Mitchell Power Plant

Notice of Intent to Comply With the Site-Specific Alternative to Initiation of Closure

CCR Unit – Bottom Ash Pond

As required by 40 CFR 257.103(f)(1)(ix)(A), this is a notification that on November 30, 2020 Mitchell Power Plant (Mitchell Plant) submitted a site-specific alternative to initiation of closure due to development of alternative capacity infeasible to US EPA. The submission has been placed in Mitchell Plant's operating record and posted to the CCR Rule Compliance Data and Information website.

American Electric Power
1 Riverside Plaza
Columbus, OH 43215
aep.com

November 30, 2020

Submitted Electronically via Email

Mr. Andrew R. Wheeler, EPA Administrator
Environmental Protection Agency
1200 Pennsylvania Avenue, N.W.
Mail Code 5304-P
Washington, DC 20460

RE: Kentucky Power Company and Wheeling Power Company
Mitchell Power Plant Alternative Closure Demonstration

Dear Administrator Wheeler,

Kentucky Power Company (Kentucky Power) and Wheeling Power Company (Wheeling) Mitchell Power Plant (Mitchell Plant), hereby submits this request to the U.S. Environmental Protection Agency (EPA) for approval of a site-specific alternative deadline to initiate closure pursuant to 40 C.F.R. § 257.103(f)(1) for the Bottom Ash Pond located at the Mitchell Plant near Moundsville, West Virginia. Mitchell Plant is requesting an extension pursuant to 40 C.F.R. § 257.103(f)(1) to allow the Bottom Ash Pond to continue to receive CCR and non-CCR wastestreams after April 11, 2021, such that retrofits can be completed. Enclosed is a demonstration prepared by American Electric Power and Worley that addresses all of the criteria in 40 C.F.R. § 257.103(f)(1)(i)-(iii) and contains the documentation required by 40 C.F.R. § 257.103(f)(1)(iv). As allowed by the agency, in lieu of hard copies of these documents, electronic files were submitted to Kirsten Hillyer, Frank Behan, and Richard Huggins via email. A separate cover letter and confidential copy of Appendix C is being submitted in hard copy by overnight mail. If you have any questions regarding this submittal, please contact me at 614-716-2281 or damiller@aep.com.

Sincerely,

David A. Miller

David A. Miller, P.E.
Director, Land Environment & Remediation Services
Environmental Services Division

Attachments

cc: Kirsten Hillyer – USEPA
Frank Behan – USEPA
Richard Huggins – USEPA

Kentucky Power Company

Wheeling Power Company

Mitchell Plant

Demonstration Request to Develop Alternative Disposal Capacity for the Bottom Ash Pond CCR Management Unit

Prepared by:

American Electric Power Service Corporation
1 Riverside Plaza
Columbus, OH 43215

and

Worley
2675 Morgantown Road
Reading, PA 19607

Submitted

11/30/2020

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Professional Engineer's Certification

I certify, as a Professional Engineer in the State of West Virginia, that the information in this document was assembled under my direct supervisory control and is accurate as of the date of my signature. This report is not intended or represented to be suitable for reuse without the specific verification or adaptation by the engineer.

DAVID ANTHONY MILLER

Printed Name of Registered Professional Engineer

DAVID ANTHONY MILLER
REGISTERED
22663
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER

David Anthony Miller

Signature

22663	WEST VIRGINIA	11.30.2020
Registration No.	**Registration State**	**Date**

INTRODUCTION

American Electric Power Service Corporation (AEP), as agent for its affiliates, Kentucky Power Company (Kentucky Power) and Wheeling Power Company (Wheeling), the owners of the Mitchell Plant, seek EPA approval under 40 CFR 257.103(f)(1) - *"Development of Alternate Capacity Infeasible"* for the coal combustion residuals (CCR) surface impoundment located at Mitchell Plant (8999 Energy Road, (Marshall County) Moundsville, West Virginia). Kentucky Power and Wheeling seeks to establish a site-specific compliance deadline to continue to receive CCR wastestreams in the bottom ash pond (BAP) until April 21, 2023 while the last generating unit is converted to dry ash handling. Non-CCR wastestreams will continue to be routed to the unlined BAP until March 13, 2023. The BAP will be physically separated in half with sheet piling and sequentially closed by removal and converted to lined wastewater ponds for the non-CCR wastestreams. Tank-based systems will provide chemical treatment for the non-CCR wastestreams to assure continued compliance with the requirements of the facility's wastewater discharge permit. Closure of the BAP will be completed by July 31, 2023. This document will demonstrate that the CCR and/or non-CCR wastestreams must continue to be managed in the CCR surface impoundments because no alternative disposal capacity is available on or off-site and it is technically infeasible to complete the measures necessary to provide alternative disposal capacity either on-site or off-site by April 11, 2021. The BAP meets the location restriction requirements including the minimum aquifer separation, but does not meet the liner requirements of the CCR regulation and must close. A groundwater monitoring system was developed for the BAP and to date, no statistically significant levels above groundwater protection standards have been observed, therefore, the BAP meets the definition of an eligible unlined CCR surface impoundment.

OVERVIEW OF MITCHELL PLANT AND AFFECTED CCR UNITS

The Mitchell Plant is located along West Virginia Route 2 near the City of Cresap, West Virginia (WV). The Mitchell Plant began operations in 1971 with two coal-fired generating units each nominally rated at 800 megawatts (MW). The mailing address of the Mitchell Plant is P.O. Box K, Moundsville, WV 26041-0961. The facility and overall layout of the plant site and CCR units are shown on **Figure 1**.

The Mitchell Plant uses bituminous coal as the primary fuel source for its two steam-turbine electric generating units. The total nameplate electric production capacity of this plant is 1,600 MW. Processes and equipment that control air emissions from the coal fired units generate CCRs comprised of fly ash, bottom ash, and gypsum. Fly ash is managed on a dry basis and goes to the Mitchell Landfill (LF). Gypsum is sent to an adjacent wallboard manufacturing facility for beneficial reuse. Bottom ash produced at the Mitchell Plant is currently sluiced to the BAP and dewatered prior to beneficial reuse or transport to the LF for disposal. This active LF is located along Gatts Ridge Road (Marshall County Road 72) approximately 2 miles north of the intersection with County Road 74 (about 2 miles due east of the Mitchell Plant).

The Mitchell BAP is an active CCR surface impoundment that is part of the Bottom Ash Complex at the facility. The Bottom Ash Complex is comprised of the BAP and the Clear Water Pond as shown on **Figure 1**. Within the Bottom Ash Complex, the BAP is positioned immediately north of the Clear Water Pond and the south dike of the BAP separates the two ponds. The Clear Water Pond is not part of the Mitchell BAP.

The Mitchell BAP is divided into two primary areas for effective settlement and treatment of the bottom ash and non-CCR wastestreams that are sluiced into the BAP. The CCR wastestream is sluiced into the eastern portion of the pond. The settled ash is stockpiled within the pond limits until it is either taken to the Mitchell landfill or removed for beneficial reuse. The non-CCR wastestreams and CCR transport water are directed into the western portion of the pond. The total flows of the CCR and non-CCR wastestreams are discharged from the BAP to the Clear Water Pond. Discharge from the Clear Water Pond to the Ohio River via Outfall 001 is authorized by West Virginia National Pollutant Discharge Elimination System (NPDES) Permit No. WV0005304.

The Mitchell BAP comprises a total area of approximately 11.9 acres (measured to the toe of the exterior dikes). Using the operating pool elevation of 676 feet amsl and the pond bottom elevation of 660 feet amsl, the maximum storage capacity of the BAP is approximately 85 acre-feet. Based upon the operating pool elevation the BAP area is 6.7 acres and the Clearwater pond is 2.2 acres.

The initial pond construction was approved by West Virginia Department of Environmental Protection (WVDEP) Division of Water and Waste Management, Dam Safety Section in 1975 as a Hazard Class 2 structure under Dam ID #05108. The BAP is constructed with compacted soil dikes along the north, west and south perimeters. The east interior slope is incised within the natural hillside. The crests of the dikes are 20 feet wide. The interior slopes are lined with a PVC liner that is covered with 3 feet of soil.

Groundwater monitoring at the BAP is accomplished using a PE-certified groundwater monitoring network composed of seven groundwater monitoring wells installed in the Ohio River alluvial aquifer. The complete Groundwater Monitoring Well Network (GWMN) Evaluation Report is provided in Appendix D. Groundwater at the unit is monitored in accordance with an assessment monitoring program, following the requirements of 40 CFR 257.95 in the CCR rule. There have been no statistically significant levels over groundwater protection standards detected for any constituent at any monitoring well in the unit’s groundwater monitoring network. Following the requirements of 40 CFR 257.95, groundwater samples from each monitoring well are analyzed for all parameters in Appendix IV of the CCR rule during the first monitoring event of the annual monitoring cycle, then during the two subsequent events in the cycle, samples from each well are analyzed for all parameters in Appendix III and those parameters in Appendix IV that were detected during the first sampling event in the cycle. Analysis results for each constituent at each monitoring well are compared to corresponding groundwater protection standards according to statistical procedures and performance standards specified in 40 CFR 257.93(f) and 40 CFR 257.93(g).

SATISFACTION OF THE CRITERIA IN 40 CFR §257.101(f)(1) FOR THE BAP CCR UNIT

WORK PLAN

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 AEP manages in the BAP and discusses the options considered for obtaining alternative disposal capacity. As discussed in more detail below, AEP has elected to convert to dry bottom ash handling at the Mitchell Plant. 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 the Mitchell Plant were no longer able to use the BAP.

Section One – Narrative Description of How Alternative Capacity will be Developed

From the regulatory text § 257.103(f)(1)(iv)(A)(1)

> *(1) 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:*
>
> > *(i) An in-depth analysis of the site and any site-specific conditions that led to the decision to select the alternative capacity being developed;*
> > *(ii) An analysis of the adverse impact to plant operations if the CCR surface impoundment in question were to no longer be available for use; and*
> > *(iii) A detailed explanation and justification for the amount of time being requested and how it is the fastest technically feasible time to complete the development of the alternative capacity;*

<u>Existing On and Off-site Disposal Capacity Evaluation</u>

The Mitchell Plant does not currently have an existing alternate pond that meets the liner requirements of EPA's CCR regulation, and considerable modifications to plant equipment, facilities, and processes will be necessary before the Mitchell Plant can cease placing CCR and non-CCR wastestreams into the BAP. Likewise, considerable modifications and new equipment would be necessary to transport CCR and non-CCR wastestreams to an off-site disposal facility, if one were available. Currently, no known off-site facilities are available that are capable of processing the wastestreams generated by the Mitchell Plant.

CCR Wastestreams:

The BAP receives approximately 1 million gallons a day (MGD) of sluiced water containing bottom ash.

In terms of on-site alternative disposal capacity; there are no other CCR surface impoundments that are available to dispose of the CCR materials. In order to develop this capacity refer to Table 3 and the timing required to do so; the current approach is the fastest feasible alternative which is to convert the generating unit to dry bottom ash handling and utilize the existing landfill. Relative to off-site disposal capacity, the effluent limitation guidelines prohibit the disposal of CCR sluice water into public treatment works. The sheer volume which will need to be handled on a daily basis makes off-site disposal of wet ash impractical. 1 MGD of bottom ash sluice flows equates to approximately 4,150 tons per day of sluiced water and would require 208 trucks per day twenty four hours per day seven days per week to haul off and dispose. There are currently no facilities to collect and load this wastestream into tankers for transport, and construction of such facilities to manage these flows on a temporary basis would interfere with the activities needed to comply with the new requirements of both the CCR and ELG rules. The increase in traffic associated with such an operation on the plant site poses significant safety risks and is impossible to achieve. The most likely facility type capable of managing industrial wastewaters are publicly-owned or private treatment works, underground injection wells, or publicly available waste management facilities capable of solidifying liquid wastes for disposal in a landfill. Given the volume and characteristics of the CCR wastestream, increases in permitted capacity or other modifications to the permitted pretreatment programs of a public or private wastewater treatment facility would likely be required to manage this flow, if one were available.

AEP evaluated each CCR wastestream placed in the BAP at the Mitchell Plant. For the reasons discussed above, and in Table 1 below, the following CCR wastestreams must continue to be placed in the BAP due to lack of alternative capacity both on and off-site.

Table 1: Mitchell Plant CCR Wastestreams

CCR Wastestream	Average Flow (gpd)	Current Configuration	AEP Notes
Bottom Ash	1,000,000	Bottom ash is currently sluiced to the BAP, where it is temporarily stored until removed, dewatered, and beneficially reused or disposed in the Mitchell Landfill.	Bottom ash wastestream cannot be removed from the BAP until new Under Hopper Drag Chain (UHDC) dry bottom ash system is installed allowing ash to be collected and transported to the Mitchell Landfill. This wastestream will cease in April 2023. The number of trucks per day to transport this wastestream off-site for disposal was calculated as follow: 1,000,000 million gallons per day * 8.3 pounds per gallon = 8,300,000 pounds / 2000 pounds per ton = 4,150 tons per day / 20 tons per truck = 207.5 or 208 trucks per day

Non-CCR Wastestreams:

Approximately 7.2 MGD of various non-CCR wastestreams are sent to the BAP. These wastewater streams include: fly ash silo sumps, landfill leachate, cooling tower blowdown, effluent from the chloride purge treatment system, pyrites sluice water, plant drains and sumps, and intermittent metal cleaning wastewaters and non-chemical metal cleaning wash.

There are no alternate ponds on the site that can accept these waststreams nor is there the existing infrastructure to deliver the wastestreams to a different location The feasibility of re-routing each individual non-CCR flow to another on-site pond such as the existing Clearwater pond or stormwater pond was evaluated initially based on wastewater quality, followed by a hydraulics analysis to assess treatment and operational efficiency. The non-CCR flows not included in the analysis are the intermittent flows and the Pyrites sluice water because the pyrites are managed with the bottom ash and will not discharge after dry conversion. Several of the non-CCR wastestreams are not recommended for re-routing based on risk of NPDES permit noncompliance due to their pollutant load, including: the fly ash silo sumps and landfill leachate tend to have high metal content and specifically high selenium in the leachate; the chloride purge stream tends to have high mercury and selenium at concentrations of concern for permit compliance. The remaining non-CCR wastestreams were then evaluated based on hydraulics. Using the ideal settling rate of 0.05 gpm/sqft or less and the TSS concentration of each stream, the pond size required to adequately settle solids was calculated and compared to the 1.4 acre area of the Clearwater pond that has 10' depth available for settling. The hydraulics analysis indicates that the larger waste streams (cooling tower blowdown and U12 WW Sumps) would require 2.4 and 1.8 acres, respectively, to allow adequate settling for permit compliance. All of the non-CCR wastestreams will be routed through the new chemical mix tanks for treatment prior to discharge to the new wastewater ponds. Rerouting these non-CCR wastestreams prior to completion of the new chemical mix tank would require permitting equivalent to the permitting required for the selected alternative. Thus doing this would not accelerate the removal of wastestreams from the BAP as compared to the selected option.

Therefore, the existing non-CCR wastestreams need to be discharged to the existing ponds and receive treatment in the current treatment path through the BAP to ensure and maintain compliance with current NPDES permit limits. In addition, once the BAP is closed and converted to lined wastewater ponds the majority of these non-CCR wastesteams will be routed through the new mix tanks, which will be constructed in parallel with the new West wastewater pond, to allow for enhanced solids settling. Relative to off-site disposal capacity and similar to bottom ash, the sheer volume which will need to be handled on a daily basis makes off-site disposal impractical. 7.2 MGD equates to approximately 30,000 tons per day of non-CCR wastestreams and would require 1,500 trucks per day (more than one truck leaving the plant site every minute of every day) to haul off and dispose of. There are currently no facilities to collect and load these wastestreams into tankers for transport, and construction of such facilities to manage these flows on a temporary basis would interfere with the activities needed to comply with the new requirements of both the CCR and ELG rules. The increase in traffic associated with such an operation on the plant site poses significant safety risks and is impossible to achieve. The most likely facility type capable of managing industrial wastewaters are publicly-owned or private treatment works, underground injection wells, or publicly available waste management facilities capable of solidifying liquid wastes for disposal in a landfill. Given the volume and characteristics of the non-CCR wastestreams, increases in permitted capacity or other modifications to the permitted pretreatment programs of a public or private wastewater treatment facility would likely be required to manage this flow, if one were available.

AEP evaluated each non-CCR wastestream placed in the BAP at Mitchell Plant. For the reasons discussed above, and in Table 2 below, each of the non-CCR wastestreams must continue to be placed in the BAP due to lack of alternative capacity both on and off-site.

Table 2: Mitchell Plant non-CCR Wastestreams

Non-CCR Wastestream	Average Flow (gpd)	Current Configuration	AEP Notes
Fly Ash Silo Sumps & Landfill Leachate	109,000	Flows to the existing BAP	The BAP provides treatment for these non-CCR wastestreams (primarily solids settling) to allow them to meet the NPDES discharge limits and no alternative capacity exists for treatment until the repurposed WWP is completed. The number of trucks per day to transport each wastestream off-
Chloride Purge System	730,000		
Cooling Tower Blowdown	1,590,000		
U1 & U2 ESP Sumps	140,000		
U1 & U2 WW Sumps	3,800,000		
Pyrite Sluice Water	860,000	Sluiced to the existing BAP	

Non-CCR Wastestream	Average Flow (gpd)	Current Configuration	AEP Notes
Non-chemical metal cleaning wash*	Intermittent: 430,000 ~ twice per year	Intermittent flow to the existing BAP	site for disposal was calculated as follow: 109,000 gallons per day * 8.3 pounds per gallon = 904,700 pounds per day / 2000 pounds per ton = 452.35 tons per day / 20 tons per truck = 22.61 → 23 trucks per day 730,000 gallons per day * 8.3 pounds per gallon = 6,059,000 pounds per day/ 2000 pounds per ton = 3,029.5 tons per day / 20 tons per truck = 151.475 → 151 trucks per day 1,590,000 gallons per day * 8.3 pounds per gallon = 13,197,000 pounds per day / 2000 pounds per ton = 6,598.5 / 20 tons per truck = 329.92 → 330 trucks per day 140,000 gallons per day * 8.3 pounds per gallon = 1,162,000 pounds per day / 2000 pounds per ton = 581 tons per day / 20 tons per truck = 29.05 → 29 trucks per day 3,800,000 gallons per day * 8.3 pounds per gallon = 31,540,000 pounds per day / 2000 pounds per ton = 15,770 / 20 tons per truck = 788.5 → 789 trucks per day 860,000 gallons per day * 8.3 pounds per gallon = 7,138,000 pounds per day / 2000 pounds per ton = 3,569 / 20 tons per truck = 178.45 → 178 trucks per day
Metal cleaning waste*	Intermittent: 45,000 over 10 days ~ every 18 months		
Gypsum Building sump*	Intermittent		
Transfer House 6/7 Sump*	Intermittent		

*Intermittent Flows not included in trucking calculations

i) <u>Alternatives for Disposal Capacity</u>

In order to comply with the CCR rule, AEP performed an evaluation (beginning in 2017 and completing in 2018) of alternative disposal capacity options at the Mitchell Plant for both CCR and non-CCR wastestreams that are managed in the BAP The evaluation determined the feasibility of options to achieve CCR compliance requirements. Feasible options were evaluated by balancing the technology, performance, schedule duration, other risk factors, and considered potential Effluent Limitation Guidelines (ELG) compliance alternatives.

The options considered for alternative disposal capacity of the wastestreams currently routed to the Bottom Ash Complex are summarized in **Table 3** below.

Table 3: Alternatives for Disposal Capacity

Alternative Capacity Technology	Estimated Implementation Time (Months)	Feasible at the Mitchell Plant?	Selected?	AEP Notes
Conversion to dry handling	32	Yes	Yes	Adequate space is available at the site to install equipment necessary for a dry bottom ash conversion. This alternative has a similar compliance schedule to the other alternatives considered and allows for compliance with ELG rules.
New CCR surface impoundment	38 to 72	No	No	New CCR impoundment alone does not provide compliance with the ELG rules. Not feasible due to the time required for siting, permitting, engineering and design, and construction of the new impoundment. Past AEP projects experienced a range from 38-72 months before waste could be placed in the new impoundment and thus was not further pursued.
Retrofit a portion of CCR surface impoundment	31.5	Yes	No	Retrofitting a portion of the pond alone will not bring the facility into compliance with the ELG rule without additional water recycle systems that have an uncertain impact on the plant water balance; the dry ash handling systems have a similar compliance schedule
Repurpose a portion of CCR surface impoundment to a lined pond for non-CCR wastestreams	31	Yes	Yes	This alternative was selected for the Mitchell Plant since the existing BAP currently handles the existing non-CCR wastestreams and provides the treatment capacity required to comply with the facility's NPDES permit. These ponds will be closed by removal and converted to lined wastewater ponds.

Alternative Capacity Technology	Estimated Implementation Time (Months)	Feasible at the Mitchell Plant?	Selected?	AEP Notes
Multiple technology system	31-32	Yes	Yes	This alternative was selected for the Mitchell Plant since the existing BAP has the capacity to receive the non-CCR wastestreams once it is closed and converted to lined wastewater ponds. Dry handling of the bottom ash (32 months) and repurposing the ponds to receive non-CCR wastestreams (31 months) will provide the necessary compliance needs on the fastest feasible schedule for the site balancing both CCR and ELG rule requirements.
Off-site disposal	N/A	No	No	As EPA explained 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) It is infeasible to collect, transport, and provide offsite treatment of the large volume of CCR and non-CCR wastestreams currently routed to the BAP without considerable modifications and new equipment necessary to transport CCR and non-CCR wastestreams to an off-site disposal facility, if one were available.
Temporary treatment system	Not defined	No	No	These systems are not proven for reliable long-term management of high volume CCR materials in the industry and would not realistically provide the required non-CCR wastewater storage capacity to replace the BAP. Temporary treatment systems to manage the CCR and non-CCR wastestreams for Mitchell Plant would require a chemical feed system, chemical mix tanks, clarifiers, and a filtration system. Based on the flow rates, the number and size of clarifiers required to handle these streams outside of the BAP would range from 2 to 4, 110 foot diameter tanks based upon typical and max flow characteristics. The size of this temporary system is well beyond any type of rental units that are available in the market.

Based on the decision to convert to a dry ash handling system at the Mitchell Plant, AEP evaluated potential options for compliance with both the CCR and ELG rules as noted in the **Table 4** below.

Table 4: Alternatives Considered for CCR Wastestreams

System	Technology	Practicability or Feasibility for the Mitchell Plant
Bottom Ash	Under Hopper Drag Chain Conveyor 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. Risk associated with managing plant water balance.
Bottom Ash	Dry Belt/Tray Conveying System	Feasible
Bottom Ash	Pneumatic Conveying System	Feasible
Bottom Ash	Vibratory Conveying System	Not practicable; requires frequent labor intensive maintenance and no longer industry standard practice for bottom ash (replaced by remote conveyors for similar costs)
Bottom Ash	Remote Settling Basins	Not practicable; requires frequent labor intensive maintenance and both water balance and safety concerns. Challenging to add remote pumps and power supply for recirculation that is not required with other options.
Bottom Ash	Remote Dewatering Bins	Not Practicable; requires frequent labor intensive maintenance and no longer industry standard practice for bottom ash (option replaced by remote conveyors for similar costs)
Bottom Ash	Closed Loop Recirculation System	Not practicable; risks associated with managing plant water balance.

Timeframe for delivering dry ash handling alternatives were determined to be equivalent and not a factor in the final selection.

Based on the evaluation of alternative disposal options, AEP selected the following options for compliance at the Mitchell Plant:

- Converting from wet bottom ash system to dry handling system, using an under hopper drag chain conveyor (UHDC).
- Closure of the BAP by CCR material removal.
- Constructing new non-CCR wastewater ponds (WWP) within the footprint of the closed BAP.

This alternative and strategy can be implemented in the least or equal amount of time of the alternatives and accommodates the unique site features such as quantity of wastestreams and the lack of off-site disposal facilities. This alternative complies with both the CCR and ELG rules at the Mitchell Plant.

AEP contracted with Worley to provide engineering, design and procurement services for the selected alternative disposal option. The conceptual design stage of the projects has been completed and includes the following scope:

- Dry Bottom Ash Handling System
    - Installation of a UHDC and associated equipment to collect and dewater bottom ash from Unit 1 and Unit 2.
    - Installation of a common ash bunker for Units 1 and 2 to collect and temporarily store material from the UHDC.
    - Installation of a sump at the ash bunker to collect stormwater and excess quench water and return flow to the cooling tower basin
    - Material from ash bunker will either be hauled to the Mitchell landfill for disposal or beneficially reused.
- Bottom Ash Pond Closure by Removal
    - All CCR material within the existing BAP will be removed via dewatering and mechanical excavation. All CCR material will either be hauled to the Mitchell landfill for disposal or beneficially reused.
    - A third-party engineer will certify the removal of CCR upon completion. Certification will be performed in phases across the BAP.
    - After certification of removal of all CCR within a given area of the existing BAP, construction of the new Non-CCR WWP will proceed.
- New Non-CCR WWP
    - New (4-acre) lined East WWP constructed within the eastern footprint of the existing BAP to treat non-CCR wastestreams generated at the plant.
    - New (3-acre) lined West WWP constructed within the western footprint of the existing BAP to receive effluent from the East WWP. The West WWP will discharge to the existing Clearwater Pond, which in turn will continue to discharge to the Ohio River through NPDES Permit WV No. WV0005304 Outfall 001.
    - Installation of tank-based chemical treatment system with appropriate retention time to provide proper mixing of chemicals to facilitate settling to meet plant discharge requirements at the new Non-CCR wastewater ponds as necessary to meet plant discharge requirements.

Appendix A includes a site plan showing the existing and future configurations after rerouting of non-CCR wastewater and removal of CCR from the BAP. The current and future water balance diagrams are included in **Appendix B**.

ii) <u>Impact to Plant Operations if Alternative Capacity Not Obtained</u>

If Mitchell Plant were required to immediately cease the placement of CCR and non-CCR wastestreams into the BAP, which is necessary for handling as much as 8.24 million gallons per day of CCR and non-CCR wastestreams, and initiate closure, AEP would have to temporarily or permanently cease power production at the plant. Idling or closure of the plant would stop the production of CCR wastestreams and some non-CCR wastestreams but would not eliminate the need for handling other non-CCR wastestreams, such as cooling tower blowdown and low volume wastewater from various water collection sumps from around the plant. The BAP is integral in receiving and treating these flows as required to meet the NPDES discharge limits. Therefore, the need for uninterrupted non-CCR wastestream capacity will be necessary for a significant amount of time after CCR waste ceases to be generated. Put simply, the BAP will be unable to immediately cease operation even if the Mitchell Plant immediately discontinued the combustion of coal and production of CCR wastestreams.

The immediate forced cessation of power production at Mitchell Plant could cause serious local power delivery constraints and more regional reliability concerns in the affected states. If other coal-fired facilities in these or neighboring states are also forced to cease power production, the consequences could be serious. For example, according to the Energy Information Administration's Electric Power Annual for 2019, coal-fired units provide the following percentages of electricity generation in 2018 and 2019 in midwestern states where AEP's units operate:

Utility Scale Generation from Coal – 2018•

State	Total Utility Scale Generation (Thousands MWh)	Utility Scale Generation from Coal (Thousands MWh)	Percentage of Utility Scale Generation from Coal
Indiana	113,460	77,455	68.3%
Kentucky	78,804	59,168	75.1%
Ohio	126,185	58,727	46.5%
West Virginia	67,249	62,039	92.3%

- Data from *Electric Power Annual 201*9, Tables 3.7 and 3.8, Energy Information Administration, eia.gov/electricity/annual/pdf/epa.gov (last referenced October 26, 2020).

Utility Scale Generation from Coal – 2019•

State	Total Utility Scale Generation (Thousands MWh)	Utility Scale Generation from Coal (Thousands MWh)	Percentage of Utility Scale Generation from Coal
Indiana	102,505	60,762	59.3%
Kentucky	71,804	51,714	72.0%
Ohio	120,001	46,765	39.0%
West Virginia	63,926	58,182	91.0%

- Data from *Electric Power Annual 201*9, Tables 3.7 and 3.8, Energy Information Administration, eia.gov/electricity/annual/pdf/epa.gov (last referenced October 26, 2020).

As shown in these tables, West Virginia and Kentucky are particularly dependent on coal-fired generation for the vast majority of electricity produced in that region. Simultaneous immediate closure of a significant portion of the coal-fired capacity in these states could destabilize the electricity grid and would not be in the public's best interest.

iii) <u>Justification for Time Needed to Complete Development of Alternative Capacity Approach</u>

The schedule for developing alternative disposal capacity is described in more detail in Section 3. As the schedule shows, AEP has already undertaken significant planning and implementation steps towards ceasing the receipt of CCR and non-CCR wastestreams within the BAP. Finalization of the both the CCR and ELG rules impacts Wheeling and Kentucky Power's ability as regulated utilities to obtain regulatory approval for the required capital expenditures to comply with both rules. This schedule represents the fastest technically feasible timeframe for compliance at the Mitchell Plant, driven primarily by the need for two major equipment tie-in outages to allow for removal of the current sluicing equipment and installation of the new UHDC equipment. The Mitchell Plant serves the PJM interconnection which manages the grid to provide electricity to 13 states and the District of Columbia. Outages are planned many years in advance with the Regional Transmission Operator (RTO) to effectively manage the generation capacity footprint. The RTO does not typically allow the Mitchell Plant much flexibility to adjust these outages or perform them in the non-shoulder months (summer and winter) due to the limited generating capacity during these peak electricity usage times and resulting potential impacts to grid stability. The sequencing and final tie-ins associated with this work as described in the work plan in Section 3 further elaborates on the complexities associated with this option. The Units must be converted to dry ash handling in order to cease receipt of CCR wastestreams in the current configuration. After receipt of regulatory approval, the dry ash handling conversion will be worked in parallel with the pond closure, new pond construction, and tank based chemical treatment and non-CCR stream reroute construction activities scope to achieve compliance as soon as possible. The total project duration of approximately 32 months from the date AEP initiated detailed design (August 2020) until the date that CCR sluicing is ceased and alternative capacity is provided for non-CCR wastestreams (April 21, 2023) is less than the average multiple technology system timeline of 39.1 months identified in the EPA Final Part A rule.

Section Two – Visual Timeline Depicting the Steps Necessary to Obtain Alternative Capacity

From the regulatory text § 257.103(f)(1)(iv)(A)(2)

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

Appendix C contains a timeline that illustrates all relevant phases and details the steps necessary for implementation of obtaining Alternative Capacity.

Section Three – Narrative of the Schedule and Timeline to Obtain Alternative Capacity

From the regulatory text § 257.103(f)(1)(iv)(A)(3). *A narrative discussion of the schedule and visual timeline representation, which must discuss all of the following:*

> *(i) Why the length of time for each phase and step is needed and a discussion of the tasks that occur during the specific step;*
> *(ii) Why each phase and step shown on the chart must happen in the order it is occurring;*
> *(iii) The tasks that occur during each of the steps within the phase; and*
> *(iv) Anticipated worker schedules;*

The schedule for this project is generally broken down into two major scopes of work: Dry Ash Handling (DAH) System installation and Pond Closure / New Pond Construction.

Dry Ash Handling System

Engineering, Design and Procurement (September 2021 – January 2023)
The conceptual design of the new DAH system has been completed. Regulatory approvals from the West Virginia and Kentucky Public Service Commissions are required for capital improvements of this magnitude. Applications for approval are being prepared and will be

submitted by the end of January 2021. Proceedings are estimated to be concluded by August 31, 2021. Detailed design of the DAH System will start in September 2021 and is scheduled to be completed by October 2022. Equipment procurement for the DAH system to support this project has a forecasted delivery date of the major equipment by January 2023.

Contractor Selection (April 2022 – December 2022)
There are 3 Construction (Labor) bid packages that are planned to be developed in parallel with the detailed design efforts. The typical timeframe to competitively bid major labor contracts is six months in accordance with AEP's procurement processes. The Civil labor contract package will be issued for bid beginning April 2022 and awarded to the selected construction contractors by September 2022. The Structural/Mechanical (S/M) and Electrical, Instrumentation, and Controls (EIC) construction bid packages are planned to be issued in June and July of 2022 and awarded by October and December of 2022. Civil construction is planned to start immediately following award in September 2022.

Construction (September 2022 – June 2023)
The civil work will include underground utility relocations, excavation and subgrade prep for the ash bunker footings and foundation installation. Once the footings and foundation are poured, the new ash bunker walls will be formed and poured. Similar activities will be performed for the belt transfer conveyor and transfer tower foundations. Soon after the civil work has started the structural/mechanical (S/M) contractor will mobilize to begin above ground utility relocations inside each Unit, structural steel reinforcing along Unit 1 and Unit 2 boiler building columns, and setting of transfer tower structural steel. Once the transfer tower steel is set, assembly and erection of the transfer conveyors from the common ash bunker back towards each Unit's boiler building will follow. The ash bunker sump pumps will be set, and piping ran back to the cooling tower basin. Balance of plant piping such as service water, instrument air, plant air, and other systems will be installed. Building penetrations will be made for the UHDC conveyors. The existing ash hopper pit concrete will be saw cut to make additional space required to route the conveyor out from underneath the ash hopper in each Unit. During this time as much demolition of existing equipment and structural steel that can be performed ahead of the Unit outages will be completed which includes reinforcing of the existing ash hopper structural steel to accommodate the new UHDC equipment loads.

The electrical/instrumentation and controls contractor (EIC) will mobilize soon after the S/M contractor to begin above ground utility relocations, installation of conduit and cable tray for both power and control cabling to the new equipment mentioned above. New electrical equipment will be set which includes distributed control system cabinets. Once the conduit and cable tray runs are completed the power and control cabling will be pulled, tested and terminated to the greatest extent possible. A majority of the power feeds and control cables for the UHDC equipment will need to be rolled up and temporarily staged at the ash hopper pits to be completed once the UHDC equipment is erected in place during the tie-in outages.

Although as much work as possible will be performed while the Units are operating, a significant portion of the work to complete the DAH system equipment installation requires a Unit outage. The generating units will be removed from service in Spring of 2023 to complete the UHDC outage related activities and final tie-ins. A portion of the outage schedule for the two units overlaps to accommodate work on common equipment.

Once the Spring outage begins both the S/M and EIC contractors will work two shifts sixty hours per week to complete the outage related activities. The pulverizer housing rotation will begin along with the demolition of boiler downcomer piping and any remaining equipment in the ash hopper pit area to allow for installation of the collection and dewatering conveyors. The support steel will be set, and the conveyors will be erected. The instrumentation and remaining connections trimmed out both electrically and mechanically to complete the UHDC system installation.

All CCR flows to the BAP will completely cease no later than April 21, 2023.

Startup and Implementation (April 2023 – June 2023)
Once the system is substantially complete, the AEP startup and commissioning group will begin checkout and functional testing to ensure proper operation once the system is completed and turned over. After the commissioning and check out is complete the system will be turned over to plant operations to perform plant testing and checkout and return the generating unit back to service.

Bottom Ash Pond Closure/ New Pond Construction

Engineering and Design (September 2020 – April 2022)
Detailed design of the balance of plant systems and tank based chemical treatment system has started and is planned to be completed by April 2022. The civil design work started in November 2020 and will complete by September 2021. The design of the ponds is dependent upon performing topographic survey, bathymetric survey, and geotechnical investigations to understand subgrade materials at the locations of the new ponds. The investigations will also be used to verify CCR depths at certain locations.

Permitting (December 2020 – June 2022)
The regulatory filing process has commenced and is planned to continue through January 2021. Additional permitting efforts relative to dam/dike modifications, the NPDES, and SWPPP necessary to construct the ponds will commence in 2021 and are planned to continue through June 2022.

Contractor Selection (May 2021 – August 2022)
There are three Construction (Labor) bid packages that are planned to be developed in parallel with the detailed design efforts. The typical time frame to competitively bid major labor contracts is six months in accordance with AEP's procurement process. The Civil labor package will be issued for bid in May 2021 and awarded to the selected construction contractors by September 2021 following receipt of regulatory approval. The S/M and EIC construction bid packages are planned to be issued in March and April of 2022 and awarded by July and August of 2022. Civil construction is planned to start immediately following award in September 2021.

Construction (September 2021 - November 2023)
The closure of the BAP and construction of the new East and West WWP requires specific sequencing in order to complete the work due to the fact that the new ponds will be located within the existing BAP footprint and need to maintain overall pond operations while including provisions to meet the NPDES discharge permit requirements throughout construction. Final completion of the Eastern portion of the pond closure and repurposing activities is dependent upon installation of the DAH system equipment and ceasing CCR flows to the BAP. However, steps have been included in the project plan to allow for parallel activities to complete the work as early as possible as shown on the schedule in **Appendix C** and further described in this section.

The Mitchell BAP was constructed with a PVC liner, overlain by three (3) feet of protective cover soil. The CCR and protective cover soil will be removed and placed in the Mitchell landfill. The existing PVC liner will be removed and disposed offsite. When the excavation has finished removing the PVC liner (or the visual bottom of the CCR in any local area where the PVC liner has been compromised, if applicable), the contractor will remove an additional one foot of material to confirm removal of CCR. Additionally, a third-party engineer will perform quality assurance/quality control (QAQC) services to independently verify that all CCR materials are removed.

The closure by removal will be verified with a minimum of two groundwater sampling events. If the groundwater monitoring concentrations taken during those events do not exceed the groundwater protections standard the BAP will be considered closed.

The pond construction and closure work will be performed in phases primarily during calendar years 2021-2023, with final certification work in July 2023. The phases are shown in the schedule in **Appendix C** and timeframes are based on the estimated volumes of material to be removed as well as the estimated earthwork, liner, and protective cover quantities required for pond construction. These durations are based on an average work schedule of five days per week / ten hours per day and do not take into account delays from periods with significant rain events greater than average or normal for the geographic location.

Phase 1 (West BAP Closure and Pond Repurpose) – The contractor will mobilize September 2021 to begin Pond Closure and Repurposing scope of work. The contractor will work to complete site preparation activities including mobilization, installing erosion control, preparing laydown and construction office areas, installation of temporary wastewater treatment equipment, installing sheet piling to isolate and prevent seepage between the two halves of the existing BAP, diverting wastewater inflows from the initial closure and construction work area, and dewatering the west half of the BAP.

The first phase of the pond closure and new pond construction scope of work also includes removal of CCR material in the existing western footprint of the BAP and will be completed in July 2022. During this time all non-CCR streams that are currently routed through the BAP will be flowing through the Eastern footprint of the BAP while pond closure and repuposing takes place in the Western portion. Upon certification of closure by removal, construction of the new West Wastewater Pond will proceed. New subgrade will be established and prepped for the liner installation which is planned to begin in August 2022. At this same time, subgrade prep and installation of the new tank based chemical treatment system will also begin. The construction of the West Wastewater Pond is scheduled for completion in March 2023 which includes the tank-based chemical treatment equipment and rerouting of non-CCR wastewater piping. Startup and commissioning activities associated with the tank-based chemical treatment equipment will also be completed in parallel.

All Non-CCR wastewater streams will cease running through the BAP by March 13, 2023 with the initial operation of the new West WWP.

Phase 2 (East BAP Closure and Pond Repurpose) - The second phase of the BAP closure and new wastewater pond construction scope of work includes removal of CCR materials from the eastern portion of the existing BAP and completion of similar activities as described above. During this time all non-CCR streams are running through the newly lined western half of the repurposed pond until the last Unit is taken out of service to allow for CCR streams to cease and CCR removal activities to begin. The removal of CCR material will be completed and certified in July 2023. The closure by removal will be certified by a third-party engineer and the records will be posted in the operating record and on the AEP CCR website as appropriate. Work will continue to construct a new lined East WWP after CCR removal is certified.

At the completion of the pond construction and CCR material removal, the temporary construction facilities, laydown areas, and erosion controls will be removed, and these areas will be restored to their pre-construction conditions.

Section Four – Narrative of the Steps Already Taken to Initiate Closure and Develop Alternative Capacity

From the regulatory text § 257.103(f)(1)(iv)(A)(4).

> *(4) 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.*

As described in Section 1 and as shown in **Appendix C**, AEP has made considerable progress at the time of this request towards creating alternative disposal capacity for the CCR and non-CCR wastestreams at the Mitchell Plant that are currently managed in the BAP. The following major activities have been completed or are in process:

- Conceptual design for all aspects of the project required to achieve the alternate disposal capacity has been completed and detailed design has commenced.
- Dry bottom ash equipment has been specified and will be procured after receipt of regulatory approval from West Virginia and Kentucky Public Service Commissions.
- Contractors have been engaged to discuss different aspects of the work and identify expected construction timeframes.
- Permitting agencies have been engaged to discuss plans.
- Geotechnical investigations required to support the work have been started and are expected to be completed in 2020

NARRATIVE STRATEGY FOR COMPLIANCE WITH ALL REQUIREMENTS OF 40 CFR 257 SUBPART D

From the regulatory text § 257.103(f)(1)(iv)(B)

(B) To demonstrate that the criteria in paragraph (f)(1)(iii) of this section have been met, the owner or operator must submit all of the following:

> *(1) A certification signed by the owner or operator that the facility is in compliance with all of the requirements of this subpart;*
>
> I hereby certify that, based on my inquiry of those persons who are immediately responsible for compliance with environmental regulations for the Mitchell Plant, the facility is in compliance with all of the requirements contained in 40 CFR 257 Subpart D –

Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments.

x David A. Miller
David A. Miller, P.E.
Director—Land Environment and Remediation Services

The Mitchell Plant is maintaining compliance with all requirements of Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments. Reports documenting compliance with the rule's provisions, such as location restriction, design criteria, operating criteria, and groundwater monitoring are posted to the AEP public CCR Rule Compliance Data and Information Internet site at the following link: http://www.aep.com/about/codeofconduct/ccrrule/.

From the regulatory text § 257.103(f)(1)(iv)(B)*(2) Visual representation of hydrogeologic information at and around the CCR unit(s) that supports the design, construction and installation of the groundwater monitoring system. This includes all of the following:*

> *(i) Map(s) of groundwater monitoring well locations in relation to the CCR unit(s);*
> *(ii) Well construction diagrams and drilling logs for all groundwater monitoring wells; and*
> *(iii) Maps that characterize the direction of groundwater flow accounting for seasonal variations;*

Groundwater monitoring at the Mitchell CCR units is accomplished using PE-certified groundwater monitoring networks. Each network is composed of 7 groundwater monitoring wells. The complete Groundwater Monitoring Well Network (GWMN) Evaluation Report is provided in Appendix D and includes the following:

- The map showing the location of the monitoring wells relative to the CCR unit is presented in the GWMN Report as *Figure 3*;
- The associated boring logs and well construction diagrams are provided in *Appendix B*.
- Groundwater flow direction maps of the latest monitoring events completed in the winter, spring, summer, and autumn, to show seasonal changes, are provided in this submittal as **Figures 2 - 5** for the BAP and **Figures 6 – 9** for the Landfill.

From the regulatory text § 257.103(f)(1)(iv)(B)*(3) Constituent concentrations, summarized in table form, at each groundwater monitoring well monitored during each sampling event;*

The most recent Groundwater Monitoring and Corrective Action Reports summarize Appendix III and IV constituent concentrations at each groundwater monitoring well monitored during each sampling event as Table 1 (see **Appendix E**).

From the regulatory text § 257.103(f)(1)(iv)(B)*(4) A description of site hydrogeology including stratigraphic cross-sections;*

The Mitchell BAP site is located in the Ohio River valley and lies within the regional geologic area of West Virginia known as the Appalachian Plateau Province. The Ohio River Valley is a significant regional geomorphological feature in the region and is separated into the upper and lower parts. The upper Ohio River valley is entrenched in the unglaciated and dissected Allegheny Plateau and is characterized by valley walls incised commonly 200 feet below the regional upland

surface. The valley is a remnant of the historic preglacial Teays Valley drainage system, which is an integral part of the history of the present Ohio River drainage basin.
The Ohio Department of Natural Resources (ODNR) has published the Groundwater Resource Map of Monroe County (1991), which is the neighboring county along the west side of the Ohio River across from the Mitchell Plant. The ODNR map distinguishes groundwater well yields in the county, including bedrock strata and the Ohio River alluvium. Mapped well yields in Monroe County, Ohio are considered to be representative of groundwater yield conditions in neighboring Marshall County, WV. The ODNR Monroe County map indicates that the Ohio River alluvial deposits, referenced herein as the Ohio River alluvial aquifer, can provide yields of several hundred gallons per minute that will support large industrial and municipal supplies from sand and gravel deposits ranging from 55 to 75 feet thick which are hydraulically connected to the Ohio River. Comparatively, bedrock strata, positioned below and confining the lateral boundaries of the Ohio River alluvium, yield very limited groundwater supplies, typically less than 2 gpm. ODNR describes the bedrock strata groundwater resource potential as “very limited and often inadequate”.

The Mitchell BAP is constructed on the Ohio River floodplain and above the sand and gravel alluvial deposits. The saturated portion of these alluvial deposits, that are in direct hydraulic connection with the Ohio River, are the regional Ohio River alluvial aquifer. Ground surface elevations range from approximately 685 to 630 feet amsl at the Mitchell Power Generation Plant with surrounding hilltops reaching elevation 1,120 to 1,200 feet amsl.

Two sets of site specific geologic cross sections have been prepared at Mitchell Plant, one from an Electric Power Research Institute (EPRI) study and another prepared from monitoring well borings completed at the periphery of the Mitchell BAP for the CCR unit’s groundwater monitoring network design report. Both sets are provided in Appendix D of the Groundwater Monitoring Network (GWMN) Evaluation Reports as follows:

- The cross sections from the EPRI study are discussed on *page 11* and presented in *Appendix A*.
- The cross sections from monitoring well borings completed at the periphery of the Mitchell BAP are discussed on *pages 14,15, and 18* and presented as *Figures 4, 5 and 6*.

Based on the data collected from the CCR unit’s monitoring well borings, both unconsolidated soils and bedrock underlying the Mitchell BAP are depicted on the cross sections. The saturated portion of the sand and gravel deposits comprises the Ohio River alluvial aquifer. This alluvial aquifer, which consists of the saturated portion of the sand and gravel alluvial deposits that are in direct hydraulic connection with the Ohio River, is appropriately defined as the uppermost aquifer beneath the Mitchell BAP.

The complete GWMN report for the Mitchell Landfill is provided in Appendix D and includes a description of the site hydrogeology. Stratigraphic cross-sections are included in the GWMN Report as *Figures 4 – 6*.

From the regulatory text § 257.103(f)(1)(iv)(B)*(5) Any corrective measures assessment conducted as required at § 257.96;*

The BAP is expected to remain in assessment monitoring until closure by removal is complete. The LF is in detection monitoring. The CCR units will transition to an assessment of corrective measures and selection of a remedy following requirements in 40 CFR 257.96 and 40 CFR 257.97, and a corrective action program following requirements in 40 CFR 257.98, if necessary.

From the regulatory text § 257.103(f)(1)(iv)(B)*(6) Any progress reports on corrective action remedy selection and design and the report of final remedy selection required at § 257.97(a);*

The Mitchell CCR units have not entered Assessment of Corrective Measures, therefore no progress reports on remedy selection and design and a report of final remedy selection have been required or prepared.

From the regulatory text § 257.103(f)(1)(iv)(B)*(7) The most recent structural stability assessment required at § 257.73(d); and*

The most recent structural stability assessment required by § 257.73(d) for the BAP is included in Appendix F. This report will be updated every 5 years as required by the CCR rule.

