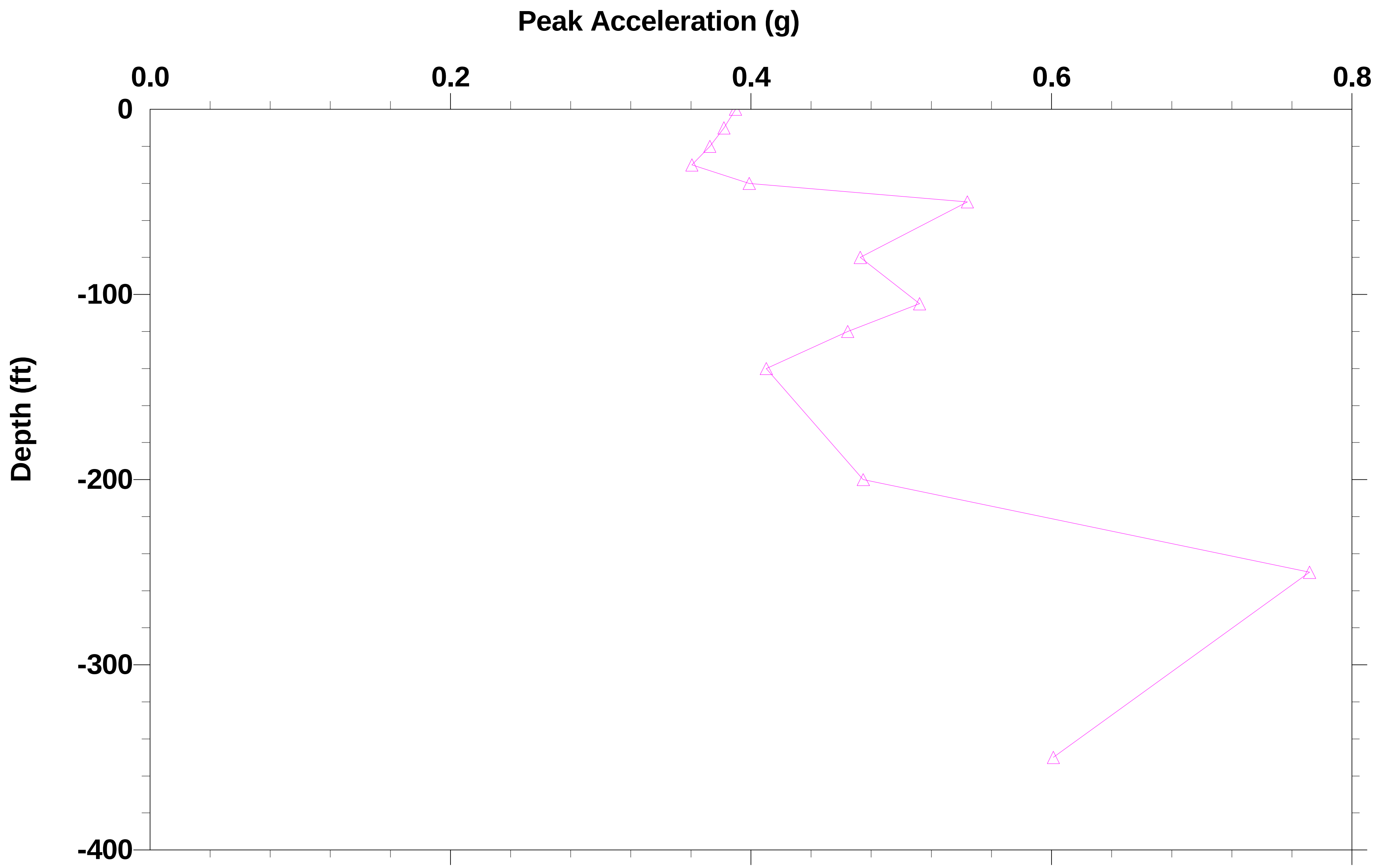



```
Notes:
     Displacement Analysis - Newmark Method
     Project: SHAKE2000 - Newmark Displacement Analysis

     Newmark Method by Kavazanjian & Matasovic
     Constant Yield Acceleration:      .19 (g)
     Acceleration Time History: Outcrop - Soil Profile No.  1 - AHL - Layer:
                            1 - Analysis: 1 - Soil Deposit: 1
     Acceleration Time History File: P:\GREDELL\2018120907\calc\Shake\Long Duration-L1A1D1-1-Soil Pro-G01000.ahl
     Peak Acceleration Value:   .39225 (g)
     Upslope Movement not Included in Analysis
     Acceleration due to gravity:   386.4 (in/sec^2)

     Displacement computed:    10.92798 in
```