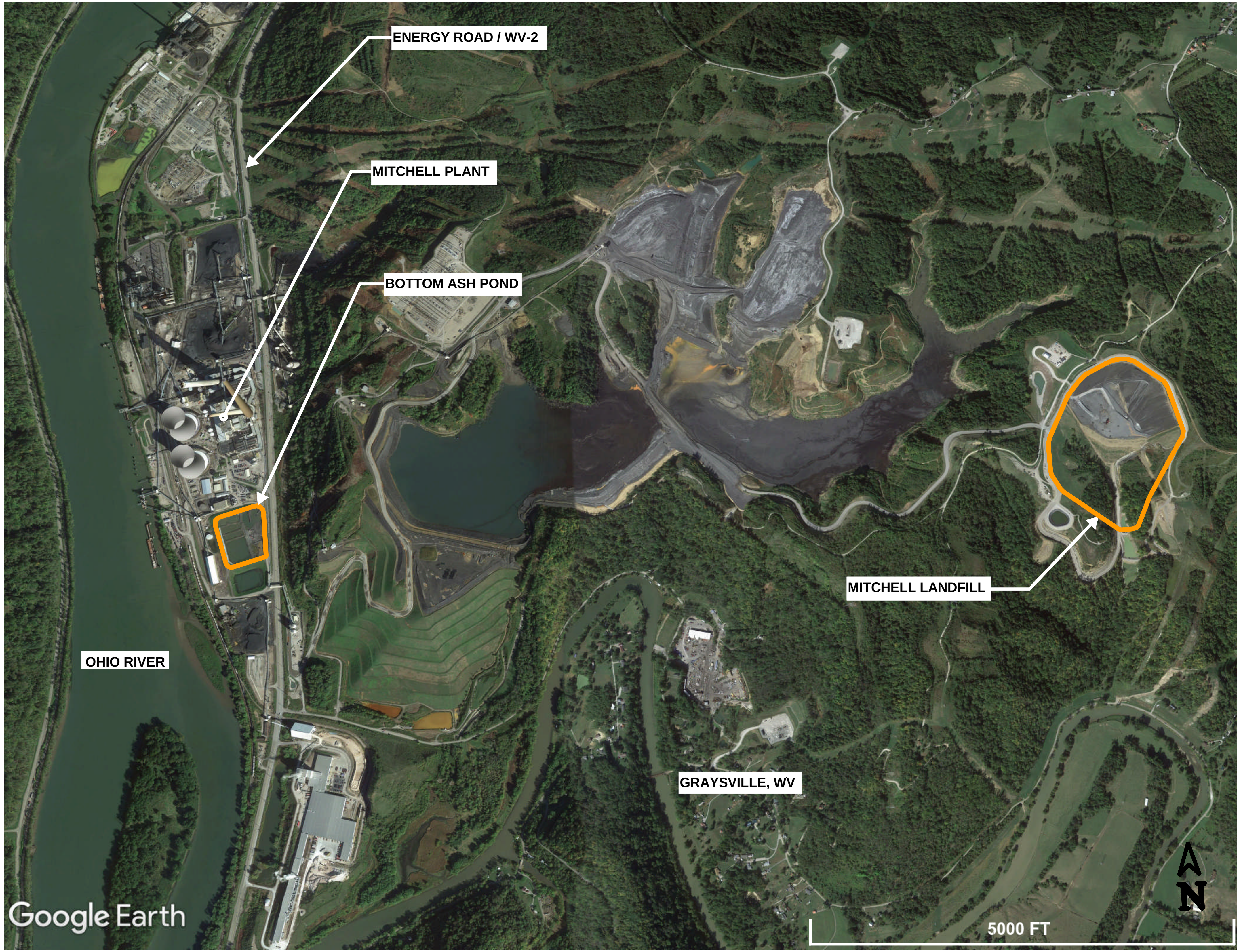
From the regulatory text § 257.103(f)(1)(iv)(B)*(8) The most recent safety factor assessment required at § 257.73(e).*

The most recent safety factor assessment required by § 257.73(e) for the BAP is included in Appendix G. This report will be updated every 5 years as required by the CCR rule.

CONCLUSION

As set forth and allowed by 40 CFR 257.103 – *Alternate Closure Requirements* and specifically 40 CFR 257.103(f)(1) – *Site Specific Alternate to Initiation of Closure Deadline,* the Mitchell Plant qualifies for the site specific alternate time frame provisions for continuing to receive CCR and non-CCR wastestreams and initiate closure of the CCR surface impoundments. Based upon the information submitted Wheeling Power Company and Kentucky Power Company seek to establish a site-specific compliance deadline to continue to receive Non-CCR wastestreams until March 13, 2023 and CCR wastestreams in the BAP until April 21, 2023. Closure by removal of the BAP will be completed by July 31, 2023.

Figures



LEGEND:

CCR UNIT BOUNDARY

REV	DATE	DESCRIPTION	DRAWN	CHECKED	REVIEWED	LEAD DESIGNER	ENGINEER/ TECH. SPEC.	LEAD DISC ENGINEER	PROJ ENGR MANAGER
A	17 JUN 20	ISSUED FOR REVIEW	FMW						

Worley energy | chemicals | resources

OneWay

PRELIMINARY STATUS — DATE - - — INFORMATION ONLY - NOT TO BE USED FOR CONSTRUCTION.
LDE

APPROVED STATUS — DATE - - — REPRESENTS REVIEWED AND APPROVED DESIGN. ANY PORTION MARKED "HOLD" RETAINS PRELIMINARY STATUS.
LDE

ORIGINATING PERSONNEL	PROFESSIONAL ENGINEER'S SEAL
DRAWN BY	
CHECKED BY	
LEAD DESIGNER	
ENGINEER/TECH SPECIALIST	
PROJECT ENGINEERING MANAGER	

ORIGINALLY PREPARED UNDER THE RESPONSIBLE SUPERVISION OF
PE: STATE:
LIC. NO.: DATE:

DATE	NO.	DESCRIPTION	APPD.

REVISIONS

THIS DRAWING IS CLASSIFIED AS:

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REFERENCE AEP's CORPORATE INFORMATION SECURITY POLICY

OHIO POWER COMPANY

MITCHELL PLANT

CRESAP — WEST VIRGINIA

CCR/ELG PROJECT

Facility and CCR Unit Layout

UNIT: — DRAWING NUMBER: — REV:

SCALE: — MECHANICAL ENGINEERING
DR:
CH:
SUP:
ENG:
DATE:
APPROVED BY
DOCUMENT PREPARED BY WORLEY

AEP AMERICAN ELECTRIC POWER

AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

PLOT DATE: 2/4/2020
PLOT TIME: 6:15:15 AM
BY: craig.rauenzahn

...\EPFSPiping2DSeed_G_V8.dgn
2/4/2020 6:15:15 AM

DRAWING NUMBER:

CROSS REFS:

Legend

- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour

Notes

- Monitoring well coordinates and water level data (collected on February 17, 2017) provided by AEP.
- Approximate Ohio River elevation was 622.83 feet at Mitchell Power Plant on February 17, 2017. Data Source: USGS Ohio River gage at Hannibal Lock and Dam (Upper), OH.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.
- Groundwater and river elevation units are feet above mean sea level (NAVD 88).

Potentiometric Surface Map - Uppermost Aquifer
February 2017

Mitchell Power Generation Plant - Bottom Ash Pond
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio | 2017/10/20

Figure 2

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Mitchell\AEP-Mitchell_Pond_GW_Feb2017.mxd. ARevezzo. 9/1/2017. Project/Phase/Task.

Legend

- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)

Notes

- Monitoring well coordinates and water level data (collected on April 4, 2017) provided by AEP.
- Approximate Ohio River elevation was 622.88 feet at Mitchell Power Plant on April 4, 2017. Data Source: USGS Ohio River gage at Hannibal Lock and Dam (Upper), OH.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.
- Groundwater and river elevation units are feet above mean sea level (NAVD 88).
* Wells marked with an asterisk were not use for contouring due to anamolous or inconsistent data. Contours and flow direction were inferred from professional judgement and observed river elevation.

250 125 0 250 Feet

Potentiometric Surface Map - Uppermost Aquifer April 2017

Mitchell Power Generation Plant - Bottom Ash Pond
Marshall County, West Virginia

Geosyntec consultants

Figure **3**

Columbus, Ohio | 2017/10/20

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Legend

- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)

Notes

- Monitoring well coordinates and water level data (collected on July 18, 2017) provided by AEP.
- Approximate Ohio River elevation was 623.16 feet at Mitchell Power Plant on July 18, 2017. Data Source: USGS Ohio River gage at Hannibal Lock and Dam (Upper), OH.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.
- Groundwater and river elevation units are feet above mean sea level (NAVD 88).
* Wells marked with an asterisk were not use for contouring due to anamolous or inconsistent data. Contours and flow direction were inferred from professional judgement and observed river elevation.

Potentiometric Surface Map - Uppermost Aquifer July 2017

Mitchell Power Generation Plant - Bottom Ash Pond
Marshall County, West Virginia

Geosyntec consultants

Figure 4

Columbus, Ohio | 2017/10/20

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Legend

- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour

Notes

- Monitoring well coordinates and water level data (collected on October 9, 2017) provided by AEP.
- Approximate Ohio River elevation was 623.5 feet at Mitchell Power Plant on October 9, 2017. Data Source: USGS Ohio River gage at Hannibal Lock and Dam (Upper), OH.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.
- Groundwater and river elevation units are feet above mean sea level (NAVD 88).

250 125 0 250
Feet

Potentiometric Surface Map - Uppermost Aquifer October 2017

Mitchell Power Generation Plant - Bottom Ash Pond
Marshall County, West Virginia

Geosyntec consultants

Figure **5**

Columbus, Ohio | 2018/01/29

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Mitchell\BAP\AEP-Mitchell_Pond_GW_Oct2017.mxd. ARevezzo. 1/29/2018. Project/Phase/Task.

Legend

- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contours (Inferred)

Notes

- Monitoring well coordinates and water level data (collected on February 7, 2017) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (NAVD 88).

Potentiometric Surface Map - Fish Creek
February 2017

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio | 2017/11/06

Figure 6

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Mitchell\Landfill-FC\AEP-Mitchell_Landfill-FC_GW_Feb2017.mxd. ARevezzo. 11/6/2017. Project/Phase/Task.

Legend

- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)

Notes

- Monitoring well coordinates and water level data (collected on April 4, 2017) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (AMEC, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (NAVD 88).

500 250 0 500
Feet

Potentiometric Contours - Fish Creek Aquifer
April 2017

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio | 2017/12/29

Figure **7**

Legend

- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)

Notes

- Monitoring well coordinates and water level data (collected on July 18, 2017) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (NAVD 88).
* MW1101F not gauged during July 2017 event; contours inferred from previous monitoring events.

500 250 0 500 Feet

Potentiometric Contours - Fish Creek Aquifer
July 2017

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio | 2017/11/06

Figure **8**

C:\Users\mmuenich\Documents\local_projects\AEP_GIS\Mitchell\MXDs\Landfill-FC\AEP-Mitchell_Landfill-FC_GW_July2017.mxd. MMuenich. 11/6/2017. Project/Phase/Task.

Legend

- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contours (Inferred)

Notes

- Monitoring well coordinates and water level data (collected on October 9, 2017) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (AMEC, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (NAVD 88).

500 250 0 500 Feet

Potentiometric Surface Map - Fish Creek October 2017

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio | 2018/01/29

Figure 9

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Mitchell\Landfill-FC\AEP-Mitchell_Landfill-FC_GW_Oct2017.mxd. ARevezzo. 1/29/2018. Project/Phase/Task.

Legend

- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)

Notes

- Monitoring well coordinates and water level data (collected on February 7, 2017) provided by AEP.
-Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (NAVD 88).

500 250 0 500 Feet

Potentiometric Surface Map - Rush Run February 2017

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Clmbus, Ohio | 2017/11/07

Figure 10

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Mitchell\Landfill-RR\AEP-Mitchell_Landfill-RR_GW_Feb2017.mxd. ARevezzo. 11/7/2017. Project/Phase/Task.

Legend

- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)

Notes

- Monitoring well coordinates and water level data (collected on April 4, 2017) provided by AEP.
-Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (NAVD 88).

500 250 0 500 Feet

Potentiometric Surface Map - Rush Run
April 2017

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Figure **11**

Clumbus, Ohio | 2017/11/07

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Mitchell\Landfill-RR\AEP-Mitchell_Landfill-RR_GW_April2017.mxd. ARevezzo. 11/7/2017. Project/Phase/Task.

Legend

- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)

Notes

- Monitoring well coordinates and water level data (collected on July 18, 2017) provided by AEP.
-Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (NAVD 88).

500 250 0 500 Feet

Potentiometric Surface Map - Rush Run July 2017

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Clmbus, Ohio	2017/11/07

Figure 12

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Mitchell\Landfill-RR\AEP-Mitchell_Landfill-RR_GW_July2017.mxd. ARevezzo. 11/7/2017. Project/Phase/Task.

Legend
- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)

Notes
- Monitoring well coordinates and water level data (collected on October 9, 2017) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (NAVD 88).

Potentiometric Surface Map - Rush Run
October 2017

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

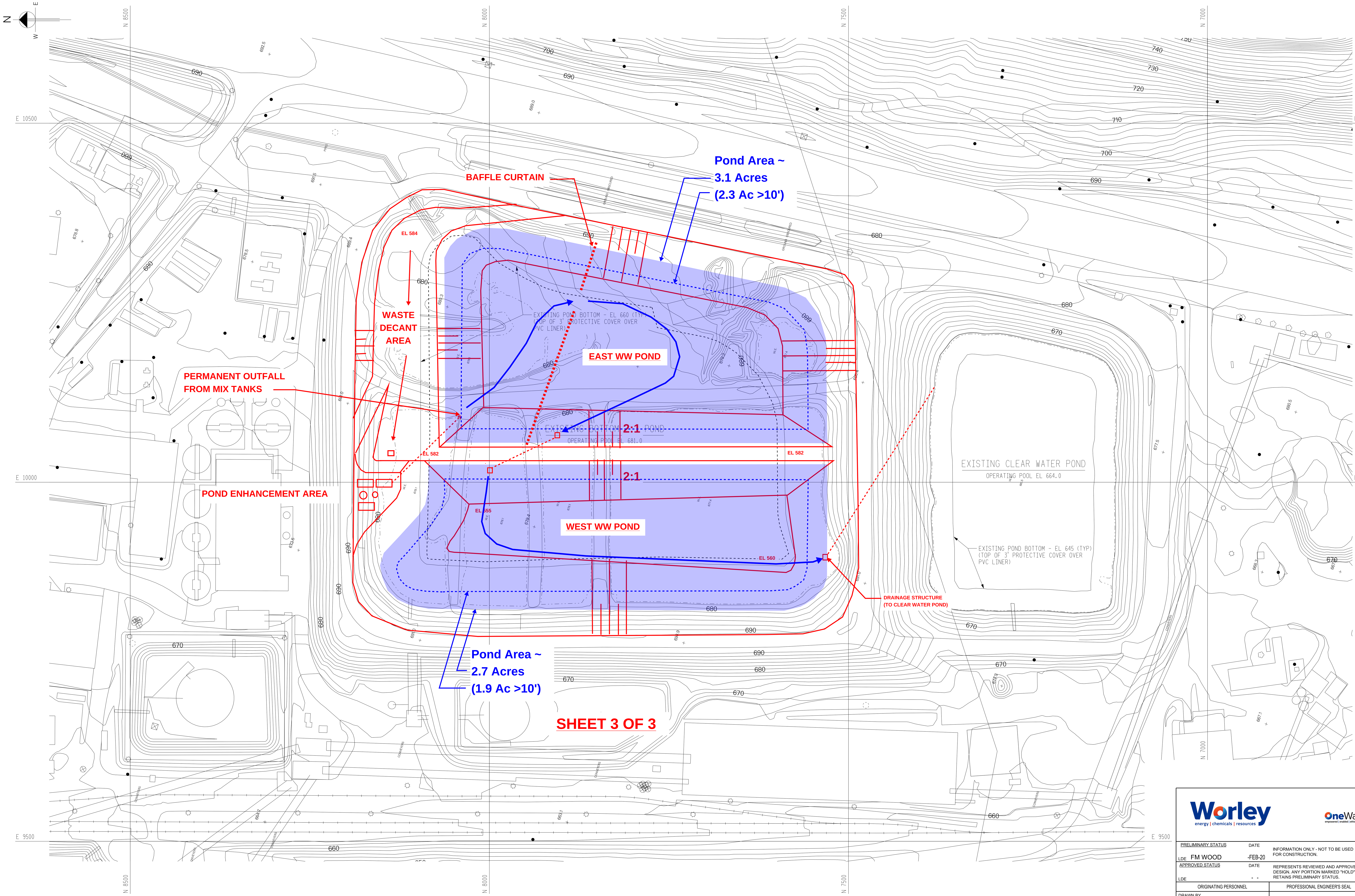
Clmbus, Ohio | 2018/01/29

Figure **13**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Mitchell\Landfill-RR\AEP-Mitchell_Landfill-RR_GW_Oct2017.mxd. ARevezzo. 1/29/2018. Project/Phase/Task.

Appendix A

Existing and Future Pond Configurations



TPC-100-EC-SK002-001

DATE	NO.	DESCRIPTION	APPD.

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OHIO POWER COMPANY

MITCHELL PLANT

CRESAP — WEST VIRGINIA

CCR/ELG PROJECT

ASH POND CLOSURE AND NEW WASTEWATER POND COMPLEX

FINAL CONDITIONS PLAN

UNIT:
DRAWING NUMBER: **TPC-100-EC-SK002-001**
REV:

SCALE: 1"=50' — CIVIL ENGINEERING

DR:
CH:
SUP:
ENG:
DATE:
APPROVED BY

DOCUMENT PREPARED BY WORLEY

Worley energy | chemicals | resources — OneWay empowered | enabled | ethical

PRELIMINARY STATUS — DATE
LDE FM WOOD -FEB-20
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APPROVED STATUS — DATE
LDE - -
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DRAWN BY
CHECKED BY
LEAD DESIGNER: KP FEEG
ENGINEER/TECH SPECIALIST: FM WOOD
PROJECT ENGINEERING MANAGER: RE SKIPTUNAS

PROFESSIONAL ENGINEER'S SEAL
ORIGINALLY PREPARED UNDER THE RESPONSIBLE SUPERVISION OF
PE: STATE:
LIC. NO.: DATE:

REV.	DATE	DESCRIPTION	DRAWN	CHECKED	REVIEWED	LEAD DESIGNER	ENGINEER/ TECH. SPEC.	LEAD DISC ENGINEER	PROJ ENGR MANAGER
A	FEB 20	ISSUED FOR CDRM				KPF	FMW	FMW	RES

AEP AMERICAN ELECTRIC POWER

AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

PLOT DATE: 2/11/2020
PLOT TIME: 8:45:31 AM
BY: kerry.fritz

CROSS REFS:

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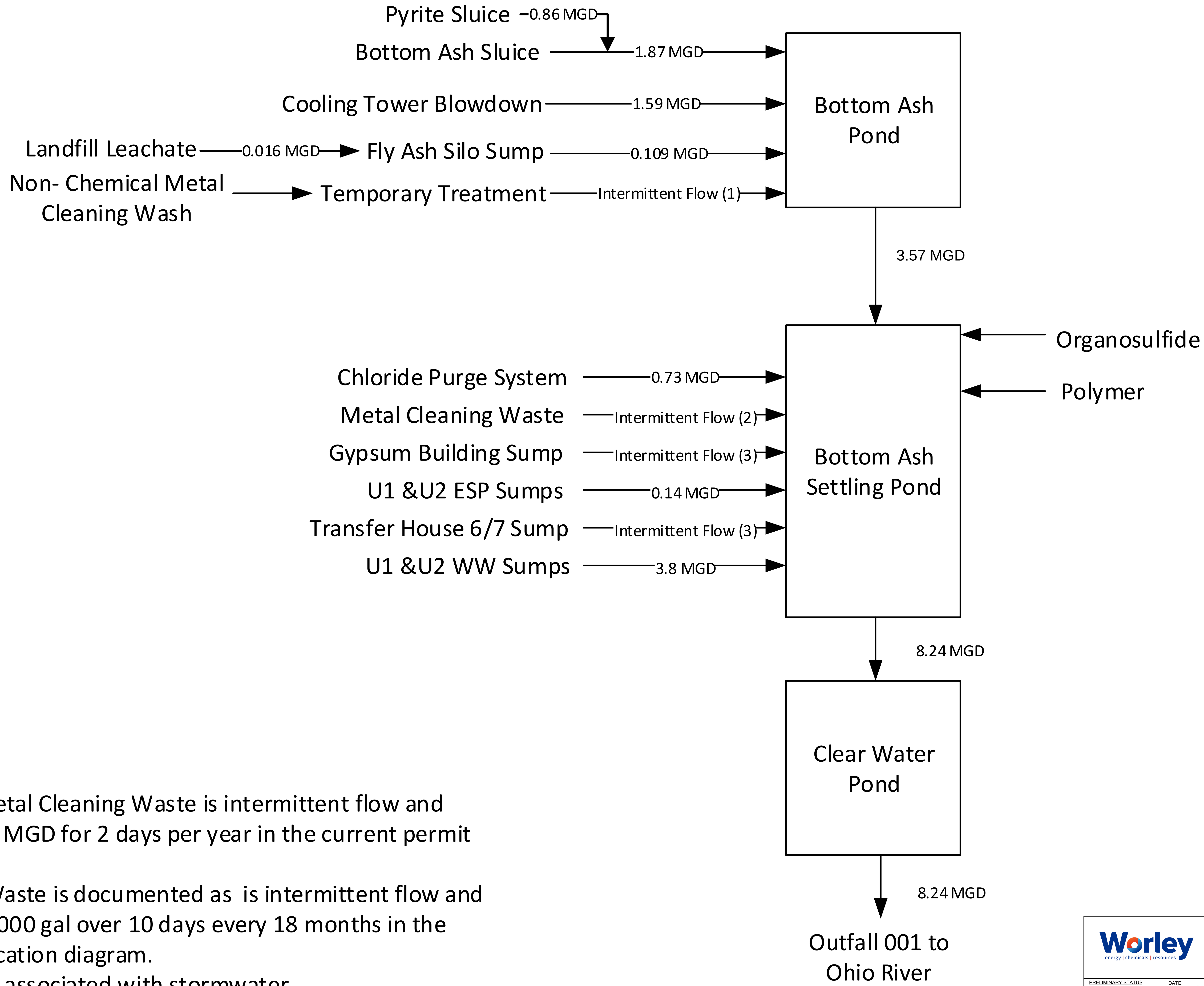
2/11/2020 8:45:31 AM

Appendix B

Existing and Future Water Balances



Note:

(1) Non-Chemical Metal Cleaning Waste is intermittent flow and documented as 0.43 MGD for 2 days per year in the current permit application diagram.

(2) Metal Cleaning Waste is documented as is intermittent flow and documented as 450,000 gal over 10 days every 18 months in the current permit application diagram.

(3) Intermittent flow associated with stormwater

REV	DATE	DESCRIPTION	DRAWN	CHECKED	REVIEWED	LEAD DESIGNER	ENGINEER/TECH SPEC.	LEAD DISC. ENGINEER	PROJ ENG. MANAGER
A	14 OCT 20	ISSUED FOR USE	JF	KL			KL	KL	

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DRAWN BY: J. FAN
CHECKED BY: K. LEBER
LEAD DESIGNER
ENGINEER/TECH SPECIALIST: K. LEBER
PROJECT ENGINEERING MANAGER

REVISIONS (DATE | NO. | DESCRIPTION | APPD.)

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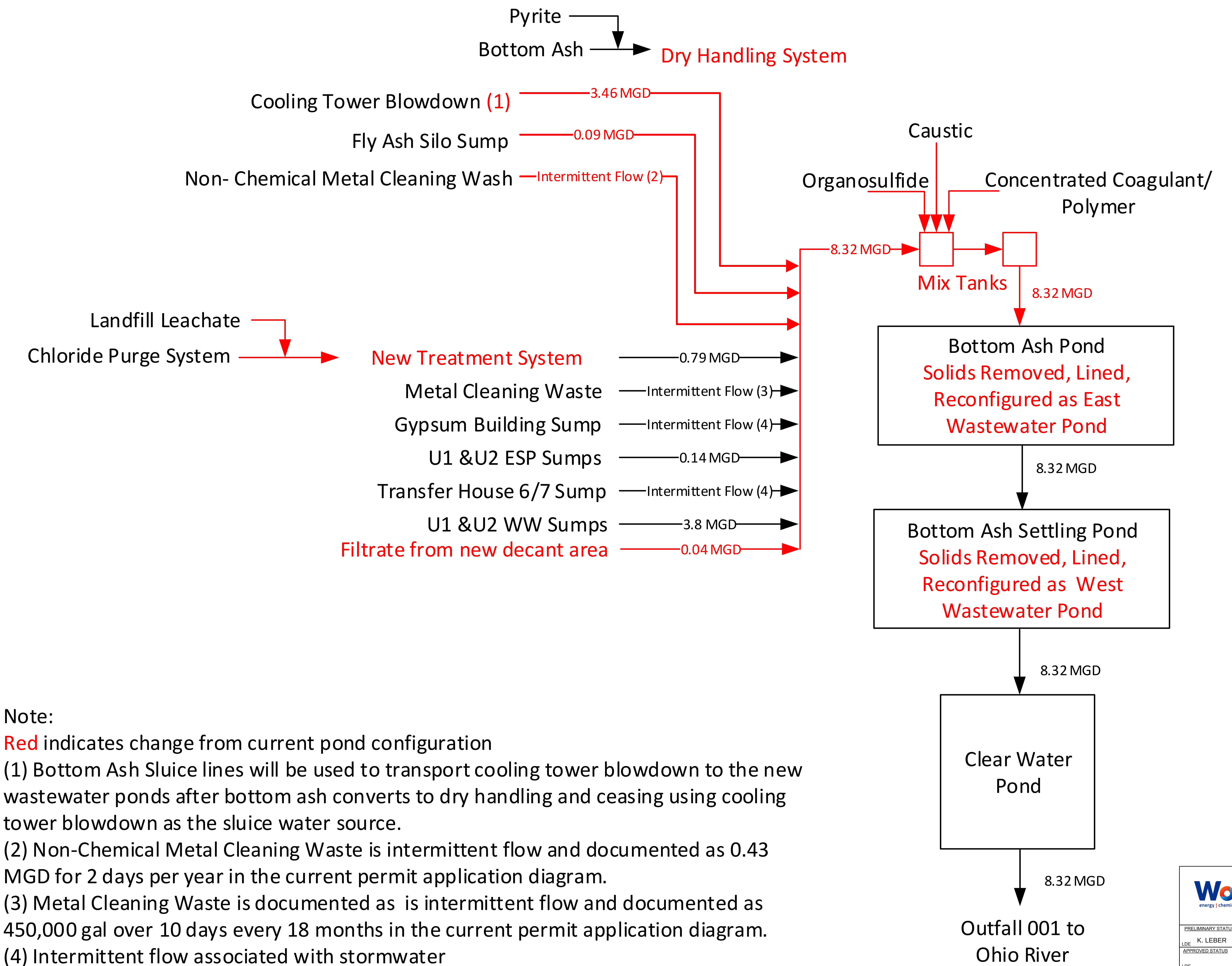
OHIO POWER COMPANY
MITCHELL PLANT
CRESAP — WEST VIRGINIA
CCR/ELG PROJECT
CURRENT CONFIGURATION WATER TREATMENT

UNIT: 0 — DRAWING NUMBER: MLP-WT-0-600-EN-SK305-001 — REV: B
MECHANICAL ENGINEERING
DOCUMENT PREPARED BY WORLEY

AMERICAN ELECTRIC POWER — AEP SERVICE CORP. 1 RIVERSIDE PLAZA COLUMBUS, OH 43215



Note:
Red indicates change from current pond configuration
(1) Bottom Ash Sluice lines will be used to transport cooling tower blowdown to the new wastewater ponds after bottom ash converts to dry handling and ceasing using cooling tower blowdown as the sluice water source.
(2) Non-Chemical Metal Cleaning Waste is intermittent flow and documented as 0.43 MGD for 2 days per year in the current permit application diagram.
(3) Metal Cleaning Waste is documented as is intermittent flow and documented as 450,000 gal over 10 days every 18 months in the current permit application diagram.
(4) Intermittent flow associated with stormwater

REV	DATE	DESCRIPTION	DRAWN	CHECKED	REVIEWED	LEAD DESIGNER	ENGINEER/ TECH. SPEC.	LEAD DISC ENGINEER	PROJ ENGR MANAGER
D	14 OCT 20	ISSUED FOR USE	JF	KL					
C	26 May 20	REVISED TO SHOW 2 PONDS	KL						
B	11 MAR 20	ISSUED FOR USE	EG		TH		KL	KL	TM
A	11 FEB 20	ISSUED FOR REVIEW	EG		TH		KL	KL	TM

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LDE - -
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DRAWN BY: E. GARCIA
CHECKED BY:
LEAD DESIGNER:
ENGINEER/TECH SPECIALIST: K. LEBER
PROJECT ENGINEERING MANAGER: T. MILLER

PROFESSIONAL ENGINEER'S SEAL
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PE: STATE:
LIC. NO.: DATE:

DATE	NO.	DESCRIPTION	APPD.

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MITCHELL PLANT
CRESAP — WEST VIRGINIA

CCR/ELG PROJECT
FUTURE CONFIGURATION WATER TREATMENT

UNIT: 0 — DRAWING NUMBER: MLP-WT-0-600-EN-SK305-001 — REV: B

SCALE: — MECHANICAL ENGINEERING
DR:
CH:
SUP:
ENG:
DATE:
APPROVED BY — DOCUMENT PREPARED BY WORLEY

AEP AMERICAN ELECTRIC POWER
AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

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2/4/2020 6:15:15 AM

PLOT DATE: 2/4/2020
PLOT TIME: 6:15:15 AM
BY: craig.rauenzahn

CROSS REFS:

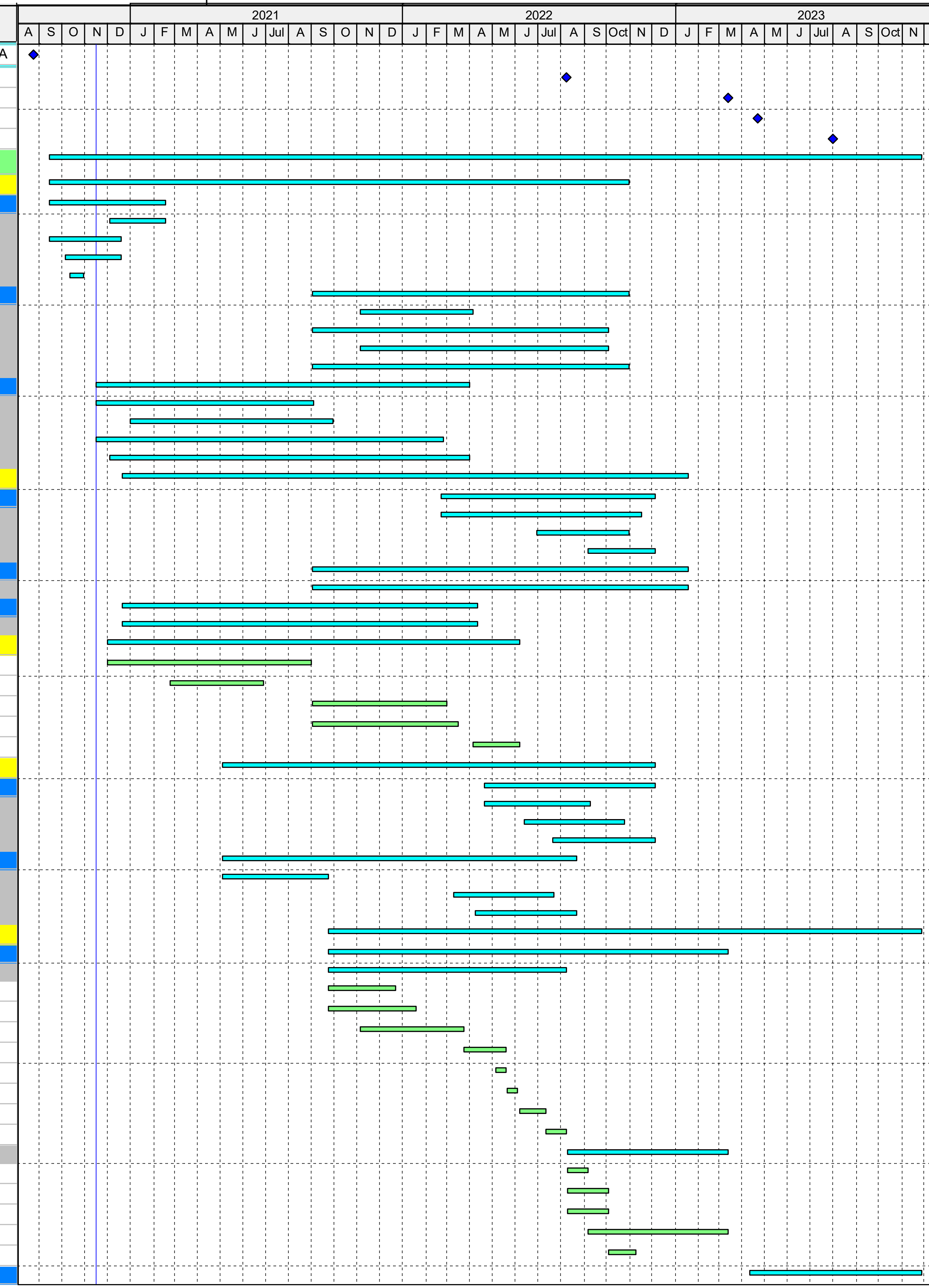
Appendix C

Site-Specific Schedule to Obtain Alternative Capacity

Mitchell - CCR/ELG EPA Updated Timelines...

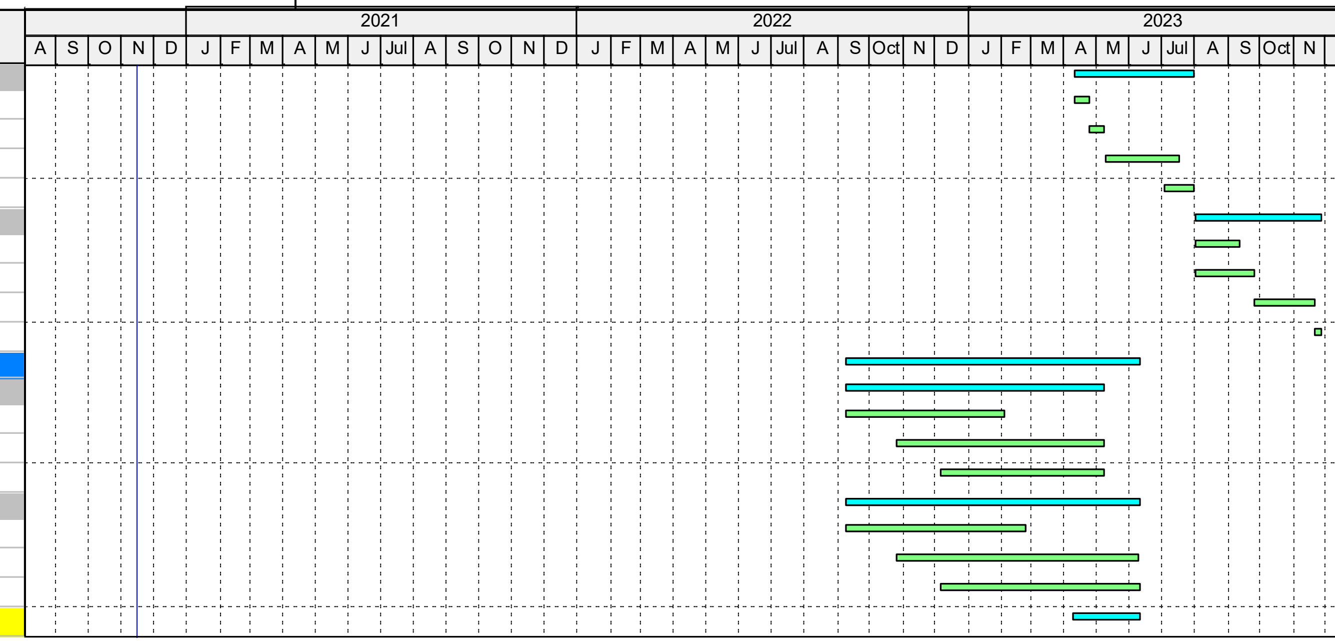
AEP CCR-ELG MLP USEPA Public Version

Activity ID	Activity Name	Duration (Months)	Start	Finish
T-00-M-020-SR-G-RPS-A80	AEP Release Engineer and OEM to Complete Detailed Design for CCR Compliance	0.0		24-Aug-20 A
T-PR-M-020-SR-G-RPS-A60	3rd Party QAQC Certification of CCR Materials Removed for West Ash Pond Closure by Removal	0.0		08-Aug-22
T-PR-M-600-SR-G-RPS-A20	Initial Operation of Repurposed West Wastewater Pond / All non-CCR Streams Routed through Lined Wastewater Pond	0.0		13-Mar-23
T-PR-M-020-SR-G-RPS-A40	Cease sluicing CCR from Unit 1 & 2 (CCR Compliance)	0.0		21-Apr-23
T-PR-M-020-SR-G-RPS-A80	3rd Party QAQC Certification of CCR Materials Removed for East Ash Pond Closure by Removal	0.0		31-Jul-23
Mitchell Plant		33.4	Sep-20 A	Nov-23
Engineering & Design		22.2	Sep-20 A	Oct-22
Common		4.5	Sep-20 A	Feb-21
Civil / Site Infrastructure		2.1	Dec-20	Feb-21
Byproduct Handling		2.8	Sep-20 A	Dec-20
Mechanical BOP Systems		2.2	Oct-20 A	Dec-20
Electrical BOP Systems		0.6	Oct-20 A	Oct-20 A
BA Conversion		12.2	Sep-21	Oct-22
Civil / Site Infrastructure		4.3	Nov-21	Apr-22
Byproduct Handling		11.4	Sep-21	Oct-22
Mechanical BOP Systems		9.5	Nov-21	Oct-22
Electrical BOP Systems		12.2	Sep-21	Oct-22
Pond Repurpose		14.4	Nov-20	Mar-22
Civil / Site Infrastructure		8.4	Nov-20	Sep-21
Byproduct Handling		7.7	Jan-21	Sep-21
Mechanical BOP Systems		13.3	Nov-20	Feb-22
Electrical BOP Systems		13.8	Dec-20	Mar-22
Procurement		21.7	Dec-20	Jan-23
Common		8.2	Feb-22	Dec-22
Byproduct Handling		7.7	Feb-22	Nov-22
Mechanical BOP Systems		3.6	Jun-22	Oct-22
Electrical BOP Systems		2.6	Sep-22	Dec-22
BA Conversion		14.4	Sep-21	Jan-23
OEM Ash Handling Equipment Engineering / Design / Fabrication / Delivery		14.4	Sep-21	Jan-23
Pond Repurpose		13.6	Dec-20	Apr-22
Mechanical BOP Systems		13.6	Dec-20	Apr-22
Permitting		15.8	Dec-20	Jun-22
T-BA-E-100-E0-Z-000-A05	Prepare / Submit CPCN Application & Obtain Regulatory Approval from Public Service Commission	7.8	Dec-20	Aug-21
T-00-L-915-SP-MP-PMT-A60	Dam/Dike Modifications (Mitchell)	3.6	Feb-21	Jun-21
T-00-L-915-SP-MP-PMT-A90	Air Permit (Mitchell)	5.2	Sep-21	Mar-22
T-00-L-915-SP-MP-PMT-A70	NPDES (Mitchell)	5.6	Sep-21	Mar-22
T-00-L-915-SP-MP-PMT-A40	SWPPP (Mitchell)	1.8	Apr-22	Jun-22
Labor Contracts		16.6	May-21	Dec-22
Bottom Ash Conversion Labor Contracts		6.6	Apr-22	Dec-22
Civil		4.1	Apr-22	Sep-22
Mechanical / Structural		3.9	Jun-22	Oct-22
Electrical / I&C		3.9	Jul-22	Dec-22
Pond Repurpose & Closure Labor Contracts		13.6	May-21	Aug-22
Civil		4.1	May-21	Sep-21
Mechanical / Structural		3.9	Mar-22	Jul-22
Electrical / I&C		3.9	Apr-22	Aug-22
Construction		22.7	Sep-21	Nov-23
West Wastewater Pond Closure & Repurpose		15.3	Sep-21	Mar-23
West Bottom Ash Pond Closure		9.1	Sep-21	Aug-22
T-PC-C-100-C-CON-S1-20	Install sheet piling to establish isolation of West Bottom Ash Pond	2.6	Sep-21	Dec-21
T-PC-C-100-C-CON-S1-10	Install piping to divert pond inflows to East Bottom Ash Pond	3.4	Sep-21	Jan-22
T-PC-C-100-C-CON-S1-70	Remove CCR from East Bottom Ash Pond (For capacity and create settling basins)	4.0	Nov-21	Mar-22
T-PC-C-100-C-CON-S1-80	Install temporary Chemical Treatment System for East Bottom Ash Pond	1.6	Mar-22	May-22
T-PC-C-100-C-CON-S1-90	Prepare Sand Filters / Pumps for Operation in East Bottom Ash Pond	0.4	May-22	May-22
T-PC-C-100-C-CON-S1-30	Dewater West Bottom Ash Pond	0.4	May-22	Jun-22
T-PC-C-100-C-CON-S1-40	CCR & PVC Liner Material Removal from West Bottom Ash Pond	1.0	Jun-22	Jul-22
T-PC-C-100-C-CON-S1-50	QA/QC of CCR Removal	0.8	Jul-22	Aug-22
West Wastewater Pond Repurpose		6.2	Aug-22	Mar-23
T-PR-C-100-C-CON-S1-10	Subgrade prep for pond enhancement equipment area (Includes Area Fill)	0.8	Aug-22	Sep-22
T-PR-C-100-C-CON-S1-20	Subgrade prep for liner	1.6	Aug-22	Oct-22
T-PR-C-100-C-CON-S1-80	Compact Fill to Construct NS Dike of the Pond	1.6	Aug-22	Oct-22
T-PR-C-100-C-CON-S1-120	Tank Based Chemical Treatment System Installation	5.4	Sep-22	Mar-23
T-PR-C-100-C-CON-S1-50	Liner installation (Double Liner)	1.1	Oct-22	Nov-22
East Bottom Ash Pond Closure & Repurpose		6.6	Apr-23	Nov-23



Current Bar Labels — Summary
Milestone

Activity ID	Activity Name	Duration (Months)	Start	Finish
East Bottom Ash Pond Closure		3.2	Apr-23	Jul-23
T-PC-C-100-C-CON-S2-10	Dewater East Bottom Ash Pond	0.4	Apr-23	Apr-23
T-PC-C-100-C-CON-S2-15	Remove Sheet Piling	0.4	Apr-23	May-23
T-PC-C-100-C-CON-S2-25	CCR & PVC Liner Material Removal	2.0	May-23	Jul-23
T-PC-C-100-C-CON-S2-30	QA/QC of CCR Removal	0.8	Jul-23	Jul-23
East Wastewater Pond Repurpose		3.4	Aug-23	Nov-23
T-PR-C-100-C-CON-S2-15	Compact Fill to Construct Waste Decant Area	1.2	Aug-23	Sep-23
T-PR-C-100-C-CON-S2-10	Subgrade prep for liner	1.6	Aug-23	Sep-23
T-PR-C-100-C-CON-S2-20	Liner and protective cover installation (Double liner, Revetment)	1.6	Sep-23	Nov-23
T-PR-C-100-C-CON-S2-25	QA/QC Consultant Prepare East Wastewater Pond Certification for Operation	0.2	Nov-23	Nov-23
Bottom Ash Conversion Construction		7.8	Sep-22	Jun-23
Construction Unit 2		6.9	Sep-22	May-23
T-BA-C-492-C-CON-72	Civil (UG Piping Relocations and Installation / Foundations / Ash Bunker)	4.2	Sep-22	Feb-23
T-BA-C-492-M-CON-99	Str / Mech (AG Utility Relos / Conv Steel / Eqpmnt Install / BoP Piping)	5.6	Oct-22	May-23
T-BA-C-492-E-CON-80	Elec / I&C (Conduit & Cable Tray Install / DCS Eqpmnt Install / Pull Power and Control Cabling and Terminate)	4.4	Dec-22	May-23
Construction Unit 1		7.8	Sep-22	Jun-23
T-BA-C-492-C-CON-82	Civil (UG Piping Relocations and Installation / Foundations / Ash Bunker)	4.8	Sep-22	Feb-23
T-BA-C-492-M-CON-109	Str / Mech (AG Utility Relos / Conv Steel / Eqpmnt Install / BoP Piping)	6.5	Oct-22	Jun-23
T-BA-C-492-E-CON-90	Elec / I&C (Conduit & Cable Tray Install / DCS Eqpmnt Install / Pull Power and Control Cabling and Terminate)	8.5	Dec-22	Jun-23
BA System Start-Up & Commissioning		1.8	Apr-23	Jun-23



Current Bar Labels
Summary
Milestone

Appendix D

Groundwater Monitoring Well Network Evaluation Reports

for

Mitchell Plant's

Bottom Ash Pond

and

Landfill

CCR GROUNDWATER MONITORING SYSTEM DEMONSTRATION

BOTTOM ASH POND
MITCHELL POWER GENERATION PLANT
MARSHALL COUNTY, WEST VIRGINIA

Prepared For:

KENTUCKY POWER COMPANY
d/b/a AMERICAN ELECTRIC POWER, INC.
COLUMBUS, OHIO

Prepared By:

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.
CINCINNATI, OHIO

CEC Project 110-416

JUNE 2016

TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

1.0 OBJECTIVE

This report has been prepared for the Mitchell Power Generation Plant, which is owned and operated by Kentucky Power Company, a public utility subsidiary of American Electric Power, Inc. (AEP), to demonstrate that the Mitchell Bottom Ash Pond, a Coal Combustion Residuals (CCR) Unit by definition of the United States Environmental Protection Agency (EPA) CCR Rule which has been published in the Federal Register (FR) on April 17, 2015 and is an extension of the current Code of Federal Rules (CFR) Title 40, Part 257 (§257), meets or exceeds the requirements for Groundwater Monitoring Systems (GMS) as defined in §257.91. Civil & Environmental Consultants, Inc. (CEC) has been contracted by AEP to provide a qualified Professional Engineer to certify compliance with the referenced GMS requirements.

2.0 BACKGROUND INFORMATION

Kentucky Power Company (KPC), a subsidiary of AEP, owns and operates the Mitchell Power Generation Plant. This facility is located along West Virginia Route 2 near the City of Cresap, West Virginia (WV) as shown on Figure 1 – Site Location Map. The mailing address of the Mitchell Power Generation Plant is P.O. Box K, Moundsville, WV 26041-0961.

The Mitchell Power Generation Plant uses bituminous coal as the primary fuel source for its two steam-turbine electric generating units. The total electric production capacity of this plant is 1,600 megawatts. Processes and equipment that control air emissions from the coal fired units generate CCRs comprised of fly ash, bottom ash and gypsum. Bottom ash produced at the Mitchell Plant is piped to the BAP and de-watered prior to beneficial reuse or transport and disposal at the Mitchell Landfill, which is located along Gatts Ridge Road (Marshall County Road 72), approximately 2 miles north of the intersection with County Road 74 (about 2 miles due east of the Mitchell Power Generation Plant).

The following subsections provide a summary of the Mitchell BAP CCR Unit.

2.1 CCR UNIT LOCATION

The Mitchell BAP is located on the southern portion of the Mitchell Power Generation Plant facility as depicted on Figure 2 – Plant and CCR Unit Location Map. The approximate center of the Mitchell BAP has the following coordinates:

- Latitude: 39 degrees 49 minutes 30.58 seconds North
- Longitude: 80 degrees 48 minutes 55.16 seconds West

2.2 DESCRIPTION OF THE CCR UNIT

The Mitchell BAP is an active CCR surface impoundment that is part of the Bottom Ash Complex at the facility. The Bottom Ash Complex is comprised of the BAP and the Clear Water Pond as shown on Figure 2 – Plant and CCR Unit Location Map. Within the Bottom Ash Complex, the BAP is positioned immediately north of the Clear Water Pond and the south dike of the BAP separates the two ponds. The BAP outlet structure, located in the southwest quadrant of the pond, is hydraulically connected to the Clear Water Pond. The Clear Water Pond is not considered part of the Mitchell BAP CCR Unit.

The Mitchell BAP was constructed utilizing dikes comprised of compacted local sandy soils for the north, west and south perimeters and is partially incised into a natural hillside along the east side. The interior slopes of the BAP are lined with a polyvinyl chloride (PVC) liner which is overlain by 3 feet of composite soils. The exterior and interior pond/dike slopes are vegetated (above the pool level on the interior slopes) to minimize erosion.

The Mitchell BAP is divided into two primary areas for progressive settlement of the bottom ash that is sluiced into the CCR unit. Initially, the bottom ash is sluiced into the northeast corner of the eastern half of the pond for initial settling and primary excavation of the decanted material. The sluice water containing finer fractions of bottom ash flows toward the south end of the eastern half of the pond before flowing into the western half of the pond for final settlement of the suspended solids. A culvert pipe allows the sluice water to transition into the west half of the pond. The working bottom of the south half of the Mitchell BAP east side is above the normal operating pool level to allow excavation and load-out operations of the bottom ash collected within the eastern portion of the pond. The western half of the pond is separated from the east half by an interior "splitter" dike and is divided into four (4) individual containment areas separated by internal dikes that direct the flow of water into the containment areas and increase the retention time in order to promote further settling of the bottom ash. After the sluice water proceeds through the west half of the pond, the water is then released from the BAP through a 30-inch diameter reinforced concrete outlet pipe located at the southwest corner of the pond to the Clear Water Pond. The normal pool elevation in the west half of the pond is maintained at approximate elevation 676 feet above mean sea level (amsl).

2.2.1 Embankment and Liner System Configuration

The BAP is constructed with compacted soil dikes along the north, west and south perimeters. The east interior slope is incised within the natural hillside. The interior and exterior slopes are constructed to approximately 3 horizontal to 1 vertical (3H:1V). The crest of the dikes are 20 feet wide. The interior slopes are lined with a PVC liner that is covered with 3 feet of soil.

A summary of the BAP dike and pool operation details is provided below:

- Dike Crest Elevation: 690 feet amsl
- Maximum Dike Height: 28 feet
- Normal Operating Pool Level: 676 feet amsl
- Maximum Design Storm Level: 678.37 feet amsl
- Freeboard: 14 feet
- Liner Bottom Elevation: 657 to 660 feet amsl

2.2.2 Area/Volume

Mitchell BAP comprises a total area of approximately 11.9 acres (measured to the toe of the exterior dikes). Using the operating pool elevation of 676 feet amsl and the pond bottom elevation of 660 feet amsl, the maximum storage capacity of the BAP is approximately 123 acre-feet. However, the operating volume of water maintained in the pond is significantly less than the maximum capacity due to the relatively dry bottom ash load-out area, splitter dike and interior diversion dikes.

2.2.3 Construction and Operational History

The Mitchell BAP was constructed and began operation in the mid to late 1970's. The pond construction was approved by West Virginia Department of Environmental Protection (WVDEP) Division of Water and Waste Management, Dam Safety Section in 1975 as a Hazard Class 2 structure under Dam ID #05108. In addition, the BAP was granted operational approval from WVDEP, in conjunction with the Clear Water Pond, in 1977 under National Pollutant Discharge Elimination System (NPDES) Permit No. WV0005304.

The BAP receives approximately 27,000 tons of bottom ash per year that is transported from the Mitchell Power Station boilers to the pond via sluiced transport methods. The bottom ash that settles from the sluice water is regularly excavated from within the BAP and is either beneficially reused off-site or transported to Mitchell Landfill for disposal. The operational pool level is maintained and controlled at about elevation 676 feet amsl through the outlet structure located near the southwest corner of the pond.

The Bottom Ash Pond Complex, including the BAP, is regularly inspected and maintained in accordance with the Maintenance Plan that has been reviewed and approved by the WVDEP Division of Water and Waste Management, Dam Safety Section. As a minimum, Mitchell BAP is inspected monthly by AEP plant personnel from the Mitchell Power Station and annually by AEP engineering staff. The inspections focus on the various structural and operation items associated with the pond and include: 1) interior and exterior dike maintenance and stability; 2) maintenance and operation of the internal water conveyance structures; 3) maintenance and operation of the inlet and outlet structures; and, 4) monitoring of established instrumentation. In addition to the owner inspection program, the WVDEP, Division of Water and Waste Management, Dam Safety Section completed and inspection on October 15, 2014. Required site and/or appurtenance maintenance or repairs identified during the inspections are completed by AEP plant personnel.

2.2.4 Surface Water Control

The Mitchell BAP is primarily designed to handle the operational inflow of sluiced bottom ash from the Mitchell Power Generation Station. Surface water from within the surrounding drainage area for the BAP is included to determine the maximum required design storage capacity. For this purpose, the design storm used in the analyses is one-half of the 6-hour Probable Maximum Precipitation (PMP) event. Based on the maximum design storm level and the normal operating pool elevation of 676 feet amsl, the maximum pool level increase is 2.37 feet (Elevation 678.37 feet amsl). The normal pool elevation is maintained by the 30-inch diameter reinforced concrete pipe outlet structure located near the southwest corner of the pond. Overflow from the BAP is conveyed to the Clear Water Pond via a concrete overflow shaft and a 30-inch diameter perforated distribution pipe that extends into the Clear Water Pond. Overflow from the Clear Water Pond is conveyed through a 36-inch diameter corrugated metal pipe; where after, it is discharged into the Ohio River in accordance with the referenced NPDES permit.

2.2.5 Groundwater Monitoring

The Mitchell BAP GMS is designed to monitor the Ohio River alluvial aquifer, which is designated to be the uppermost aquifer at the Mitchell BAP as discussed in Sections 3.1.1.4 and 3.1.1.5. The BAP GMS was installed in October and November 2015 and consists of seven monitoring wells constructed at the locations shown on Figure 3 – CCR Unit and Monitoring Wells. Well construction details are provided in Table 1 – Monitoring Well Construction Summary. BAP GMS monitoring wells are designated with a MW15XX naming convention, where the follow abbreviations apply:

- MW = monitoring well;
- 15 = last two digits of the year the monitoring well was installed; and,
- XX = monitoring well number (varies).

Initially, monitoring wells MW1509 and MW1510 were designated as piezometers P-2 and P-1, respectively. Following the collection of static water levels in December 2015 and February 2016 (provided in Table 2 – Static Water Levels) the piezometers were re-designated as groundwater monitoring wells in the BAP GMS.

The BAP Monitoring Well Network Installation Report (February 2016) provides details of the BAP GMS installation, including descriptions of the following activities:

- Drilling and soil sampling;
- Monitoring well construction;

- Monitoring well development;
- Single well slug testing;
- Static water level measurement; and,
- Installation of dedicated pumps.

In addition, a Field Sampling and Analysis Plan (FSAP, April 2016) was completed which includes methods and procedures for background, detection, and assessment monitoring for compliance with the CCR rules in 40 CFR §257.93, §257.94, and §257.95, respectively.

The BAP Monitoring Well Network Installation Report (February 2016) and the FSAP (April 2016) have been added to the Mitchell BAP CCR Operating Record.

Additional information describing the Mitchell BAP GMS is provided in Section 3.1.1.6.

2.3 SUPPORTING INVESTIGATIONS AND DOCUMENTS

CEC has reviewed the following documents which are the most relevant for evaluation of compliance with the CCR GMS requirements:

1. Groundwater Quality at the Kammer and Mitchell Power Plants, Marshall County, West Virginia, EPRI Research Project 9106, Site Investigation Report, May 1999.
2. Response to WVDWWM Order Number DS2009-0002 (Item 2), Mitchell Bottom Ash Complex, Marshall County, West Virginia WVOWWM 1.0. No. 05108, GA File No. 09-379, Prepared For AEP Service Corporation, 1 Riverside Plaza, Columbus, Ohio 43215-2373, Prepared by Geo/Environmental Associates, Inc., 3502 Overlook Circle, Knoxville, Tennessee 37909, March 18, 2009.
3. CCW Impoundments Inspection Report (Draft), Mitchell Power Plant, Marshall County, West Virginia, Prepared for U.S. Environmental Protection Agency, Washington, D.C., Under Subcontract to Lockhead Martin, Edison, New Jersey, Prepared by Paul C. Rizzo Associates, Inc., 101 Westpark Boulevard, Columbia, South Carolina, USA 29210, Project No. 09-4157, October 2009.
4. Well Details from G. M. Baker & Son Co. Production Test of Well June 12, 2014.
5. State of West Virginia, Source Water Assessment and Protection Program, Source Water Assessment Report, Revised Report, Mitchell Plant, PWSID WV9925015, Marshall County, Prepared by: West Virginia Department of Health and Human Resources, Bureau for Public Health, Office of Environmental Health Services, Source Water Protection Unit, January 2014.

6. Monitoring Well Network Installation Work Plan, Revision #1, Bottom Ash Pond, Mitchell Power Generation Plant, Marshall County, West Virginia, Prepared for American Electric Power, Columbus, Ohio, Prepared by Civil & Environmental Consultants, Inc., Cincinnati, Ohio, CEC Project 110-416.7701, September 2015.
7. Monitoring Well Network Installation Report, Bottom Ash Pond, Mitchell Power Generation Plant, Marshall County, West Virginia, Prepared for American Electric Power, Prepared by Civil & Environmental Consultants, Inc., Cincinnati, Ohio, CEC Project 110-416.7709, February 2016
8. Field Sampling and Analysis Plan, Mitchell Power Generation Plant, Mitchell Landfill and Mitchell Bottom Ash Pond, Marshall County, West Virginia, Prepared for Kentucky Power Company, D/B/A American Electric Power, Inc., 1 Riverside Drive, Columbus, Ohio 43215, Prepared by Civil & Environmental Consultants, Inc., Worthington, Ohio, CEC Project 110-416.7608. April 2016.
9. BAP Piezometer and Pool Water Levels, September 2009 to December 2012 and May 2015, provided by Kentucky Power, Mitchell Power Generation Plant, Marshall County, West Virginia.

2.4 HYDROGEOLOGIC SETTING

Hydrogeologic conditions at the Mitchell BAP have been investigated, evaluated and reported in several documents including: 1) Groundwater Quality at the Kammer and Mitchell Power Plants by EPRI dated May 1999; 2) Response to WVOWWM Order Number DS2009-0002 (Item 2), Mitchell Bottom Ash Complex, Marshall County, West Virginia by Geo/Environmental Associates, Inc. (GA) dated March 18, 2009; and, 3) CCW Impoundments Inspection Report (Draft) by Paul C. Rizzo Associates, Inc. (PCR) dated October 2009. In addition, groundwater and pool level measurements recorded as part of the regular inspections were reviewed. Based on a review of the available information, the following sections provide a summary of the hydrogeologic conditions at the Mitchell BAP. Wells and/or piezometers installed for the investigations cited above are not incorporated into the Mitchell BAP GMS.

2.4.1 Climate

Climatic data for Mitchell BAP is summarized as follows:

Average monthly temperature:

Jan./July (degrees F)	Feb./Aug. (degrees F)	March/Sep. (degrees F)	April/Oct. (degrees F)	May/Nov. (degrees F)	June/Dec. (degrees F)
26.70	28.80	38.50	50.10	59.70	68.1
72.00	70.60	64.10	52.50	41.60	31.4

Average monthly precipitation:

Jan./July (inches)	Feb./Aug. (inches)	March/Sep. (inches)	April/Oct. (inches)	May/Nov. (inches)	June/Dec. (inches)
2.86	2.40	3.58	3.28	3.54	3.30
3.83	3.31	2.80	2.49	2.34	2.57

Evapotranspiration:

Jan./July (inches)	Feb./Aug. (inches)	March/Sep. (inches)	April/Oct. (inches)	May/Nov. (inches)	June/Dec. (inches)
0.603	0.467	1.022	2.826	2.477	2.315
2.485	2.087	1.607	1.633	1.349	0.896

2.4.2 Regional and Local Geologic Setting

2.4.2.1 Regional Geomorphology and Bedrock Geology

The Mitchell BAP site is located in the Ohio River valley and lies within the regional geologic area of West Virginia known as the Appalachian Plateau Province. The Ohio River Valley is a significant regional geomorphological feature in the region and is separated into the upper and lower parts. The upper Ohio River valley is entrenched in the unglaciated and dissected Allegheny Plateau and is characterized by valley walls incised commonly 200 feet below the regional upland surface. The valley is a remnant of the historic preglacial Teays Valley drainage system, which is an integral part of the history of the present Ohio River drainage basin. Dismemberment of the preglacial Teays Valley system and development of the present Ohio River valley began in the late Tertiary or early Pleistocene glacial age.

The width characteristics of the upper Ohio River valley upstream from Marietta, Ohio, indicates that at some time during the Pleistocene, the head of southwest-flowing drainage in the Ohio River valley originated in southern Marshall County, WV. Above this point, drainage flowed northeastward. Ray (1974) describes that somewhere near New Martinsville, WV there was a divide in the Ohio River valley between north- and south-flowing drainage. The north-flowing drainage followed the valley of Beaver Creek in Pennsylvania and was blocked by the advance of a continental glacier from the north. The glacial dam caused the formation of a lake in the valley of the Ohio River that rose high enough to overflow the divide. The divide was worn down rapidly by the overflow, and, when the glacial ice had finally melted back, the channel through the divide near New Martinsville was lower than the old north-heading channel at Beaver Creek, which had been filled with morainal debris. As a result, the present headwaters of the Ohio River above New Martinsville were diverted to their present course.

By Illinoian time, the present Ohio River was largely established in its present course. The bedrock valley was deepened and broadened and filled with glaciofluvial deposits during interglacial stages. Post-glacial activity has resulted in downgrading and cutting of terraces and floodplain surficial deposits. Alluvial sand, gravel and clay deposits in the Ohio River valley are more than 100 feet thick and more than one-half mile wide in some areas and are a significant regional groundwater resource. The alluvial sediments in the valley consist of a glaciofluvial fill of medium- to coarse-grained sand and gravel of Wisconsin age and postglacial terrace deposits mainly of the "point-bar" type of river sediment. Sedimentary structures are of the cut-and-fill type, characteristic of aggrading streams. The individual beds are highly lenticular, and there are abrupt changes in particle size both horizontally and vertically. Lower terraces are often covered by 20 to 30 feet of silty clay and clay which contain some channel-fill sand lenses. These are interpreted as normal flood-plain deposits, mainly of the point-bar type. Flood plains are commonly underlain by thick sections of silt, sand, and clay.

The existing Ohio River bedrock valley has the shape of a trench with a flat bottom and abrupt, steep walls with buried rock benches (Carlston, 1962). Based on the Geologic Map of West Virginia (WVGES Publication: Map 25A), the bedrock in Marshall County predominantly consists of sedimentary bedrock of the Pennsylvanian and Permian age Dunkard, Monogahela and Conemaugh Groups. Bedrock forming the valley walls is composed of cyclic sequences of sandstone, siltstone, claystone, shale, limy shale, shaly limestone, and minor coal beds. While limestone is present within the region, the beds are generally thin and discontinuous. Most of the limestone is non-marine and there are no known karst features noted in the region. The literature indicates that the bedrock was deposited in a wide fluvial-deltaic plain where sediment eroding from the Appalachian Mountains traveled west to be deposited in a large shallow sea in the interior of the continent (Martin, 1998).

The Mitchell BAP is located approximately five miles northwest of the Proctor Syncline which strikes to the northeast/southwest. No evidence of folding or faulting was observed during at the site during field investigations completed at the Mitchell Landfill located approximately 2 miles east of the Mitchell BAP. Additional regional folds identified on the West Virginia GIS Technical Center website (http://wvgis.wvu.edu/index.php) are present southeast of the BAP which include the New Martinsville Anticline, the Loudenville Syncline, the Washington Anticline and Nineveh Syncline all striking northeast/southwest.

2.4.2.2 Regional Groundwater Resources

The Ohio Department of Natural Resources (ODNR) has published the Groundwater Resource Map of Monroe County (1991), which is the neighboring county along the west side of the Ohio River across from the Mitchell Power Generation Plant. The ODNR map distinguishes groundwater well yields in the county, including bedrock strata and the Ohio River alluvium. Mapped well yields in Monroe County, Ohio are considered to be representative of groundwater yield conditions in neighboring Marshall County, WV. The ODNR Monroe County map indicates that the Ohio River alluvial deposits, referenced herein as the Ohio River alluvial aquifer, can provide yields of several hundred gallons per minute that will support large industrial and municipal supplies from sand and gravel deposits ranging from 55 to 75 feet thick which are hydraulically connected to the Ohio River. Comparatively, bedrock strata, positioned below and confining the lateral boundaries of the Ohio River alluvium, yield very limited groundwater supplies, typically less than 2 gpm. ODNR describes the bedrock strata groundwater resource potential as “very limited and often inadequate”.

CEC interprets that the Ohio River acts as a discharge boundary for the alluvial aquifer during low river flow and a recharge boundary during seasonal high river stage conditions. Seasonal water levels in the Ohio River are partially controlled by a series of locks and dams that are operated by the USACE. Thus, the seasonal high water elevation in the Ohio River alluvial aquifer is interpreted to be equal to the Ohio River Ordinary High Water Elevation published by the US Army Corp of Engineers (USACE).

2.4.2.3 Local Geology

The Mitchell BAP is constructed on the Ohio River floodplain and above the sand and gravel alluvial deposits. The saturated portion of these alluvial deposits, that are in direct hydraulic connection with the Ohio River, are the regional Ohio River alluvial aquifer. Ground surface elevations range from approximately 685 to 630 feet amsl at the Mitchell Power Generation Plant with surrounding hilltops reaching elevation 1,120 to 1,200 feet amsl. Local geologic conditions at the Mitchell BAP were primarily identified by the referenced EPRI report which included approximately 75 geotechnical borings and water level data from eight monitoring wells. These borings ranged in depth from about 36 feet below ground surface (bgs) to 116 feet bgs. Five of the borings were advanced into bedrock with core samples collected from depths of 98 feet bgs to 116 feet bgs. Additional boring data was developed as part of the referenced GA 2009 report that included 5 borings and installation of 4 piezometers. These supplemental borings were advanced through the constructed perimeter BAP dikes and the investigated depths were limited to about 50 feet below the original ground surface. GA field boring logs describe subsurface soils to be primarily classified as sand, with occasional, thin silt or clay intervals. There is no indication on the boring logs that organic soils or dredge materials were encountered in the BAP dike borings. Laboratory analysis of select soils samples verified these field classifications.

Site specific geologic cross sections from the referenced EPRI report are provided in Appendix A. The cross section locations are presented on Figure 3-3. Figures 3-4 and 3-5 present Sections A-A' and B-B', which are oriented approximately perpendicular to the Ohio River. Section C-C' is presented on Figure 3-6 and is aligned with the river. These cross sections show the variability in the natural unconsolidated soils and strata beneath the Mitchell Power Generation Plant and that the confining bedrock strata rise steeply to the east along the eastern portion of the plant boundary. Generally, the stratigraphy of unconsolidated soil deposits consists of a surficial fill layer underlain by natural silts and clays, then sand and interbedded sand and gravel deposits. EPRI identified four generalized textural zones were within the alluvial deposits. Significant variability was noted with respect to both zone thickness and textural characteristics. The referenced EPRI textural zones and their thickness ranges are as follows:

Textural Zone	Thickness (ft.)
Clay	0-17
Sand	0-30
Gravel	0-97
Gravel lenses	0-50

Fill was used extensively for establishing the required land surface grade of about elevation 667 feet amsl at the BAP site. The fill is composed of light brown silts and clays with minor amounts of coal, sand, and gravel. The fill is up to 25 feet thick and covers the western portion of the site, where it was used to extend an upper river terrace toward the river and establish the required land surface grade of about 667 feet amsl for the Mitchell Power Generation Plant. Between the Ohio River and the eastern portion of the Mitchell Power Generation Plant, including most of the BAP, the bedrock is near level at about elevations 570 feet amsl or about 100 feet below the original ground surface as shown on Figures 3-4 and 3-5 in Appendix A.

Subsurface data collected during installation of the Mitchell BAP GMS in October and November 2015 are presented in Section 3.1.1 and are consistent with hydrogeologic conditions described in the GA and EPRI investigations, completed in 2009 and 1999, respectively.

2.4.3 Local Groundwater Use

The Mitchell Power Generating Plant withdrawals water from the Ohio River alluvial aquifer that serves as a source of potable water for the plant. Currently, there are two groundwater supply wells operating at the plant. Information provided by AEP indicates that the supply wells produced an approximate average of 628,000 gallons per month in 2014. The influence of the supply wells is shown on the EPRI Water Table Contour Map for the Mitchell Plant site (August 20, 1996) on Figure 3-7 in Appendix A. Water levels collected on May 20, 2015 from six of the eight original monitoring wells at the plant are similar to those recorded during the EPRI study and also reflect the pumping well influence. A summary of the supply wells is provided below.

Supply Well #2

- Total Well Depth 92.6 feet
- Screen Length 15 feet with Top of Screen at 77 feet
- Well Diameter 10 inches
- Static Water Level 43.6 feet on 6/12/14 Step Test
- Step Test performed – specific capacity at 163 GPM = 233 GPM/FT
- End of Step Test 224 GPM = 1.10 feet drawdown

Supply Well #3

- Total Well Depth 91.6 feet
- Screen Length 20 feet with Top of Screen at 71 feet
- Well Diameter 14 inches
- Static Water Level 41.2 feet on 5/30/14 Step Test
- Step Test performed – specific capacity at 172 GPM = 82 GPM/FT
- End of Step Test 231 GPM = 2.70 feet drawdown

3.0 §257.91 GROUNDWATER MONITORING SYSTEM

3.1 §257.91(A) THROUGH §257.91(C) RULE DESCRIPTION

40 CFR 257.91(a) through (c) states:

(a) Performance standard. The owner or operator of a CCR unit must install a groundwater monitoring system that consists of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the uppermost aquifer that:

- ***(1) Accurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit. A determination of background quality may include sampling of wells that are not hydraulically upgradient of the CCR management area where:***
  - ***(i) Hydrogeologic conditions do not allow the owner or operator of the CCR unit to determine what wells are hydraulically upgradient; or,***
  - ***(ii) Sampling at other wells will provide an indication of background groundwater quality that is as representative or more representative than that provided by the upgradient wells; and,***
- ***(2) Accurately represent the quality of groundwater passing the waste boundary of the CCR unit. The downgradient monitoring system must be installed at the waste boundary that ensures detection of groundwater contamination in the uppermost aquifer. All potential contaminant pathways must be monitored.***

(b) The number, spacing, and depths of monitoring systems shall be determined based upon site-specific technical information that must include thorough characterization of:

- ***(1) Aquifer thickness, groundwater flow rate, groundwater flow direction including seasonal and temporal fluctuations in groundwater flow; and,***
- ***(2) Saturated and unsaturated geologic units and fill materials overlying the uppermost aquifer, materials comprising the uppermost aquifer, and materials comprising the confining unit defining the lower boundary of the uppermost aquifer, including, but not limited to, thicknesses, stratigraphy, lithology, hydraulic conductivities, porosities and effective porosities.***

(c) The groundwater monitoring system must include the minimum number of monitoring wells necessary to meet the performance standards specified in paragraph (a)

of this section, based on the site-specific information specified in paragraph (b) of this section. The groundwater monitoring system must contain:

(1) A minimum of one upgradient and three downgradient monitoring wells; and,

(2) Additional monitoring wells as necessary to accurately represent the quality of background groundwater that has not been affected by leakage from the CCR unit and the quality of groundwater passing the waste boundary of the CCR unit.

3.1.1 Information Supporting Rule Compliance

3.1.1.1 Hydrostratigraphic Units

The Mitchell BAP is constructed on the Ohio River floodplain and above the sand and gravel alluvial deposits. The saturated portion of these alluvial deposits that are in direct hydraulic connection with the Ohio River are the regional Ohio River alluvial aquifer, which is a prolific aquifer capable of supplying hundreds of gallons per minute. Bedrock forming the Ohio River valley, which contains the Ohio River alluvial aquifer, is composed of cyclic sequences of sandstone, siltstone, claystone, shale, limy shale, shaly limestone, and minor coal beds. While limestone is present within the region, the beds are generally thin and discontinuous and there are no known karst features in the vicinity. Comparatively, bedrock strata yield very limited groundwater supplies, typically less than 2 gpm. ODNR describes the bedrock strata groundwater resource potential as “very limited and often inadequate”.

As stated in Section 2.4.2.3, GA field boring logs describe subsurface soils below the Mitchell BAP to be primarily classified as sand, with occasional, thin silt or clay intervals. There is no indication on the boring logs that organic soils or dredge materials were encountered in the BAP dike borings. Laboratory analysis of select soils samples verified these field classifications. This was further confirmed by the 2015 GMS borings described in Section 3.1.1.6.

Geologic cross sections were prepared from monitoring well borings completed at the periphery of the Mitchell BAP in October 2015 at the locations shown on Figure 4 – Geologic Cross Section Location Map. Based on the data collected from these monitoring well borings, unconsolidated soils and bedrock underlying the Mitchell BAP are depicted on Figure 5 – Geologic Cross Sections A-A’ and Figure 6 – Geologic Cross Section B-B’. The saturated portion of the sand and gravel deposits comprises the Ohio River alluvial aquifer. Unconsolidated deposits comprising the Ohio River alluvial aquifer at the Mitchell BAP monitoring wells locations consist of sand and gravel, classified as well graded sand (SP), poorly graded sand with gravel (SP), well graded sand (SW), and well graded sand with gravel (SW).

As depicted on Figure 5 – Geologic Cross Section A-A' the Ohio River alluvial aquifer ranges in thickness due to the confining bedrock strata that rises to the east along the eastern portion of the plant boundary. Beneath the Mitchell BAP, the saturated aquifer ranges in thickness from approximately 47 feet to the west to 27 feet to the east.

The Mitchell BAP monitoring wells were constructed with well screens that monitor the phreatic surface (water table) in the Ohio River alluvial aquifer. Monitoring well screened intervals range from approximate elevations 616 feet amsl to 596 feet amsl as indicated in Table 1 – Monitoring Well Construction Summary. Further description of the Mitchell BAP monitoring wells is provided in Section 3.1.1.6.

3.1.1.2 Hydraulic Conductivity

Groundwater flow in the Ohio River alluvial aquifer is through primary porosity in the sand and gravel deposits that comprise the aquifer. In-situ hydraulic conductivity tests (slug tests) were completed at each of the Mitchell BAP monitoring wells installed in October 2015. Slug testing was completed five days following the completion of well development activities for the Mitchell BAP monitoring wells. Slug test data were collected with In-Situ Level Troll 700™ electronic data transducers. Downloaded data were analyzed using AQTESOLV™ software. Hydraulic conductivity (K) values calculated from the Mitchell BAP monitoring wells are summarized as follows:

- Highest K value: MW1505 1.43 x 10^{-2} centimeters per second (cm/s);
- Lowest K value: MW1508 5.61 x 10^{-3} cm/s; and,
- Average K value: 4.62 x 10^{-2} cm/s.

These hydraulic conductivity values are representative of the Ohio River alluvial aquifer at the Mitchell BAP.

3.1.1.3 Groundwater Flow

Groundwater flow in the Ohio River alluvial aquifer in the vicinity of the Mitchell BAP was initially determined by the referenced EPRI report to be toward the Ohio River with some influence from the Mitchell Generation Power Station water supply wells as shown in Figure 3-7 in Appendix A. Figure 7 – Ohio River Alluvial Aquifer Potentiometric Map, December 10, 2015 and Figure 8 – Ohio River Alluvial Aquifer Potentiometric Map, February 8, 2016 were prepared using static water levels from the recently installed Mitchell BAP monitoring wells and the remaining EPRI wells. The potentiometric surface maps are comparable to those reported by EPRI in 1999. Groundwater flow at the Mitchell BAP is influenced by the on-site pumping wells to the north, bedrock confining beds to the east, and the Ohio River discharge boundary to the west. The potentiometric surface beneath the Mitchell BAP is relatively flat, exhibiting only 0.14 feet difference between the highest and lowest static water level measurement on December 10, 2015 and 0.37 feet difference on February 8, 2016. Based on the December 2015 and February 2016 water level data, monitoring well MW1508 is upgradient and wells MW1504 and MW1510 are sidegradient of the Mitchell BAP. The remaining BAP monitoring wells are downgradient wells as indicated in Table 1 – Monitoring Well Construction Summary.

Groundwater flow velocities in the alluvial aquifer were calculated using monitoring well water level data recorded on December 10, 2015 and corresponding potentiometric contours and flow lines depicted in Figure 7–Ohio River Alluvial Aquifer Potentiometric Map, December 10, 2015. Groundwater flow velocities were calculated using Darcy's Law, average hydraulic conductivity from slug tests, a referenced effective porosity for the aquifer deposits, and the change in potentiometric head along two representative flow lines, one toward the Mitchell Plant groundwater supply wells north of the BAP and the other from monitoring well MW1508 to EPRI well MW-8 to the south of the BAP. The calculated groundwater flow velocities along these flow paths are:

- Flow line from BAP toward the supply well: 0.87 feet per day (ft./day); 319 feet per year (ft./yr.)
- Flow line from MW1508 to MW-8: 0.26 ft./day; 94 ft./yr.

Based on these groundwater flow velocities, the approximate travel time from the BAP to the Mitchell Plant supply well is approximately three years and travel time from the BAP to the Ohio River is approximately eight years. The BAP Monitoring Well Network Installation Report (February 2016) provides the groundwater flow velocity calculations.

3.1.1.4 CCR Rule Definition of Uppermost Aquifer

The CCR Rule definition of the uppermost aquifer is found in 40 CFR §257.53 and is provided below:

> *Uppermost aquifer means the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility's property boundary. Upper limit is measured at a point nearest to the natural ground surface to which the aquifer rises during the wet season.*

As further discussed in Section 3.1.1.5, the Ohio River alluvial aquifer meets the CCR rule criteria for being the uppermost aquifer at the Mitchell BAP.

3.1.1.5 Identified On-site Uppermost Aquifer

The referenced EPRI report identifies that the Mitchell Power Generation Station and subject BAP are positioned over Ohio River alluvial deposits consisting of 40 to 50 feet of lenticular sand and gravel overlain by a layer of fine grained material, consisting of approximately 20 feet of clay and clayey silt and 10 to 20 feet of clayey sand. The unconsolidated alluvial deposits pinch out against the confining bedrock strata that contain the Ohio River channel and form the adjacent ridges positioned east of the subject site and west of the Ohio River.

The Ohio River alluvial aquifer, which consists of the saturated portion of the sand and gravel alluvial deposits that are in direct hydraulic connection with the Ohio River, is appropriately defined as the uppermost aquifer beneath the Mitchell BAP. Water elevations in Mitchell BAP monitoring wells and remaining EPRI wells on December 10, 2015 are presented in Table 2 – Static Water Levels. Comparison of the remaining EPRI well water elevation measured December 10, 2015 to EPRI monitoring well elevations included in the referenced EPRI report are comparable, as summarized below:

EPRI Well No.	December 10, 2015 Static Water Level feet amsl	November 1996 Static Water Level feet amsl
MW-4	623.00	622.57
MW-5	623.05	622.60
MW-6	623.11	622.51
MW-7	623.33	623.15
MW-8	623.87	624.32

EPRI Figure 3-8 in Appendix A provides temporal variations in groundwater elevations in the Ohio River alluvial aquifer which vary less than one foot during two monitoring events in August and November 1996. Water levels and are expected to fluctuate slightly due to seasonal conditions. Additional static water levels collected in February 2016 are presented in Section 3.1.1.3 and are consistent with groundwater levels recorded during the EPRI investigation in 1999.

The seasonal high water elevation in the Ohio River alluvial aquifer is equal to the Ohio River Ordinary High Water Elevation, which is elevation 627.3 feet amsl in the vicinity of the Mitchell BAP.

3.1.1.6 Monitoring Well Network

The BAP CCR groundwater monitoring system was installed from October 5 to November 12, 2015 and consists of seven groundwater monitoring wells installed in the Ohio River alluvial aquifer at the locations shown on Figure 3 – Bottom Ash Pond Monitoring Well Network. The well locations were selected to provide potential upgradient and downgradient monitoring positions relative to the Mitchell BAP based on the influence of the water supply wells at the Mitchell Power Plant, the Ohio River, surrounding bedrock hydraulic boundaries, and drill rig access constraints. EPRI monitoring wells also provide additional water levels for potentiometric mapping.

Table 1 – Monitoring Well Construction Summary provides construction details for the Mitchell BAP GMS. The wells monitor the uppermost aquifer, defined in Section 3.1.1.5 as the Ohio River alluvial aquifer. Boring logs and as-built well diagrams provided in Appendix B describe the monitored unconsolidated deposit characteristics. Graphic representations of the alluvial deposits penetrated by the Mitchell BAP monitoring well borings and well construction details are shown on Figure 5 – Geologic Cross Section A-A' and Figure 6 – Geologic Cross Section B-B'. Static water levels measured in December 2015 are also included on these geologic cross sections.

Subsequent to monitoring well installation and development, AEP installed dedicated bladder pumps in the five BAP monitoring wells (MW1504 through MW1508) on December 19, 2015. AEP selected and installed Geotech stainless steel bladder pumps, model 1.66, 36-inch length. The dedicated pumps were set approximately 1 to 2 feet above each well bottom. Subsequently, AEP installed dedicated Geotech bladder pumps in BAP monitoring wells MW1509 and MW1510 on April 8, 2016.

A summary of the Mitchell BAP monitoring well bottom depths measured from ground surface and elevations is provided below:

<u>Ohio River Alluvial Aquifer Monitoring Well Depths/Elevations (measured from ground surface)</u>

- MW1504: 93.5 ft. bgs/598.40 ft. amsl
- MW1505: 94.0 ft. bgs/597.05 ft. amsl
- MW1506: 95.0 ft. bgs/596.36 ft. amsl
- MW1507: 94.0 ft. bgs/598.08 ft. amsl
- MW1508: 87.0 ft. bgs/595.72 ft. amsl

- MW1509 (P-2): 94.0 ft. bgs/597.86 ft. amsl
- MW1510 (P-1): 81.0 ft. bgs/597.01 ft. amsl

As stated previously, static water levels measured in December 2015 and February 2016 are presented on Figure 7 – Ohio River Alluvial Aquifer Potentiometric Map, December 10, 2015 and Figure 8 – Ohio River Alluvial Aquifer Potentiometric Map, February 8, 2016. Based on the initial water elevation data from the Mitchell BAP GMS, there is 0.14 feet of variation in groundwater elevations in December 2015 and 0.37 feet of variation in February 2016 (Table 2 – Static Water Levels). Interpreted groundwater flow lines based on the December 2015 and February 2016 water level data indicate that monitoring well MW1508 is upgradient of the Mitchell BAP and wells MW1504 and MW1510 are sidegradient. The remaining monitoring wells are downgradient of the Mitchell BAP as indicated in Table 1 – Monitoring Well Construction Summary.

3.1.1.7 BAP CCR Background, Detection, and Assessment Monitoring

There will be a total of eight background sampling events beginning in late May 2016 and will be completed by October 17, 2017 for compliance with 40 CFR §257.93. BAP CCR background monitoring will include all of the parameters listed in Appendix III and Appendix IV of the CCR rules. Detection monitoring is required by the CCR rules in 40 CFR §257.94 to be semi-annual (twice yearly) and will begin after the October 17, 2017 deadline for background monitoring. BAP detection monitoring will include the parameters listed in Appendix III of the CCR rules and will occur every six months (semi-annually).

Within 90 days of determining a statistically significant increase (SSI) over background for an Appendix III parameter during semi-annual detection monitoring events, it may be demonstrated that the SSI is a result of error in sampling, analysis, statistical analysis or natural variation in groundwater quality. If a successful demonstration is completed within the 90-day period, detection monitoring may continue. If a successful demonstration is not completed within the 90-day period, as assessment monitoring program must be initiated as required by 40 CFR §257.95, which includes sampling each well for Appendix III and IV parameters.

3.1.2 Compliance with §257.91(a) through §257.91(c) Requirements

The Mitchell BAP GMS, as described in the Monitoring Well Network Installation Report (February 2016) and summarized in Section 3.1.1.6, consists of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples that: 1) accurately represent the quality of background groundwater that has not been affected by leakage from the Mitchell BAP CCR unit; 2) accurately represent the quality of groundwater passing the waste boundary of the Mitchell BAP CCR unit; and, 3) the monitoring well network consists of appropriate number, spacing, and depths of monitoring wells based upon site-specific technical information (summarized in Section 3.1.1) that included thorough characterization of the saturated and unsaturated geologic units, aquifer thicknesses, groundwater flow rates, groundwater flow directions, and seasonal/temporal fluctuations in groundwater flow. Thus, the Mitchell BAP GMS complies with 40 CFR 257.91(a) through 40 CFR 257.91(c) requirements.

3.2 §257.91(D) RULE DESCRIPTION

40 CFR 257.91(d) states:

(d) The owner or operator of multiple CCR units may install a multiunit groundwater monitoring system instead of separate groundwater monitoring systems for each CCR unit.

(1) The multiunit groundwater monitoring system must be equally as capable of detecting monitored constituents at the waste boundary of the CCR unit as the individual groundwater monitoring system specified in paragraphs (a) through (c) of this section for each CCR unit based on the following factors:

(i) Number, spacing, and orientation of each CCR unit;

(ii) Hydrogeologic setting;

(iii) Site history; and,

(iv) Engineering design of the CCR unit.

(2) If the owner or operator elects to install a multiunit groundwater monitoring system, and if the multiunit system includes at least one existing unlined CCR surface impoundment as determined by § 257.71(a), and if at any time after October 19, 2015 the owner or operator determines in any sampling event that the concentrations of one or more constituents listed in appendix IV to this part are detected at statistically significant levels above the groundwater protection standard established under § 257.95(h) for the multiunit system, then all unlined CCR surface impoundments comprising the multiunit groundwater monitoring system are subject to the closure requirements under § 257.101(a) to retrofit or close.

3.2.1 Compliance With §257.91(D)

AEP is not proposing to install a multi-unit groundwater monitoring system; therefore, this rule does not apply to Mitchell Landfill.

3.3 §257.91(E) AND §257.91(F) RULE DESCRIPTION

40 CFR 257.91(e) and (f) states:

(e) Monitoring wells must be cased in a manner that maintains the integrity of the monitoring well borehole. This casing must be screened or perforated and packed with gravel or sand, where necessary, to enable collection of groundwater samples. The annular space (i.e., the space between the borehole and well casing) above the sampling depth must be sealed to prevent contamination of samples and the groundwater.

- ***(1) The owner or operator of the CCR unit must document and include in the operating record the design, installation, development, and decommissioning of any monitoring wells, piezometers and other measurement, sampling, and analytical devices. The qualified professional engineer must be given access to this documentation when completing the groundwater monitoring system certification required under paragraph (f) of this section.***
- ***(2) The monitoring wells, piezometers, and other measurement, sampling, and analytical devices must be operated and maintained so that they perform to the design specifications throughout the life of the monitoring program.***

(f) The owner or operator must obtain a certification from a qualified professional engineer stating that the groundwater monitoring system has been designed and constructed to meet the requirements of this section. If the groundwater monitoring system includes the minimum number of monitoring wells specified in paragraph (c)(1) of this section, the certification must document the basis supporting this determination.

3.3.1 Information Supporting Rule Compliance

The Mitchell BAP monitoring wells were installed following the procedures and materials specified in the Monitoring Well Network Installation Work Plan (September 2015), including:

- Monitoring well locations
- Drilling and soil sampling methods
- Annulus sealing methods
- Monitoring well materials
- Well development procedure

- Well testing procedures

The BAP Monitoring Well Network Installation Report (February 2016) documents completed drilling and well installation procedures and materials, well development activities, and well testing details.

Figure 3 – CCR Unit and Monitoring Wells identifies the locations of the Mitchell BAP monitoring wells. Table 1 – Monitoring Well Construction Summary provides construction details for the Mitchell BAP GMS. Boring logs and as-built well diagrams are provided in Appendix B. Monitoring well development records are included in Appendix C. Final turbidity levels following well development ranged as follows:

Well Development Results

Well No.	Final Turbidity (NTUs)	Well Volumes Removed	Gallons Removed
MW1504	9.7	156.9	687.5
MW1505	736.0	161.4	785
MW1506	16.9	106.7	525
MW1507	20.8	82.0	362.5
MW1508	23.8	180.1	836.3
MW1509 (P-2)	85.8	96.4	431.5
MW1510 (P-1)	4.7	121.4	552.5

Note that well volumes vary depending on the height of the water column in the individual well and that well volumes do not equal gallons of water removed from a well.

Interpreted groundwater flow lines based on the December 2015 and February 2016 water level data indicate that monitoring well MW1508 is upgradient of the Mitchell BAP and wells MW1504 and MW1510 are sidegradient. The remaining monitoring wells are downgradient of the Mitchell BAP as indicated in Table 1 – Monitoring Well Construction Summary. Groundwater flow lines relative to the Mitchell BAP are depicted on Figure 7 – Ohio River Alluvial Aquifer Potentiometric Map, December 10, 2015 and Figure 8 – Ohio River Alluvial Aquifer Potentiometric Map, February 8, 2016.

3.3.2 Compliance with §257.91(e) and §257.91(f) Requirements

As described in the Monitoring Well Network Installation Report (February 2016) and summarized in Section 3.1.1.6, the Mitchell BAP groundwater monitoring wells were constructed and cased in a manner that maintains the integrity of the monitoring well borehole for the collection of groundwater samples, including: 1) the annular space above each well's sampling depth is sealed with bentonite to prevent contamination of samples and the groundwater; and 2) wells are constructed with slotted well screens surrounded by silica sand filter packs that reduce suspended solids and turbidity in the groundwater samples. Well design, installation, and development of monitoring wells is contained in the BAP Monitoring Well Network Installation Report (February 2016) as summarized in Section 3.1.1.6. The developed data is maintained in the Mitchell BAP CCR Operating Record. The measurement, sampling, and analytical device maintenance and operation are documented in the FSAP (April 2016) which is also maintained in the CCR Operating Record.

A CEC Certified Professional Geologist (CPG), under the supervision and direction of the certifying Professional Engineer, has been directly involved with the design of the BAP GMS, data collection, site characterization, well installation, and well development, and has reviewed applicable information recorded in the Operating Record. The information referenced in Section 3.3.1 demonstrates that the Mitchell BAP GMS complies with 40 CFR 257.91(e) and 40 CFR 257.91(f) requirements.

4.0 SUMMARY AND PROFESSIONAL ENGINEER'S CERTIFICATION

This CCR Groundwater Monitoring System Demonstration describes the Mitchell Bottom Ash Pond CCR unit, site geology and groundwater monitoring system in support of demonstrating compliance with 40 CFR §257.91 Groundwater Monitoring Systems. Section 3.0 of this report provides supporting information and conclusions demonstrating that the applicable Groundwater Monitoring System requirements have been met.

The following certification statement provides confirmation that this report was prepared by a qualified professional engineer and that there is sufficient information to demonstrate that the existing Mitchell Bottom Ash Pond meets the Groundwater Monitoring System requirements stated in 40 CFR §257.91.

Professional Engineer's Certification

By means of this certification, I certify that I have reviewed this CCR Groundwater Monitoring System Demonstration Report, Mitchell Bottom Ash Pond, Mitchell Power Generation Plant, and the design, construction, operation, and maintenance of Mitchell Bottom Ash Pond Groundwater Monitoring System meets the requirements of Section 40 CFR §257.91.

Anthony P. Amicon
Printed Name of Professional Engineer

Signature

19206	West Virginia	06-23-2011
Registration No.	Registration State	Date

5.0 BIBLIOGRAPHY

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Walker, Alfred C., February 1991. Ground Water Resources of Monroe County, Ohio Department of Natural Resources, Columbus, Ohio.

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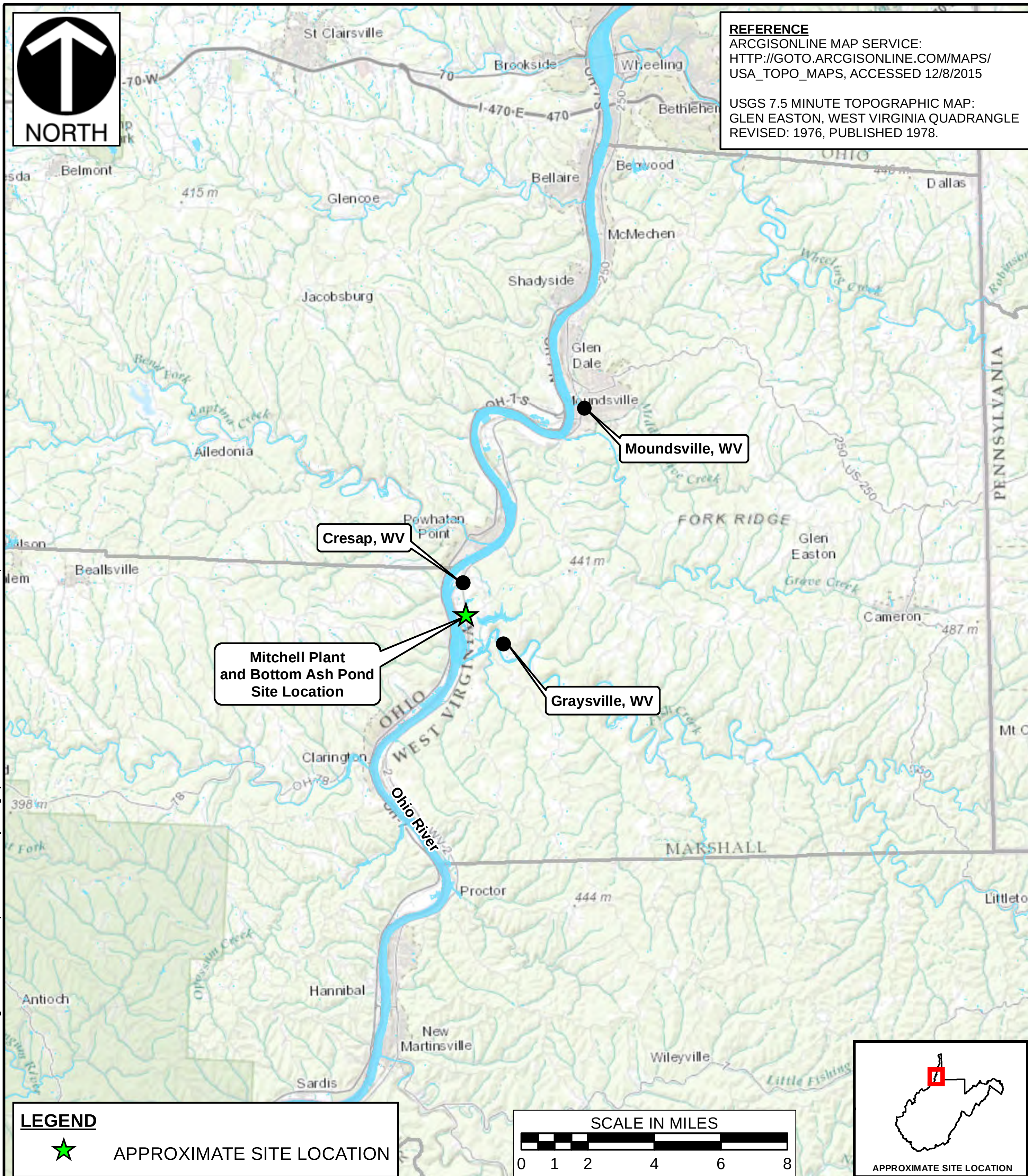
Web: www.wvgs.wvnet.edu, Map: Original 1968/1969 map revised, March 2011, Map Date: May 16, 2011.