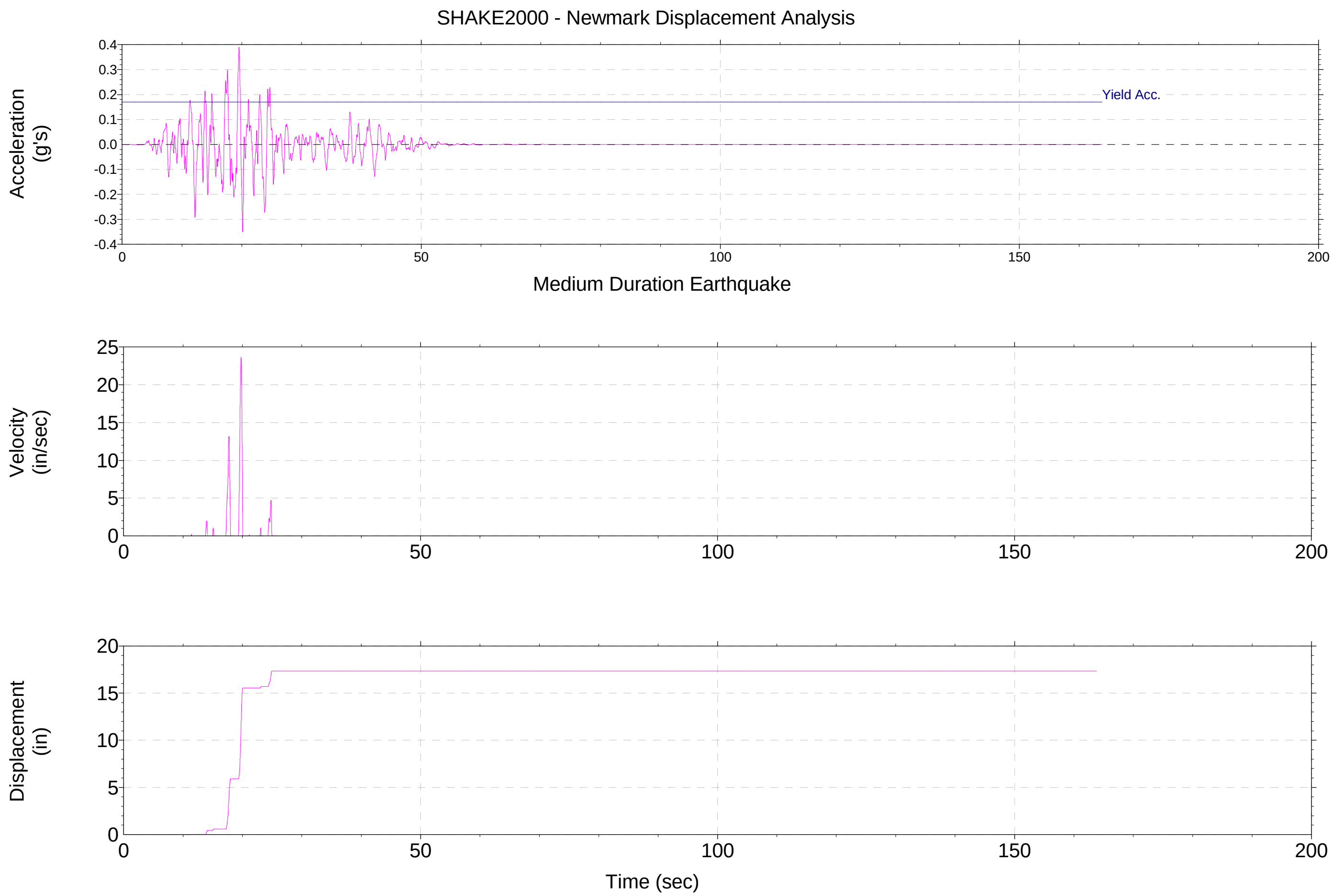


Medium Duration
1.5
1.0
0.5
0.0
Spectral Acceleration (g)
0.001
0.01
0.1
1
10
100
Period (sec)
Sa for 5% damping - SHAKE
IBC Design - USGS 2012 Maps - Site Class E - Ss: 2.3469g - S1: .8624g