FIGURES



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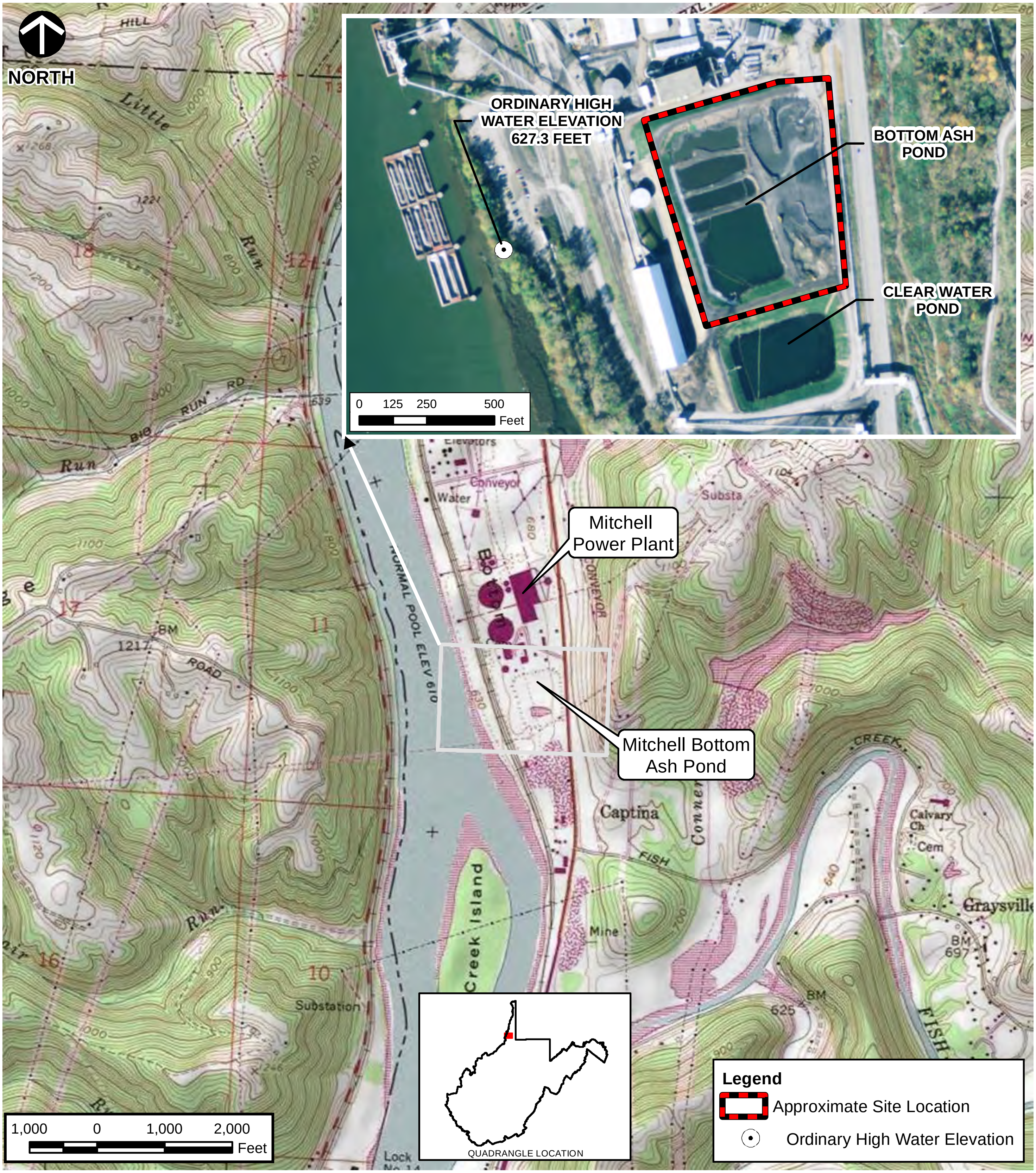
MITCHELL POWER GENERATION PLANT
MARSHALL COUNTY, WEST VIRGINIA

GROUNDWATER MONITORING SYSTEM DEMONSTRATION
SITE LOCATION MAP

DRAWN BY: MAD	CHECKED BY: RAS	APPROVED BY: APA*	FIGURE:
DATE: 12/8/2015	MAP SCALE: 1 " = 4 miles	PROJECT NO: 110-416-7701	1

*Hand signature on file



SOURCE: PORTION OF THE USGS 7.5-MINUTE SERIES TOPOGRAPHIC QUADRANGLE MAP - GLEN EASTON, WV - 1978 AND POWHATAN POINT, WV - 1978.
SOURCE; AERIAL PHOTOGRAPH - ARCGISONLINE MAP SERVICE: HTTP://GOTO.ARCGISONLINE.COM/MAPS/WORLD_IMAGERY, ACCESSED 12/8/2015 IMAGERY DATE 10/24/2014

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GROUNDWATER MONITORING SYSTEM DEMONSTRATION
PLANT AND CCR UNIT LOCATION MAP

DRAWN BY: JBF	CHECKED BY: RAS	APPROVED BY: APA*	FIGURE NO: 2
DATE: DECEMBER 08, 2015	DWG SCALE: 1 " = 2,000 '	PROJECT NO: 110-416-7701	

Signature on File *

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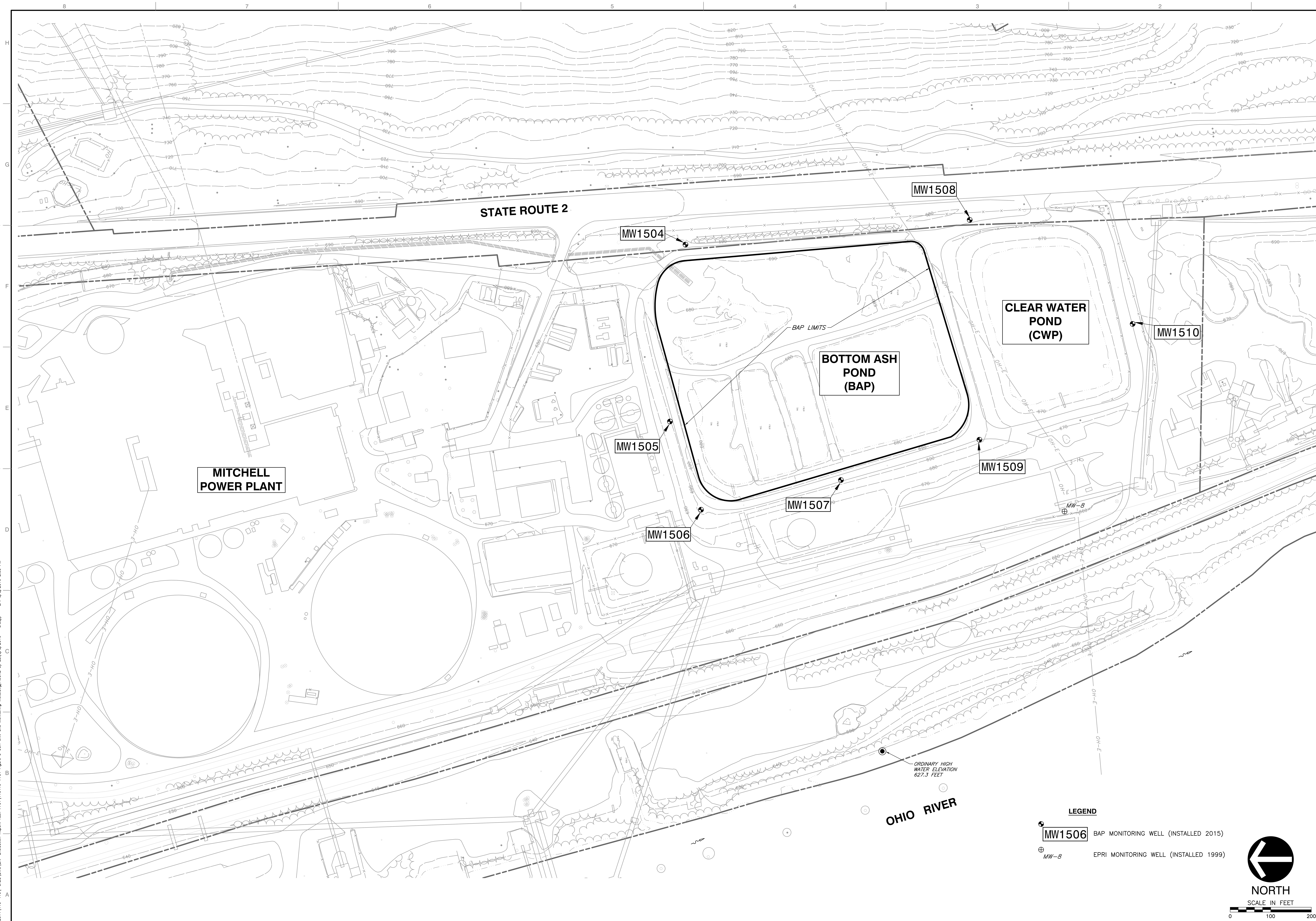

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NO	DATE	DESCRIPTION

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MARSHALL COUNTY, WEST VIRGINIA

GROUNDWATER MONITORING SYSTEM DEMONSTRATION

CCR UNIT AND MONITORING WELLS

DATE:	DECEMBER 2015	DRAWN BY:	DAR
DWG SCALE:	AS NOTED	CHECKED BY:	RAS
PROJECT NO:	110-416-7701		
APPROVED BY:	(HAND SIGNATURE ON FILE) *APA		

FIGURE NO.: **3**

STATE ROUTE 2
MW1504
MW1505
MW1506
MW1507
MW1508
MW1509
MW1510
MW-8
A'
A
B
B'
BAP LIMITS
BOTTOM ASH POND (BAP)
CLEAR WATER POND (CWP)
MITCHELL POWER PLANT
OHIO RIVER
ORDINARY HIGH WATER ELEVATION 627.3 FEET
LEGEND
B B' CROSS SECTION LOCATION
MW1506 BAP MONITORING WELL (INSTALLED 2015)
MW-8 EPRI MONITORING WELL (INSTALLED 1999)
NORTH
SCALE IN FEET
0 100 200
REVISION RECORD
NO DATE DESCRIPTION
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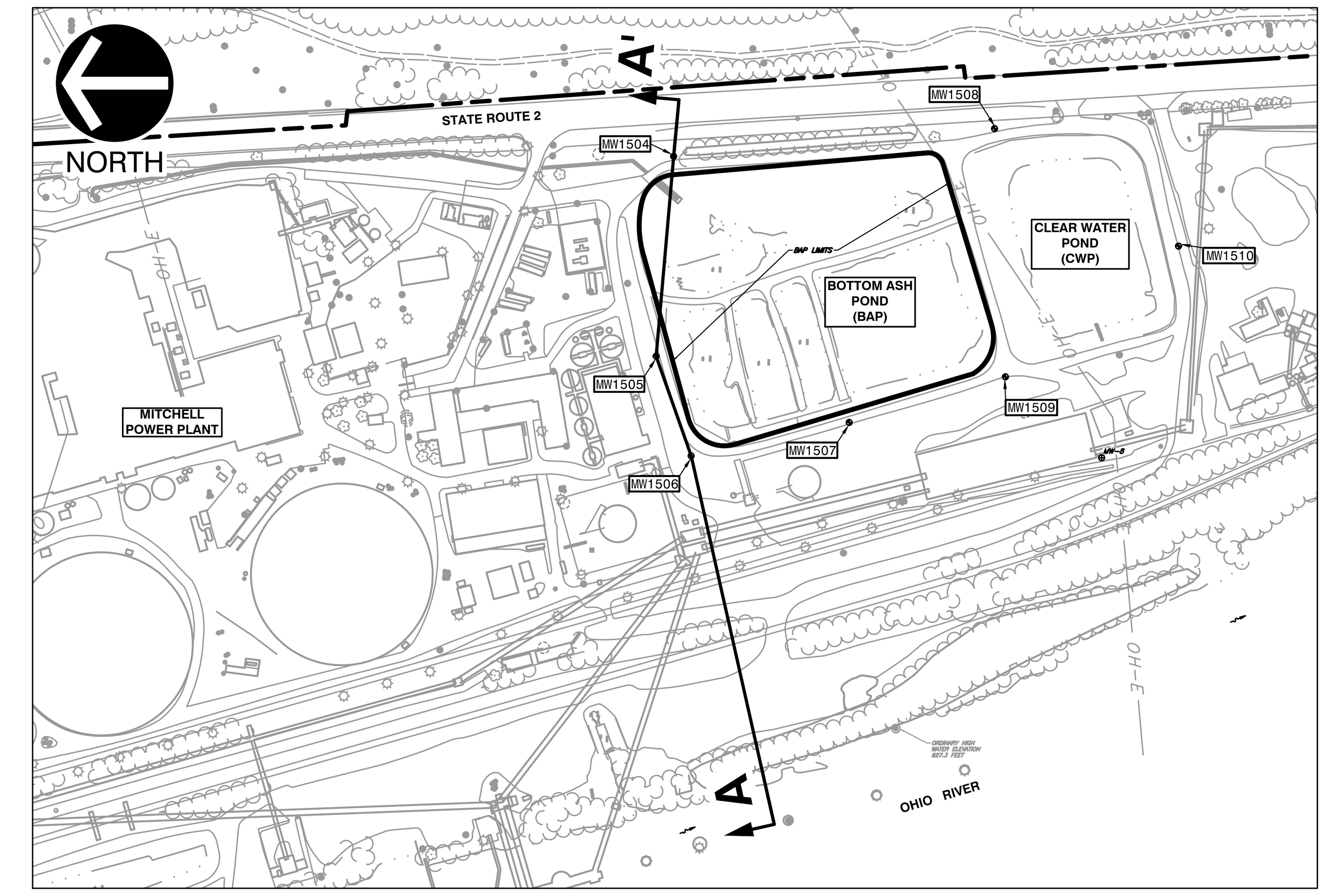
MITCHELL POWER GENERATION PLANT
MARSHALL COUNTY, WEST VIRGINIA
GROUNDWATER MONITORING SYSTEM DEMONSTRATION
GEOLOGIC CROSS SECTION LOCATION MAP
DATE: DECEMBER 2015 DRAWN BY: DAR
DWG SCALE: AS NOTED CHECKED BY: RAS
PROJECT NO: 110-416-7701
APPROVED BY: (HAND SIGNATURE ON FILE) *APA
FIGURE NO.: 4



KEY PLAN

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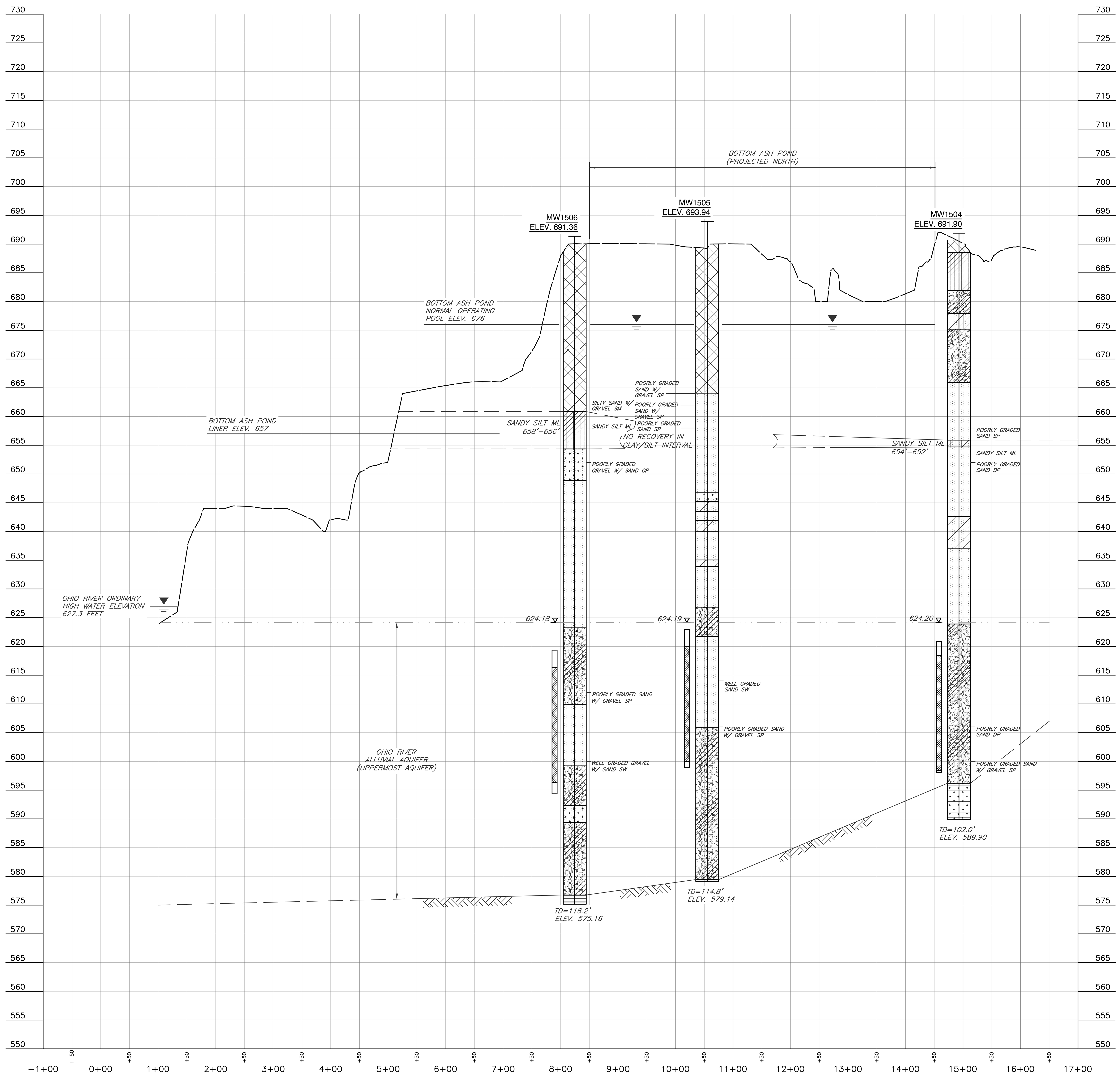

SECTION A-A' PROFILE

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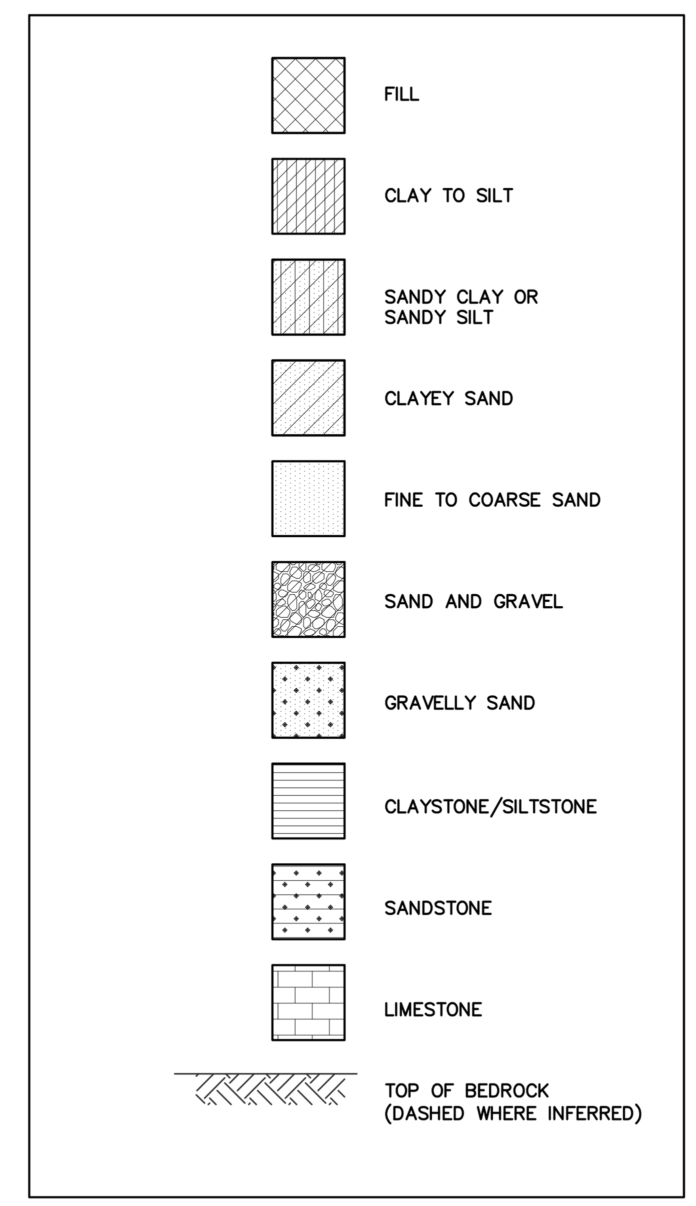

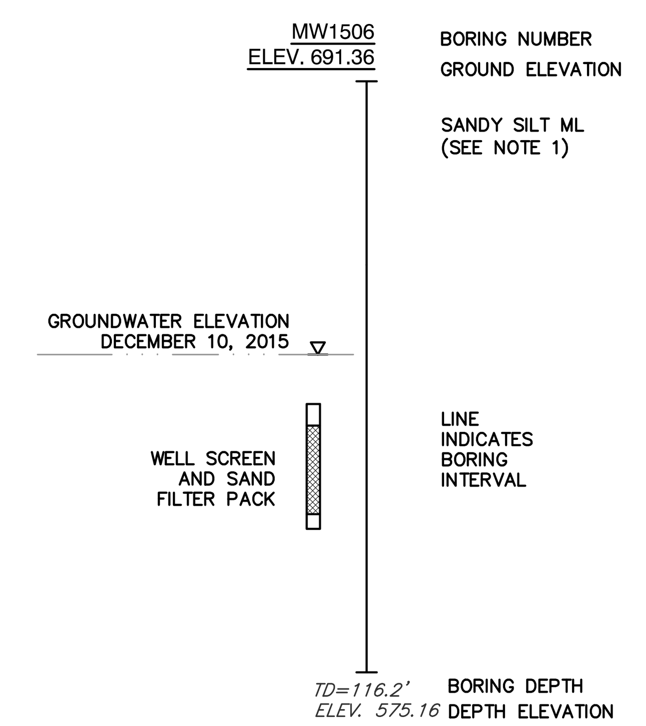

MONITORING WELL DIAGRAM

NOTE:

1. NOTED SOIL DESCRIPTIONS FROM GEOTECHNICAL LABORATORY TESTING RESULTS PROVIDED BY AEP DOLAN LABORATORY.

SCALE IN FEET 0 100 200

SCALE IN FEET 0 10 20

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GEOLOGIC CROSS SECTION A-A'

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PROJECT NO:	110-416-7701		
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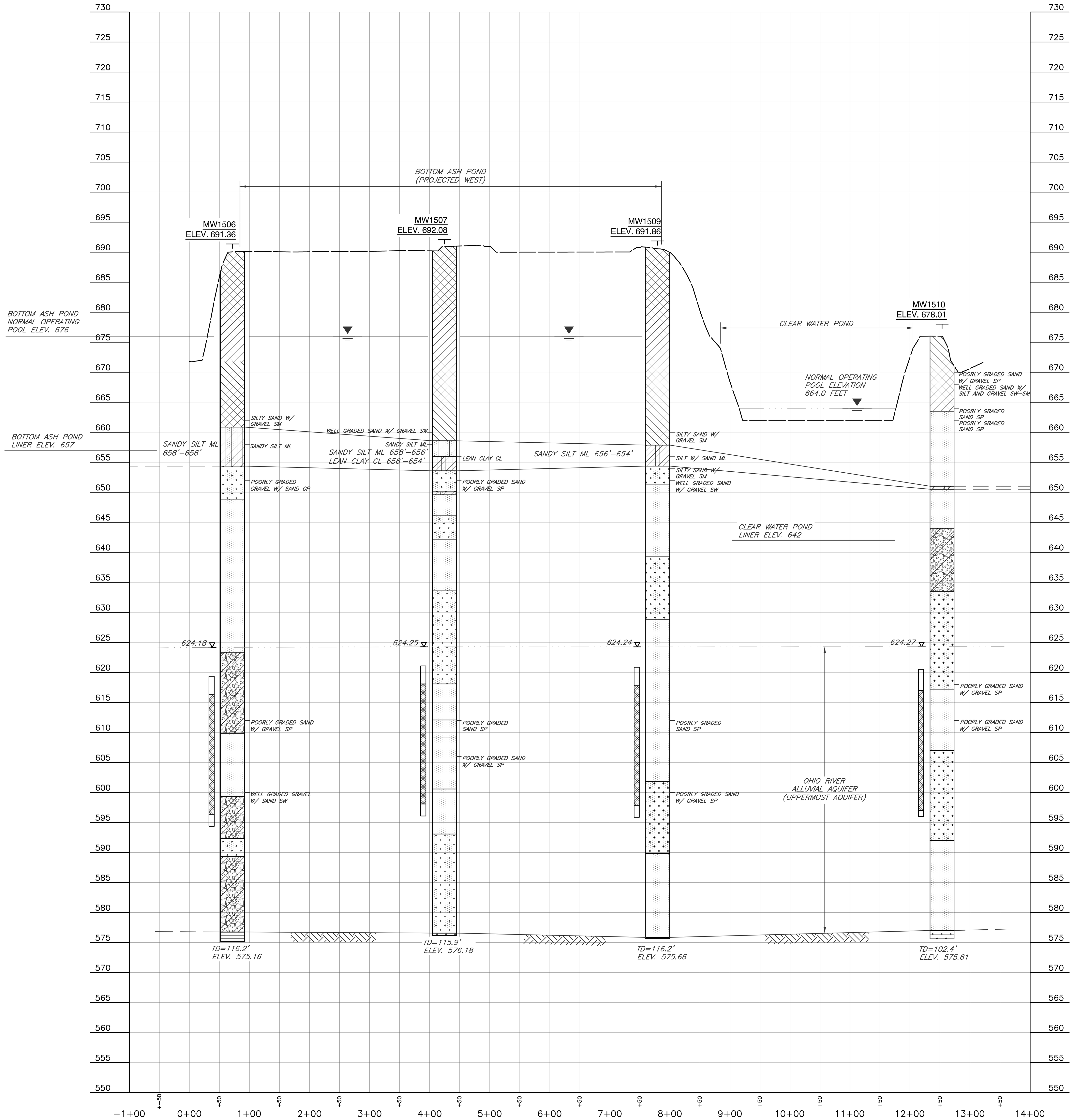
FIGURE NO.: 5



SECTION B-B" PROFILE

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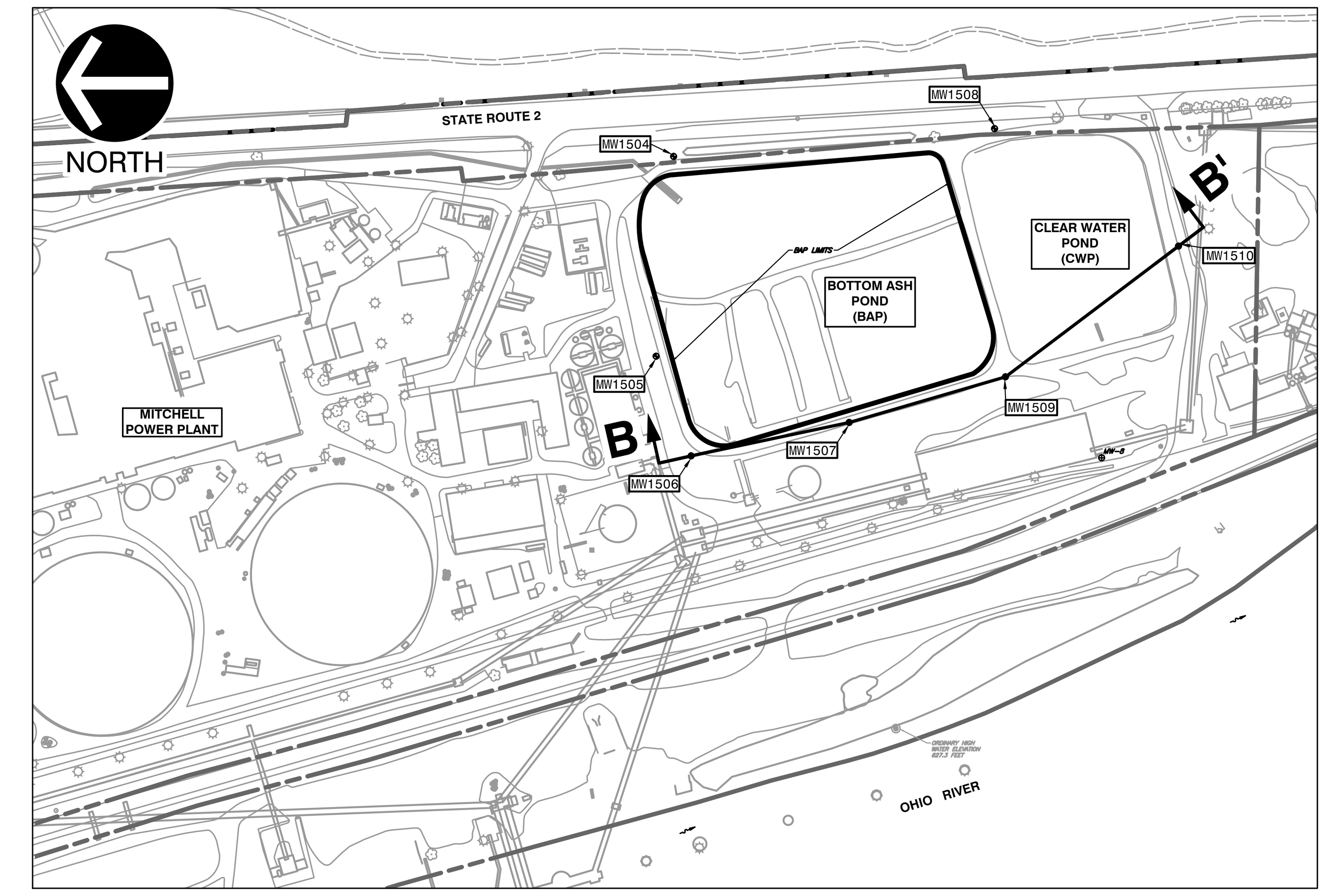

KEY PLAN

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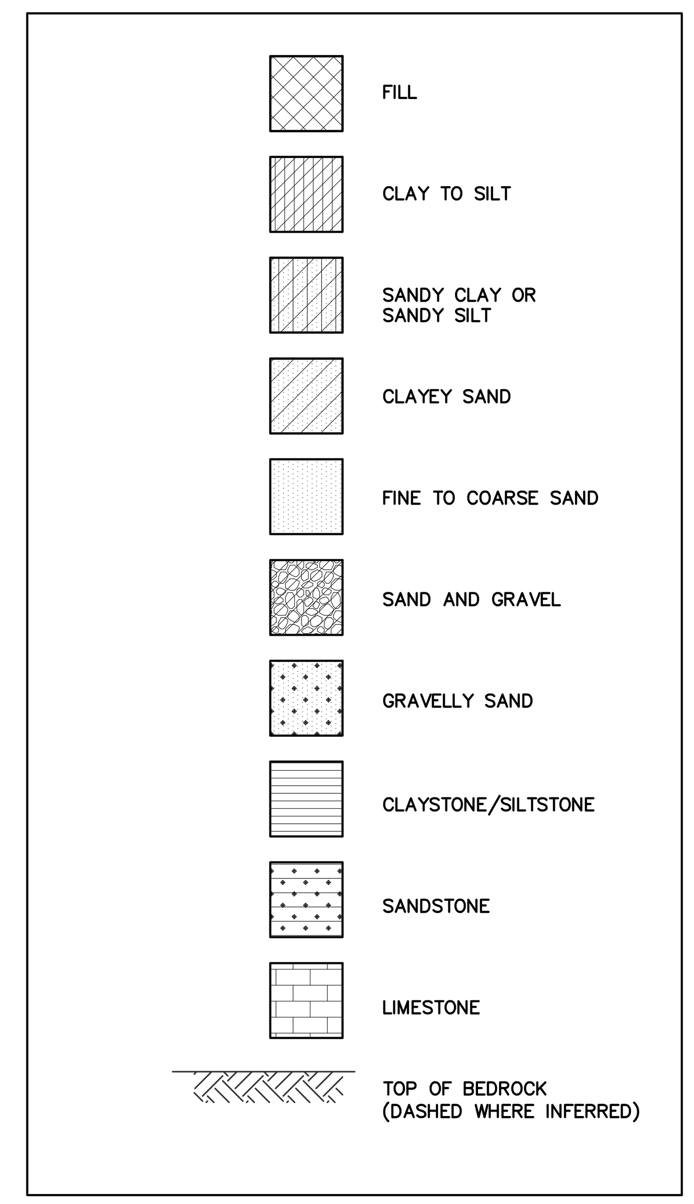

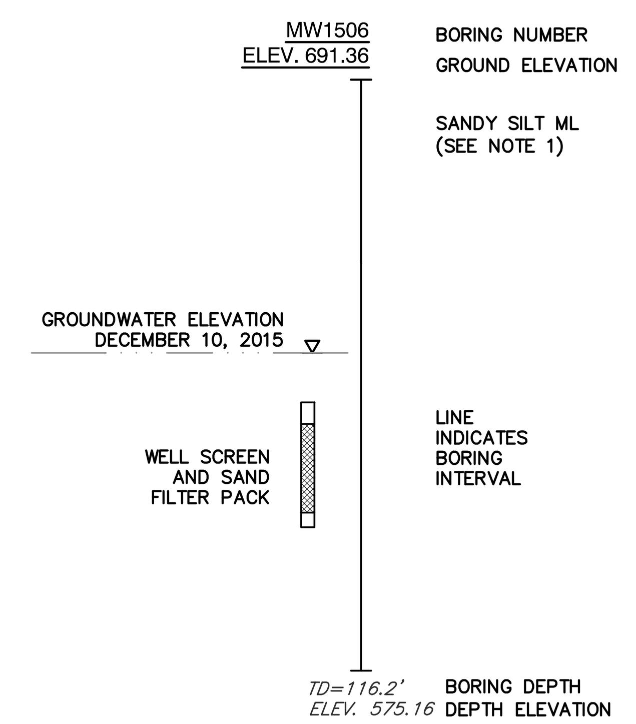

MONITORING WELL DIAGRAM

NOTE:

1. NOTED SOIL DESCRIPTIONS FROM GEOTECHNICAL LABORATORY TESTING RESULTS PROVIDED BY AEP DOLAN LABORATORY.

SCALE IN FEET

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GROUNDWATER MONITORING SYSTEM DEMONSTRATION

GEOLOGIC CROSS SECTION B-B'

DATE:	DECEMBER 2015	DRAWN BY:	DAR
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PROJECT NO:	110-416-7701		
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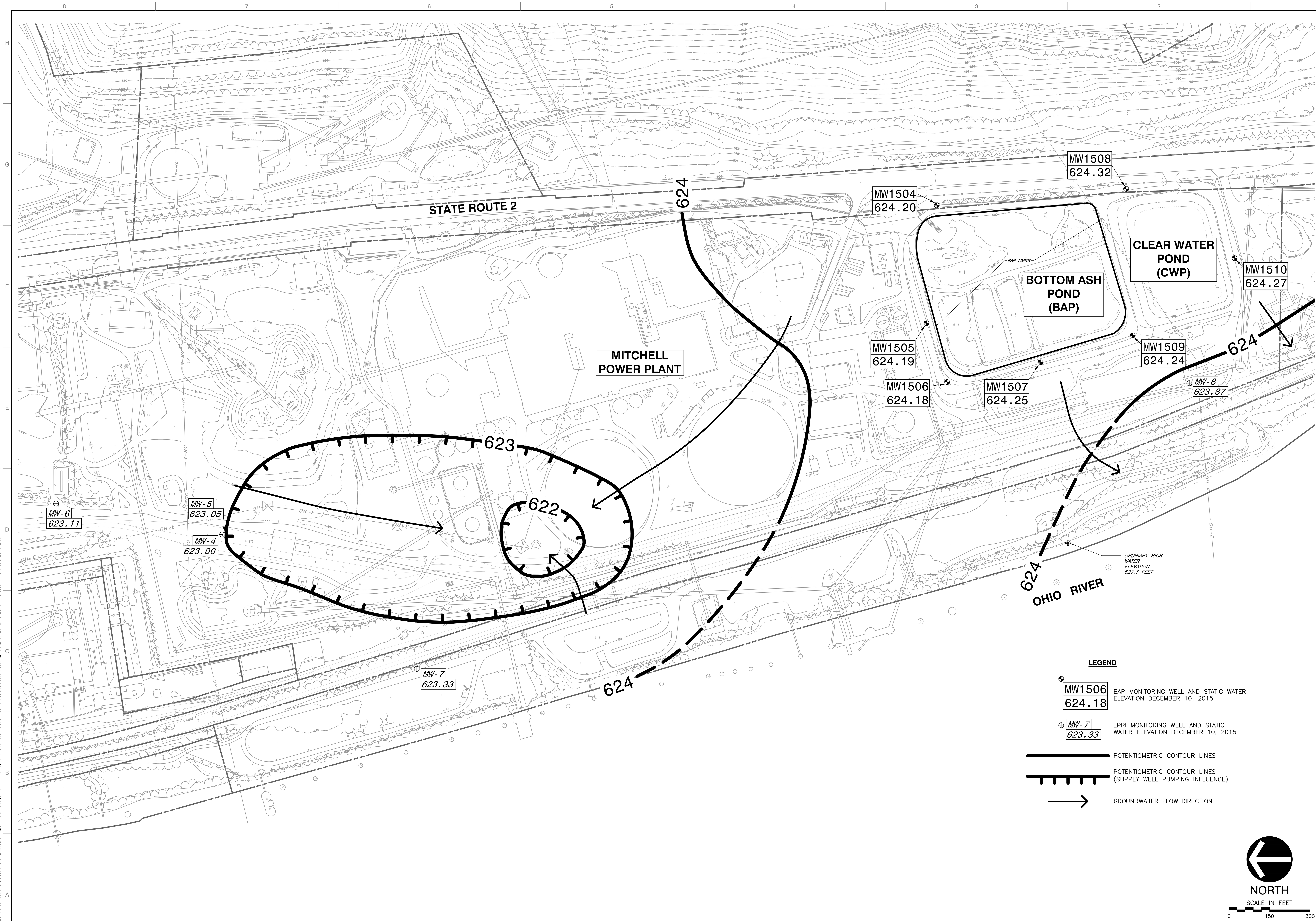
FIGURE NO.: 6



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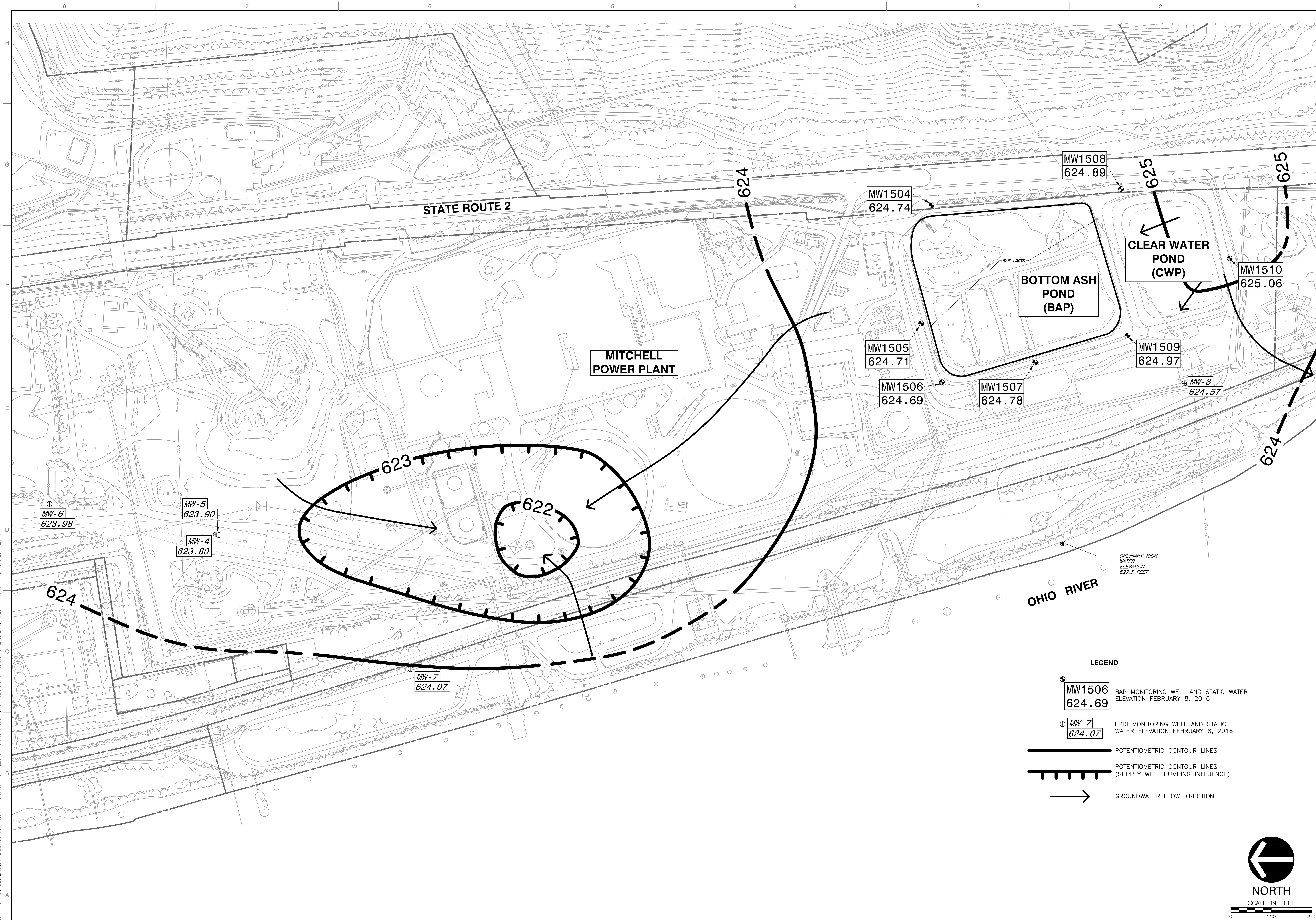
GROUNDWATER MONITORING SYSTEM DEMONSTRATION
OHIO RIVER ALLUVIAL AQUIFER
POTENTIOMETRIC MAP, DECEMBER 10, 2015

DATE:	DECEMBER 2015	DRAWN BY:	DAR
DWG SCALE:	AS NOTED	CHECKED BY:	RAS
PROJECT NO:	110-416-7701		
APPROVED BY:	(HAND SIGNATURE ON FILE) *APA		

FIGURE NO.: 7



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OHIO RIVER ALLUVIAL AQUIFER
POTENTIOMETRIC MAP, FEBRUARY 8, 2016

DATE:	FEBRUARY 2016	DRAWN BY:	DAR
DWG SCALE:	AS NOTED	CHECKED BY:	RAS
PROJECT NO:	110-416-7701		
APPROVED BY:	(HAND SIGNATURE ON FILE) *APA		

FIGURE NO.: **8**

TABLES

TABLE 1
MONITORING WELL CONSTRUCTION SUMMARY
MITCHELL BOTTOM ASH POND GROUNDWATER MONITORING SYSTEM DEMONSTRATION
MITCHELL POWER GENERATION PLANT
AMERICAN ELECTRIC POWER
CEC PROJECT 110-416.7701

Well No.	Date Installed	Northing	Easting	Ground Elevation (ft. MSL)	Boring Total Depth (ft. BGS)	Top of Riser Elevation (ft. MSL)	Screen Interval* (ft. MSL)		Screen Interval* (ft. BGS)		Screen Interval** (ft. BGS)		Sand Pack Interval* (ft. MSL)		Sand Pack Interval* (ft. BGS)		Stratigraphic Unit	Hydraulic Position Relative to BAP
							Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom		
Ohio River Alluvial Aquifer Monitoring Wells & Piezometers																		
MW1504	10/14/15	485671.78	1599370.81	691.90	102.00	694.79	618.40	598.40	73.5	93.5	76.4	96.4	620.90	598.1	71.0	93.8	Sand & Gravel	Sidegradient
MW1505	10/26/15	485699.10	1598929.25	691.05	114.80	693.94	617.05	597.05	74.0	94.0	76.9	96.9	620.05	596.1	71.0	95.0	Sand & Gravel	Downgradient
MW1506	10/23/15	485633.39	1598717.14	691.36	116.20	694.26	616.36	596.36	75.0	95.0	77.9	97.9	619.36	594.4	72.0	97.0	Sand & Gravel	Downgradient
MW1507	10/30/15	485288.61	1598790.27	692.08	115.90	694.98	618.08	598.08	74.0	94.0	76.9	96.9	621.08	596.1	71.0	96.0	Sand & Gravel	Downgradient
MW1508	10/08/15	484971.27	1599431.57	682.72	106.80	685.77	615.72	595.72	67.0	87.0	70.1	90.1	618.12	594.7	64.6	88.0	Sand & Gravel	Upgradient
MW1509 (P-2)	11/06/15	484947.44	1598889.64	691.86	116.40	694.63	617.86	597.86	74.0	94.0	76.8	96.8	620.86	595.9	71.0	96.0	Sand & Gravel	Downgradient
MW1510 (P-1)	11/12/15	484569.80	1599175.22	678.01	102.40	680.77	617.01	597.01	61.0	81.0	63.8	83.8	620.41	596.0	57.6	82.0	Sand & Gravel	Sidegradient

Notes:
* Measured from ground surface
** Measured from top of casing
ft. MSL = feet above mean sea level
ft. BGS = feet below ground surface
Monitoring Wells MW1504 through MW1508 have dedicated Geotech® bladder pumps installed approximately 2 feet above the screen bottoms

TABLE 2
STATIC WATER LEVELS
MITCHELL BOTTOM ASH POND GROUNDWATER MONITORING SYSTEM DEMONSTRATION
MITCHELL POWER GENERATION PLANT
AMERICAN ELECTRIC POWER
CEC PROJECT 110-416.7701

Well No.	Northing	Easting	Ground Elevation (ft. MSL)	Top of Casing Elevation (ft. MSL)	Screen Interval (ft. MSL)		Screen Interval (ft. BGS)		Depth to Water 12/10/15 (ft. TOC)	Groundwater Elevation 12/10/15 (ft. MSL)	Depth to Water 2/8/16 (ft. TOC)	Groundwater Elevation 2/8/16 (ft. MSL)
					Top	Bottom	Top	Bottom				
Bottom Ash Pond Monitoring Well/Piezometers Network												
MW1504	485671.78	1599370.81	691.90	694.79	618.40	598.40	73.5	93.5	70.59	624.20	70.05	624.74
MW1505	485699.10	1598929.25	691.05	693.94	617.05	597.05	74.0	94.0	69.75	624.19	69.23	624.71
MW1506	485633.39	1598717.14	691.36	694.26	616.36	596.36	75.0	95.0	70.08	624.18	69.57	624.69
MW1507	485288.61	1598790.27	692.08	694.98	618.08	598.08	74.0	94.0	70.73	624.25	70.20	624.78
MW1508	484971.27	1599431.57	682.72	685.77	615.72	595.72	67.0	87.0	61.45	624.32	60.88	624.89
MW1509	484947.44	1598889.64	691.86	694.63	617.86	597.86	74.0	94.0	70.39	624.24	69.66	624.97
MW1510	484569.80	1599175.22	678.01	680.77	617.01	597.01	61.0	81.0	56.50	624.27	55.71	625.06
EPRI Piezometers												
MW-4	488310.90	1598152.80	NA	668.02	NA	NA	NA	NA	45.02	623.00	44.22	623.80
MW-5	488304.80	1598152.10	NA	667.88	NA	NA	NA	NA	44.83	623.05	43.98	623.90
MW-6	488930.20	1598267.50	NA	663.40	NA	NA	NA	NA	40.29	623.11	39.42	623.98
MW-7	487595.80	1597656.50	NA	640.26	NA	NA	NA	NA	16.93	623.33	16.19	624.07
MW-8	484737.60	1598712.90	NA	663.34	NA	NA	NA	NA	39.47	623.87	38.77	624.57

Notes:

Static water levels were collected December 10, 2015 and February 8, 2016

ft. MSL = feet above mean sea level

ft. BGS = feet below ground surface

ft. TOC = feet below top of casing (top of PVC riser pipe)

APPENDIX A

EPRI DRAWINGS

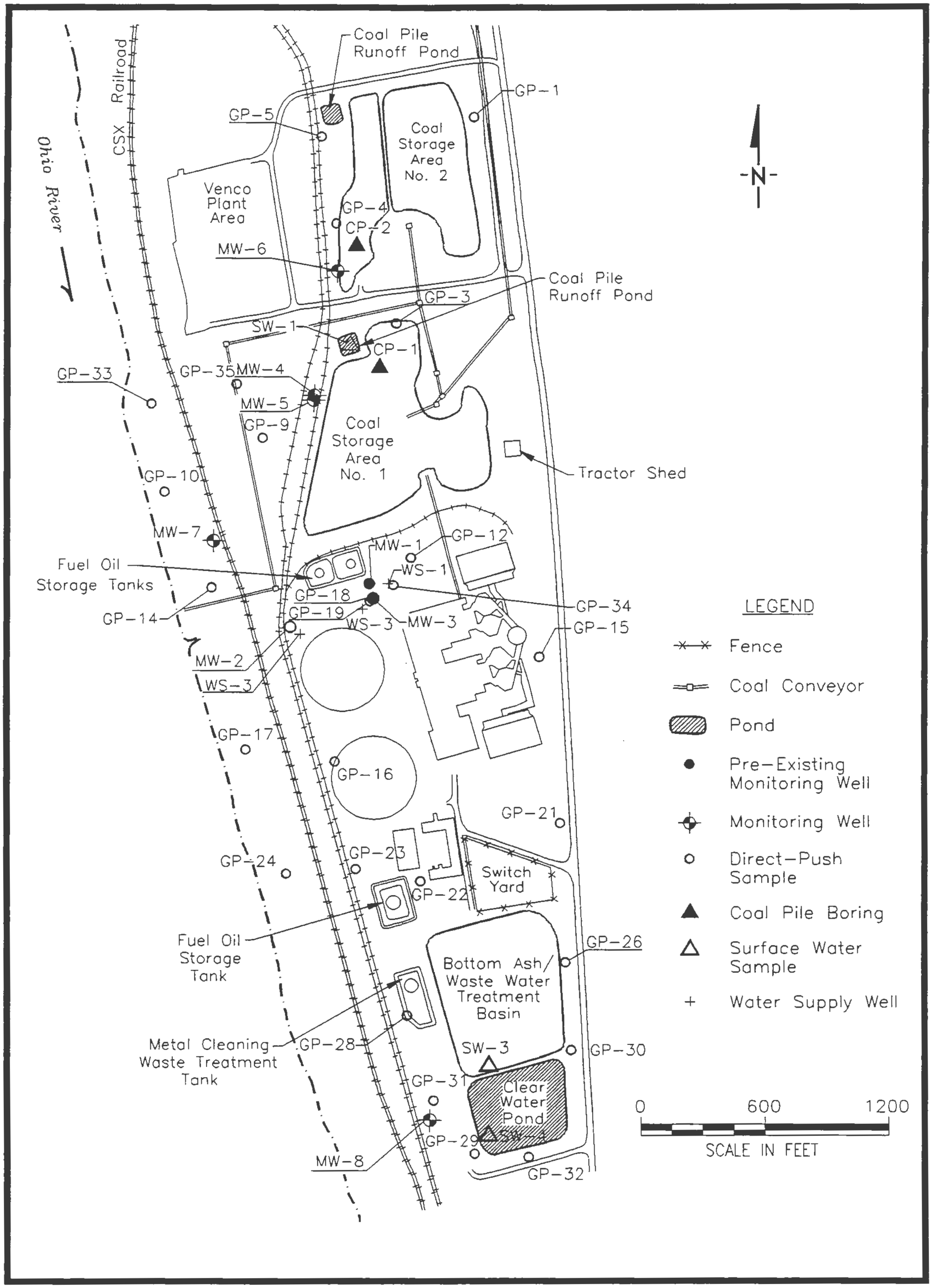

Figure 3-1 Mitchell Plant site.

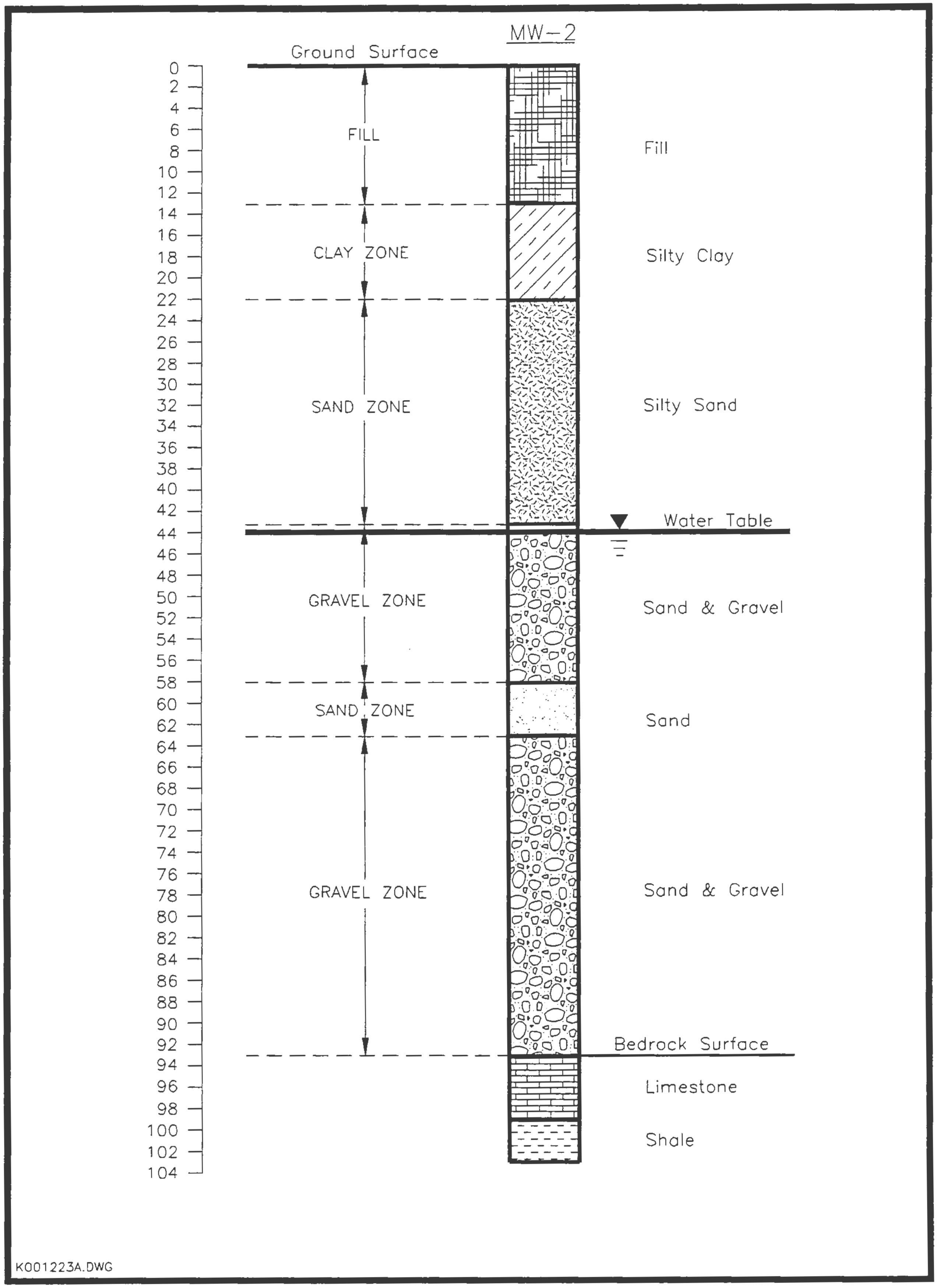

Figure 3-2 Lithologic log for monitoring well MW-2 at the Mitchell Plant site.

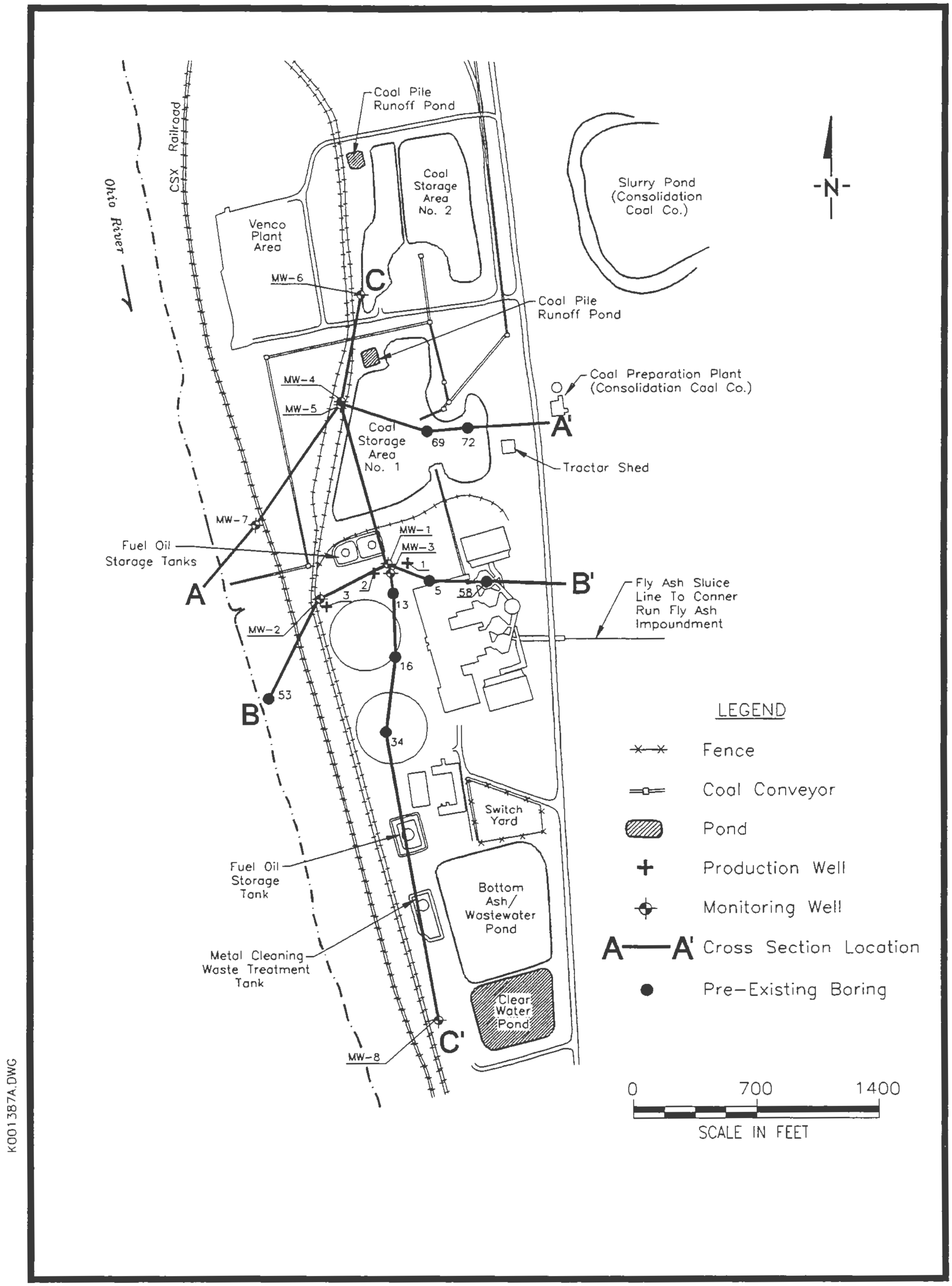

Figure 3-3 Locations of geologic cross-sections at the Mitchell Plant site.

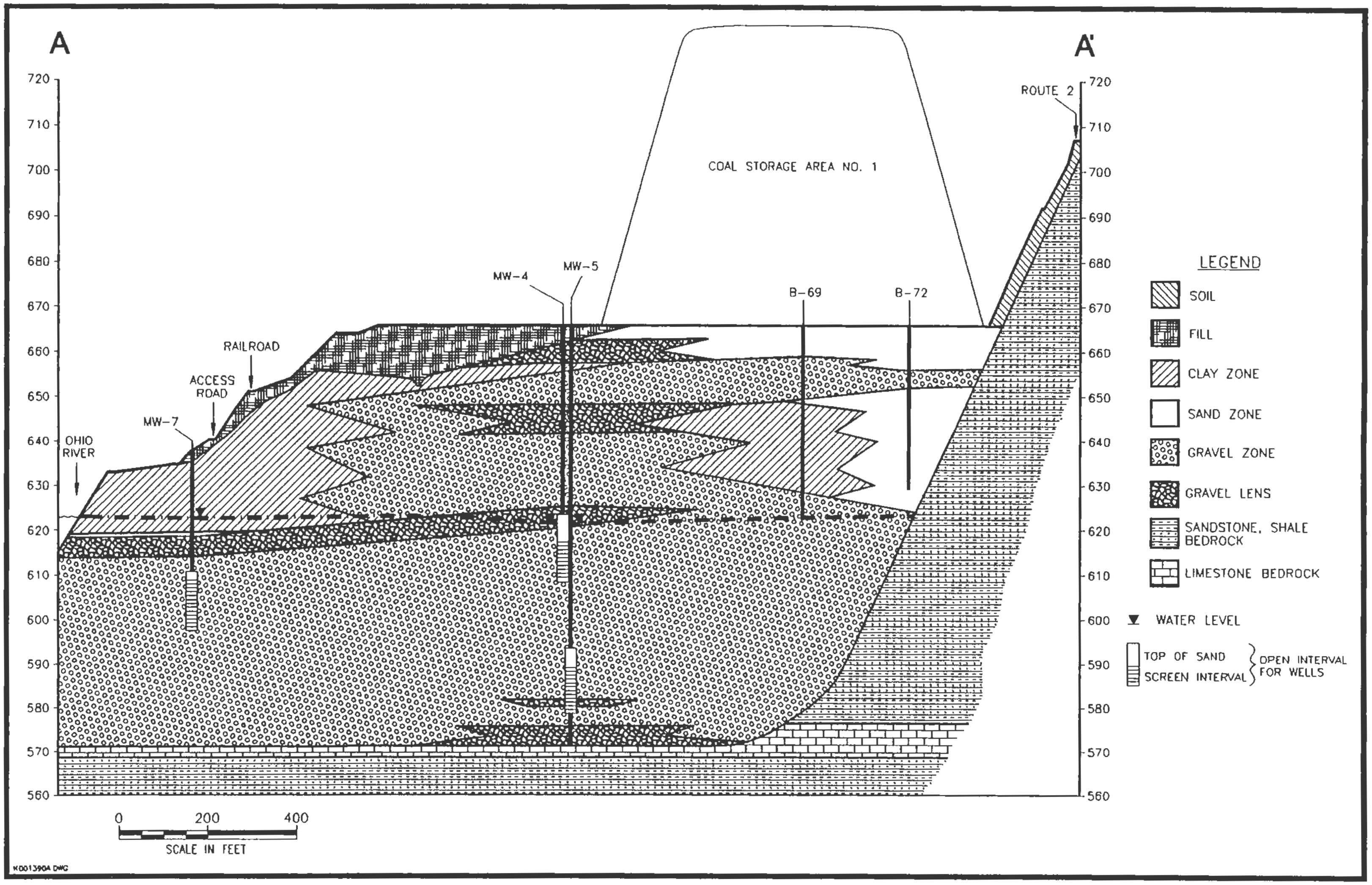

Figure 3-4 Geologic cross-section A-A' at the Mitchell Plant site.

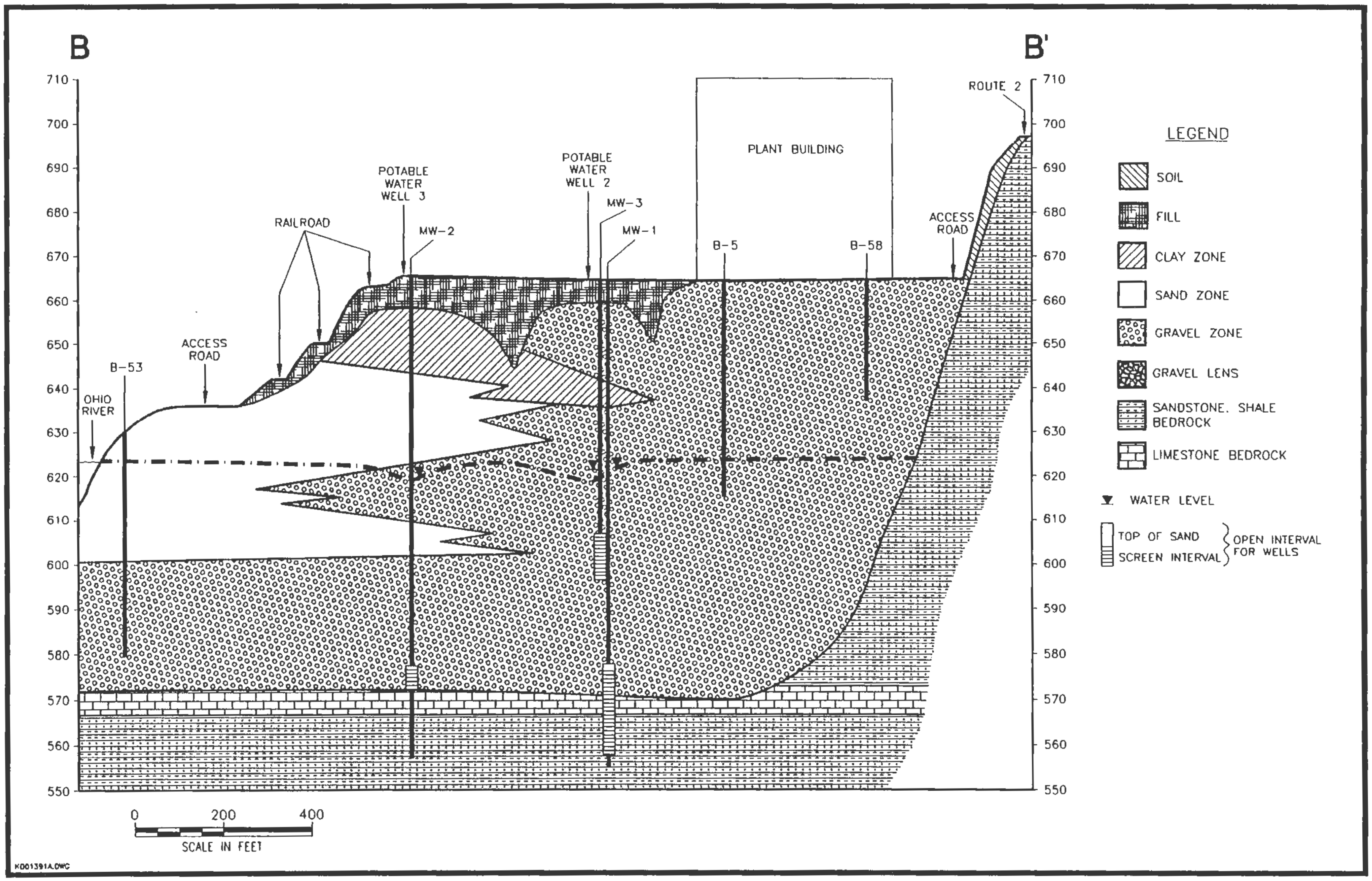

Figure 3-5 Geologic cross-section B-B' at the Mitchell Plant site.

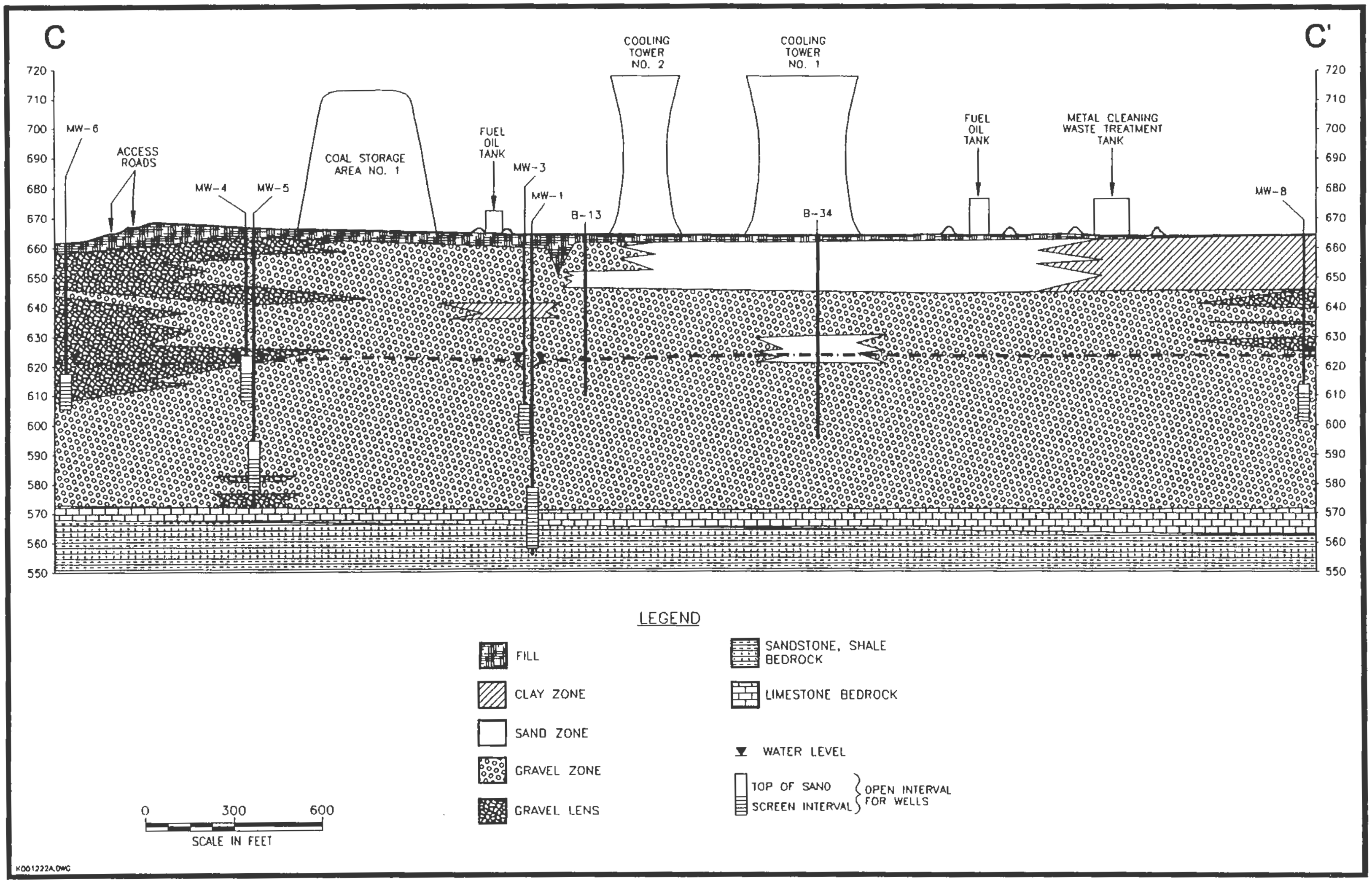

Figure 3-6 Geologic cross-section C-C' at the Mitchell Plant site.

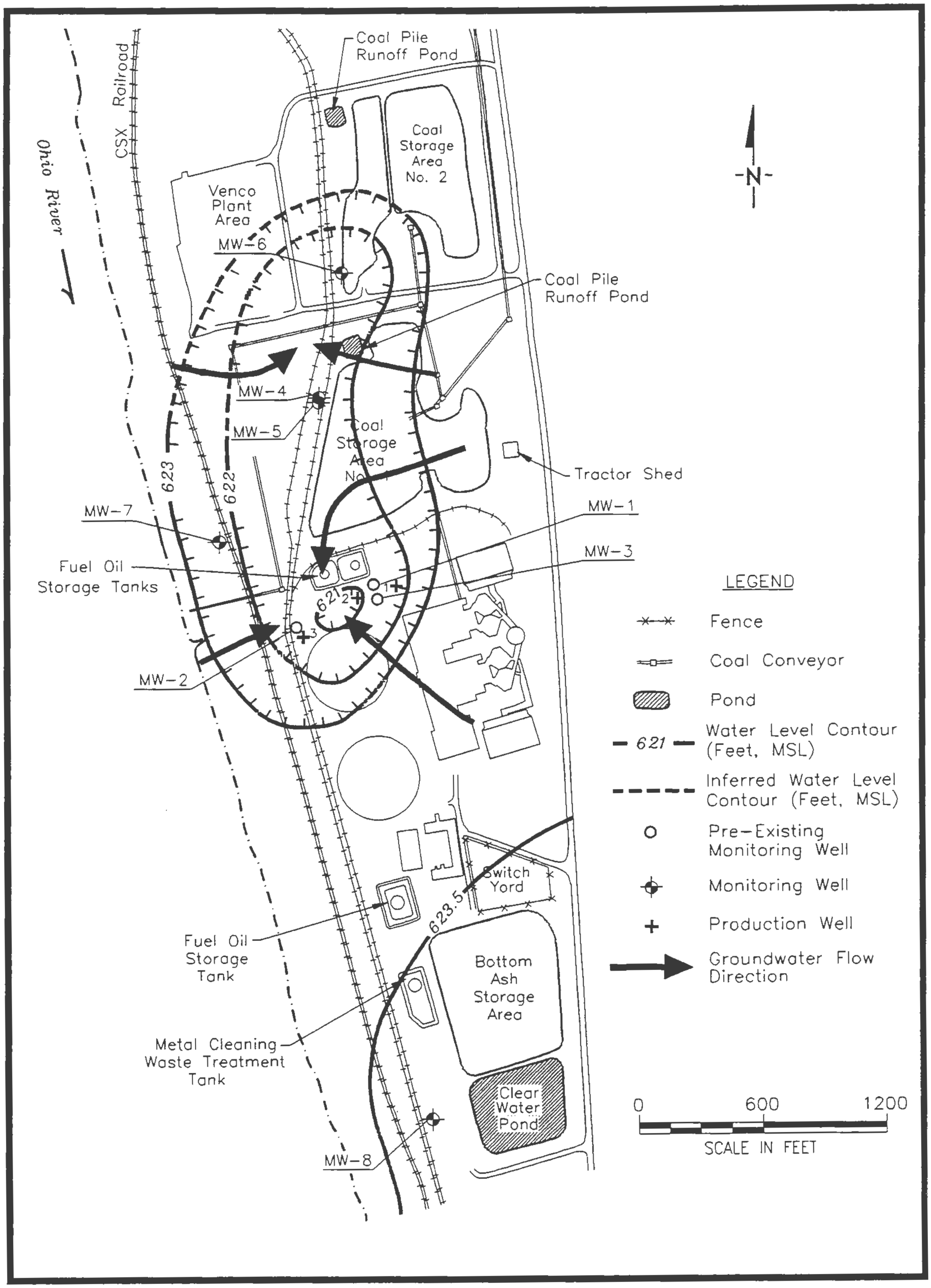

Figure 3-7 Water table contour map for the Mitchell Plant site (August 20, 1996).

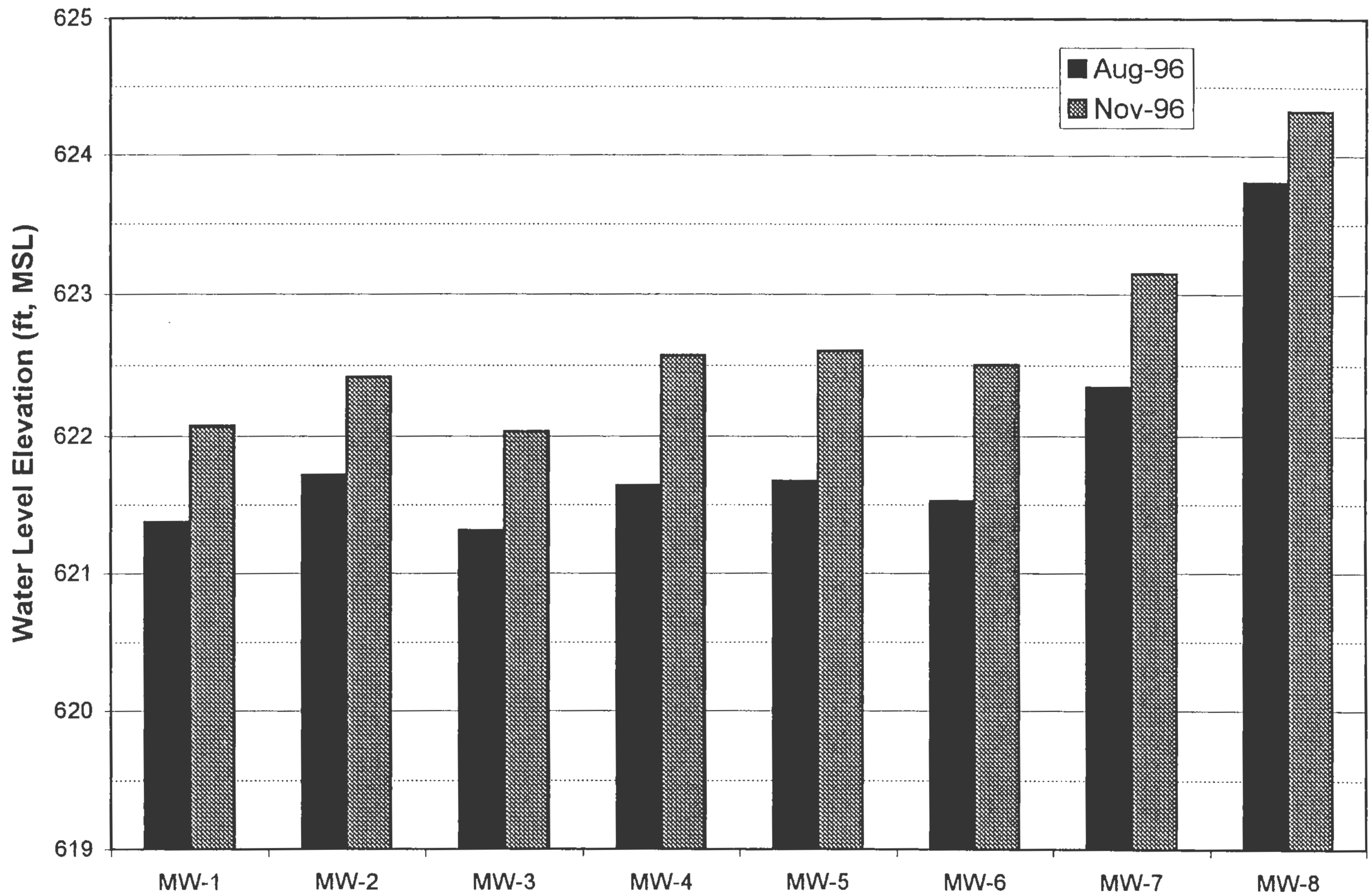

Figure 3-8 Temporal variations in groundwater elevations in monitoring wells at the Mitchell Plant site.

APPENDIX B

MONITORING WELL AND PIEZOMETER BORING LOGS AND AS-BUILT DIAGRAMS

WELL NUMBER MW1504

Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

CLIENT American Electric Power
PROJECT NAME Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Bottom Ash Pond, Cresap, West Virginia
DATE STARTED 10/9/15 **COMPLETED** 10/14/15
GROUND ELEVATION 691.90 ft **HOLE SIZE** 8.25"
DRILLINGCONTRACTOR AEP
TOP OF PVC ELEVATION 694.79 ft
DRILLING METHOD 4.25" I.D. HSA: Auto Hammer & Split Spoon
GROUND WATER LEVELS:
LOGGED BY B. Bashore **CHECKED BY** RAS
AT END OF DRILLING ---
LOCATION Northing: 485671.78 Easting: 1599370.81

SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
SS 1	75	16-20-25-27 (45)
SS 2	100	3-8-9-12 (17)
SS 3	83	4-15-20-28 (35)
SS 4	96	3-5-5-7 (10)
SS 5	83	3-6-14-22 (20)
SS 6	79	7-11-9-18 (20)
SS 7	96	5-14-16-13 (30)
SS 8	75	4-6-10-18 (16)
SS 9	100	3-7-11-18 (18)
SS 10	67	3-7-9-12 (16)

DEPTH (ft)	MATERIAL DESCRIPTION	ELEVATION
0	Dark Gray to Brown SILTY GRAVEL (FILL), dry, dense, some clay and fine sand. Below 2', loose.	
3.4	Gray to Brown SILTY CLAY (CL - ML), dry, stiff, low plasticity, some roots.	688.5
4.4	Dark Gray to Brown SILTY SAND (SM), dry, dense, medium grained, trace fine gravel, trace clay, trace coal fragments.	687.5
6.4	Brown SANDY CLAY (CLS), moist, medium stiff, low to medium plasticity, some fine gravel.	685.5
7.4	Gray SILTY CLAY (CL - ML), moist, medium stiff, high plasticity, some fine sand and gravel.	684.5
8.0	Orange - Brown SILTY SAND (SM), moist, loose to medium dense, fine to medium grained, some fine gravel, trace clay.	683.9
10.0	Brown CLAYEY SAND w/ GRAVEL (SC), moist, loose to medium dense, medium to coarse grained sand, fine to coarse gravel.	681.9
13.4	Gray SILTY SAND & GRAVEL (SM, GM), moist to wet, medium dense, medium grained sand, fine gravel, trace clay.	678.5
14.0	Gray SILTY CLAY (CL - ML), dry to moist, medium stiff to stiff, low plasticity, trace fine gravel.	677.9
15.5	Orange - Brown SANDY CLAY (CLS), dry to moist, very stiff, low plasticity.	676.4
16.0	Gray SILTY CLAY (CL - ML), dry to moist, soft to medium stiff, low to medium plasticity, trace fine gravel.	675.9
16.7	Orange - Brown CLAYEY SAND & GRAVEL (SC, GC), moist, medium dense, medium to coarse grained sand, fine gravel. Below 18', loose to medium dense, clay content decreasing.	675.2

WELL DIAGRAM

Total Depth of BAP-1 offset boring 93.8'

Bentonite Grout

2-Inch Solid PVC Riser

(Continued Next Page)

CLIENT American Electric Power
PROJECT NAME Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM
20	SS 11	75	5-6-6-7 (12)		Orange - Brown CLAYEY SAND & GRAVEL (SC, GC), moist, medium dense, medium to coarse grained sand, fine gravel. *(continued)* Below 20', loose.		
	SS 12	54	5-8-9-7 (17)				
25	SS 13	71	2-5-4-6 (9)	26.0	25.5' to 26', moist to wet.	665.9	
	SS 14	58	0-2-3-7 (5)	28.8	Orange - Brown SANDY GRAVEL (GWS), wet, very loose to loose, fine to coarse, fine to medium grained sand, some clay.	663.1	
	SS 15	83	4-4-4-11 (8)	30.7	Orange - Brown GRAVELLY SAND (SWG), wet, loose, coarse to medium grained, fine to coarse gravel, trace clay	661.2	2-Inch Solid PVC Riser
30	SS 16	92	7-8-8-7 (16)		Orange - Brown SAND (SP), moist, loose, fine to medium grained, trace fine gravel.		
	SS 17	79	3-4-7-11 (11)				
35	SS 18	75	4-6-6-8 (12)	36.0	Below 34', moist to wet.	655.9	
	SS 19	100	2-2-3-11 (5)	36.6	Orange - Brown CLAYEY SAND (SC), wet, very loose, fine grained.	655.3	
				37.2	Orange - Brown SANDY CLAY (CLS), moist, soft, low plasticity, fine grained sand.	654.7	
					Orange - Brown SAND (SP), moist, loose to medium dense, fine to medium grained, trace fine gravel.		
	SS 20	71	0-4-4-10 (8)		At 39.1', coal stringer <0.05" thick.		
40	SS 21	63	0-4-8-17 (12)		Below 40', no gravel.		Bentonite Grout

(Continued Next Page)

Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

WELL NUMBER MW1504

CLIENT American Electric Power
PROJECT NAME Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
	SS 22	88	3-8-7-12 (15)
45	SS 23	75	2-4-6-11 (10)
	SS 24	75	0-2-5-10 (7)
	SS 25	83	3-5-4-5 (9)
50	SS 26	71	2-1-3-9 (4)
	SS 27	75	0-3-1-5 (4)
55	SS 28	83	0-2-4-8 (6)
	SS 29	75	0-2-4-7 (6)
	SS 30	71	1-2-3-8 (5)
60	SS 31	92	5-6-7-10 (13)
	SS 32	71	5-5-7-12 (12)
65	SS 33	75	5-6-9-17 (15)

Depth (top)	MATERIAL DESCRIPTION	Elevation (bottom)
	Orange - Brown SAND (SP), moist, loose to medium dense, fine to medium grained, trace fine gravel. *(continued)*	647.9
44.0	Brown SAND (SP), moist, very loose to loose, fine to medium grained, some coal fragments at 45.5'.	645.4
46.5	Brown SANDY CLAY (CLS), moist, soft, low plasticity, fine grained sand.	645.0
46.9	Brown SAND (SP), moist, loose, fine to medium grained. 47.4' to 47.5', coal seam. 48.5' to 49.3', laminated coal , wet.	642.6
49.3	Orange - Brown CLAYEY SAND (SC), moist, loose, fine grained. Below 50', very loose.	640.7
51.2	Brown SAND (SP), moist, loose to very loose, fine grained.	639.9
52.0	Brown CLAYEY SAND (SC), moist to wet, very loose to loose, fine grained.	637.1
54.8	Brown to Orange - Brown SAND (SP), moist to wet, loose, fine grained.	635.9
56.0	Orange - Brown SAND (SP), moist to wet, very loose to loose, fine grained, trace to some clay. Below 58', some to trace clay.	631.9
60.0	Orange - Brown SAND (SP), moist, loose, fine grained.	629.9
62.0	Orange - Brown SAND (SP), moist, loose to medium dense, fine to medium grained, trace fine gravel.	

WELL DIAGRAM: 2-Inch Solid PVC Riser (at ~55 ft); Bentonite Grout (at ~60 ft)

(Continued Next Page)

Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

CLIENT American Electric Power | **PROJECT NAME** Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416 | **PROJECT LOCATION** Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
	SS 34	67	5-7-9-13 (16)		Orange - Brown SAND (SP), moist, loose to medium dense, fine to medium grained, trace fine gravel. *(continued)* Below 66', moist to wet.	Bentonite Pellets
				68.0	623.9	
	SS 35	67	5-5-7-13 (12)		Brown GRAVELLY SAND (SWG), wet, loose, medium to fine grained, fine gravel.	
				68.8	623.1	
					Brown SAND (SP), wet, loose to medium dense, medium to fine grained, trace fine gravel.	
70				70.0	621.9	
	SS 36	100	11-10-12-15 (22)		Brown GRAVELLY SAND (SWG), wet, medium dense, fine to coarse grained, fine to coarse gravel, some silt.	
				72.4	619.5	
	SS 37	75	9-11-14-19 (25)		Brown SANDY GRAVEL (GWS), wet, medium dense, fine to coarse, medium to coarse grained sand, trace silt	
75	SS 38	54	10-10-13-14 (23)		Below 74', sand medium to coarse grained.	#5 Filter Sand
				76.0	615.9	
	SS 39	50	8-9-11-16 (20)		Brown SAND (SP), wet, loose to medium dense, medium to coarse grained, trace fine gravel.	
				78.0	613.9	
	SS 40	58	6-7-8-10 (15)		Brown SANDY GRAVEL (GPS), wet, loose, fine, medium to coarse sand, trace silt.	
80	SS 41	58	7-6-7-11 (13)		Below 80', coarse to fine gravel.	2-Inch, 0.010-Inch Slotted Screen
	SS 42	63	8-8-10-13 (18)		Below 82', loose.	
				82.8	609.1	
					Brown SAND (SP), wet, medium dense, medium to coarse grained, some fine gravel, trace silt. Below 84', loose to medium dense, fine to medium grained.	
85	SS 43	67	7-9-11-12 (20)			
				86.0	605.9	
	SS 44	67	10-8-7-9 (15)		Brown GRAVELLY SAND (SPG), wet, loose, medium to coarse grained, fine to coarse gravel, trace coal fragments. Below 88', loose to medium dense.	

(Continued Next Page)

CLIENT American Electric Power **PROJECT NAME** Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416 **PROJECT LOCATION** Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
90	SS 45	96	9-8-10-15 (18)		Highly weather coal seam 89.4' to 89.5'. Brown GRAVELLY SAND (SPG), wet, loose, medium to coarse grained, fine to coarse gravel, trace coal fragments. *(continued)* 90.0 / 601.9	#5 Filter Sand
					90.3 Black COAL, wet, soft, highly weathered, some fine sand. 601.6	
	SS 46	63	10-11-11-14 (22)		Brown GRAVELLY SAND (SPG), wet, loose, medium to coarse grained, fine to coarse gravel, trace coal fragments. 92.0 / 599.9	2-Inch, 0.010-Inch Slotted Screen
	SS 47	114	23-50/1"		Brown SANDY GRAVEL (GWS), wet, medium dense, coarse to fine, medium to coarse grained sand. Sandstone boulder at bottom of spoon (93.7') 94.6 / 597.3	
95	SS 48	88	21-18-23-42 (41)		Gray SAND (SP), moist to wet, medium dense to dense, fine to medium grained, trace fine to coarse gravel. 95.7 / 596.2	
	SS 49	54	12-33-13-32 (46)		Gray SANDSTONE (BEDROCK), moderate hard to weak, moderately cemented, fine to medium grained, moderately to highly weathered, micaceous.	
100	SS 50	25	12-12-16-44 (28)		100.0 / 591.9	
	SS 51	50	23-16-33-36 (49)		Gray SHALE (BEDROCK), very weak, trace interbedded fine sand, soft and moderately plastic when wet (clayey). 100.9 / 591.0	
					Gray SANDSTONE (BEDROCK), moderate hard to weak, moderately cemented, fine to medium grained, moderately to highly weathered, micaceous. 102.0 / 589.9	

Bottom of hole at 102.0 feet

Boring grouted to surface and monitoring well installed on 10/14/2015 in offset boring.

Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

WELL NUMBER MW1505

CLIENT American Electric Power
PROJECT NAME Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Bottom Ash Pond, Cresap, West Virginia
DATE STARTED 10/15/15 **COMPLETED** 10/26/15
GROUND ELEVATION 691.05 ft **HOLE SIZE** 8.25"
DRILLINGCONTRACTOR AEP
TOP OF PVC ELEVATION 693.94 ft
DRILLING METHOD 4.25" I.D. HSA: Auto Hammer & Split Spoon
GROUND WATER LEVELS:
LOGGED BY B. Bashore **CHECKED BY** RAS
AT END OF DRILLING ---
LOCATION Northing: 485699.10 Easting: 1598929.25

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0	SS 1	88	21-24-29-41 (53)		Brown to Dark Gray SILTY SAND & GRAVEL (FILL), dry, medium dense to dense, fine to medium grained sand, fine to coarse gravel, some clay.	Total Depth of BAP-2 offset boring 95'
	SS 2	100	2-10-14-15 (24)		Below 2', loose to medium dense.	
5	SS 3	88	1-5-6-5 (11)		Below 4', very loose to loose, trace clay.	Bentonite Grout
	SS 4	75	2-1-5-22 (6)		Below 6', very loose to medium dense, wet. 6.7' to 7.1', trace coal and limestone fragments.	
	SS 5	83	4-20-32-31 (52)		Below 8', loose to dense.	
10					10.0 — 681.1	
	SS 6	100	2-9-25-45 (34)		Brown to Dark Gray SILTY SAND & GRAVEL (FILL), dry, loose to dense, some clay, trace limestone and coal fragments.	
	SS 7	83	3-9-17-36 (26)		Below 12', no coal fragments.	
15	SS 8	100	5-15-22-29 (37)		Below 14', dry to moist, loose to medium dense.	
	SS 9	100	4-15-11-16 (26)		Below 16', moist, loose to medium dense, some shale fragments.	2-Inch Solid PVC Riser
20	SS 10	100	6-13-9-15 (22)		Wet at 19.6'. 19.6 — 671.5	

(Continued Next Page)

Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

WELL NUMBER MW1505

CLIENT American Electric Power | **PROJECT NAME** Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416 | **PROJECT LOCATION** Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
20	SS 11	100	6-7-10-20 (17)		Dark Gray to Brown CLAYEY SAND (FILL), moist, medium dense, fine to medium grained, some shale fragments, trace coal. *(continued)* Below 20', loose to medium dense.	
22.0					(669.1)	
	SS 12	50	3-12-13-14 (25)		Orange - Brown to Dark Gray CLAYEY SAND (FILL), moist to dry, loose to medium dense, medium to fine grained, some silt, some sandstone boulder fragments, trace shale fragments.	
25	SS 13	42	3-5-6-7 (11)		Below 24', loose.	
	SS 14	33	0-4-5-7 (9)		Below 26', very loose to loose.	
	SS 15	4	3-5-4-5 (9)			
30 (30.0)					(661.1)	Bentonite Grout
	SS 16	54	0-2-3-5 (5)		Orange - Brown SAND (SP), moist to wet, very loose to loose, medium to coarse grained, trace fine gravel. Wet at 30'.	
	SS 17	63	0-2-2-4 (4)		Below 32', moist, very loose, no gravel.	
33.0					(658.1)	
					Orange - Brown SAND (SP), moist, very loose, medium to fine grained.	
35	SS 18	58	0-2-4-8 (6)		Below 34', very loose to loose, trace fine gravel.	
36.0					(655.1)	
	SS 19	75	0-2-2-4 (4)		Orange - Brown SAND (SP), moist, very loose, fine to medium grained.	
	SS 20	75	0-2-3-6 (5)		Below 38', orange - brown to brown, very loose to loose.	
40	SS 21	75	0-0-5-8 (5)		Below 40', moist to dry.	Bentonite Grout
42.0					(649.1)	
					Brown SAND (SP), moist to dry, very loose to loose, fine to medium grained.	