Figure 3-4



Medium Duration Earthquake




```
Notes:
      Displacement Analysis - Newmark Method
      Project: SHAKE2000 - Newmark Displacement Analysis

      Newmark Method by Kavazanjian & Matasovic
      Constant Yield Acceleration:      .17 (g)
      Acceleration Time History: Outcrop - Soil Profile No.  1 - AHL - Layer:
                                 1 - Analysis: 1 - Soil Deposit: 1
      Acceleration Time History File: P:\GREDELL\2018120907\calc\Shake\Med Duration-L1A1D1-1-Soil Pro-TUJ352.ahl
      Peak Acceleration Value:  .389637 (g)
      Upslope Movement not Included in Analysis
      Acceleration due to gravity:   386.4 (in/sec^2)

      Displacement computed:    17.34549 in
```

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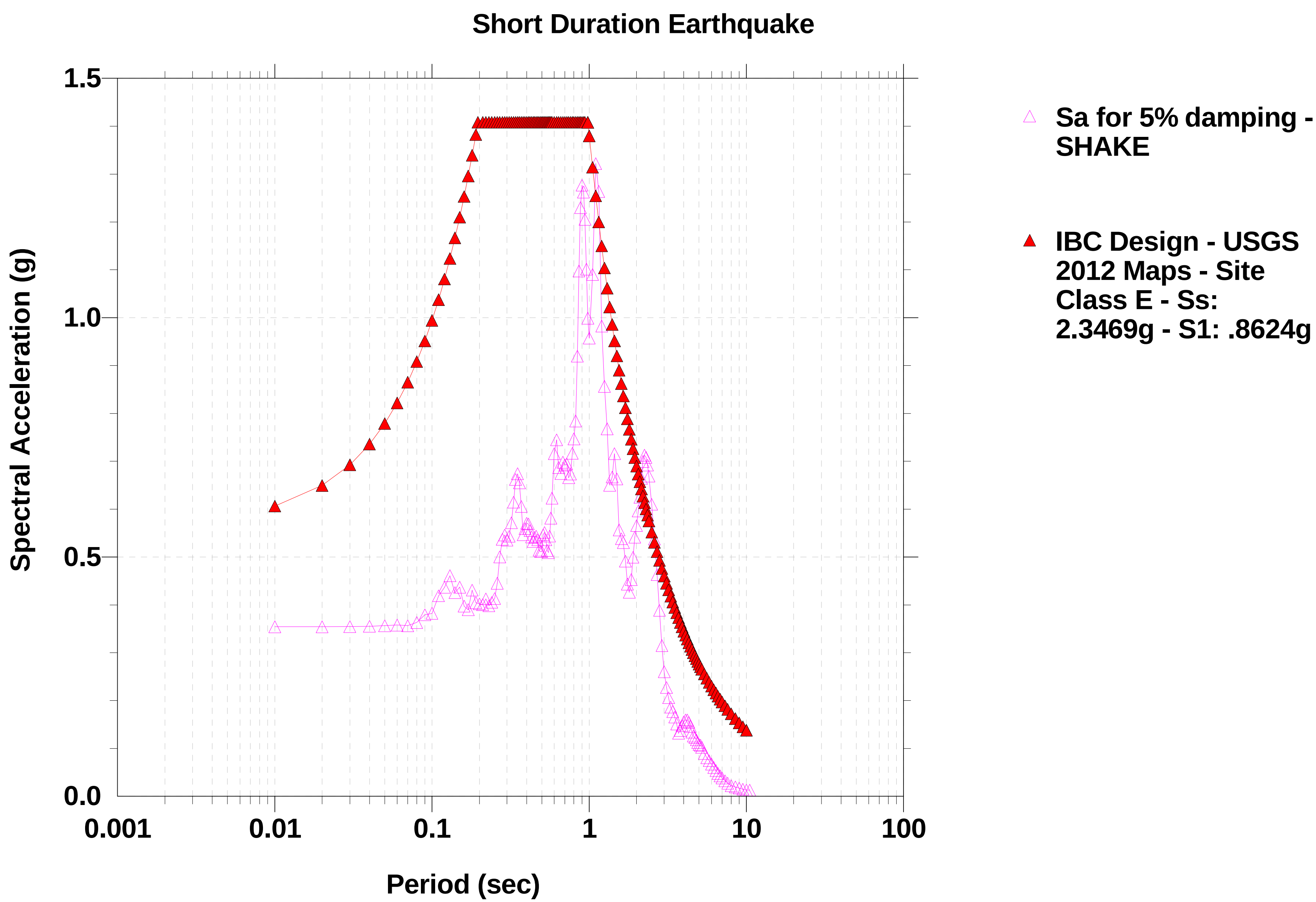
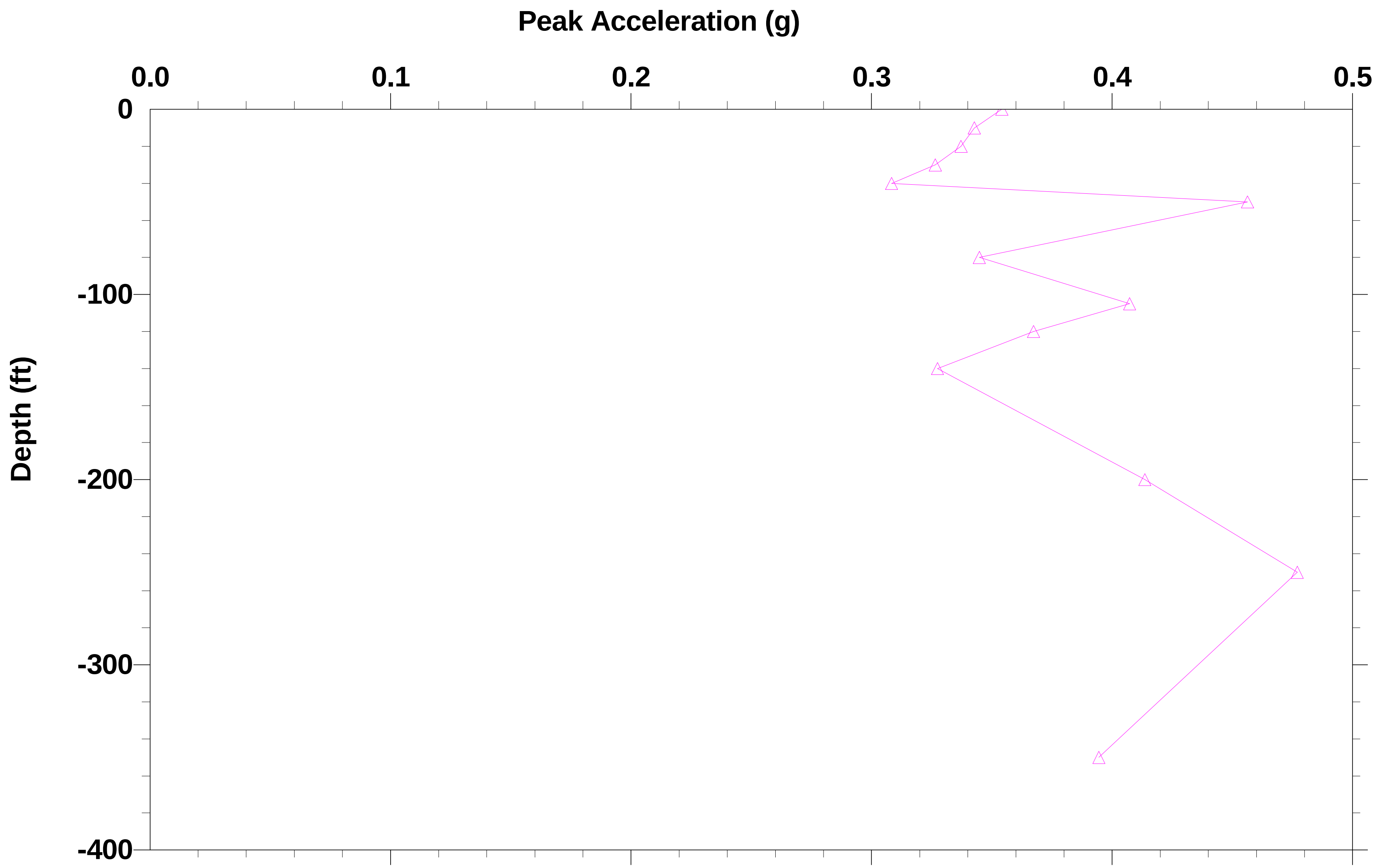
Figure 3-6



Short Duration Earthquake
Spectral Acceleration (g)
1.5
1.0
0.5
0.0
0.001
0.01
0.1
1
10
100
Period (sec)
Sa for 5% damping - SHAKE
IBC Design - USGS 2012 Maps - Site Class E - Ss: 2.3469g - S1: .8624g

Figure 3-7



Soil Profile No. 1 - Analysis No. 1 - Profile No. 1 - Soil Pro-TUJ352

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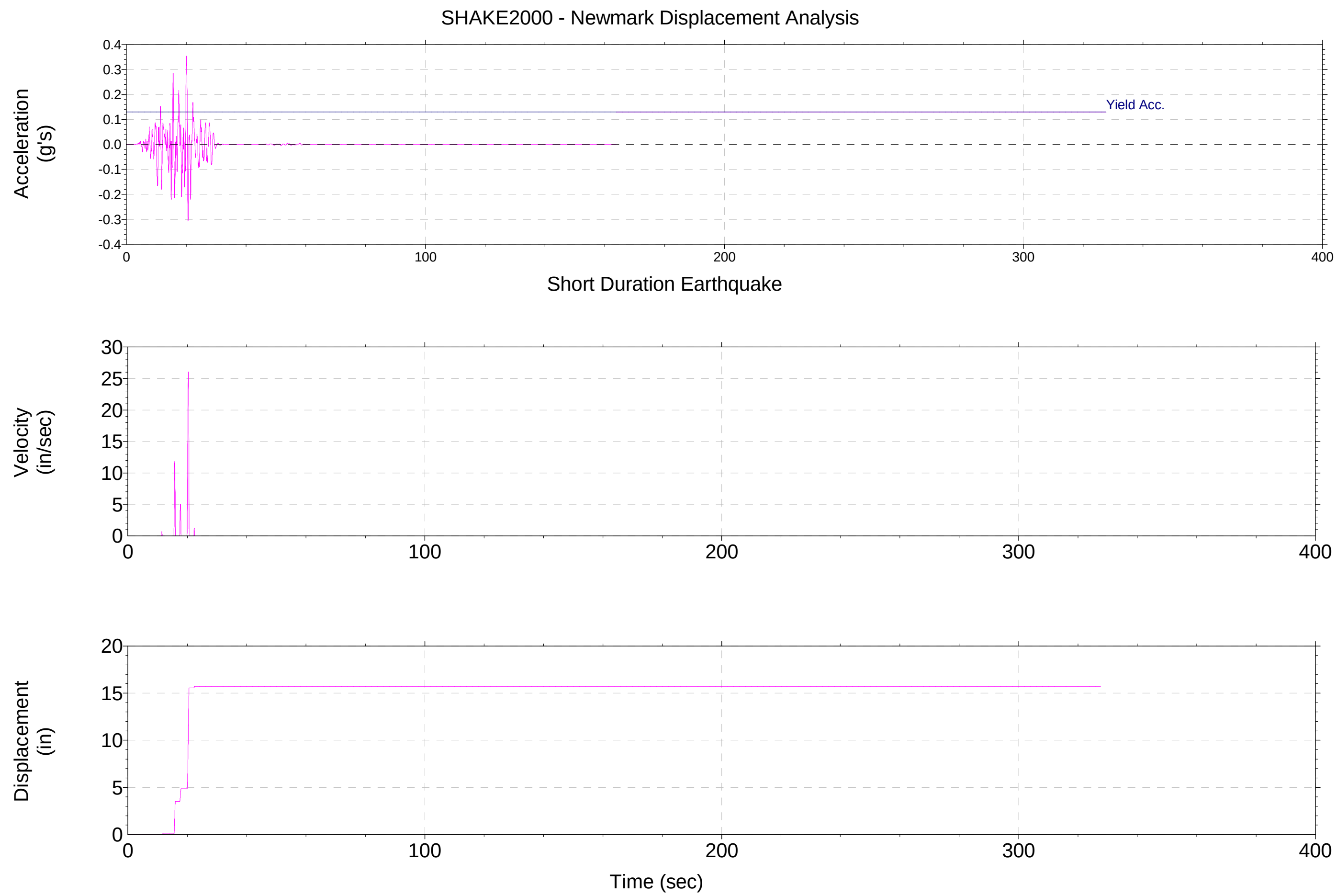
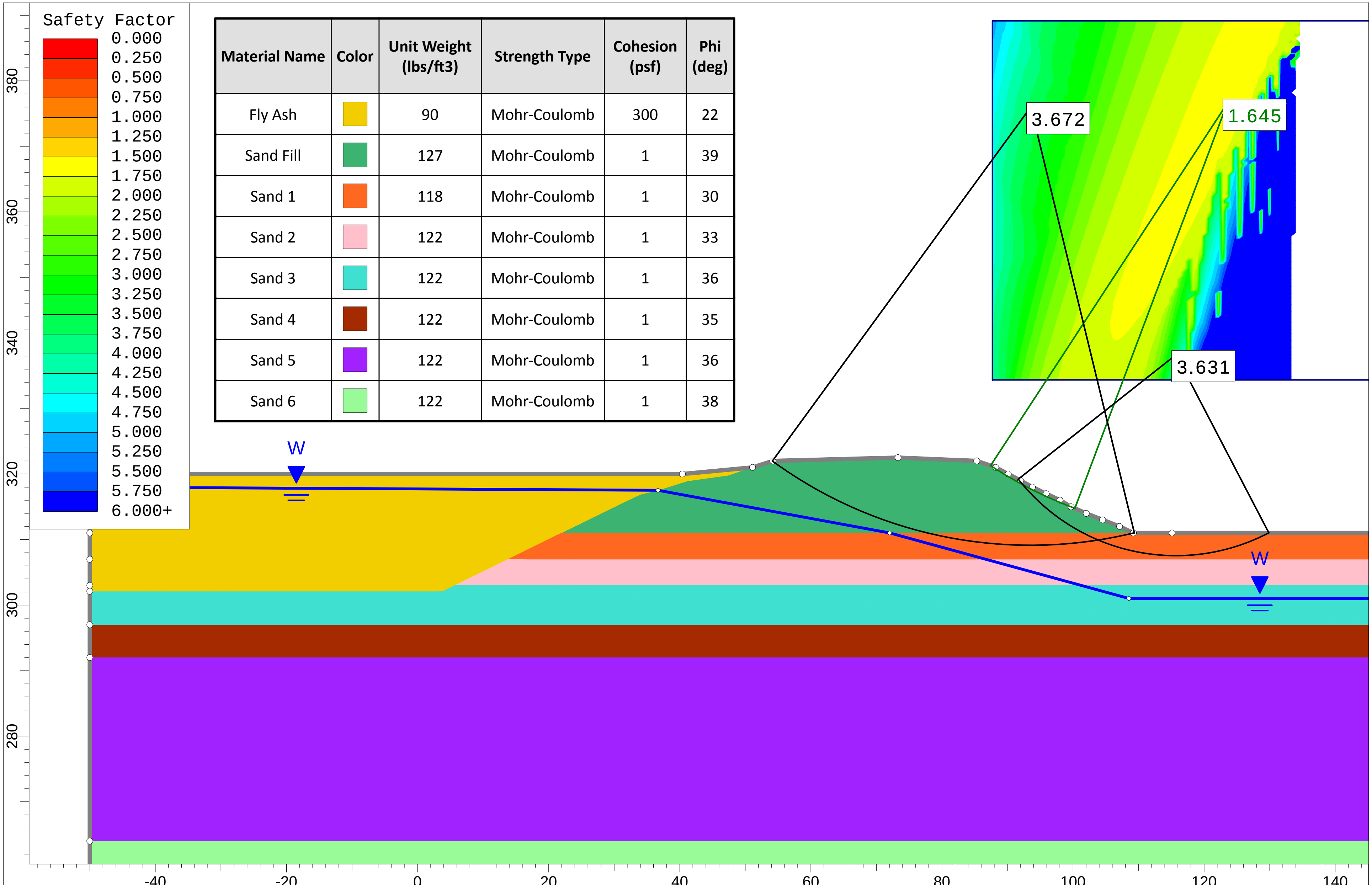
Figure 3-8




```
Notes:
     Displacement Analysis - Newmark Method
     Project: SHAKE2000 - Newmark Displacement Analysis

     Newmark Method by Kavazanjian & Matasovic
     Constant Yield Acceleration:      .13 (g)
     Acceleration Time History: Outcrop - Soil Profile No.  1 - AHL - Layer:
                           1 - Analysis: 1 - Soil Deposit: 1
     Acceleration Time History File: P:\GREDELL\2018120907\calc\Shake\short Duration-L1A1D1-1-Soil Pro-TUJ352.ahl
     Peak Acceleration Value:  .354113 (g)
     Upslope Movement not Included in Analysis
     Acceleration due to gravity:   386.4 (in/sec^2)

     Displacement computed:    15.70344 in
```