(Continued Next Page)

Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

WELL NUMBER MW1505

CLIENT American Electric Power **PROJECT NAME** Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416 **PROJECT LOCATION** Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
	SS 22	79	0-4-4-5 (8)		Brown SAND (SP), moist to dry, very loose to loose, fine to medium grained. *(continued)*	
45	SS 23	96	4-4-5-9 (9)		Below 44', moist. Coal stringer at 45.5', 0.25" thick.	
	SS 24	71	2-5-5-8 (10)		Below 46', moist to wet. 47.1 — 644.0 Brown GRAVELLY SAND (SWG), moist, loose, fine to coarse grained, fine to coarse gravel.	
	SS 25	71	0-3-5-5 (8)		Below 48', very loose. 48.7 — 642.4 Orange - Brown CLAYEY SAND (SC), moist, loose, fine grained.	
50	SS 26	71	0-4-5-8 (9)		Below 50', very loose. 50.5 — 640.6 Brown SAND (SP), moist to wet, loose, fine to medium grained.	
	SS 27	75	0-2-5-7 (7)		52.0 — 639.1 Brown CLAYEY SAND (SC), moist, very loose to loose, fine grained.	
55	SS 28	83	0-3-7-9 (10)		54.0 — 637.1 Brown SAND (SP), moist, very loose to loose, fine grained.	2-Inch Solid PVC Riser
	SS 29	79	0-2-5-8 (7)		56.0 — 635.1 Brown SAND (SP), moist to wet, very loose, fine grained. 57.2 — 633.9 Orange - Brown SAND (SP), moist, loose, fine to medium grained.	
	SS 30	71	2-4-7-9 (11)		Below 58', very loose. 58.9 — 632.2 Orange - Brown CLAYEY SAND (SC), moist, loose, fine grained.	
60	SS 31	75	2-3-3-4 (6)		60.0 — 631.1 Orange - Brown SAND (SP), moist to wet, very loose, fine grained, trace to some clay.	Bentonite Grout
	SS 32	29	0-6-16-14 (22)		Below 62', wet to moist, loose to medium dense.	
65	SS 33	79	0-4-10-15 (14)		64.0 — 627.1 Brown SAND (SP), moist, loose to medium dense, fine to medium grained, trace fine gravel.	

(Continued Next Page)

CLIENT American Electric Power

PROJECT NAME Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	MATERIAL DESCRIPTION
				Brown SAND (SP), moist, loose to medium dense, fine to medium grained, trace fine gravel. *(continued)* Below 66', loose.
	SS 34	67	2-5-7-11 (12)	67.1 — 624.0: Brown GRAVELLY SAND (SPG), wet, loose to medium dense, medium to coarse grained, fine gravel.
	SS 35	46	2-3-6-11 (9)	68.0 — 623.1: Brown SANDY GRAVEL (GWS), wet, very loose to medium dense, medium to coarse, fine to coarse grained sand, some silt.
70	SS 36	71	5-6-8-13 (14)	
	SS 37	67	7-7-10-18 (17)	72.2 — 618.9: Below 72', loose. Brown SAND (SP), wet, loose to medium dense, medium to coarse grained, trace fine gravel.
75	SS 38	75	11-17-19-26 (36)	Below 74', medium dense, less coarse sand.
	SS 39	100	9-17-20-28 (37)	76.0 — 615.1: Brown SAND (SP), wet, loose to medium dense, medium to coarse grained, some fine to coarse gravel.
	SS 40	46	10-17-18-21 (35)	79.0 — 612.1: Brown SAND (SP), wet, medium dense, fine to medium grained, some fine to coarse gravel.
80	SS 41	71	13-16-16-24 (32)	Below 80', gravel content increasing.
	SS 42	75	13-12-11-17 (23)	82.0 — 609.1: Brown SAND (SP), wet, medium dense, medium to coarse grained, trace silt, trace fine gravel.
85	SS 43	71	6-10-13-21 (23)	Below 84', loose to medium dense, some fine to coarse gravel.
	SS 44	75	11-19-17-20 (36)	Below 86', medium dense, some silt. Note: Sandstone boulder lodged at bottom of SS-44 spoon.
				88.0 — 603.1

WELL DIAGRAM: Bentonite Pellets; #5 Filter Sand; 2-Inch, 0.010-Inch Slotted Screen

(Continued Next Page)

WELL NUMBER MW1505

CLIENT American Electric Power
PROJECT NAME Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	MATERIAL DESCRIPTION		WELL DIAGRAM
	SS 45	100	9-14-12-19 (26)	Brown SANDY GRAVEL (GWS), wet, loose to medium dense, fine to coarse, medium to coarse grained sand, some silt, trace coal fragments. *(continued)*		#5 Filter Sand
90	SS 46	83	35-39-38-45 (77)	Below 90', dense.		
90.8				Brown SILTY GRAVEL w/ SAND (GM), wet, dense, fine to coarse, medium to coarse grained sand.	600.3	
92.0	SS 47	75	6-22-30-46 (52)	Brown CLAYEY SAND (SC), moist to wet, loose to medium dense, fine to medium grained, some fine to coarse gravel, silty	599.1	
92.7				Brown GRAVELLY SAND (SWG), wet, dense, fine to medium grained, some fine gravel.	598.4	
95	SS 48	88	18-25-21-25 (46)	Below 94', medium dense, medium to coarse grained.		
96.0	SS 49	83	25-25-18-20 (43)	Brown SANDY GRAVEL (GPS), wet, medium dense, coarse to fine, fine to coarse grained sand, some silt.	595.1	
	SS 50	71	25-18-20-28 (38)	Below 98', sand content increasing. Note: Sandstone boulder at 98.5'		
100 / 100.0	SS 51	75	26-24-26-36 (50)	Brown GRAVELLY SAND (SWG), wet, medium dense to dense, medium to coarse grained, fine to coarse gravel, trace silt.	591.1	
102.4	SS 52	71	23-17-15-24 (32)	Brown SAND (SP), wet, medium dense, medium to coarse grained, some to trace fine gravel.	588.7	
104.0	SS 53	58	23-22-19-17 (41)	Brown GRAVELLY SAND (SWG), wet, medium dense, medium to coarse grained, fine to coarse gravel, some silt.	587.1	
105						
106.3	SS 54	92	13-19-21-35 (40)	Brown SAND (SP), wet, medium dense to dense, medium to coarse grained, some fine gravel, some silt.	584.8	
	SS 55	67	17-19-20-36 (39)	Below 108', trace coal fragments.		
110	SS 56	71	12-16-16-27	Below 110', medium dense.		

(Continued Next Page)

CLIENT American Electric Power
PROJECT NAME Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
			(32)		112.0 — 579.1	
	SS 57	54	18-19-21-22 (40)		Brown GRAVELLY SAND (SWG), wet, medium dense, medium to coarse grained, fine to coarse gravel. Note: Limestone fragments at bottom of SS-57 spoon.	
	SS 58	111	11-50/3"		114.5 — 576.6	
					114.8 — 576.3 Brown LIMESTONE (BEDROCK), moderate hard, moderately weathered, high reaction to HCL. Note: Hard to very hard at 114.8'.	

Bottom of hole at 114.8 feet

Boring grouted to surface and monitoring well installed on 10/26/2015 in offset boring.

Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

WELL NUMBER MW1506

CLIENT American Electric Power
PROJECT NAME Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Bottom Ash Pond, Cresap, West Virginia
DATE STARTED 10/20/15 **COMPLETED** 10/23/15
GROUND ELEVATION 691.36 ft **HOLE SIZE** 8.25"
DRILLINGCONTRACTOR AEP
TOP OF PVC ELEVATION 694.26 ft
DRILLING METHOD 4.25" I.D. HSA: Auto Hammer & Split Spoon
GROUND WATER LEVELS:
LOGGED BY D. Follett **CHECKED BY** RAS
AT END OF DRILLING ---
LOCATION Northing: 485633.39 Easting: 1598717.14

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0	SS 1	100	7-8-12-23 (20)		Dark Brown SAND (FILL), dry, loose to medium dense, fine to medium grained, few gravel, trace silt, trace iron stained.	Total Depth of BAP-3 offset boring 96'
	SS 2	92	5-29-23-37 (52)		2.5 — 688.9 Light Brown to Brown SAND & GRAVEL (FILL), dry, loose to dense, fine to medium grained sand, subrounded to subangular, subrounded to well rounded gravel. Below 4', dark brown to brown.	
5	SS 3	88	6-13-18-34 (31)		5.0 — 686.4 Brown SILT (FILL), dry, firm, few subrounded gravel. 5.4 — 686.0 Dark Brown to Brown SAND & GRAVEL (FILL), dry, loose to dense, fine to medium grained sand, subrounded to subangular, subrounded to well rounded gravel.	Bentonite Grout
	SS 4	83	1-12-30-30 (42)		6'-6.5', silty.	
	SS 5	96	6-18-21-32 (39)		8.5 — 682.9 Brown SANDY SILT (FILL), dry to moist, loose to medium dense, trace subrounded gravel, trace coal, moist around gravel clasts.	
10	SS 6	96	6-14-23-33 (37)		11.0 — 680.4 Dark Brown CLAYEY GRAVEL (FILL), dry, medium dense, subrounded, some subrounded coarse sand, some coal. 11.5 — 679.9 Dark Brown to Brown SAND & GRAVEL (FILL), dry, loose to dense, fine to medium grained sand, subrounded to subangular, subrounded to well rounded gravel.	
	SS 7	96	4-19-28-34 (47)		Below 13', moist. Below 14', no coal fragments.	
15	SS 8	96	4-15-19-33 (34)			
	SS 9	100	4-20-24-35 (44)		Below 16', some coal ash.	2-Inch Solid PVC Riser
20	SS 10	96	9-16-14-17 (30)		19.6 — 671.8	

(Continued Next Page)

CLIENT American Electric Power
PROJECT NAME Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
20	SS 11	88	7-20-21-16 (41)		Dark Brown to Dark Gray SILT (FILL), dry, medium dense, trace subrounded gravel. *(continued)*	
					22.0 Below 21.8', dry to moist, few coarse sand, some subrounded gravel. 669.4	
	SS 12	71	3-12-20-21 (32)		22.5 Dark Brown to Brown SAND & GRAVEL (FILL), wet, loose to dense, fine to medium grained sand, subrounded to subangular, subrounded to well rounded gravel. 668.9	
					23.0 Dark Brown to Dark Gray SILT (FILL), moist, medium dense, coarse sand, some gravel. 668.4	
25	SS 13	88	4-12-20-21 (32)		Dark Brown to Brown SAND & GRAVEL (FILL), wet, medium dense, fine to coarse grained sand, subrounded to subangular, poorly sorted, subrounded gravel. Below 24', moist to wet. 25.0 666.4	
					26.0 Gray SANDY CLAY (FILL), moist to dry, medium dense, subrounded coarse sand, some subrounded gravel, trace coal fragments. 665.4	
	SS 14	37	9-10-24-50/1"		27.0 Dark Brown to Brown SAND & GRAVEL (FILL), wet, medium dense, fine to coarse grained sand, subrounded to subangular, poorly sorted, subrounded gravel. 664.4	
					28.0 Gray SANDY CLAY (FILL), moist to dry, medium dense, subrounded coarse sand, some subrounded gravel, trace coal fragments. 663.4	
	SS 15	71	5-26-36-31 (62)		28.5 Dark Brown to Brown SAND & GRAVEL (FILL), wet to moist, medium dense, fine to coarse grained sand, subrounded to subangular, poorly sorted, subrounded gravel. 662.9	
					29.0 Black SAND (FILL), moist, medium dense, fine to medium grained, some coal. 662.4	
30	SS 16	88	4-8-12-22 (20)		30.5 Orange - Brown GRAVELLY SAND (FILL), moist, dense, fine to coarse grained, subrounded, subrounded gravel, trace coal. Below 30', moist to wet. 660.9	Bentonite Grout
					32.5 Brown SILTY CLAY (CL - ML), dry to moist, medium dense, few fine to coarse subrounded sand, few subrounded gravel. 658.9	
	SS 17	67	7-10-11-18 (21)		33.0 Brown CLAYEY SILT (MH), dry, soft to firm, non cohesive, few gray silty laminations. 658.4	
					34.0 Gray SILT (ML), dry to moist, firm, non cohesive, trace subrounded gravel, trace coarse sand. 657.4	
35	SS 18	58	4-10-12-21 (22)		34.5 Dark Brown to Brown SANDY CLAY (CLS), moist, soft to firm, fine to coarse grained sand. 656.9	
					36.0 Brown SILTY CLAY (CL - ML), dry to moist, soft to firm, low platicity, few subrounded gravel. 655.4	
	SS 19	83	5-6-8-7 (14)		37.0 Gray CLAY (CL), dry, soft to firm, medium plasticity, trace organics, trace silt, cohesive. 654.4	
					Orange - Brown GRAVELLY SAND (SPG), moist to dry, loose, medium grained, subrounded gravel.	
	SS 20	67	5-6-8-7 (14)			
40	SS 21	88	0-0-6-7 (6)		40' to 41', dark brown to brown.	2-Inch Solid PVC Riser
					41' to 42' orange to brown, few clay.	
					42.0 649.4	
					42.5 Brown GRAVELLY SAND (SPG), dry to moist, loose, subrounded gravel. 648.9	

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CLIENT American Electric Power

PROJECT NAME Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
	SS 22	71	3-4-4-6 (8)		Orange - Brown SAND (SP), moist, loose, very fine to coarse grained, poorly sorted, few subrounded gravel. *(continued)*	
45	SS 23	17	7-9-9-12 (18)		Below 44', wet, fine gravel, some silt.	
	SS 24	54	2-3-4-6 (7)		Below 46', moist, no silt.	
					48.0 / 643.4	
	SS 25	46	0-4-5-8 (9)		48.2 / 643.2 Brown SANDY CLAY (CLS), moist to wet, soft, medium plastic, trace subrounded gravel.	
50					Orange - Brown SAND (SP), dry to moist, loose, very fine to coarse grained, poorly sorted, few subrounded gravel.	
	SS 26	46	0-5-7-9 (12)		Below 50' trace coal.	
	SS 27	17	0-6-10-17 (16)			
55	SS 28	46	0-7-11-19 (18)			2-Inch Solid PVC Riser
	SS 29	50	3-2-10-7 (12)			
					58.0 / 633.4	
	SS 30	75	5-6-9-11 (15)		58.2 / 633.2 Dark Gray SANDY CLAY (CLS), moist to wet, soft, medium plastic, cohesive, subrounded fine to medium grained sand, trace gravel.	
					Orange - Brown SAND (SP), dry to moist, loose to medium dense, very fine to coarse grained, poorly sorted, few subrounded gravel.	
60	SS 31	38	4-8-11-10 (19)			Bentonite Grout
	SS 32	63	5-8-19-21 (27)		Below 60', moist to wet, coarse gravel, trace silt.	
65	SS 33	67	8-10-10-12 (20)		Below 64', fine to medium grained.	Bentonite Pellets

(Continued Next Page)

CLIENT American Electric Power **PROJECT NAME** Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416 **PROJECT LOCATION** Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	MATERIAL DESCRIPTION	WELL DIAGRAM
	SS 34	50	5-6-7-6 (13)	Orange - Brown SAND (SP), dry to moist, loose to medium dense, very fine to coarse grained, poorly sorted, few subrounded gravel. *(continued)* Below 67', moist.	Bentonite Pellets
68.0				(Elev. 623.4)	
	SS 35	46	4-3-11-8 (14)	Brown GRAVELLY SAND (SWG), wet, loose to medium dense, fine to coarse grained, subrounded, poorly sorted, fine to coarse subround gravel, trace silt.	
70	SS 36	63	7-6-6-10 (12)		
72.0				(Elev. 619.4)	
72.4				Brown SAND (SW), wet, very loose, fine grained, well sorted, trace silt. (Elev. 619.0)	
	SS 37	79	0-9-9-16 (18)	Brown SANDY GRAVEL (GPS), wet, medium dense, fine, subrounded, fine to coarse sand. Coal stringer at 73'.	
74.0				(Elev. 617.4)	
74.4				Brown SAND (SW), wet, medium dense, very fine to coarse grained, poorly sorted, trace silt. (Elev. 617.0)	
75	SS 38	83	9-9-8-16 (17)	Brown SANDY GRAVEL (SWG), wet, medium dense, fine, subrounded, fine to coarse sand, grades to brown SAND.	
75.4				(Elev. 616.0)	
	SS 39	79	9-8-9-14 (17)	Brown SAND (SP), wet, medium dense, fine grained, well sorted, trace coal stringers, no silt, grades to poorly sorted brown sand at 77'.	#5 Filter Sand
77.0				(Elev. 614.4)	
	SS 40	58	16-11-14-18 (25)	Brown SAND (SW), wet, medium dense, fine to coarse grained, poorly sorted, trace subrounded gravel. 78'-78.5', increased gravel.	
80 / 80.0				(Elev. 611.4)	
	SS 41	100	10-12-15-25 (27)	Brown GRAVELLY SAND (SPG), wet, medium dense, medium to coarse grained, subrounded, fine subrounded gravel.	2-Inch, 0.010-Inch Slotted Screen
81.5				(Elev. 609.9)	
	SS 42	100	10-14-15-22 (29)	Brown SAND (SW), wet, medium dense, medium to coarse grained, moderately sorted, trace subrounded gravel. 83.5' to 83.75', some gravel. Below 84', trace to few gravel.	
85	SS 43	67	14-16-18-29 (34)		
	SS 44	63	11-14-11-15 (25)		

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CLIENT American Electric Power **PROJECT NAME** Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416 **PROJECT LOCATION** Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
90	SS 45	71	15-17-15-16 (32)		89.0 / 602.4; 89.1 / 602.3 Dark Brown to Black GRAVELLY CLAY (CL - CH), moist to wet, soft to firm, medium to high plasticity, fine to coarse subrounded gravel. Brown SAND (SW), wet, medium dense, medium to coarse grained, moderately sorted, trace subrounded gravel. At 92', white sandstone cobble in bottom of spoon, fine grained, friable.	
	SS 46	42	21-19-23-44 (42)			
	SS 47	83	24-21-18-36 (39)		92.0 / 599.4 Brown SANDY CLAY (CLS), moist, firm, medium plastic, very fine to fine sand, few fine subrounded gravel. 93.0 / 598.4 Brown SAND (SW), wet, medium dense to dense, fine to coarse grained, subrounded to subangular, poorly sorted, some fine subrounded gravel.	2-Inch, 0.010-Inch Slotted Screen
95	SS 48	83	13-29-39-50/5"		94.5 / 596.9 Brown to Dark Brown CLAYEY GRAVEL (GC), wet, dense to very dense, subrounded, coarse, some fine to coarse sand, some sandstone fragments.	
	SS 49	79	11-36-38-43 (74)			#5 Filter Sand
100	SS 50	71	12-24-40-36 (64)		99.0 / 592.4 Brown GRAVELLY SAND (SPG), wet, dense, fine to coarse grained, fine to coarse subrounded gravel.	
	SS 51	71	24-25-18-30 (43)		At 101', orange-brown sand seam, 1" thick, fine grained, subrounded, well sorted.	
	SS 52	63	19-14-16-22 (30)		102.0 / 589.4 Brown SAND (SW), wet, medium dense, fine to coarse grained, subrounded, poorly sorted, little fine gravel.	
105	SS 53	63	15-17-20-34 (37)		104.0 / 587.4; 104.2 / 587.2 Gray SAND (SW), wet, medium dense, coarse grained, moderately sorted, graded, subangular to subrounded, trace silt. Brown SAND (SW), moist to wet, medium dense, fine to medium grained, subrounded, moderately sorted, trace fine subrounded gravel. Below 106', trace fine to coarse gravel, coarse gravel clasts composed of micaceous fine grained sandstone.	
	SS 54	67	10-20-24-22 (44)			
110	SS 55	63	19-12-20-34 (32)		Below 108', brown to gray.	
	SS 56	63	12-27-25-30		111' to 111.1' Tan sandstone cobble, weak, medium grained, friable, moderately decomposed, subangular to subrounded grains.	

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Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

WELL NUMBER MW1506

CLIENT American Electric Power **PROJECT NAME** Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416 **PROJECT LOCATION** Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
			(52)		Brown SAND (SW), moist to wet, medium dense, fine to medium grained, subrounded, moderately sorted, trace fine subrounded gravel. *(continued)* Below 112', medium grained, well sorted.	
	SS 57	75	14-15-19-29 (34)			
					114.5 — 576.9	
115	SS 58	58	25-40-31-36 (71)		114.6 Orange-Brown SILT (ML) w/ COAL, dry to moist, soft, iron stained. 576.8	
					Gray Brown SILTSTONE (BEDROCK), wet, weak, trace mica.	
					116.0 — 575.4	
	SS 59	75	50/4"		116.2 Dark Gray CLAYSTONE (BEDROCK), dry, weak. 575.2	
					Bottom of hole at 116.2 feet	

Boring grouted to surface and monitoring well installed on 10/23/2015 in offset boring.

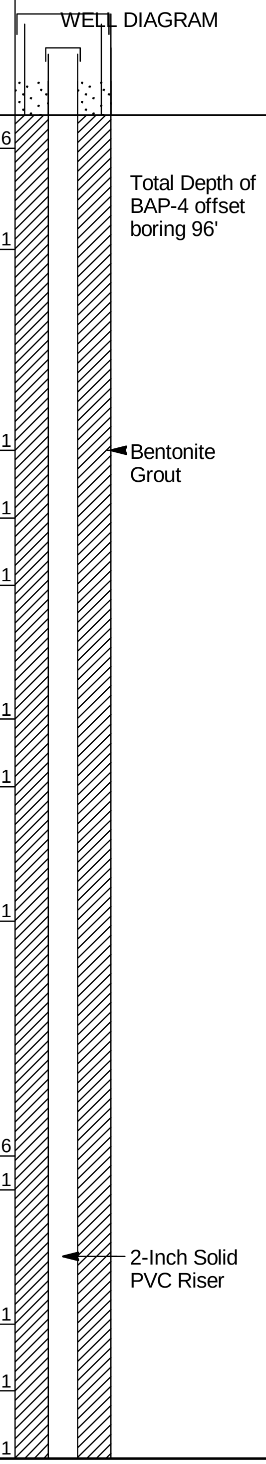
WELL NUMBER MW1507

Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

CLIENT American Electric Power
PROJECT NAME Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Bottom Ash Pond, Cresap, West Virginia
DATE STARTED 10/27/15 **COMPLETED** 10/30/15
GROUND ELEVATION 692.08 ft **HOLE SIZE** 8.25"
DRILLINGCONTRACTOR AEP
TOP OF PVC ELEVATION 694.98 ft
DRILLING METHOD 4.25" I.D. HSA: Auto Hammer & Split Spoon
GROUND WATER LEVELS:
LOGGED BY D. Follett **CHECKED BY** RAS
AT END OF DRILLING ---
LOCATION Northing: 485288.61 Easting: 1598790.27

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0.5	SS 1	79	14-19-25-33 (44)		Gray SANDY SILT (FILL), dry, medium hard, few subangular gravel.	691.6
2.0					Brown SANDY SILT (FILL), dry, medium hard to hard, some subrounded gravel, trace clay, trace coal.	690.1
5.0	SS 2	104	12-20-25-50/5"		Dark Brown to Brown SILTY SAND (FILL), dry, medium dense to very dense, fine to medium grained, moderately sorted, some fine subrounded gravel.	687.1
6.0	SS 3	79	5-23-30-45 (53)		Brown SAND (FILL), dry, dense, medium grained, subrounded to subangular, well sorted, coarse subangular limestone gravel.	686.1
7.0	SS 4	96	5-19-29-45 (48)		Dark Brown to Brown SANDY SILT (FILL), dry to moist, firm to hard, few subrounded to subangular fine to coarse grained sand, little fine subrounded gravel, trace clay.	685.1
9.0					Brown to Reddish Brown SAND (FILL), moist, dense, medium grained, well sorted, subrounded to subangular, trace subrounded coarse sand.	683.1
10.0	SS 5	71	1-11-26-36 (37)		Brown to Dark Brown SILTY SAND (FILL), moist, medium dense to dense, medium to coarse grained, subrounded, moderately sorted, trace fine subrounded gravel.	682.1
12.0	SS 6	104	11-13-19-50/5"		Dark Brown to Reddish Brown CLAYEY SAND (FILL), medium dense to very dense, coarse grained, subrounded, poorly sorted, few fine to coarse subrounded gravel, trace coal.	680.1
15.5	SS 7	95	7-21-34-50/4"		Dark Brown to Brown SAND (FILL), moist, medium dense to dense, medium grained, subrounded, moderately sorted, trace fine subrounded gravel. Below 14', fine to coarse gravel.	676.6
16.0	SS 8	100	18-23-20-48 (43)		Gray to Brown SILTY CLAY (FILL), dry to moist, very hard, medium plastic, few subrounded coarse sand, trace coal.	676.1
18.0	SS 9	79	3-23-29-40 (52)		Dark Brown to Brown SAND (FILL), dry to moist, loose to dense, subrounded, poorly to moderately sorted, few fine to coarse subrounded gravel, trace silt.	674.1
19.0	SS 10	100	8-12-28-34 (40)		Gray SANDY CLAY (FILL), moist, firm, moderate plastic, subrounded medium to coarse grained sand, trace subrounded gravel.	673.1
20.0					Dark Brown SAND (FILL), dry to moist, dense, medium to coarse grained, moderately sorted, subrounded, few fine subrounded gravel.	672.1

WELL DIAGRAM



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CLIENT American Electric Power

PROJECT NAME Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	Top Depth	MATERIAL DESCRIPTION	Elevation	WELL DIAGRAM
20	SS 11	92	3-11-13-18 (24)		Gray SANDY CLAY (FILL), moist, firm, moderate plastic, subrounded medium to coarse grained sand, trace subrounded gravel.		
				21.0	Brown CLAYEY SAND (FILL), moist to dry, medium dense, medium to coarse grained, poorly sorted, few fine subrounded gravel.	671.1	
	SS 12	100	2-11-20-24 (31)	22.0	Gray CLAY (FILL), moist, very soft to firm, highly plastic, few subrounded coarse grained sand, trace subrounded fine to coarse gravel, moist to wet around clasts.	670.1	
				23.0	Brown SILTY SAND (FILL), moist, medium dense, medium to coarse grained, subrounded, poorly sorted, few fine subrounded gravel.	669.1	
25	SS 13	100	16-19-23-44 (42)	24.5	Brown SAND (FILL), moist, medium dense, medium grained, subrounded, well sorted, trace fine gravel.	667.6	
	SS 14	71	2-12-24-43 (36)	25.0	Brown CLAYEY SAND (FILL), moist, medium dense to dense, fine to coarse grained, subrounded, trace subrounded gravel. At 27', wet.	667.1	
	SS 15	58	0-6-29-40 (35)		Below 28', moist to wet.		
30	SS 16	78	2-8-18-50/5"		Below 30', gray, wet.		Bentonite Grout
				31.5	Dark Gray CLAYEY SILT (FILL), wet, hard, few coarse subrounded sand, trace fine subrounded gravel.	660.6	
	SS 17	79	6-24-31-38 (55)	32.0	Dark Gray GRAVELIY CLAY (FILL), moist, firm, moderately plastic, subrounded gravel , few coarse grained sand.	660.1	
				33.5	Reddish Brown to Brown SILT (ML), dry, very hard, few gray silt laminations with desiccation cracks throughout, trace roots, trace subrounded coarse grained sand.	658.6	
35	SS 18	100	4-6-9-12 (15)	34.0	Gray to Dark Gray SILT (ML), dry to moist, soft to firm, trace roots, trace subrounded fine to medium grained sand.	658.1	
				35.0	Reddish Brown to Brown SILT (ML), dry, firm, trace roots, trace fine grained sand.	657.1	
	SS 19	79	2-5-10-13 (15)	36.0	Gray to Dark Gray SANDY CLAY (CLS), moist, soft to firm, medium plastic, subrounded fine to coarse grained sand,	656.1	
				36.5	Reddish Brown SILT (ML), dry, soft to firm, trace fine to coarse grained sand. At 37.5', grades to GRAVELIY SILT (MLG), dry, firm, subrounded gravel.	655.6	
	SS 20	63	7-7-6-7 (13)	38.0	Brown to Reddish Brown SILT (ML), dry, firm, dark gray vertical desiccation cracks 1/2" width throughout, trace coarse subrounded sand.	654.1	
40	SS 21	8	8-7-9-10 (16)	38.5	Orange-Brown GRAVELLY SAND (SWG), dry to moist, loose, fine to coarse grained, subangular, poorly sorted, fine subrounded gravel.	653.6	2-Inch Solid PVC Riser
				42.0	Brown SANDY CLAY (CLS), moist, soft to firm, few subrounded coarse sand, trace subrounded gravel.	650.1	
				42.5		649.6	

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Civil & Environmental Consultants, Inc.
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Worthington, OH 43085

WELL NUMBER MW1507

CLIENT American Electric Power **PROJECT NAME** Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416 **PROJECT LOCATION** Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
	SS 22	67	5-5-6-8 (11)		Grayish Brown SAND (SW), dry to moist, very loose to loose, medium grained, subrounded, well sorted, few subrounded coarse grained sand, trace subrounded gravel. *(continued)*	
45	SS 23	71	3-3-5-6 (8)		45.5' to 45.8', few coarse subrounded gravel, trace coal.	
46.0	SS 24	67	4-5-5-6 (10)		646.1 Orange-Brown to Brown GRAVELLY SAND (SWG), dry to moist, very loose to loose, fine to coarse grained, subrounded, moderately sorted, fine subrounded gravel, few coal stringers <1/4" thick throughout.	
	SS 25	63	0-3-6-6 (9)			
50 / 50.0	SS 26	67	0-2-4-7 (6)		642.1 Orange-Brown SAND (SW), moist, very loose to loose, medium grained, subrounded, well sorted, trace subrounded coarse sand.	
	SS 27	63	0-3-3-5 (6)		52'-54', few thinly bedded coal stringers.	
55	SS 28	63	0-3-6-9 (9)			2-Inch Solid PVC Riser
56.5	SS 29	58	0-5-7-9 (12)		635.6 Dark Gray to Black COAL, dry soft.	
57.0					635.1 Orange-Brown SAND (SW), moist, very loose to loose, medium grained, subrounded, well sorted, trace subrounded coarse sand.	
58.0	SS 30	79	3-9-13-23 (22)		634.1 Gray CLAY (CL), moist, firm, high plasticity, few subrounded fine to coarse grained sand.	
58.3					633.8 Dark Gray to Black COAL, dry to moist, soft.	
58.5					633.6 Brown GRAVELLY SAND (SWG), moist, very loose to medium dense, medium grained, subrounded, moderately sorted, fine to coarse subrounded gravel.	
60	SS 31	50	0-6-9-12 (15)		61'-61.25', increased clay.	Bentonite Grout
	SS 32	54	0-7-10-20 (17)		62.5'-62.75', increased clay.	
65	SS 33	54	11-23-14-19 (37)		64'-66', few cobbles	

(Continued Next Page)

Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

WELL NUMBER MW1507

CLIENT American Electric Power

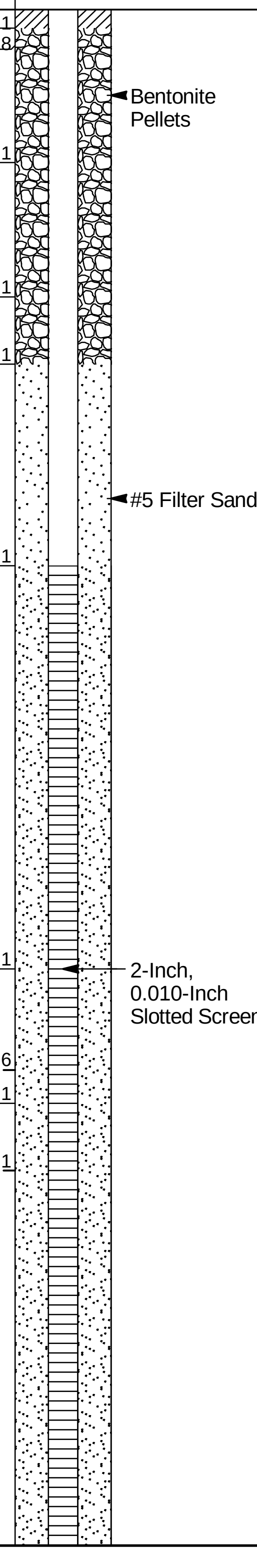
PROJECT NAME Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	MATERIAL DESCRIPTION
				66.0 — 626.1
	SS 34	46	0-17-17-15 (34)	66.3 — Brown to Dark Brown SAND (SP), dry to moist, very loose, fine grained, well sorted, subrounded. — 625.8 Brown GRAVELLY SAND (SWG), moist, very loose to medium dense, medium grained, subrounded, moderately sorted, fine to coarse subrounded gravel. 68.0 — 624.1
70	SS 35	54	5-7-5-10 (12)	Gray SANDY GRAVEL (GWS), wet, loose to medium dense, subrounded, medium to coarse subrounded sand, trace silt. 70.0 — 622.1
	SS 36	67	9-13-14-15 (27)	Gray SAND (SP), wet, loose to medium dense, coarse grained, subrounded, well sorted, subvertical 1/2" thick coal seam throughout, few silt. 71.0 — 621.1 Brown GRAVELLY SAND (SWG), wet, medium dense, fine to coarse grained, subrounded, poorly sorted, fine to coarse subrounded gravel.
	SS 37	63	15-14-12-19 (26)	74.0 — 618.1
75	SS 38	58	10-13-16-24 (29)	Brown SAND (SP), wet, medium dense, very fine to fine grained, subrounded, well sorted, trace fine subrounded gravel.
	SS 39	71	10-18-20-25 (38)	Below 77', very fine to fine sand grades to medium to coarse sand, well sorted to moderately sorted, bedded, trace subrounded coarse gravel.
80	SS 40	58	12-11-15-21 (26)	80.0 — 612.1
	SS 41	100	14-15-16-22 (31)	Brown SILTY SAND (SM), wet, medium dense, fine to medium grained, subrounded, moderate to poorly sorted, trace subrounded gravel, grades to brown SAND. 81.5 — 610.6 Brown SAND (SW), wet, medium dense, fine to coarse grained, subrounded, poorly sorted, few fine to coarse subrounded gravel, trace silt. 82.0 — 610.1
	SS 42	83	9-14-13-18 (27)	Gray SILTY SAND (SM), wet, medium dense, fine to coarse grained, subrounded, poorly sorted, trace silt, grades to brown SAND. 83.0 — 609.1 Brown SAND (SW), wet, medium dense, fine to medium grained, moderately sorted, trace fine subrounded gravel, trace silt. Below 84', medium to coarse grained, no silt.
85	SS 43	79	10-16-21-24 (37)	
	SS 44	63	13-13-15-16 (28)	Below 87', trace fine to coarse gravel.
				88'-89', gray.

WELL DIAGRAM



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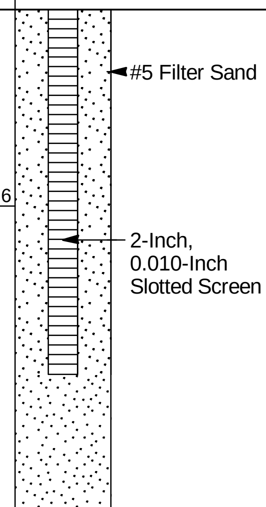
Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

CLIENT American Electric Power **PROJECT NAME** Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416 **PROJECT LOCATION** Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	MATERIAL DESCRIPTION
90	SS 45	71	13-12-15-20 (27)	Brown SAND (SW), wet, medium dense, fine to medium grained, moderately sorted, trace fine subrounded gravel, trace silt. *(continued)*
	SS 46	75	18-19-27-37 (46)	91.5 — 600.6
	SS 47	83	29-27-19-21 (46)	Brown SILTY SAND (SM), wet, medium dense to dense, very fine to fine grained, subrounded, moderately sorted. Below 93', little fine to coarse subrounded gravel.
95	SS 48	83	33-38-35-30 (73)	
	SS 49	87	32-37-42-50/5"	At 97', some orange-brown silt around gravel clasts.
	SS 50	67	19-27-28-38 (55)	99.0 — 593.1 Gray to Brown GRAVELLY SAND (SWG), wet, medium dense to dense, fine to coarse grained, subrounded, poorly sorted, fine to coarse subrounded gravel, trace to little silt, trace coal.
100	SS 51	58	17-28-27-33 (55)	
	SS 52	67	14-23-22-25 (45)	Below 103', decreased silt, fine gravel. 104.0 — 588.1
105	SS 53	71	21-30-22-21 (52)	Gray SAND (SW), wet, medium dense, medium to coarse grained, subrounded, poorly sorted, little gravel. 104.5 — 587.6 Brown SAND (SP), wet, medium dense, medium grained, subrounded, well sorted, trace fine subrounded gravel.
	SS 54	71	13-17-13-17 (30)	107.5 — 584.6
	SS 55	75	13-13-16-21 (29)	Gray GRAVELLY SAND (SWG), wet, medium dense, medium to coarse grained, subrounded, moderately sorted, fine subrounded gravel. 108.5 — 583.6 Brown SAND (SP), wet, medium dense, fine to medium grained, subrounded, well sorted, few fine subrounded gravel.
110	SS 56	79	15-18-18-23	

WELL DIAGRAM



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CLIENT American Electric Power
PROJECT NAME Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
			(36)		111.5 Dark Gray to Black COAL, wet, soft. 580.6	
	SS 57	67	32-29-27-41 (56)		111.8 Brown SAND (SP), wet, medium dense to dense, fine to medium grained, subrounded, well sorted, few fine subrounded gravel. 580.3	
115	SS 58	83	18-23-29-50/5"		115.5 576.6	
					115.9 Tan to Brown SANDSTONE (BEDROCK), wet, hard, very fine to fine grained, subrounded to subangular grains, moderately cemented. 576.2	

Bottom of hole at 115.9 feet

Boring grouted to surface and monitoring well installed on 10/30/2015 in offset boring.

BORING NUMBER MW1508

Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

CLIENT American Electric Power

PROJECT NAME Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Bottom Ash Pond, Cresap, West Virginia

DATE STARTED 10/5/15 **COMPLETED** 10/8/15

GROUND ELEVATION 682.72 ft **HOLE SIZE** 8.25"

DRILLINGCONTRACTOR AEP

TOP OF PVC ELEVATION 685.77 ft

DRILLING METHOD 4.25" I.D. HSA: Auto Hammer & Split Spoon

GROUND WATER LEVELS:

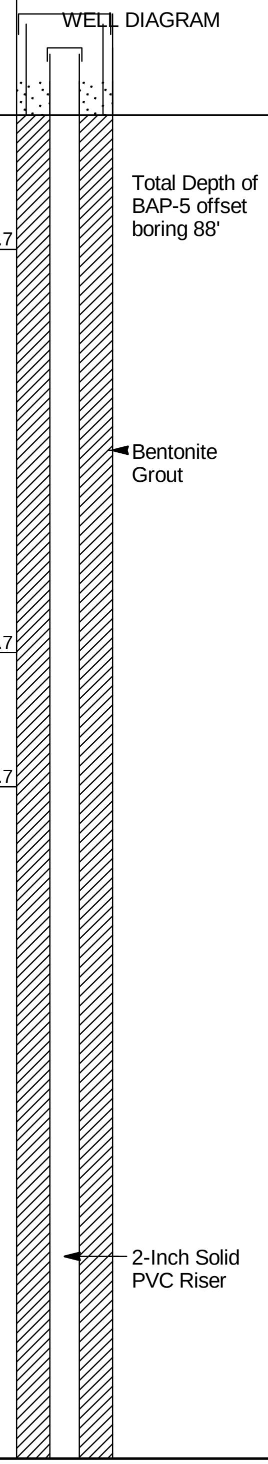
LOGGED BY B. Bashore / R. Stanley **CHECKED BY** RAS

AT END OF DRILLING ---

LOCATION Northing: 484971.27 Easting: 1598790.27

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION
0	SS 1	94	16-22-32 (54)		Gray SILTY SAND & GRAVEL (FILL), dry, very dense.
2.0					680.7
	SS 2	92	2-9-11-15 (20)		Orange-Brown SILT & CLAY (ML), moist to dry, medium stiff, trace fine sand.
5	SS 3	63	3-3-3-4 (6)		
	SS 4	33	1-2-3-6 (5)		
8.0					674.7
	SS 5	71	3-5-5-6 (10)		Orange-Brown SILTY SAND (SM), moist, loose, fine to medium grained, trace clay.
10.0					672.7
10	SS 6	63	3-5-4-7 (9)		Orange-Brown SILTY SAND & GRAVEL (SW), moist, loose.
	SS 7	63	4-4-4-5 (8)		Below 14', more sand, less gravel.
15	SS 8	75	2-3-4-7 (7)		Below 16', moist to wet, more gravel.
	SS 9	54	2-3-3-6 (6)		Below 20', wet, very loose.
20	SS 10	63	3-2-3-3 (5)		Note: Wet at bottom of sample SS-10.

WELL DIAGRAM



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Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

CLIENT American Electric Power
PROJECT NAME Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
20	SS 11	50	3-2-2-2 (4)		Orange-Brown SILTY SAND & GRAVEL (SW), moist, loose. *(continued)*	
	SS 12	63	1-3-3-3 (6)		Below 22', fine to coarse sand with gravel, silty, trace clay, loose.	
25	SS 13	50	0-2-3-3 (5)		Below 24', slightly more silty clay, less gravel, loose wet.	
26.0					656.7	
	SS 14	83	1-1-2-3 (3)		Orange-Brown SILTY SAND (SM), wet, loose, fine to coarse grained, trace clay, trace gravel, slightly cohesive.	
	SS 15	54	2-3-3-4 (6)			
30	SS 16	63	3-3-5-5 (8)		Below 31', less silt and clay.	Bentonite Grout
32.0					650.7	
	SS 17	88	1-2-3-5 (5)		Orange-Brown SAND (SP), wet, loose, fine to medium grained, some silt.	
35	SS 18	75	0-3-3-5 (6)		Below 34', medium to fine sand, no gravel, clean.	
	SS 19	75	0-3-4-7 (7)		Below 36', wet to moist.	
	SS 20	88	3-3-5-8 (8)			
40	SS 21	96	0-4-5-9 (9)		Below 40', some to trace silt, no clay.	Bentonite Grout
					Below 42', medium dense, moist.	

(Continued Next Page)

Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

BORING NUMBER MW1508

CLIENT American Electric Power **PROJECT NAME** Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416 **PROJECT LOCATION** Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
	SS 22	71	0-6-7-11 (13)		Orange-Brown SAND (SP), wet, loose, fine to medium grained, some silt. *(continued)*	
45	SS 23	88	3-3-5-7 (8)		Below 44', loose.	
	SS 24	100	4-6-7-10 (13)		Below 46', medium dense.	
	SS 25	104	4-5-5-9 (10)			
50	SS 26	75	4-4-6-10 (10)		Below 50', loose, trace silt.	Bentonite Grout
	SS 27	96	4-5-6-11 (11)		Below 52', loose to medium dense, becoming more fine.	
55	SS 28	92	4-5-6-9 (11)		Below 54', loose.	2-Inch Solid PVC Riser
	SS 29	92	5-5-3-7 (8)		Below 56.5', some fine to coarse gravel. 57.1 — 625.6 Orange-Brown SANDY CLAY (CL), moist, medium stiff, medium plastic. 57.6 — 625.1 Orange-Brown SAND (SP), wet, loose, fine to medium grained, some fine gravel, trace silt. 58.0 — 624.7	
	SS 30	100	2-4-6-12 (10)		Brown CLAYEY SILT (MH), moist, very loose, very fine. 58.7 — 624.0 Brown SAND & GRAVEL (SP, GW), wet, loose, medium to fine grained, fine to coarse gravel, some silt. 59.6 — 623.1 Brown CLAYEY SILT (MH), moist, medium dense, very fine. 60.0 — 622.7	
60	SS 31	100	5-3-6-9 (9)		Brown SANDY GRAVEL (GWS), wet, loose, fine to coarse, fine to medium sand, some silt. 62.0 — 620.7	Bentonite Pellets
	SS 32	88	5-5-4-6 (9)		Brown GRAVELLY SAND (SWG), wet, loose, fine to medium grained, fine gravel, trace silt. 62.9 — 619.8 Brown SANDY GRAVEL (GWS), wet, loose, fine to coarse, fine to medium sand, trace silt. 64.0 — 618.7	
65	SS 33	88	5-5-6-9 (11)		Brown GRAVELLY SAND (SWG), wet, loose, fine to medium grained, fine gravel. 65.0 — 617.7 Black COAL, wet, soft, highly weathered, some sand, no odor. 65.3 — 617.4	#5 Filter Sand

(Continued Next Page)

CLIENT American Electric Power
PROJECT NAME Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
66.0					Brown GRAVELLY SAND (SWG), wet, loose, fine to medium grained, fine gravel. *(continued)* 616.7	
	SS 34	33	7-6-7-10 (13)		Brown SAND (SP), wet, loose, medium to coarse grained.	
	SS 35	42	9-9-10-13 (19)		Below 68', loose to medium dense, trace silt, trace fine gravel.	
70	SS 36	100	7-10-8-12 (18)		70.9' to 71', coal seam, highly weathered.	2-Inch, 0.020-Inch Slotted Screen
71.4					611.3	
	SS 37	100	6-9-12-17 (21)		Brown GRAVELLY SAND (SWG), wet, loose to medium dense, fine to medium grained, fine to coarse gravel. Below 72', some silt. Note: 0.2" coal stringer at 73.4'	
73.4					609.3	
75	SS 38	67	8-8-11-13 (19)		Orange-Brown GRAVELLY SAND (SWG), wet, medium dense, fine to medium grained, fine gravel.	
76.0					606.7	
	SS 39	100	7-10-7-13 (17)		Orange-Brown SAND (SP), wet, loose to medium dense, fine to medium grained, some fine gravel.	
78.0					604.7	
	SS 40	83	7-7-31-49 (38)		Orange-Brown SANDY CLAY (CLS), moist, medium stiff, low plasticity, trace fine gravel.	
78.9					603.8	
80					Orange-Brown SANDY GRAVEL (GWS), wet, dense, fine to coarse, medium to coarse sand.	
	SS 41	88	15-21-25-31 (46)		Below 80', medium dense to dense.	
	SS 42	71	13-28-32-35 (60)		Below 82', medium dense.	
83.0					Note: 82.2'-82.3', completely weathered coal fragments. 599.7	
85	SS 43	83	7-24-18-35 (42)		Orange-Brown SANDY GRAVEL (GWS), wet, dense, fine to coarse, medium to coarse sand. Below 84', medium dense to dense, some to trace clay.	
86.0					596.7	
	SS 44	79	25-31-25-25 (56)		Orange-Brown SANDY GRAVEL (GWS), wet to moist, medium dense, fine to coarse, medium to coarse sand, trace clay, trace sandstone fragments. Note: 0.1" thick highly weathered coal stringer at 87.6'.	#5 Filter Sand
88.2					594.5	

(Continued Next Page)

Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

BORING NUMBER MW1508

CLIENT American Electric Power **PROJECT NAME** Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416 **PROJECT LOCATION** Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
90	SS 45	75	18-25-22-26 (47)		Orange-Brown GRAVELLY SAND (SWG), wet to moist, medium dense, fine to coarse grained, fine to coarse gravel, trace medium grained moderately cemented sandstone gravel. *(continued)*	
	SS 46	71	11-21-35-43 (56)		Below 90', medium dense to dense, medium to coarse grained, trace siltstone fragments.	
	SS 47	75	21-30-40-42 (70)		Below 92', wet to moist, dense, trace sandstone fragments.	
					94.0 — 588.7	
95	SS 48	83	14-17-25-40 (42)		Brown to Orange-Brown GRAVELLY SAND (SWG), wet, medium dense to dense, medium to coarse grained, fine gravel.	
	SS 49	75	10-25-28-38 (53)		Below 96', wet to moist.	
					98.0 — 584.7	
100	SS 50	75	14-22-26-42 (48)		Brown SAND (SP), wet to moist, medium dense to dense, fine to medium grained, some fine gravel.	
	SS 51	75	11-18-25-42 (43)		Below 100', moist to wet, trace fine gravel.	
					102.6 — 580.1	
	SS 52	100	13-22-50/5"		Brown SAND (SP), moist, medium dense, fine grained. Note: coarse gravel at bottom of sample SS-52.	
					104.0 — 578.7	
105	SS 53	71	27-34-50/2"		Gray to Brown CLAYEY SAND w/ GRAVEL (SC), moist to wet, dense, fine grained, fine gravel.	
					104.3 — 578.4	
					Gray SILTSTONE (BEDROCK), dry, weak, highly weathered, micaceous.	
					104.6 — 578.1	
	SS 54	107	24-50/3"		Brown to Gray SANDSTONE (BEDROCK), moderate strong to strong, fine to medium grained, moderate to well cemented.	
					106.8 — 575.9	

Bottom of hole at 106.8 feet

Boring grouted to surface and monitoring well installed on 10/8/2015 in offset boring.

Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

WELL NUMBER MW1509 (P-2)

CLIENT American Electric Power
PROJECT NAME Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Bottom Ash Pond, Cresap, West Virginia
DATE STARTED 11/3/15 **COMPLETED** 11/6/15
GROUND ELEVATION 691.86 ft **HOLE SIZE** 8.25"
DRILLINGCONTRACTOR AEP
TOP OF PVC ELEVATION 694.63 ft
DRILLING METHOD 4.25" I.D. HSA: Auto Hammer & Split Spoon
GROUND WATER LEVELS:
LOGGED BY D. Follett **CHECKED BY** RAS
AT END OF DRILLING ---
LOCATION Northing: 484947.44 Easting: 1598889.64

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	MATERIAL DESCRIPTION	ELEV.	WELL DIAGRAM
0	SS 1	83	8-14-13-22 (27)	Dark Brown SILTY SAND (FILL), dry, loose to medium dense, medium to coarse grained, subrounded, moderately sorted, little subrounded gravel.		Total Depth of P-2 offset boring 96'
	SS 2	83	7-16-23-33 (39)			
5	SS 3	88	3-16-14-24 (30)			Bentonite Grout
6.0				Dark Brown SILT (FILL), dry to moist, firm, few medium grained sand, subrounded, trace subrouned gravel, trace iron.	685.9	
6.5	SS 4	83	5-14-18-24 (32)	Dark Brown SILTY SAND (FILL), dry, loose to medium dense, medium to coarse grained, subrounded, moderately sorted, little subrounded gravel.	685.4	
8.0	SS 5	83	3-13-19-36 (32)	Brown SAND (FILL), dry, loose to dense, subrounded, well sorted, trace subrounded gravel.	683.9	
10.0				Dark Brown CLAYEY SAND (FILL), moist, loose, medium grained, moderately sorted, subrounded, trace gravel.	681.9	
10.5	SS 6	92	7-17-28-45 (45)	Brown SAND (FILL), dry, loose to dense, subrounded, well sorted, trace subrounded gravel.	681.4	
12.0	SS 7	92	4-21-27-40 (48)	Dark Brown SANDY SILT (FILL), dry to moist, firm to hard, nonplastic, medium subrounded sand, trace fine to coarse subrounded gravel.	679.9	
13.0				Brown SAND (FILL), dry, loose to dense, subrounded, well sorted, trace subrounded gravel.	678.9	
14.0	SS 8	88	2-14-18-21 (32)	Dark Brown SANDY SILT (FILL), dry to moist, firm to hard, nonplastic, medium subrounded sand, trace coarse subrounded gravel.	677.9	
15.0				Brown SAND (FILL), dry, loose to dense, subrounded, well sorted, trace subrounded gravel.	676.9	
15.5	SS 9	100	3-12-14-36 (26)	Dark Brown SANDY SILT (FILL), dry to moist, firm to hard, nonplastic, medium subrounded sand, trace coarse subrounded gravel.	676.4	2-Inch Solid PVC Riser
17.5				Brown SAND (FILL), dry, loose to dense, subrounded, well sorted, trace subrounded gravel.	674.4	
18.0	SS 10	100	8-23-28-30 (51)	Dark Brown SANDY SILT (FILL), dry to moist, firm to hard, nonplastic, medium subrounded sand, trace coarse subrounded gravel.	673.9	
18.5				Brown SAND (FILL), moist, medium dense to dense, subrounded, well sorted, few fine to coarse subrounded gravel.	673.4	
20.0					671.9	

(Continued Next Page)

WELL NUMBER MW1509 (P-2)

Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

CLIENT American Electric Power
PROJECT NAME Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
20	SS 11	92	6-10-10-15 (20)
	SS 12	79	3-12-16-30 (28)
25	SS 13	100	6-19-25-40 (44)
	SS 14	88	13-25-28-29 (53)
	SS 15	92	4-14-27-40 (41)
30	SS 16	96	10-14-27-45 (41)
	SS 17	55	26-50/5"
35	SS 18	100	5-14-12-17 (26)
	SS 19	96	3-10-19-21 (29)
40	SS 20	67	5-7-7-9 (14)
	SS 21	92	2-7-8-11 (15)

Depth (ft)	MATERIAL DESCRIPTION	Elevation
	Dark Brown SANDY SILT (FILL), dry to moist, firm to hard, nonplastic, medium subrounded sand, trace coarse subrounded gravel.	
21.0	Dark Gray SILTY CLAY (FILL), dry to moist, firm, moderate plasitic, trace fine subrounded gravel.	670.9
22.5		669.4
23.0	Brown SAND (FILL), wet, loose, subrounded, well sorted, few fine to coarse subrounded gravel.	668.9
	Dark Brown GRAVELLY SAND (FILL), moist, medium dense to dense, medium to coarse grained, poorly sorted, fine subrounded gravel, some silt.	
24.0		667.9
24.5	Dark Gray SILTY CLAY (FILL), dry to moist, firm, moderate plastic, trace fine to coarse subrounded gravel.	667.4
	Dark Brown GRAVELLY SAND (FILL), moist, medium dense to dense, medium to coarse grained, poorly sorted, fine subrounded gravel, some silt, trace coal. Wet at 26'	
27.0		664.9
27.2	Dark Brown SANDY CLAY (FILL), moist, firm, moderate plastic, subrounded fine to coarse grained sand, trace subrounded gravel.	664.7
28.0	Dark Brown GRAVELLY SAND (FILL), moist, medium dense to dense, medium to coarse grained, poorly sorted, fine subrounded gravel, some silt, trace coal.	663.9
28.9	Dark Brown SILT (FILL), dry to moist, firm, some fine grained sand, trace subrounded gravel.	663.0
	Brown SAND (FILL), moist, medium dense to dense, fine to coarse grained, moderately sorted, trace fine subrounded fine gravel. Wet at 30'	
31.0	Dark Brown SANDY SILT (FILL), dry to moist, hard to very hard, subrounded medium grained sand, few coarse subrounded gravel.	660.9
32.0	Dark Brown SANDY CLAY (FILL), moist, hard, moderate plastic, fine grained sand, trace gravel. Dark Gray SILTSTONE cobble stuck in bottom of spoon.	659.9
34.0	Light Brown to Dark Gray SILT (ML), dry, firm, light colored laminations, below 35' grades to dark gray silt, few coal stringers, some roots, trace clay, trace fine subrounded gravel.	657.9
36.5	Tan SILTY CLAY (CL-ML), dry, hard, laminated with light gray silt, low plasticity, gradational contact.	655.4
37.5		654.4
38.0	Orange-Brown GRAVELLY SAND (SWG), dry, medium dense, fine to coarse grained, poorly sorted, subrounded, fine to coarse subrounded gravel, some clay.	653.9
38.5	Dark Brown SILTY CLAY (CL-ML), dry, firm, low plasticity, trace subrounded coarse sand, trace subrounded gravel.	653.4
	Orange-Brown GRAVELLY SAND (SWG), moist, loose, coarse grained, subrounded, moderately sorted, trace silt, few gray sandstone cobbles.	
40.0		651.9
40.5	Brown SILTY CLAY (CL-ML), dry to moist, firm, low plasticity, some subrounded coarse grained sand, trace subrounded gravel.	651.4
	Orange-Brown SAND (SW), moist, loose to medium dense, medium grained, subrounded, well sorted. At 42', little fine to coarse subrounded gravel.	

WELL DIAGRAM: 2-Inch Solid PVC Riser; Bentonite Grout

(Continued Next Page)

WELL NUMBER MW1509 (P-2)

Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

CLIENT American Electric Power

PROJECT NAME Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
	SS 22	75	5-6-7-8 (13)		Orange-Brown SAND (SW), moist, loose to medium dense, medium grained, subrounded, well sorted. *(continued)*	
					At 44', color change to brown.	
45	SS 23	83	3-4-6-8 (10)	44.9		647.0
				45.1	Dark Gray COAL, dry, hard, fissile, moist along fractures, trace plant fossils	646.8
				46.0	Brown SAND (SW), moist, loose to medium dense, medium grained, subrounded, well sorted.	645.9
	SS 24	92	2-2-4-5 (6)	46.3	Dark Brown SILTY SAND (SM), dry, loose, medium grained, subrounded.	645.6
				48.2	Brown SAND (SW), moist, loose to medium dense, medium grained, subrounded, well sorted, coal stringers throughout.	643.7
	SS 25	92	4-2-4-7 (6)	48.4	Dark Gray COAL, moist, soft.	643.5
				49.0	Brown SAND (SW), moist, loose to medium dense, medium grained, subrounded, well sorted, coal stringers throughout.	642.9
				49.4	Dark Gray COAL, moist, soft.	642.5
50				50.0	Brown SAND (SW), moist, loose to medium dense, medium grained, subrounded, well sorted, coal stringers throughout.	641.9
	SS 26	79	5-4-5-10 (9)	50.3	Dark Gray COAL, moist, soft.	641.6
				50.6	Brown SAND (SW), moist, loose to medium dense, medium grained, subrounded, well sorted, coal stringers throughout.	641.3
				50.8	Dark Gray COAL, moist, soft.	641.1
	SS 27	67	2-3-5-12 (8)	52.5	Brown SAND (SW), moist, loose to medium dense, medium grained, subrounded, well sorted, coal stringers throughout. Below 52', wet, very loose.	639.4
					Brown SANDY GRAVEL (GWS), moist, loose to medium dense, subrounded, poorly sorted, some clay.	
55	SS 28	92	7-11-18-35 (29)			2-Inch Solid PVC Riser
	SS 29	92	13-25-19-21 (44)		At 56', some coarse gravel.	
	SS 30	75	5-16-22-42 (38)		At 58', loose to dense, fine to coarse gravel.	
60				60.0		631.9 Bentonite Grout
	SS 31	92	15-18-27-28 (45)		Brown GRAVELLY SAND (SWG), dry to moist, medium dense, subrounded to subangular, medium to coarse grained, moderately sorted, fine to coarse subrounded gravel.	
	SS 32	88	9-10-8-20 (18)	63.0		628.9
				63.4	Light Brown SILT (ML), wet, firm, trace fine sand.	628.5
				64.5	Brown SAND (SW), moist, loose to medium dense, fine to coarse grained, subrounded, poorly sorted, few fine subrounded gravel.	627.4
65	SS 33	88	8-6-7-9 (13)	65.0	Brown SAND (SW), moist, loose, medium grained, well sorted.	626.9
					Brown GRAVELLY SAND (SWG), moist, loose, subrounded, medium to coarse grained, moderately sorted, trace silt.	

(Continued Next Page)

CLIENT American Electric Power **PROJECT NAME** Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416 **PROJECT LOCATION** Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
	SS 34	67	6-6-10-4 (16)		66.0 Light Brown SAND (SW) interbedded with GRAVELY SAND (SWG), moist, loose to medium dense, medium grained, well sorted, fine to coarse subrounded gravel intebeds 0.25' thick. 625.9	Bentonite Pellets
	SS 35	67	5-5-5-8 (10)		68.0 Brown SAND (SW), wet, loose, fine to coarse grained, poorly sorted, grades to little subrounded gravel below 69', trace silt. 623.9	
70	SS 36	67	3-4-7-11 (11)		70.0 Brown GRAVEL (GW), wet, loose, subrounded, few subrounded coarse grained sand, few silt. 621.9 71.0 Brown SAND (SW), wet, loose, fine grained, well sorted, subrounded, trace coarse grained sand. 620.9	
	SS 37	67	6-3-3-6 (6)		72.0 Brown GRAVEL (GW), wet, subrounded, few, subrounded, coarse grained, sand, few silt. 619.9 72.5 Brown SAND (SW), wet, loose, medium to coarse grained, subrounded, moderately sorted, trace silt. 619.4	
75	SS 38	67	4-4-5-9 (9)		74.2' to 74.4', coarse grained.	#5 Filter Sand
	SS 39	67	10-7-10-16 (17)		76.5' to 76.75', coarse grained.	
	SS 40	100	11-7-9-13 (16)			
80	SS 41	54	11-7-13-21 (20)		Below 80', medium grained.	2-Inch, 0.010-Inch Slotted Screen
	SS 42	71	7-8-14-26 (22)			
85	SS 43	58	10-9-14-14 (23)		Below 84', fine to medium grained, poorly sorted, trace fine to coarse gravel.	
	SS 44	67	8-7-13-19 (20)			
					At 88', limestone cobble.	

(Continued Next Page)

CLIENT American Electric Power

PROJECT NAME Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
90	SS 45	50	12-8-8-12 (16)
	SS 46	75	15-14-18-35 (32)
	SS 47	75	18-17-17-33 (34)
95	SS 48	71	20-26-29-30 (55)
	SS 49	92	21-23-28-28 (51)
100	SS 50	67	8-10-18-30 (28)
	SS 51	71	14-13-16-46 (29)
	SS 52	83	5-9-14-23 (23)
105	SS 53	63	8-11-16-25 (27)
	SS 54	21	22-17-13-15 (30)
110	SS 55	54	6-9-14-20 (23)
	SS 56	88	6-11-13-30 (24)

MATERIAL DESCRIPTION

Brown SAND (SW), wet, loose, medium to coarse grained, subrounded, moderately sorted, trace silt. *(continued)*

90.0 — 601.9

Brown GRAVELLY SAND (SWG), wet, medium dense to dense, fine to coarse grained, poorly sorted, subrounded, fine to coarse subrounded gravel, grades to fine grained sand.

Below 96', coarse gravel, increased silt.

Below 100', decreased silt.

102.0 — 589.9

Light Brown SAND (SW), wet, loose, very fine to fine grained, well sorted, subrounded.

103.0 — 588.9

Gray SAND (SW), wet, medium dense, medium to coarse grained, moderately sorted, subrounded, trace subrounded gravel, gradational contact.

104.0 — 587.9

Light Brown SAND (SW), wet, loose, very fine to fine grained, well sorted, subrounded.

105.0 — 586.9

Gray SAND (SW), wet, medium dense, coarse grained, well sorted, subrounded, trace subrounded gravel, gradational contact.

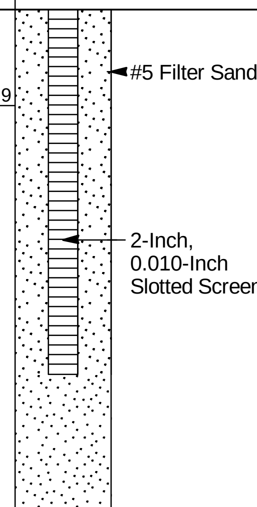
106.0 — 585.9

Light Brown SAND (SW), wet, loose, very fine to fine grained, well sorted, subrounded.

109' to 110', grades medium to coarse gained, trace gravel.

111' to 112', grades medium to coarse gained, trace gravel.

WELL DIAGRAM



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WELL NUMBER MW1509 (P-2)

CLIENT American Electric Power
PROJECT NAME Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
					Light Brown SAND (SW), wet, loose, very fine to fine grained, well sorted, subrounded. *(continued)* 112' to 114', loose to medium dense.	
	SS 57	54	4-7-11-20 (18)			
115	SS 58	88	5-14-39-30 (53)		115.5 — 576.4	
					116.0 — Light Brown SILTY CLAY (CL-ML), moist, hard, low plasticity, trace subrounded gravel, limestone cobble in bottom of spoon. — 575.9	
	SS 59	175	50/4"		116.2 — Gray LIMESTONE (BEDROCK), wet, hard. — 575.7	

Bottom of hole at 116.4 feet

Boring grouted to surface and monitoringwell installed on 11/6/2015 in offset boring.

Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

WELL NUMBER MW1510 (P-1)

CLIENT American Electric Power
PROJECT NAME Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Bottom Ash Pond, Cresap, West Virginia
DATE STARTED 11/9/15 **COMPLETED** 11/12/15
GROUND ELEVATION 678.01 ft **HOLE SIZE** 8.25"
DRILLINGCONTRACTOR AEP
TOP OF PVC ELEVATION 680.77 ft
DRILLING METHOD 4.25" I.D. HSA: Auto Hammer & Split Spoon
GROUND WATER LEVELS:
LOGGED BY D. Follett **CHECKED BY** RAS
AT END OF DRILLING ---
LOCATION Northing: 484569.80 Easting: 1599175.22

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0	SS 1	50	6-5-9-30 (14)		Gray to Brown SILTY GRAVEL (FILL), dry, loose to dense, subangular to angular.	Total Depth of P-1 offset boring 82'
	SS 2	83	15-12-19-33 (31)		3.0 — 675.0 Brown SILTY SAND (FILL), dry, medium dense to dense, fine grained, subrounded, little subrounded gravel.	
5	SS 3	71	9-16-20-28 (36)		5.0 — 673.0 Brown SAND (FILL), dry, medium dense, very fine to fine grained, subangular, well sorted, thinly bedded, trace fine subrounded gravel, trace coal. 6.0 — 672.0	Bentonite Grout
	SS 4	100	8-13-16-23 (29)		Dark Brown SILTY SAND (FILL), dry, loose to medium dense, fine to medium grained, subrounded, poorly sorted, trace subrounded gravel.	
	SS 5	96	6-10-15-26 (25)		9.0 — 669.0 9.1 — 668.9 Dark Brown SILTY CLAY (FILL), moist, firm, low plasticity, trace coal, moist to wet at 9'. Dark Brown SILTY SAND (FILL), dry, loose to medium dense, fine to medium grained, subrounded, poorly sorted, trace subrounded gravel.	
10	SS 6	100	10-11-14-12 (25)		11.0 — 667.0 Gray SAND (FILL), wet, medium dense, fine grained, subrounded, well sorted, trace subrounded gravel. 11.8 — 666.2 Dark Gray COAL (FILL), moist, soft. 12.0 — 666.0	
	SS 7	75	2-4-8-10 (12)		Gray SAND (FILL), moist, loose, fine grained, well sorted, subrounded. 12.5 — 665.5 Gray CLAYEY SAND (FILL), moist, loose, fine grained, trace coal, trace brick. 13.0 — 665.0 Light Brown to Brown SAND (FILL), dry to moist, loose to medium dense, fine to coarse grained, subrounded to subangular, poorly sorted. 14.0 — 664.0	
15	SS 8	79	4-5-5-8 (10)		Gray to Dark Gray SILTY SAND (FILL), moist, loose, fine to medium grained, subrounded, moderately sorted, some wood. 14.5 — 663.5 Light Brown SAND (SW), moist, loose, fine grained, subrounded, well sorted, trace fine subrounded gravel.	
	SS 9	83	3-3-4-6 (7)			2-Inch Solid PVC Riser
20	SS 10	88	3-4-3-5 (7)		Below 18', light brown to brown, dry to moist, bedded.	

(Continued Next Page)

CLIENT American Electric Power

PROJECT NAME Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
20	SS 11	88	4-2-3-5 (5)		Light Brown SAND (SW), moist, loose, fine grained, subrounded, well sorted, trace fine subrounded gravel. *(continued)*	
	SS 12	83	2-3-2-5 (5)			
25	SS 13	88	2-3-4-5 (7)		Below 25', coal stringers.	
	SS 14	96	3-3-5-6 (8)		27.0 / 651.0 — Light Brown SILT (ML), dry, soft, trace sand. 27.5 / 650.5	
	SS 15	79	3-3-5-7 (8)		Light Brown SAND (SW), moist, loose, fine grained, subrounded, well sorted, trace fine subrounded gravel. 28.2' to 28.4', increased silt.	
30	SS 16	38	4-5-6-9 (11)			Bentonite Grout
	SS 17	75	3-4-8-22 (12)		33.5 / 644.5 — Brown SILTY SAND (SM), dry to moist, loose to medium dense, fine grained, moderately sorted, little fine to coarse subrounded gravel. 34.0 / 644.0	
35	SS 18	75	12-22-31-38 (53)		Light Brown GRAVELLY SAND (SPG), dry to moist , medium dense to dense, medium grained, subrounded, well sorted, fine to coarse subrounded gravel.	
	SS 19	88	11-17-31-40 (48)			
	SS 20	88	10-24-29-47 (53)			
40	SS 21	96	19-27-33-45 (60)			2-Inch Solid PVC Riser
			10-17-15-			

(Continued Next Page)

CLIENT American Electric Power

PROJECT NAME Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
	SS 22	79	22 (32)		43.5 — 634.5	
					Light Brown SANDY GRAVEL (GWS), dry to moist, medium dense, fine, subrounded, medium grained sand. 44.5 — 633.5	
45	SS 23	83	5-3-13-23 (16)		Below 44', coarse gravel.	
					Brown SILT (ML), moist to wet, soft, trace mica. 45.5 — 632.5	
					Light Brown SAND (SW), dry to moist, medium dense, medium grained, subangular to subrounded, well sorted. 46.0 — 632.0	
	SS 24	83	10-9-17-22 (26)		Light Brown GRAVELLY SAND (SPG), dry to moist, loose to medium dense, subangular to subrounded, medium to coarse grained, modertaley sorted, fine to coarse gravel. 47.0 — 631.0	
					Brown SILT (ML), moist, firm, bedded, trace mica. 47.4 — 630.6	
	SS 25	83	7-11-12-17 (23)		Light Brown GRAVELLY SAND (SPG), dry to moist, loose to medium dense, subangular to subrounded, medium to coarse grained, modertaley sorted, fine to coarse gravel. 49.0 — 629.0	
50	SS 26	88	6-5-9-29 (14)		Light Brown SAND (SW), dry, medium dense, medium grained, subrounded to subangular, well sorted, bedded, trace fine subrounded gravel. 51.2 — 626.8	Bentonite Grout
					Brown SILT (ML), moist, firm, trace mica. 51.6 — 626.4	
	SS 27	88	6-3-15-22 (18)		Light Brown SAND (SW), dry, medium dense, medium grained, subrounded to subangular, well sorted, bedded, trace fine subrounded gravel. 52.5 — 625.5	Bentonite Pellets
					Brown SILT (ML), moist to wet, firm, trace mica. 53.0 — 625.0	
					Brown SAND (SW), moist to wet, medium dense, medium to coarse grained, subrounded, moderately sorted, trace fine subrounded gravel. 54.3 — 623.8	
55	SS 28	83	9-12-16-25 (28)		Brown GRAVELLY SAND (SPG), moist, loose to medium dense, fine to medium grained, subrounded, moderately sorted. 55.0 — 623.0	2-Inch Solid PVC Riser
	SS 29	92	7-14-17-18 (31)		Gray SANDY GRAVEL (GWS), wet, medium dense, fine to coarse, subrounded, coarse grained sand. 57.0 — 621.0	
					Brown SAND (SW), wet, medium dense, medium to coarse grained, subrounded, moderately sorted, few fine gravel. 58.0 — 620.0	
	SS 30	88	10-8-9-13 (17)		Gray SANDY GRAVEL (GWS), wet, medium dense, fine, subrounded, coarse sand. 59.0 — 619.0	
					Brown SAND (SW), wet, medium dense, medium grained, subrounded, well sorted. 59.5 — 618.5	
60	SS 31	100	8-10-12-26 (22)		Brown SILT (ML), wet, firm, trace mica. 60.2 — 617.8	#5 Filter Sand
					Gray SAND (SW), wet, loose, fine to coarse grained, poorly sorted, subrounded, trace subrounded gravel. 60.5 — 617.5	
					Brown SILT (ML), wet, firm, trace mica. 60.8 — 617.3	
	SS 32	100	15-8-13-14 (21)		Brown SAND (SW), wet, medium dense, medium to coarse grained, subrounded, moderately sorted. 64.7 — 613.3	2-Inch, 0.010-Inch Slotted Screen
65	SS 33	100	12-7-7-10 (14)		65.0 — 613.0 Gray SANDY GRAVEL (SPG), wet, loose, subrounded, coarse grained sand, gradational contact.	

(Continued Next Page)

Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

WELL NUMBER MW1510 (P-1)

CLIENT American Electric Power
PROJECT NAME Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
	SS 34	67	7-6-13-22 (19)
	SS 35	75	10-12-14-23 (26)
70	SS 36	83	10-14-16-18 (30)
	SS 37	83	9-14-23-37 (37)
75	SS 38	75	7-18-23-35 (41)
	SS 39	63	31-33-23-17 (56)
80	SS 40	96	14-17-20-28 (37)
	SS 41	79	16-19-18-21 (37)
	SS 42	87	14-18-22-50/5"
85	SS 43	71	24-15-10-15 (25)
	SS 44	71	11-12-16-24 (28)

MATERIAL DESCRIPTION

Brown SAND (SW), wet, loose to medium dense, medium grained, subrounded, well sorted. *(continued)*

Below 68', trace coarse subrounded gravel.

71.0 — 607.0

Brown GRAVELLY SAND (SWG), wet, medium dense, medium to coarse grained, subrounded, moderately sorted, fine subrounded gravel.

Below 73', increased silt.

74.0 — 604.0

Dark Brown SILTY GRAVEL (GM), wet, loose, fine, subrounded.

74.4 — 603.6

Brown GRAVELLY SAND (SWG), wet, medium dense, medium to coarse grained, subrounded, moderately sorted, fine subrounded gravel.

Below 76', trace coal.

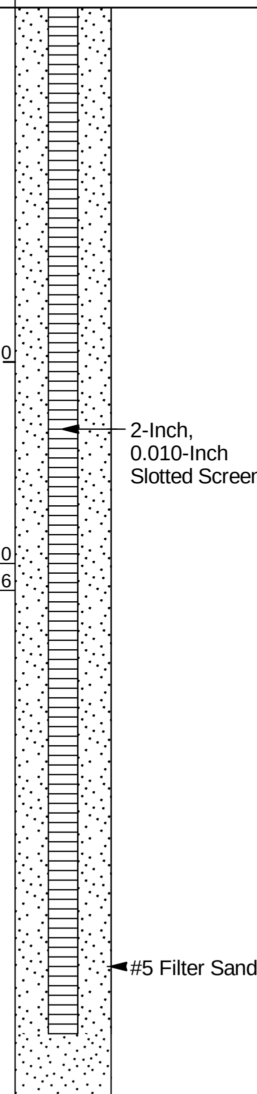
82' to 84', coarse gravel, sandstone fragments.

86.0 — 592.0

Gray SAND (SW), wet, medium dense, medium to coarse grained, subrounded, moderately sorted, trace subrounded gravel.

Below 88', brown to gray.

WELL DIAGRAM



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Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

WELL NUMBER MW1510 (P-1)

CLIENT American Electric Power
PROJECT NAME Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Bottom Ash Pond, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
	SS 45	54	10-7-11-15 (18)		Gray SAND (SW), wet, medium dense, medium to coarse grained, subrounded, moderately sorted, trace subrounded gravel. *(continued)*	
90	SS 46	75	11-8-12-21 (20)		90' to 91', brown, medium to coarse grained. 91' to 92', brown, medium to coarse grained.	
	SS 47	92	12-12-19-26 (31)		Below 92', medium grained, well sorted.	
95	SS 48	83	32-11-11-23 (22)		94' to 94.5', coarse grained. 94.5' to 94.75', few silt.	
	SS 49	100	20-14-19-31 (33)		96' to 98', medium grained, well sorted, trace subrounded gravel.	
	SS 50	100	20-15-22-34 (37)		98' to 101', grades to fine to medium grained, some silt lens.	
100	SS 51	100	16-28-50/5"		101.0 577.0	
					Gray SANDSTONE (BEDROCK), wet, hard, very fine grained.	
	SS 52	0	50/4"		102.4 575.6	
					Bottom of hole at 102.4 feet	
					Boring grouted to surface and monitoring well installed on 11/12/2015 in offset boring.	

APPENDIX C

WELL DEVELOPMENT FIELD FORMS

CEC

WELL DEVELOPMENT FORM

Well # ~~BAP-1~~ DP MW-1504

Diameter (in): 2

Initial Static DTW (ft): 70.69

Total Depth (ft): 96.98 soft

Casing Volume (g): 4.47

Date: 10/22/15-10/23/15

Developed By: Follett

Purge Method: Disposable Bailer (Stainless steel) / Grundfos

Total Gallons Removed: 20

Well Volumes Removed: 4.47

	Time	Purged	pH	(°C)	(uS)	Turb.	DTW	Comments
10/22/15	1330	Intial	–	–	–	>1000	70.69	Begin Bail from Bottom, Surge w/ Bailer
	1405	5	–	–	–	>1000	71.07	Silt & fine sand in purge water
	1445	10	–	–	–	>1000	71.07	End Bail TD = 97.26. Silt & fine sand in purge water
10/23/15	1040	10	–	–	–	>1000	70.72	TD = 97.26, begin Bail & Surge from Bottom
	1120	15	–	–	–	>1000	71.02	Silt & fine sand in purge water
	1152	20	–	–	–	>1000	71.03	TD = 97.42 End Bail

Civil & Environmental Consultants, Inc. ♦ 8740 Orion Place, Suite 100 ♦ Columbus, Ohio ♦ 42340 ♦ phone: (614) 540-6633 ♦ fax: (614) 540-6638

WELL DEVELOPMENT FORM

MW-1504

Well # ~~MW-1501~~ DP

Diameter (in): 2

Initial Static DTW (ft): 70.48

Total Depth (ft): 97.32

Casing Volume (g): 4.38

Date: 12/8/15 - 12/9/15

Developed By: Chelsea Fleming / Dave Follett

Purge Method: Disposable Bailer / Grundfos (circled)

Total Gallons Removed: 667.5

Well Volumes Removed: ~152.40

	Time	Purged	pH	(°C)	(uS)	Turb.	DTW	Comments
12/8/15	1420	Intial	7.21	15.9	1565	>1000	70.48	Pump On Rate 1.5 GPM Pump set at 92'
	1500	45	7.10	16.1	1259	117	70.68	Pump set at 88'
	1600	135	7.06	15.9	1236	30.0	70.70	Pump set at 84'
	1640	195	7.07	15.8	1225	64.9	70.74	Pump off
12/9/15	0815	195	7.13	15.1	1241	>1000	70.51	Pump on, Rate 1.5 GPM, Pump Set at 91'
	0845	240	7.19	15.0	1259	170	70.69	Rate 2.0 GPM
	0930	307.5	7.19	14.6	1203	31.9	70.65	set pump @ 88'
	0950	337.5	7.23	14.5	1215	12.7	70.65	set pump to 87'
	1030	397.5	7.29	14.4	1220	11.2	70.65	set pump to 86'
	1110	457.5	7.28	14.3	1230	9.1	70.65	set pump to 85'
	1140	502.5	7.29	14.2	1245	25.2	70.65	set pump to 84'
	1320	652.5	7.20	14.3	1250	11.1	70.65	set pump to 87'
	1325	660.0	7.18	14.3	1245	8.1	70.65	
	1330	667.5	7.22	14.3	1240	9.7	70.65	pump off
			7			~~8.8~~		

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* See MW-8 12-9-15 for cal info

* See P-2 12-8-15 for cal. info

Page 1 of 2

WELL DEVELOPMENT FORM

Well #	~~MW-1502 DA~~ MW-1505
Diameter (in):	2
Initial Static DTW (ft):	69.67
Total Depth (ft):	98.29
Casing Volume (g):	4.87

Cal
pH: 4.01 = 4.01
7.0 = 7.0
10.01 = 10.01
1413 us = 1413 us
10.0 ntu = 9.5 ntu

Date:	12/7/15
Developed By:	Follett
Purge Method:	Disposable Bailer / Grundfos
Total Gallons Removed:	~~DA 585.0~~ 765.0
Well Volumes Removed:	~~DA 120.12~~ 157.1

Time	Purged	pH	(°C)	(uS)	Turb.	DTW	Comments
0928	Initial	6.96	18.3	1862	>1000	69.67	Pump In/Pump On Rate 1.5 gal/min
0943	22.5	6.96	18.6	2020	601	69.68	Surged w/Pump
0958	45.0	—	—	—	—	—	Pump off
1041	45.0	7.00	18.3	1839	>1000	69.75	Pump On Rate 1.5 gal/min / Pump top of Screen
1056	67.5	7.00	18.9	1885	927	69.87	
1126	112.5	7.00	18.8	1995	378	69.81	Rate 1.25 gal/min
1140	130.0	—	—	—	—	—	Pump placed middle of Screen/Pump off
1240	130.0	7.10	18.6	1994	>1000	~~71.00~~ 69.83	Grundfos Pump Installed, pump on 1.25 GPM
1310	167.5	6.99	19.4	1981	382	69.81	Rate 1.75 GPM Pump set @ 90' TOC
1400	255.0	7.12	19.3	1983	332	69.84	Rate 2.0 GPM Pump set @ 83' TOC
1430	315.0	7.04	19.3	1994	590	69.87	Pump set at 86' TOC
1445	345.0	7.05	19.5	2010	>1000	69.87	
1500	405.0	7.04	19.8	1996	35	69.87	Pump set at 90'
1515	465.0	7.06	20.0	2000	>1000	69.87	
1530	525.0	7.04	19.7	2000	258	69.87	Pump set at 93'
1545	585.0	7.05	19.8	2000	>1000	69.87	

WELL DEVELOPMENT FORM

Well # MW-1505 ~~MW-1502~~ DF
Diameter (in): 2
Initial Static DTW (ft): 69.67
Total Depth (ft): 98.29
Casing Volume (g): 4.87

Date: 12/7/15
Developed By: Follett
Purge Method: Disposable Bailer / Grundfos (circled)
Total Gallons Removed: 765.0
Well Volumes Removed: 157.1

Time	Purged	pH	(°C)	(uS)	Turb.	DTW	Comments
1600	645.0	7.04	19.9	2010	379	69.88	Pump @ 90' TOC
1615	705.0	7.04	19.9	1996	617	69.88	Pump set @ 85' TOC
1630	765.0	7.05	19.8	1995	736	69.88	Pump off

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WELL DEVELOPMENT FORM

Well # ~~BAP-2~~ DP MW-1505
Diameter (in): 2
Initial Static DTW (ft): 69.88
Total Depth (ft): 97.77 soft
Casing Volume (g): 4.74

Date: 10/30/15
Developed By: Follett
Purge Method: Disposable (Stainless Steel Bailer) / Grundfos
Total Gallons Removed: 20
Well Volumes Removed: 4.22

10/30/15

Time	Purged	pH	(°C)	(uS)	Turb.	DTW	Comments
0900	Initial	–	–	–	>1000	69.88	Begin Bail from Bottom/Surge w/ Bailer
0928	5	–	–	–	>1000	70.45	Silt & Fine Sand in Purge, end Bail
1153	5	–	–	–	>1000	69.91	Begin Bail from Bottom, Surge w/ Bailer
1226	10	–	–	–	>1000	70.14	Silt & Fine Sand in purge
1253	15	–	–	–	>1000	70.08	" "
1320	20	–	–	–	>1000	70.05	End Bail

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12-7-15 Calibration @ 0845
pH: 7.00 = 7.06
4.00 = 4.00
10.00 = 10.10
SpeCond: 1413 = 1415
turb: 20.00 = 19.00

WELL DEVELOPMENT FORM

Well # ~~MW-1503~~ MW-1506 DA
Diameter (in): 2
Initial Static DTW (ft): 70.02
Total Depth (ft): 99.02
Casing Volume (g): 4.93

29 x 0.17 = 4.93

Date: 12/7/15
Developed By: Chelsea Fleming
Purge Method: Disposable Bailer / Grundfos / Hurricane
Total Gallons Removed: 505
Well Volumes Removed: ~~≈104~~ ~102.43

Time	Gallons Purged	pH	(°C)	(uS)	Turb.	DTW	Comments
0925	Initial	7.58	17.0	1860	>1000	70.02	surged pump 1.25 gpm
0929	5.00	7.21	19.9	2400	>1000	70.13	
0934	10.00	7.16	19.3	1845	>1000	"	
0939	15.00	7.14	19.9	1754	>1000	"	
0944	20.00	7.15	20.0	1828	>1000	"	
0949	25.00	7.16	20.0	1840	>1000	"	pump stopped working; changed motor
~~1030~~ 1020	~~40.00~~ 35.00	4.70	18.0	1813	>1000	"	start pump again 1.00 gpm
1043	48.00	7.01	18.8	1819	533	"	
1055	60.00	7.03	18.6	2050	219	"	surge pump
1110	75.00	7.10	18.3	1818	87.0	"	surge pump
1125	90.00	7.12	18.9	2300	78.5	"	"
1140	105.00	7.13	18.9	1789	377	"	
1200	125.00	7.12	19.1	1787	20.8	"	
1240	165.00	7.12	18.8	1788	14.88	"	
1300	185.00	7.12	18.9	1791	7.88	"	remove Monsoon pump / install grundfos
1320	185.00	7.12	18.9	1800	>1000	"	

WELL DEVELOPMENT FORM

Well # ~~MW-1503 DP~~ MW-1506
Diameter (in): 2
Initial Static DTW (ft): 70.02
Total Depth (ft): 99.02
Casing Volume (g): 4.93

29 x 0.17 = 4.93

Date: 12-7-15
Developed By: Chelsea Fley
Purge Method: Disposable Bailer / Grundfos Hurricane
Total Gallons Removed: 505
Well Volumes Removed: ~102.43

Time	Gallons Purged	pH	(°C)	(uS)	Turb.	DTW	Comments
1355	220	7.14	19.8	1780	31.2	70.13	
1410	235	7.14	19.9	1798	54.7	"	changed to 2 gallons
1420	255	7.11	19.8	1815	~~5~~540	"	
1450	315	7.14	19.8	1816	671	"	moved pump down 5'
1505	345	7.14	20.0	1791	281	"	
1525	385	7.14	20.0	1791	11.80	"	Moved pump down 5'
1540	415	7.13	20.1	1793	>1000	"	lower pump 5'
1600	455	7.16	20.1	1787	196	"	
1610	475	7.14	20.1	1790	17.38	"	
1625	505	7.11	20.2	1791	16.99	"	pump off

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WELL DEVELOPMENT FORM

Well # ~~BAP-3~~ DP MW-1506
Diameter (in): 2
Initial Static DTW (ft): 70.23
Total Depth (ft): 98.11 soft
Casing Volume (g): 4.74

Date: 10/26/15 - 11/5/15
Developed By: Follett
Purge Method: Stainless steel Bailer / Grundfos (printed: Disposable Bailer / Grundfos)
Total Gallons Removed: 20
Well Volumes Removed: 4.22

	Time	Purged	pH	(°C)	(uS)	Turb.	DTW	Comments
10/26/15	1205	Intal	—	—	—	>1000	70.23	Begin Bail from Bottom, Surge w/Bailer
	1256	5	—	—	—	>1000	70.51	Silt & Sand in purge water
	1325	10	—	—	—	>1000	70.64	End Bail TD=99.07
11/5/15	1115	10	—	—	—	>1000	70.24	TD=99.06; Begin Bail from Bottom
	1142	15	—	—	—	>1000	70.51	
	1214	20	—	—	—	>1000	70.50	TD=99.08, End Bail

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WELL DEVELOPMENT FORM

Well # ~~BAR-4~~DP MW-1507

Diameter (in): 2

Initial Static DTW (ft): 70.91

Total Depth (ft): 97.17 so ft

Casing Volume (g): 4.46

Date: 11/6/15

Developed By: Follett

Purge Method: ~~Disposable~~ Stainless steel Bailer / Grundfos

Total Gallons Removed: 20

Well Volumes Removed: 4.48

	Time	Purged	pH	(°C)	(uS)	Turb.	DTW	Comments
11/6/15	0825	Initial	—	—	—	>1000	70.91	Begin Bail From Bottom, Surge w/ Bailer
	0900	5	—	—	—	>1000	71.15	
	0944	10	—	—	—	>1000	71.08	
	1017	15	—	—	—	>1000	71.06	
	1051	20	—	—	—	>1000	71.03	End Bail TD= 97.77

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CEC

WELL DEVELOPMENT FORM

Well #: ~~B-MW-1504~~ MW-1507
Diameter (in): 2
Initial Static DTW (ft): 70.69
Total Depth (ft): 97.78
Casing Volume (g): 4.42

97.78 end TD

Date: 12/8/15
Developed By: Chelsea Fleming/Dave Fillett
Purge Method: Disposable Bailer / Grundfos (circled)
Total Gallons Removed: 342.5
Well Volumes Removed: ~ 77.49

Time	Purged	pH	(°C)	(uS)	Turb.	DTW	Comments
0820	Initial	6.87	17.6	2370	>1000	70.69	Pump on Rate 1.0 GPM
0840	10	7.04	18.2	2470	~~289~~ >1000	70.69	
0900	30	7.08	17.9	2390	>1000	70.69	
0910	40	7.05	18.0	2500	207	70.69	move pump up 5'
0930	60	7.06	18.1	2400	>1000	70.69	
0950	80	7.11	18.7	2490	370	70.69	Pump off
1020	80	7.17	18.7	2460	586	70.69	Pump on, rate 1.0 GPM
1100	120	7.08	18.3	2520	>1000	70.69	Move pump down 5'
1135	155	7.07	18.4	2620	>1000	70.69	move pump down 5' (TOP 90.60)
1145	165	7.01	18.6	2620	187	70.69	turned pump up to 1.5 gpm
1225	225	7.03	18.4	2560	>1000	70.69	Move pump to 86'
1300	277.5	7.06	18.5	2580	43.9	70.69	
1315	300.0	7.04	18.5	2580	29.2	70.69	
1320	0327.5	7.07	18.6	2590	22.1	70.69	
1325	335	7.08	18.6	2590	21.9	70.69	
1330	342.5	7.06	18.6	2580	20.8	70.69	pump off

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See P-2 For Cal. Info

WELL DEVELOPMENT FORM

Well # ~~BAP 5~~.DP MW-1508

Diameter (in): 2

Initial Static DTW (ft): 61.57

Total Depth (ft): 87.78 s.At

Casing Volume (g): 4.46

Date: 10/22/15 - 11/11/15

Developed By: Follett

Purge Method: Disposable Bailer Stainless Steel / Grundfos

Total Gallons Removed: 30

Well Volumes Removed: 6.73

	Time	Purged	pH	(°C)	(uS)	Turb.	DTW	Comments
10/22/15	1530	Initial	—	—	—	>1000	61.57	Begin Bail from Bottom/Surge w/Bailer
	1602	5	—	—	—	>1000	62.31	Fine sand & silt in purge water
	1627	10	—	—	—	>1000	62.29	TD=89.12 End Bail
10/23/15	1222	10	—	—	—	>1000	61.57	TD=89.05 Begin Bail & Surge from Bottom
	1254	15	—	—	—	>1000	62.05	Fine sand & silt in purge water
	1321	20	—	—	—	>1000	62.07	TD=89.92 End Bail
11/11/15	1427	20	—	—	—	>1000	61.61	TD=89.82, Begin Bail from Bottom
	1455	25	—	—	—	>1000	62.03	
	1521	30	—	—	—	>1000	62.09	TD=89.95 End Bail

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WELL DEVELOPMENT FORM

Well # ~~MW-1505 DP~~ MW-1508
Diameter (in): 2
Initial Static DTW (ft): 61.34
Total Depth (ft): 89.85
Casing Volume (g): 4.65

Date: 12/8/15
Developed By: Follett
Purge Method: Disposable Bailer / (Grundfos)
Total Gallons Removed: 806.25
Well Volumes Removed: ~173.39

Time	Purged	pH	(°C)	(uS)	Turb.	DTW	Comments
0917	Initial	7.12	15.1	1959	71000	61.34	Pump On Rate 1.5 GPM, Pump set at 80'
0935	27.0	7.11	15.1	1481	159	61.70	Pump set at 78'
1000	64.5	7.18	14.9	1503	91.5	61.70	Pump set at 73' Rate 2.25 GPM
1045	165.75	7.15	14.6	1499	154	61.82	Pump set at 81'
1145	300.75	7.16	14.7	1499	~~18~~ 32.2	61.75	Pump set at 85'
1245	435.0	7.13	15.3	1524	27.0	61.85	Pump set at 85'
1305	480.0	7.16	15.3	1534	44.1	61.89	Pump set at 85'
1405	615.0	7.11	15.8	1515	85.8	61.89	Pump set at 80'
1440	693.75	7.14	15.4	1548	26.0	61.89	Pump set at 75'
1520	783.75	7.06	15.4	1516	43.5	61.89	
1525	795.0	7.06	15.4	1523	37.0	61.89	
1530	806.25	7.05	15.4	1527	23.8	61.89	Pump off
~~1600 DF~~							

* See P-2 12-8-15 for cal info

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WELL DEVELOPMENT FORM

Well # ~~R-2DP~~ P-1
Diameter (in): 2
Initial Static DTW (ft): 56.34
Total Depth (ft): 84.25
Casing Volume (g): 4.55

Date: 12/8/15 - 12-9-15
Developed By: Chelsea Fleming / Dave Follett
Purge Method: Disposable Bailer / Grundfos (circled)
Total Gallons Removed: 552.5
Well Volumes Removed: ~121.43

Time	Purged	pH	(°C)	(uS)	Turb.	DTW	Comments
1115	Initial	7.09	12.6	1824	>1000	56.34	Start Bail / Surge from Bottom
1130	5.0	7.09	12.4	1765	>1000	56.70	End Bail, TD = 84.75'
12/9/15 0755	5.0	7.04	14.2	1866	>1000	56.40	Pump Set at 80.6' Rate 1.5GPM
0825	50.0	7.06	14.3	1885	30.5	56.62	Set pump at 79.0'
0855	95.0	7.08	14.5	1901	9.44	56.59	Set Pump at 78'
0915	110.0	7.06	14.3	1865	11.8	56.60	Set pump to 77'
0940	147.5	7.21	14.4	1850	16.8	56.60	set pump to 76'
1010	192.5	7.23	14.3	1840	4.2	56.61	set pump to 75'
1040	237.5	7.24	14.3	1846	3.7	56.60	set pump to 74'
1120	297.5	7.26	14.3	1880	3.6	56.60	set pump to 73'
1200	357.5	7.22	14.4	1888	4.9	56.60	set pump to 72'
1235	410	7.18	14.3	1890	5.1	56.60	set pump to 71'
1315	470	7.18	14.4	1880	5.3	56.60	set pump to 67
1400	537.5	7.19	14.4	1900	5.7	56.60	
1405	545	7.16	14.4	1888	6.9	56.60	
1410	552.5	7.18	14.3	1880	4.7	56.60	pump off