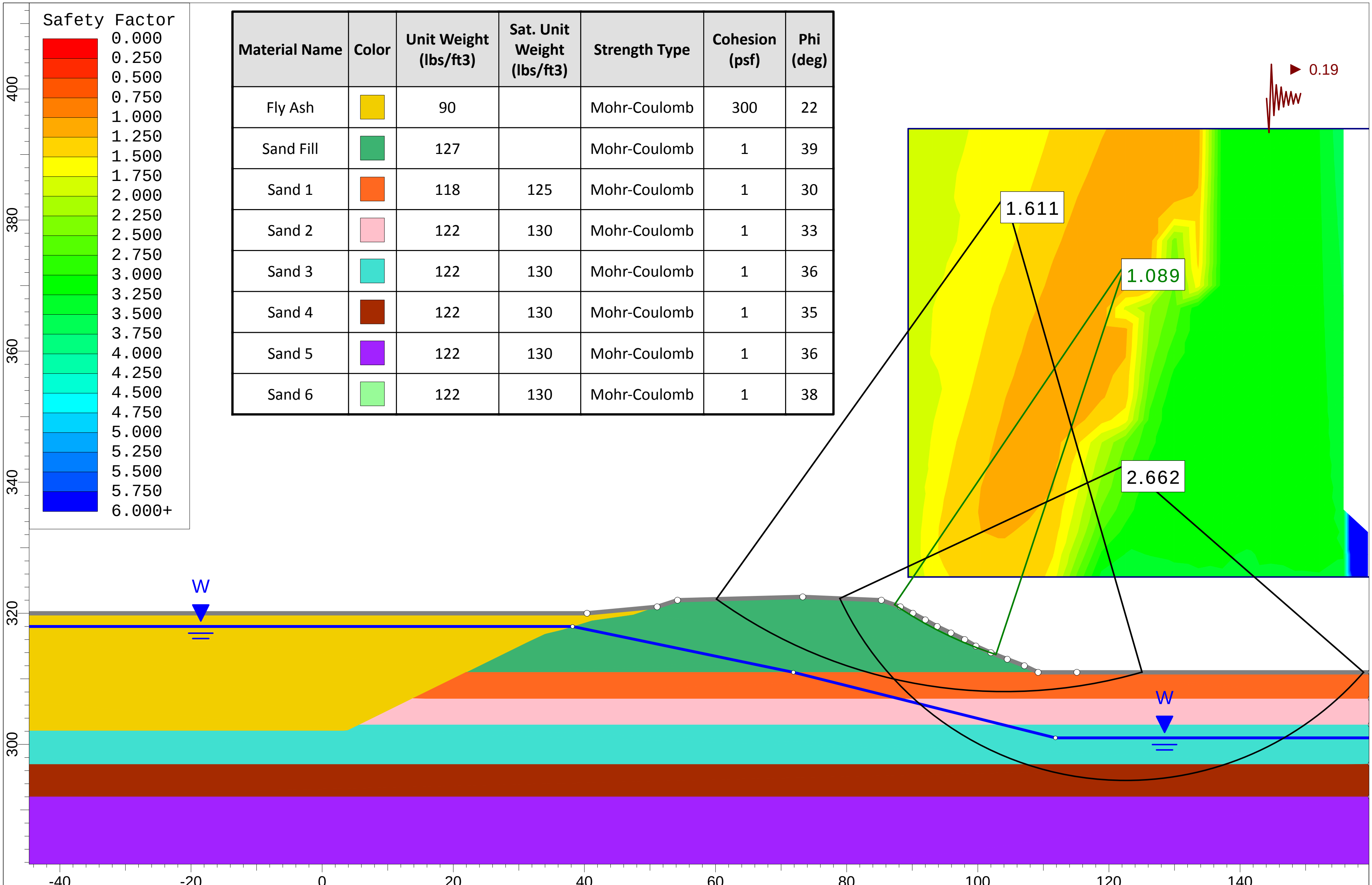


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fly Ash		90	Mohr-Coulomb	300	22
Sand Fill		127	Mohr-Coulomb	1	39
Sand 1		118	Mohr-Coulomb	1	30
Sand 2		122	Mohr-Coulomb	1	33
Sand 3		122	Mohr-Coulomb	1	36
Sand 4		122	Mohr-Coulomb	1	35
Sand 5		122	Mohr-Coulomb	1	36
Sand 6		122	Mohr-Coulomb	1	38

Sikeston BMU / Sikeston Power Station Fly Ash Pond
Section A-A', Static, Long-Term (Drained) Properties, Maximum Pool

REITZ & JENS, INC.

Figure 4-1

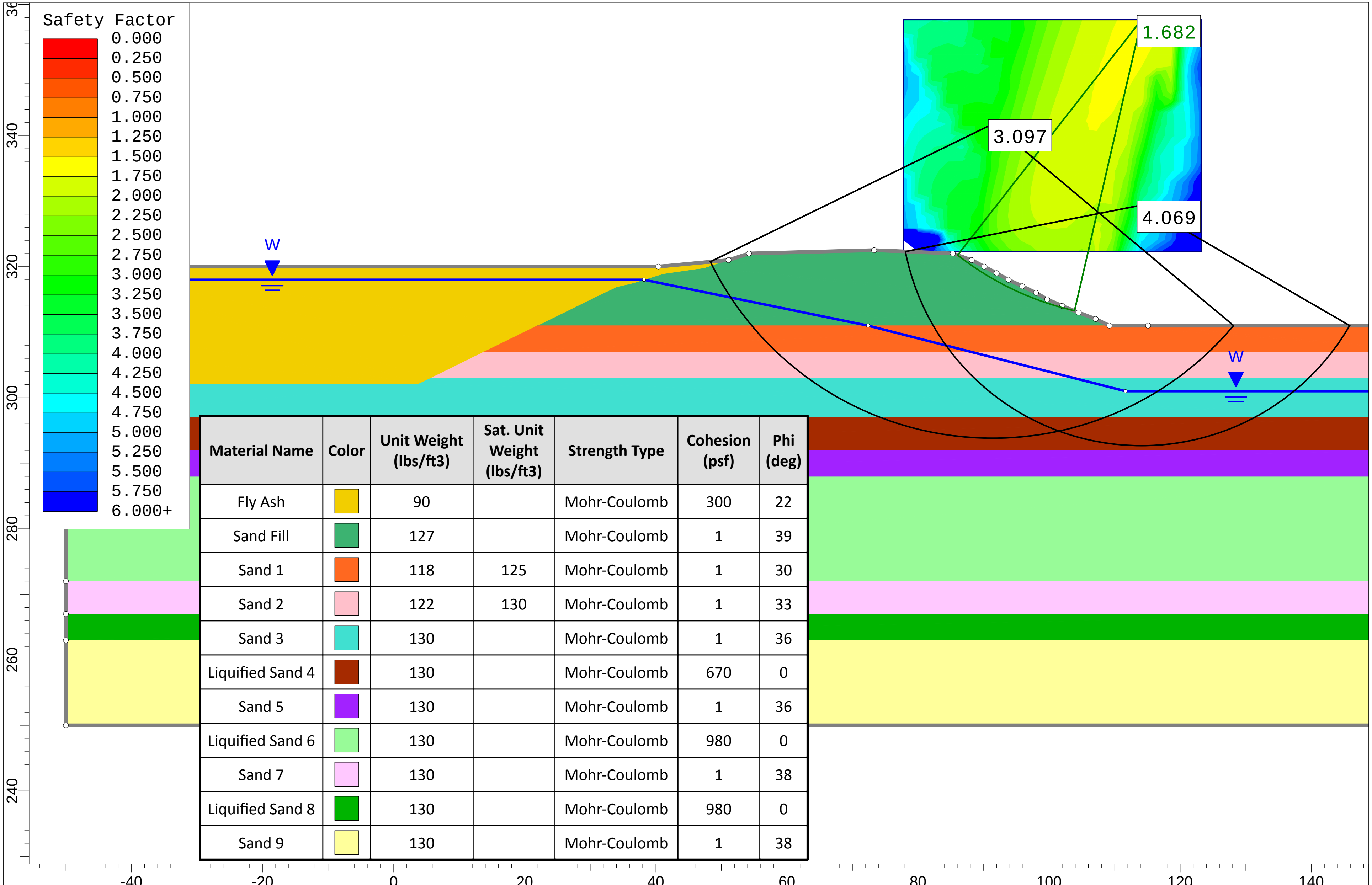


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fly Ash		90		Mohr-Coulomb	300	22
Sand Fill		127		Mohr-Coulomb	1	39
Sand 1		118	125	Mohr-Coulomb	1	30
Sand 2		122	130	Mohr-Coulomb	1	33
Sand 3		122	130	Mohr-Coulomb	1	36
Sand 4		122	130	Mohr-Coulomb	1	35
Sand 5		122	130	Mohr-Coulomb	1	36
Sand 6		122	130	Mohr-Coulomb	1	38

Sikeston BMU / Sikeston Power Station Fly Ash Pond
Section A-A', Pseudostatic, Long-Term Properties, Maximum Pool

REITZ & JENS, INC.

Figure 4-2



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fly Ash		90		Mohr-Coulomb	300	22
Sand Fill		127		Mohr-Coulomb	1	39
Sand 1		118	125	Mohr-Coulomb	1	30
Sand 2		122	130	Mohr-Coulomb	1	33
Sand 3		130		Mohr-Coulomb	1	36
Liquified Sand 4		130		Mohr-Coulomb	670	0
Sand 5		130		Mohr-Coulomb	1	36
Liquified Sand 6		130		Mohr-Coulomb	980	0
Sand 7		130		Mohr-Coulomb	1	38
Liquified Sand 8		130		Mohr-Coulomb	980	0
Sand 9		130		Mohr-Coulomb	1	38

Sikeston BMU / Sikeston Power Station Fly Ash Pond
Section A-A', With Liquefaction, Maximum Pool

REITZ & JENS, INC.

Figure 4-3

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