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~~* See R-2 12-8~~
See MW-8 12-9-15 for cal info

CEC

WELL DEVELOPMENT FORM

Well # P-2

Diameter (in): 2

Initial Static DTW (ft): 70.58

Total Depth (ft): 97.74

Casing Volume (g): 4.62

Date: 11/11/15

Developed By: Follett

Purge Method: Stainless Steel ~~Disposable~~ Bailer / Grundfos

Total Gallons Removed: 20

Well Volumes Removed: 4.33

Time	Purged	pH	(°C)	(uS)	Turb.	DTW	Comments
11/11/15 1155	Intial	—	—	—	>1000	70.58	Begin Bail from Bottom
1226	5	—	—	—	>1000	70.90	fine silt & sand in Bailer
1257	10	—	—	—	>1000	70.75	" "
1330	15	—	—	—	>1000	70.71	" "
1401	20	—	—	—	>1000	70.68	TD=97.82 End Bail

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WELL DEVELOPMENT FORM

Cal
pH 4.01 = 4.01
7.0 = 7.0
10.01 = 10.01
1413 us = 1413 us
10.0 ntu = 10.5 ntu

Well # P-2
Diameter (in): 2
Initial Static DTW (ft): 70.35
Total Depth (ft): 97.80
Casing Volume (g): 4.47

Date: 12/8/15
Developed By: Dave Follett / Chelsea Fleming
Purge Method: Disposable Bailer / Grundfos (circled)
Total Gallons Removed: 411.5
Well Volumes Removed: 92.06

Time	Purged	pH	(°C)	(uS)	Turb.	DTW	Comments
816	Initial	6.89	16.9	2420	>1000	70.35	Pump On Grundfos Rate 1.0 GPM
0840	24	7.05	18.4	2390	86.7	70.35	Pump Set at 90'
0855	39	7.11	18.3	2510	36.3	70.35	
0915	59	7.12	18.6	2480	168	70.35	move pump up 5 ft
0930	74	7.10	18.7	2510	>1000	70.35	
0945	89	7.07	17.9	2520	560	70.35	
1015	119	7.08	18.5	2180	154	70.40	Pump Set at 80' Rate 1.5 GPM
1055	~~15~~ 179	7.04	18.7	2390	>1000	70.40	move pump down ~~85~~ 83'
1125	224	7.10	18.3	2400	>1000	70.40	move pump down ~~86~~ 88'
1220	306.5	7.10	18.3	2410	84.00	70.40	~~Move 89.9'~~ move pump to 89.75 (TOP)
1300	366.5	6.87	18.3	2220	252	70.40	
1310	381.5	7.11	18.1	2250	153	70.40	
1320	396.5	7.10	18.1	2280	118	70.40	
1325	411.5	7.11	18.1	2290	85.8	70.40	Pump off TD = 97.80'

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WELL DEVELOPMENT FORM

Well # MW-8
Diameter (in): 2
Initial Static DTW (ft): 39.35
Total Depth (ft): 62.27
Casing Volume (g): 3.70

Date: 12-8/9-15
Developed By: Chelsa Fleming / Dave Follett
Purge Method: Disposable Bailer / Grundfos
Total Gallons Removed: 354
Well Volumes Removed: ~95.68

	Time	Purged	pH	(°C)	(uS)	Turb.	DTW	Comments
12-8-15	1215	Initial	7.02	14.3	2360	>1000	39.35	Begin Bail from Bottom
	1230	4.0	7.04	14.3	2310	>1000	39.40	End Bail TD=62.27
	1405	4.0	7.09	15.9	2870	>1000	39.70	install pump; start purge @ 16 gpm @ 55.85' TOP
	1410	9.00	7.08	15.9	2930	>1000	39.70	
	1415	14.00	7.07	15.9	2980	467	39.70	
	1425	24.00	7.09	16.1	2780	146	39.70	
	1435	34.00	7.08	16.0	2609	96.2	39.70	surged well
	1445	44.00	7.06	16.3	2780	12.01	40.35 ~~39.70~~	~~surged well~~ switched to 1.5 gpm
	1500	66.5	7.06	16.3	2900	20.0	~~39.70~~	surged well
	1515	89.00	7.08	16.3	2980	24.8	~~39.70~~	~~surged well~~
	1530	111.5	7.06	16.3	2940	691.00	~~39.70~~	surged well
	1600	156.5	7.07	16.3	2890	120.1	~~39.70~~	
	1625	194	7.08	16.1	2890	34.1	~~39.70~~	well started pumping @ 1 gallon per min
	1635	204	7.04	16.3	2840	2.70	~~39.70~~	1.5 gpm
~~12-9-14~~	1650	226.5	7.06	16.1	2880	1.89	40.45	end purge
12-9-15	0750	226.5	7.20	15.6	2900	273	40.12	start purge @ 1.5 gpm

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* see P-2 12-8-15 for cal. info

12-9-15 calibration info:
pH: 7.00 = 7.06
4.00 = 4.04
10.00 = 10.13
Spec Cond: 1413 = 1420
turb: 20.00 = 19.88

WELL DEVELOPMENT FORM

Well # MW-8
Diameter (in): 2
Initial Static DTW (ft): 39.35
Total Depth (ft): 62.27
Casing Volume (g): 3.70

Date: 12-8-15 / 12-9-15
Developed By: Chelsea Flemy / Dave Follett
Purge Method: Disposable Bailer / Grundfos
Total Gallons Removed: 354
Well Volumes Removed: ≈95.68

12-9-15

Time	Purged	pH	(°C)	(uS)	Turb.	DTW	Comments
0820	271.5	6.98	15.6	2900	2.41	40.21	1.5 gpm
0840	301.5	7.01	15.4	2890	2.14	40.21	
0900	331.5	7.04	15.3	2900	1.17	40.21	
0905	339	7.01	15.3	2860	0.97	40.21	
0910	346.5	7.02	15.3	2870	0.63	40.21	
0915	354.0	7.02	15.3	2860	0.59	40.21	pump off

Civil & Environmental Consultants, Inc. ♦ 8740 Orion Place, Suite 100 ♦ Columbus, Ohio ♦ 42340 ♦ phone: (614) 540-6633 ♦ fax: (614) 540-6638

* See p-2 12-8-15 for cal info

CCR GROUNDWATER MONITORING SYSTEM DEMONSTRATION

MITCHELL LANDFILL
MITCHELL POWER GENERATION PLANT
MARSHALL COUNTY, WEST VIRGINIA

Prepared For:
KENTUCKY POWER COMPANY
d/b/a AMERICAN ELECTRIC POWER, INC.
COLUMBUS, OHIO

Prepared By:
CIVIL & ENVIRONMENTAL CONSULTANTS, INC.
CINCINNATI, OHIO

CEC Project 110-416

MARCH 2016

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APPENDICES

1.0 OBJECTIVE

This report has been prepared for Kentucky Power Company d/b/a American Electric Power, Inc. (AEP) to demonstrate that the Mitchell Landfill, a Coal Combustion Residuals (CCR) Unit by definition of the United States Environmental Protection Agency (USEPA) CCR Rule which has been published in the Federal Register (FR) on April 17, 2015 and is an extension of the current Code of Federal Rules (CFR) Title 40, Part 257 (§257), meets or exceeds the requirements for Groundwater Monitoring Systems (GMS) as defined in §257.91. Civil & Environmental Consultants, Inc. (CEC) has been contracted by AEP to provide a qualified Professional Engineer to certify compliance with the GMS requirements.

2.0 BACKGROUND INFORMATION

Kentucky Power Company (KPC), a subsidiary of AEP, owns and operates the Mitchell Power Generation Plant. This facility is located along West Virginia Route 2 near the City of Cresap, West Virginia as shown on Figure 1 – Site Location Map. The mailing address of the Mitchell Power Generation Plant is P.O. Box K, Moundsville, WV 26041-0961.

The Mitchell Power Generation Plant uses bituminous coal as the primary fuel source for its two steam-turbine electric generating units. The total electric production capacity of this plant is 1,600 megawatts. Processes and equipment that control air emissions from the coal fired units generate CCRs comprised of fly ash, bottom ash and Flue Gas Desulfurization (FGD) gypsum. CCRs that are not beneficially used, primarily fly ash, are disposed of at an off plant site CCR Unit identified as the Mitchell Landfill, which is a solid waste landfill that is owned and operated by KPC. Mitchell Landfill is classified as a Class F Industrial Landfill Facility by the West Virginia Department of Environmental Protection (WVDEP) Division of Water and Waste Management (DWWM). The landfill was designed, permitted and operates in accordance with the WV Code of State Rules, Title 33, Series 1-Solid Waste Management Rule (33CSR1) and a Solid Waste/National Pollutant Discharge Elimination System (SW/NPDES) Permit that was approved by the WVDEP on May 29, 2013 (Permit No. WV0116742). In addition, the WVDEP issued a State 401 Water Quality Certification (No. 12011) on January 10, 2013 and the United States Army Corps of Engineers (USACE) issued a Clean Water Act Section 404 permit (No. 2011-1499) on February 25, 2013. These permits provide the regulatory authority to impact aquatic resources including wetlands, streams and a pond.

The following subsections provide a summary of the Mitchell Landfill CCR Unit.

2.1 CCR UNIT LOCATION

Mitchell Landfill is located along Gatts Ridge Road (Marshall County Road 72), approximately 2 miles north of the intersection with County Road 74 (about 2 miles due east of the Mitchell Power Generation Plant). The approximate location of Mitchell Landfill is depicted on Figure 1 – Site Location Map and Figure 2 – Plant and CCR Unit Location Map. The center of Mitchell Landfill is located at the following coordinates:

- Latitude: 39 degrees 49 minutes 37 seconds North
- Longitude: 80 degrees 46 minutes 32 seconds West

2.2 DESCRIPTION OF CCR UNIT

Mitchell Landfill provides a maximum disposal capacity of about 10 million cubic yards of excess CCR produced from the Mitchell Power Generating Plant that is not beneficially reused.

The overall landfill boundary comprises about 169.6 acres with CCR being placed within a footprint of 57.6 acres (the CCR Unit disposal area is depicted on Figure 2 – Plant and CCR Unit Location Map). The landfill will be operated in 5 Phases with Phases 1 through 4 completing the maximum CCR Unit disposal footprint and Phase 5 comprising CCR placement atop the first four phases. Figure 3 – CCR Unit and Monitoring Wells, depicts the approximate boundary of the 5 Phases. Each phase of the landfill has an estimated design life that varies from about 4 to 8 years. The expected life of the landfill is 24 years, based on the current estimated average yearly CCR production rates and beneficial use quantities.

In addition to the CCR disposal footprint, the CCR Unit includes several appurtenant structures that include: 1) a perimeter haul road; 2) a leachate storage pond; 3) three stormwater ponds (identified as South, West and North Ponds); and, 4) a Maintenance Building. Figure 3 – CCR Unit and Monitoring Wells, depicts the CCR Unit boundary, the landfill disposal footprint and the appurtenant structures.

2.2.1 Engineering Systems

The landfill was designed and constructed to protect the environment in accordance with the WVDEP Class F Industrial Landfill requirements. To meet these requirements, Mitchell Landfill includes several engineering controls which consist of: 1) a groundwater interceptor drainage system; 2) a composite liner system; 3) a leachate collection system; and, 4) a surface water management system. These engineering systems are summarized below.

2.2.1.1 Groundwater Interceptor Drainage System

The groundwater interceptor drainage system for the landfill is a combination of pipes and aggregate drains that collect and direct groundwater from beneath the liner system to a discharge point beyond the landfill limits. This system is designed to accommodate natural groundwater volumes and the potential increased groundwater volume that may result from future hydrostatic conditions associated with future pool level increases for the Conner Run Impoundment, owned by Coal Consolidation Company and operated by Murray Energy, that is positioned in the adjacent valley west of the landfill.

2.2.1.2 Composite Liner System

An impermeable barrier is constructed at the base of the Mitchell Landfill CCR Unit that is protective of groundwater and complies with the applicable WVDEP performance standards for a Class F Industrial Landfill Facility. The bottom elevations of the impermeable barrier/composite liner provide the required separation from bedrock, the seasonal high water table and the uppermost significant aquifer.

The composite liner system is comprised of the following (from top to bottom):

- 30-mil PVC geomembrane;
- Geosynthetic Clay Liner (GCL);
- A minimum 6-inch thick layer of compacted subbase soil; and,
- Structural fill or isolation soil as needed to provide the minimum separation from groundwater and bedrock.

2.2.1.3 Leachate Collection System

Mitchell Landfill has been constructed to include a leachate collection system that conveys leachate collected above the composite liner system via gravity flow to a lift station that pumps the leachate to a storage pond (denoted as the Leachate Storage Pond) via a force main. Stormwater runoff from within active landfill areas is directed to the leachate collection layer within the landfill via vertical aggregate drains (denoted as chimney drains). The leachate collection layer conveys both stormwater from the chimney drains and leachate that seeps through the CCR placed in the landfill and transports the combined flow to the lift station. The leachate collection system is designed to maintain a leachate head on the composite liner system of one-foot or less. The locations of the lift station and Leachate Storage Pond are identified on Figure 3 - CCR Unit and Monitoring Wells.

The leachate collection system within the waste placement limits (leachate collection layer) consists of the following:

- Geocomposite Drainage Net (GDN) – covers the entire bottom of the landfill and is constructed directly above the composite liner system;
- Granular Drainage Layer – non-carbonate, open graded, aggregate material constructed to a depth of 18-inches across the bottom of the landfill within the main valley axis; and,
- Leachate Collection Pipes – perforated HDPE pipes, surrounded by non-calcareous coarse aggregate and nonwoven, needle-punched geotextile, are constructed within the Granular Drainage Layer. These leachate collection pipes convey leachate collected at the base of the landfill to the lift station via gravity drainage, which is then pumped (via a force main) to the Leachate Storage Pond.

Leachate collected and transferred to the Leachate Storage Pond is beneficially reused for dust suppression within landfill waste limits, moisture conditioning of fly ash during compaction procedures or moisture conditioning at the fly ash silo storage facility. Any leachate that is not beneficially reused is transported to the Mitchell Plant Wastewater Treatment Bottom Ash Pond Complex for treatment prior to discharge into the Ohio River.

2.2.1.4 Surface Water Management System

Management of surface water that is not in contact with CCR placed in the landfill is accomplished by collection and conveyance of runoff to three stormwater detention basins: 1) South Pond; 2) West Pond; and, 3) North Pond. The South and West Ponds are utilized through all phases of the landfill life and the North Pond is utilized in Phase 3 through Phase 5. The three ponds are depicted on Figure 3 – CCR Unit and Monitoring Wells.

Site runoff generated from both un-stabilized and stabilized constructed areas (i.e., construction areas, stockpiles, temporary landfill cover and permanent landfill cover) is conveyed to the ponds via drainage channels and pipes. The collection, conveyance and ponds are designed to meet the required criteria in the referenced WVDEP regulations. The stormwater conveyed to the ponds is detained and released through a non-clogging dewatering skimmer device that allows settling of suspended solids and evacuation of the stored volume of water within a seven to eight day period.

2.2.2 Construction and Operational History

2.2.2.1 Landfill Construction

Construction of Mitchell Landfill was initiated in 2013 and Phases 1A, 1B, 2A and 2B have been completed. The landfill construction was performed in accordance with the SW/NPDES Permit (May 29, 2013), the construction drawings, technical specifications and the Quality Assurance and Quality Control Plan. Certification Reports were prepared and submitted to WVDEP in 2014 and 2015 that provide confirmation and documentation that the construction was performed in accordance with the design and permit requirements.

Construction of Phase 3 is tentatively scheduled to begin in 2018.

2.2.2.2 Landfill Operations

Mitchell Landfill began operation in July 2014 and is currently receiving CCRs from Mitchell Power Generation Plant. Landfill operations, construction and monitoring are being performed in accordance with the SW/NPDES Permit.

2.2.2.3 Groundwater Monitoring

The initial groundwater monitoring well network at Mitchell Landfill was installed in 2011 and consisted of 12 wells. Figure 3 – CCR Unit and Monitoring Wells identifies the original monitoring well network with MW11OOX well names. Background groundwater quality monitoring for the 2011 wells began in February 2012 and was completed in December 2014. Sampling and analysis procedures for the background sampling program followed the Field Sampling and Analysis Plan (FSAP), dated February 2012. Operational groundwater monitoring is conducted semi-annually in accordance with the WVDEP SW/NPDES permit requirements. Groundwater quality results are statistical analyzed as part of each semi-annual groundwater monitoring event and included as part of the Operating Record. Five additional groundwater monitoring wells were installed in a southern area of the landfill facility in July 2015 to represent downgradient monitoring positions in the Rush Run Sandstone and Fish Creek Sandstone units. The approximate locations of the additional monitoring wells are depicted on Figure 3 – CCR Unit and Monitoring Wells and are denoted by MW15OOX well names. Background sampling from these additional wells will be completed by October 2017 per 40 CFR §257.94. Additional information describing the Mitchell Landfill groundwater monitoring network is provided in Sections 3.1.1.7 and 3.1.1.8.

2.3 SUPPORTING INVESTIGATIONS AND DOCUMENTS

CEC has reviewed the following documents for evaluation of compliance with the CCR GMS:

- SW/NPDES Permit Application, Mitchell Landfill, Mitchell Plant, Cresap, West Virginia, Prepared for American Electric Power, Prepared by Civil & Environmental Consultants, Inc., CEC Project 110-416, April 12, 2012.
- SW/NPDES Permit Number WV0116742, May 29, 2013. West Virginia Department of Environmental Protection, 601 57th Street, Charleston, West Virginia 25304.
- Hydrogeologic and Geotechnical Subsurface Investigation Report, Mitchell Landfill, Marshall County, West Virginia, Prepared for American Electric Power, Prepared By Civil & Environmental Consultants, February 2012.
- Field Sampling and Analysis Plan, American Electric Power, Proposed Mitchell Landfill, Moundsville, West Virginia, Prepared for American Electric Power, 1 Riverside Drive, Columbus, Ohio, Prepared by Civil & Environmental Consultants, Inc., Cincinnati, Ohio, CEC Project 110-416, February 2012.
- Background Groundwater Monitoring Report, Mitchell Landfill, Mitchell Electric Generating Plant, Marshall County, West Virginia, Prepared for American Electric Power, Prepared By Civil & Environmental Consultants, Inc., February 2014.
- Kentucky Power Company, Mitchell Plant – Landfill, SW/NPDES Permit No. WV0116742, Semi-Annual Groundwater Sampling Event. Letter report to Scott Mandirola, Director, Division of Water and Waste Management, West Virginia Department of Environmental Protection, 601 57th Street, Charleston, West Virginia 25304, October 23, 2015.
- Mine Subsidence Analysis, Mitchell Landfill, Marshall County, West Virginia, Report to American Electric Power, 1 Riverside Plaza, Columbus, Ohio 43215, Prepared by Civil & Environmental Consultants, Inc., 4274 Glendale Milford Road, Cincinnati, Ohio 45242, CEC Project 110-416-2000, February 2012.

- Operating Record, Mitchell Landfill, Mitchell Plant, Cresap, West Virginia, Prepared for AEP, Kentucky Power, Prepared by AEP Environmental Services, Land Environment & Remediation Services, August 2014.

In addition to review of the documents above, hydrogeologic information was considered from the completion of three additional core borings and the installation of five additional monitoring wells at the Mitchell Landfill in June and July 2015 (refer to Section 2.2.2.3). CEC provided oversight services to AEP for the 2015 drilling and well installation project. The wells were installed to improve the landfill monitoring well network by providing additional monitoring locations downgradient of the limits of waste in the Rush Run Sandstone and Fish Creek Sandstone units. The 2015 core borings include B-1501, B-1502 and B-1503 installed at the locations shown on Figure 3 – CCR Unit and Monitoring Wells in the southern landfill area. Nested Rush Run Sandstone and Fish Creek Sandstone monitoring wells were installed at borings B-1501 and B-1503. The Fish Creek Sandstone is incised and not present at the B-1502 boring location; thus, only a Rush Run Sandstone monitoring well was installed at B-1502. Monitoring well boring logs and well as-built information for both the 2011 and 2015 well installation projects are provided in Appendix A. Additional information describing the current Mitchell Landfill groundwater monitoring network is provided in Section 3.1.1.7.

2.4 HYDROGEOLOGIC SETTING

A site-specific subsurface investigation was conducted in the area of the Mitchell Landfill to support the Class F Industrial Landfill Facility Application, submitted and approved by WVDEP, as well as to support the various engineering analyses and design of the landfill. The hydrogeologic and geotechnical subsurface investigation was completed to meet the requirements of 33CSR1, subsection 3.8 of Rule 33-1-3 Solid Waste Facility Permitting Requirements. The corresponding summary report is identified as the Hydrogeologic and Geotechnical Subsurface Investigation Report (HGSIR), Mitchell Landfill, dated February 2012.

The purpose of the subsurface investigation was to characterize the in-situ soil and bedrock types and properties, as well as determine the hydrogeologic features and conditions within the planned landfill limits. The investigation was comprised of site reconnaissance, soil and rock borings, test pits, monitoring well installation and development, geophysical logging, pressure packer testing, in-situ hydraulic conductivity testing and laboratory testing of selected soil and rock samples. The information developed from the field and laboratory programs associated with the subsurface investigation provided the basis for conclusions regarding the subsurface soil and bedrock profile characterizations, the hydrogeologic evaluation and geotechnical engineering properties associated with the in-situ soils/bedrock, recompacted borrow soils and CCR materials.

Subsurface boring information from the supplemental monitoring well borings B-1501, B-1502, and, B-1503 confirmed previous hydrogeologic data contained in the HGSIR as summarized in Section 3.1.1.

2.4.1 Climate

Climatic data for Mitchell Landfill is summarized as follows:

Average monthly temperature

Jan./July (degrees F)	**Feb./Aug.** (degrees F)	**March/Sep.** (degrees F)	**April/Oct.** (degrees F)	**May/Nov.** (degrees F)	**June/Dec.** (degrees F)
26.70	28.80	38.50	50.10	59.70	68.1
72.00	70.60	64.10	52.50	41.60	31.4

Average monthly precipitation

Jan./July (inches)	**Feb./Aug.** (inches)	**March/Sep.** (inches)	**April/Oct.** (inches)	**May/Nov.** (inches)	**June/Dec.** (inches)
2.86	2.40	3.58	3.28	3.54	3.30
3.83	3.31	2.80	2.49	2.34	2.57

Evapotranspiration

Jan./July (inches)	**Feb./Aug.** (inches)	**March/Sep.** (inches)	**April/Oct.** (inches)	**May/Nov.** (inches)	**June/Dec.** (inches)
0.603	0.467	1.022	2.826	2.477	2.315
2.485	2.087	1.607	1.633	1.349	0.896

2.4.2 Regional and Local Geologic Setting

2.4.2.1 Regional Geology

The Mitchell Landfill site lies within the regional geologic area of West Virginia known as the Appalachian Plateau Province. This region comprises the western two-thirds of the state and is characterized by relatively flat-lying bedrock containing minable coal seams. While limestone is present within the region, the beds are generally thin and discontinuous. Most of the limestone is non-marine and there are no known karst features noted in the region. Based on the Geologic Map of West Virginia (WVGES Publication: Map 25A), the bedrock in Marshall County predominantly consists of Permian age sedimentary bedrock composed of a cyclic sequences of sandstone, siltstone, claystone, shale, limestone and coal. The literature indicates that the bedrock was deposited in a wide fluvial-deltaic plain where sediment eroding from the Appalachian Mountains traveled west to be deposited in a large shallow sea in the interior of the continent (Martin, 1998). The bedrock units mapped within the vicinity of Mitchell Landfill are of Pennsylvanian/Permian age Dunkard, Monongahela and Conemaugh Groups.

The Mitchell Landfill site is located approximately 3.5 miles northwest of the Proctor Syncline which strikes to the northeast/southwest. No evidence of folding or faulting was observed during at the site during field investigations. Additional regional folds identified on the West Virginia GIS Technical Center website (http://wvgis.wvu.edu/index.php) are present southeast of the landfill site which include the New Martinsville Anticline, the Loudenville Syncline, the Washington Anticline and Nineveh Syncline all striking northeast/southwest.

According the Mine Subsidence Analysis Report (February 2012) included in the Mitchell Landfill Permit Application, the Pittsburgh coal formation rests in an elevation between approximately 420 to 460 feet above mean sea level (amsl). Ground surface elevations at Mitchell Landfill range from approximately 960 to 1,320 feet amsl; therefore, the Pittsburgh coal formation is approximately 500 to 800 feet below the ground surface.

2.4.2.2 Local Geology

The bedrock geology of the site consists of shale, claystone, siltstone, sandstone and occasional limestone and coal deposits of the Permian Age, Dunkard Group, Greene and Washington Formations. The deposits are typical of cyclothemic sedimentation common throughout the region. The predominant lithologies are shale (which accounts for approximately 47 percent) and sandstone plus siltstone (which accounts for 44 percent of the deposits), based on the bedrock encountered in borings drilled to at least 300 feet below ground surface (ft. bgs), or between approximate elevations of 1,228 to 930 amsl. Claystone, coal, limestone and soil make up less than 10 percent of the deposits. This is a much different lithology than that presented by Cross and Schemel (1956) and Barlow (1975) which suggests sandstone as the dominant lithology throughout the Greene Formation.

Site specific geologic cross sections were developed as part of the HGSIR for Mitchell Landfill. Two of these cross sections, Geologic Cross Sections C-C’ and D-D’, identified on Figure 4 – Geologic Cross Section Location Map, represent the typical hydrogeologic strata and include subsurface information from the additional monitoring well borings completed in June and July 2015. These two cross sections are depicted on Figure 5 – Geologic Cross Section D-D’, which extends west to east in the southern site area and Figure 6 – Geologic Cross Section C-C’, which extends south to north along the central valley. These cross sections identify that facies changes occur across the landfill site making it difficult to correlate bedrock units. However, a relatively persistent black and dark gray limestone bed and a black shale bed were documented at numerous locations. Therefore, these units are considered to be “marker beds” and are sufficient to identify specific bedrock units. Moreover, several thin coal seams are present which can be used to identify units. Overall, the position of the sandstone units with respect to each other and the approximate elevation of the marker beds shown on Figure 5 – Geologic Cross Section D-D' have been used to identify the bedrock units at the Mitchell Landfill site. While several sandstone units occur across the site, they are not continuous due to the incised topography, as depicted in the referenced cross sections.

Sandstone was described as gray in color, fine to medium grained and micaceous with occasional limestone inclusions. Most of the sandstone was well cemented with calcite cement and on occasion contained calcite filled fractures. The rock was hard and fresh at depth. Some zones contained interbedded sequences of sandstone and shale, or siltstone and shale.

The other predominant bedrock lithology at the site was shale. Shale unit thicknesses range from 1 to 23 feet. Small, less than ¼ inch, pyrite nodules were observed in 10 of the 22 rock cores, occurring 69 percent of the time in shale, followed by siltstone and sandstone. Pyrite occurrence was generally below an elevation of 1,180 feet amsl. Plant fossils were also observed in 15 of the 22 rock cores, occurring in shale units 81 percent of the time, the remainder being observed in siltstone.

The named sandstone units include (from bottom to top): the Hundred Sandstone; the Jollytown Sandstone; the Rush Run Sandstone; the Fish Creek Sandstone; and, the Burton Sandstone. The contacts between the sandstone units generally consist of sharp contacts to underlying dark gray and black shale with coals seams noted in the case of the Hundred and Jollytown Sandstone units. Note that the Hundred and Jollytown Sandstone units are not continuous beneath the Mitchell Landfill site. A black shale marker bed is present near the base of the Fish Creek Sandstone unit.

Based on the marker beds, bedrock appears to dip slightly to the south and southeast. Fracture and joint mapping was conducted on bedrock outcrops within and surrounding the Mitchell Landfill site. Overall, joints and fractures are oriented predominantly to the northeast between 10 and 90 degrees.

No faults were observed at or near the Mitchell Landfill site, nor are faults present according to available geologic information. As noted previously, a series of anticlines and synclines are located as near as 3.5 miles southeast of the site.

2.4.3 Uppermost Significant Aquifer

WV 33CSR1-Definitions(§33-1-2), Subsection 2.135 defines an Uppermost Aquifer to mean "the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility's permit boundary." Subsection 2.136 defines the Uppermost Significant Aquifer (USA) as "the first, uppermost aquifer encountered that is laterally persistent under the entire site and is free flowing throughout the year. This defines the aquifer that flows all twelve (12) months of the year and can be encountered under any given point on the permitted site." Based on information developed from site investigations, it has been concluded that the Rush Run Sandstone is the uppermost aquifer which meets the referenced definitions: 1) is below the landfill composite liner system; and, 2) extends laterally beyond the permitted limits of waste. Further, by definition, the Rush Run Sandstone is designated as the USA at Mitchell Landfill, as described in the referenced and approved SW/NPDES Permit issued by WVDEP. This USA designation is based on site-wide occurrence and elevation of the unit. Additional information describing the Rush Run Sandstone is provided in Section 3.1.1.

2.4.4 Surface Water and Surface Water-Groundwater Interactions

Groundwater at the site follows surface topography and bedrock bedding planes where there is a lower permeability rock type, such as a shale underlying a sandstone. Groundwater recharge is along the hilltop ridges and percolates slowly through shallow fractured bedrock into the central valley. Groundwater discharges at meager springs and seeps along the incised channels and the valley walls where bedrock subcrops are typically covered with a veneer of residual soils. Seeps within streambeds were observed during the surface water delineation and additional locations were observed during other site reconnaissance. Locations of these features were mapped using a handheld Global Position System (GPS) unit, or mapped using the site topographic map and surficial features where the GPS could not receive signals (e.g., within steep portions of the valleys). Groundwater discharging as seeps and springs, flows downslope to the unnamed tributary to Fish Creek that is at the base of the incised valley.

2.4.5 Water Users

A private water well and an abandoned hand dug well were located at the 146 Gatts Ridge Road and located within about 300 feet of Mitchell Landfill waste limits. These two wells were sealed by a WV licensed well driller on December 27, 2011 in accordance with the guidelines provided by the Marshall County Health Department. Water Well Abandonment Reports (Well Abandonment Permit No. DW-25-2011-06) were subsequently submitted to the Marshall County Health Department. Therefore, the Mitchell Landfill disposal area is not located within 1,200 feet of any public or private water well supply.

3.0 §257.91 GROUNDWATER MONITORING SYSTEM

3.1 §257.91(a) THROUGH §257.91(c) RULE DESCRIPTION

40 CFR 257.91(a) through (c) states:

(a) Performance standard. The owner or operator of a CCR unit must install a groundwater monitoring system that consists of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the uppermost aquifer that:

(1) Accurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit. A determination of background quality may include sampling of wells that are not hydraulically upgradient of the CCR management area where:

(i) Hydrogeologic conditions do not allow the owner or operator of the CCR unit to determine what wells are hydraulically upgradient; or,

(ii) Sampling at other wells will provide an indication of background groundwater quality that is as representative or more representative than that provided by the upgradient wells; and,

(2) Accurately represent the quality of groundwater passing the waste boundary of the CCR unit. The downgradient monitoring system must be installed at the waste boundary that ensures detection of groundwater contamination in the uppermost aquifer. All potential contaminant pathways must be monitored.

(b) The number, spacing and depths of monitoring systems shall be determined based upon site-specific technical information that must include thorough characterization of:

(1) Aquifer thickness, groundwater flow rate, groundwater flow direction including seasonal and temporal fluctuations in groundwater flow; and,

(2) Saturated and unsaturated geologic units and fill materials overlying the uppermost aquifer, materials comprising the uppermost aquifer and materials comprising the confining unit defining the lower boundary of the uppermost aquifer, including, but not limited to, thicknesses, stratigraphy, lithology, hydraulic conductivities, porosities and effective porosities.

(c) The groundwater monitoring system must include the minimum number of monitoring wells necessary to meet the performance standards specified in paragraph (a) of this section, based on the site-specific information specified in paragraph (b) of this section. The groundwater monitoring system must contain:

(1) A minimum of one upgradient and three downgradient monitoring wells; and,

(2) Additional monitoring wells as necessary to accurately represent the quality of background groundwater that has not been affected by leakage from the CCR unit and the quality of groundwater passing the waste boundary of the CCR unit.

3.1.1 Information Supporting Rule Compliance

3.1.1.1 Hydrostratigraphic Units

Water-bearing units at the Mitchell Landfill site include from deepest to shallowest; the Hundred Sandstone, Rush Run Sandstone, the Fish Creek Sandstone and the shallow bedrock combined with the Burton Sandstone. Shale and claystone beds and minor beds of limestone, are interspersed with the sandstone units and act as confining beds. The Fish Creek Sandstone and the Burton Sandstone are discontinuous, naturally incised sandstones which subcrop along the valley side slopes where they discharge as seeps and minor springs. Groundwater was not encountered in the Burton Sandstone above the Fish Creek Sandstone unit north and northwest of the limits of waste. The Burton Sandstone has been determined to be an inadequate monitoring unit because the unit is not water-bearing upgradient of the landfill and is naturally incised and absent downgradient of the landfill. The Burton Sandstone is not included in monitoring requirements in the WVDEP SW/NPDES Permit (May 29, 2013). Thus, this unit is not applicable for further discussion. The Fish Creek Sandstone extends downgradient of the Mitchell Landfill limits of waste in some areas; however, the unit is dissected along the centerline of the valley within the southern portion of the limits of waste. The Rush Run Sandstone is positioned below the base elevation of the Mitchell Landfill composite liner system and is designated as the USA as described in Section 2.4.3. The Hundred Sandstone is below the Rush Run Sandstone uppermost aquifer and is also naturally incised down valley from the landfill boundary. The Hundred Sandstone is not required to be monitored in compliance with the CCR Rules because it occurs below the designated uppermost aquifer, the Rush Run Sandstone; therefore, this unit will not be discussed further in this report. Additional information describing the Rush Run Sandstone and Fish Creek Sandstone hydrogeologic characteristics area provided below.

The Rush Run Sandstone is laterally persistent at the site but is naturally incised in a localized area down valley of the Mitchell Landfill limits of waste, where the unit subcrops along the central valley side slopes. The Rush Run Sandstone is a fine to medium grained, gray sandstone. The top elevation of the unit ranges from approximately 1,025 feet amsl to the south and 1,048 feet amsl to the north as shown on Figure 7 – Top of Rush Run Sandstone Contours. The bottom elevation ranges from approximately 1,009 feet amsl to the south and 1,039 feet amsl to the north and dips gently to the south. Figure 8 – Rush Run Sandstone Isopach Contours, depicts the thickness of the unit which ranges from approximately 9 feet to 32 feet. The Rush Run Sandstone at the site is positioned approximately 370 to 400 feet above the downgradient Fish Creek valley bottom; thus, groundwater discharge from the unit occurs at subcrop positions along the incised terrain in the area. Seeps and springs mapped at the Mitchell Landfill site demonstrate this condition. Shale beds above the Rush Run Sandstone provide confining aquitards that separate the unit from the landfill composite liner system. Where the upper confining aquitards have been naturally incised or removed during landfill construction in the southern portion of the central valley, structural fill and geologic isolation material have been constructed which provide the required separation between groundwater and the landfill's composite liner system. Recharge to the Rush Run Sandstone unit occurs along the hilltop ridges in the area and from leakage through the shale aquitards from overlying sandstone aquifers.

The Fish Creek Sandstone, while bisected by the valley at the landfill, has a unit thickness that ranges from 9 to 47 feet. The top elevation of the Fish Creek Sandstone ranges from approximately 1,059 feet amsl to 1,112 feet amsl. The bottom elevation ranges from approximately 1,050 feet amsl to 1,072 feet amsl dipping to the south as shown on Figure 9 – Base of Fish Creek Sandstone Contours. Figure 10 – Fish Creek Sandstone Isopach Contours, depicts the thickness of the unit which ranges from approximately 9 feet to 47 feet. The contact between the Fish Creek Sandstone and underlying deposits is marked by the presence of a dark gray and sometime black, shale occurring between approximately 1,046 and 1,052 feet amsl.

3.1.1.2 Hydraulic Conductivity

Groundwater flow through the Rush Run Sandstone and Fish Creek Sandstone units is primary through secondary porosity (fractures), especially in shallow bedrock and to a lesser extent through primary porosity. Hydraulic conductivity values generally decreased with increasing depth. This pattern of decreasing hydraulic conductivity with depth has been observed in areas where unloading of bedrock by overburden removal results in stress relief fracturing of shallower units creating secondary porosity (e.g., fractures).

A mean K value developed from the pressure packer tests within each sandstone unit was calculated and summarized below:

- Rush Run – 7.48 x 10^{-8} centimeters per second (cm/sec)
- Fish Creek – 1.37 x 10^{-7} cm/sec

Recovery and rising head/falling head tests were conducted in groundwater monitoring wells. A summary of the geometric means of K for each monitored unit are summarized below:

- Rush Run – 1.07×10^{-6} cm/sec
- Fish Creek – 1.24×10^{-7} cm/sec

Shale units, which act as aquitards limiting flow between the sandstone units, were determined to have a mean K value of 1.93×10^{-7} cm/sec based on packer tests completed at the site.

3.1.1.3 Groundwater Flow

The following paragraphs provide a general summary of the groundwater flow corresponding to each referenced sandstone unit. Groundwater elevations measured in the Rush Run Sandstone monitoring wells generally decrease from north to south at the Mitchell Landfill site. The base of this sandstone unit is marked by low permeability shale and dips to the south-southwest. Stress relief fracturing in the shallow bedrock within the valley, in conjunction with thin colluvium, provides a preferential pathway for groundwater to discharge into the valley. Based on this information, the groundwater flow direction in the Rush Run Sandstone is likely down slope with respect to local surface topography, as well as down dip on the underlying bedrock. The groundwater flow direction is likely to mimic surface topography; therefore, flowing into the central valley and generally south as depicted on Figure 11 – Rush Run Sandstone Potentiometric Surface Map.

An inward hydraulic gradient (groundwater flow toward the landfill) in the Rush Run Sandstone and overlying bedrock strata, is created by the incised bedrock topography causing groundwater to discharge as seeps and springs along the valley side slopes. The landfill underdrain system, discussed below, has been installed to collect this inward flow and subsequently improve slope stability beneath the landfill liner. Thus, most Rush Run Sandstone monitoring positions at the periphery of the site are positioned upgradient of the landfill. A relatively narrow portion of the Rush Run Sandstone that extends down slope in the central valley is downgradient of Mitchell Landfill.

The Rush Run Sandstone is a low-yield aquifer characterized by groundwater flow primarily through open fractures and joints and secondarily through interstitial pore space in the sandstone matrix. Borings completed at the site indicate that open fractures and joints are sparsely distributed in the bedrock units encountered; thus, monitoring wells installed in the Rush Run Sandstone typically yield meager quantities of groundwater that require low-flow or passive sampling techniques.

Groundwater flow in the Fish Creek Sandstone is likely to be similar to the Rush Run Sandstone where it follows surface topography into the central valley as depicted on Figure 12 – Fish Creek

Sandstone Potentiometric Surface Map. Recharge to the Fish Creek Sandstone is from leakage through the overlying shale and clay units beneath the ridges surrounding the landfill site. A portion of the groundwater likely percolates slowly and deeper into the Rush Run Sandstone.

Groundwater discharge in the landfill area occurs at the Rush Run Sandstone and Fish Creek Sandstone subcrop position in the central valley as springs and seeps along the stream channels and the valley walls. As described in Section 2.2.1.1, Mitchell Landfill is constructed with a groundwater interceptor underdrain system designed to collect seepage along the interbedded sandstone subcrop positions located below structural fill and isolation fill materials that are constructed beneath the landfill composite liner system. The underdrain system provides an engineered, non-mechanical (gravity drained) hydraulic control that assures separation between groundwater and the composite liner system. In the central valley area near the southern limits of waste, the underdrain system collects groundwater from the Rush Run Sandstone and Fish Creek Sandstone subcrops.

Initial water levels collected from Mitchell Landfill monitoring wells may be unreliable due to the low yield nature of most of the wells and may represent inflow of water that was used for pressure testing during well drilling in November and December 2011. Other than the initial two rounds of measurements, the remaining water level data appear to be representative of seasonal variations due to recharge and discharge characteristics at the Mitchell Landfill site. However, two anomalies are noted: 1) the Fish Creek Sandstone well MW1101F where there was a steep decline of approximately 49 feet from elevation 1,106 to 1,056 feet amsl, then a rebound to a relatively stable elevation of approximately 1,094 to 1,082 feet amsl, followed by a steep increase to elevation 1,122 feet amsl in April 2015 and a gentle decline to elevation 1,097 feet amsl as of November 2015; and, 2) the Rush Run Sandstone well MW1102R exhibits a steady increase in groundwater level elevation of approximately 25 feet from June 2012 to September 2013, reaching an elevation of 1054 feet amsl, followed by a decline to elevation 1,030 feet amsl and fluctuations between 1,030 and 1,040 feet amsl since October 2014. Overall, the monitoring well data indicates relatively consistent downward gradients between each of the referenced hydrostratigraphic units at the Mitchell Landfill site. The corresponding hydrographs that present water elevations from wells monitoring the Rush Run Sandstone and Fish Creek Sandstone are presented in Appendix B.

Site specific information collected during the HGSIR completed at the Mitchell Landfill site were used to calculate groundwater flow rates within the two referenced sandstone units. The calculations require median porosity values for each sandstone unit, which were determined from the neutron porosity logs and mean hydraulic conductivity values, which were derived from field testing (pressure packer, slug tests and recovery tests).

The calculated flow rates, in feet per year (ft/yr), are summarized below:

- Rush Run – 1.11 x 10^{-2} feet per year (ft/yr)
- Fish Creek – 1.23 x 10^{-2} ft/yr

3.1.1.4 CCR Rule Definition of Uppermost Aquifer

The CCR Rule definition of the Uppermost Aquifer (UA) is found in 40 CFR §257.53 and is provided below:

> *Uppermost aquifer means the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility's property boundary. Upper limit is measured at a point nearest to the natural ground surface to which the aquifer rises during the wet season.*

The CCR Rule definition of the UA is equivalent to the WV CSR definition (presented in Section 2.4.3). However, the WV CSR definition of the USA more specifically includes the laterally persistence characteristic, which is applicable to upland, naturally incised sandstone aquifers that occur at Mitchell Landfill. To comply with the GMS requirements in 40 CFR §257.91(a)(2), a laterally persistent UA must be monitored in order to accurately represent the quality of groundwater passing the waste boundary of the CCR unit. As further discussed in the following section (Section 3.1.1.5), the USA (Rush Run Sandstone) established for the Mitchell Landfill meets the criteria for being the UA at the site.

3.1.1.5 Identified On-site Uppermost Aquifer

Sandstone aquifers overlying the Rush Run Sandstone are naturally incised and are not laterally persistent below the Mitchell Landfill composite liner system. Therefore, the Rush Run Sandstone was identified in the HGSIR as the USA at Mitchell Landfill and meets the CCR Rule definition of the UA, as discussed above. The Rush Run Sandstone is laterally persistent beneath the Mitchell Landfill composite liner system with the exception of a small, localized area down valley of the Mitchell Landfill limits of waste, where the unit subcrops along the lower side slopes, near the central valley axis. This relatively small incised area does not preclude the availability to monitor the Rush Run Sandstone downgradient of the limits of waste. As depicted on Figure 11 – Rush Run Sandstone Potentiometric Surface Map, supplemental groundwater monitoring wells MW1501, MW1502 and MW1503, were installed in the Rush Run Sandstone downgradient of the Mitchell Landfill in 2015 to meet 40 CFR §257.91 requirements. The Rush Run Sandstone is a low-yield aquifer; thus, monitoring wells installed in the unit typically yield meager quantities of groundwater that require low-flow or passive sampling techniques.

3.1.1.6 Landfill Separation from the Uppermost Aquifer

The base of the Mitchell Landfill composite liner system ranges from 1,290 feet amsl in the northwestern limits to 1,038.5 feet amsl in the southern limits. Seasonal high water elevations in the Rush Run Sandstone correspondingly range from approximately 1,045 feet amsl in the northern and eastern areas to 1,010 feet amsl near the southern limits of waste placement. Separation between the landfill liner system and the top of the UA is provided by natural shale aquitards, or where the shales are incised by the placement of structural fill and geologic isolation material. Furthermore, the Groundwater Interceptor Drain System (refer to Section 2.2.1.1) provides a non-mechanical (gravity) drain at the Rush Run Sandstone subcrop position which serves as hydraulic discharge control in the southern central valley area. This underdrain system provides effective control of the seasonal fluctuations in potentiometric head beneath the composite liner including the UA. Natural shale aquitards, construction of isolation materials and the use of underdrains demonstrate that the base of the composite liner system is constructed greater than 1.52 meters (5 feet) above the Rush Run Sandstone at the Mitchell Landfill as depicted on Figure 13 – Isolation from Uppermost Aquifer Isopach.

3.1.1.7 CCR Groundwater Monitoring System

The Mitchell Landfill WVDEP SW/NPDES permit and CCR GMS groundwater monitoring well locations are shown on Figure 3 – CCR Unit and Monitoring Wells. The Mitchell Landfill CCR GMS includes only wells monitoring the Rush Run Sandstone (UA) and the overlying Fish Creek Sandstone, which were installed during completion of the HGSIR for the WVDEP SW/NPDES permit application and additional wells which were installed in June and July 2015 at downgradient monitoring locations, including three in the Rush Run Sandstone and two in the Fish Creek Sandstone. Table 1 – Summary of Monitoring Well and Piezometer Construction provides monitoring well construction details (2011 and 2015 well installations) and the upgradient and downgradient hydraulic positions relative to the limits of waste. A summary of the Mitchell Landfill CCR GMS, comprised of the Rush Run Sandstone and the overlying Fish Creek Sandstone monitoring wells is provided below:

<u>Rush Run Sandstone Monitoring Wells and Depths/Elevations</u> (measured from ground surface)

- MW1101R: 212 ft. bgs/1006.7 ft. amsl
- MW1102R: 204 ft. bgs/1022.7 ft. amsl
- MW1103R: 198 ft. bgs/1040.1 ft. amsl
- MW1104R: 212 ft. bgs/1016.7 ft. amsl
- MW1501R: 150 ft. bgs/1008.8 ft. amsl
- MW1502R: 33 ft. bgs/1012.2 ft. amsl
- MW1503R: 99 ft. bgs/1009.3 ft. amsl

Fish Creek Sandstone Monitoring Wells and Depths/Elevations (measured from ground surface)

- MW1101F: 169 ft. bgs/1050.0 ft. amsl
- MW1102F: 177 ft. bgs/1049.8 ft. amsl
- MW1103F: 179 ft. bgs/1057.4 ft. amsl
- MW1104F: 172 ft. bgs/1056.5 ft. amsl
- MW1501F: 150 ft. bgs/1052.8 ft. amsl
- MW1503F: 99 ft. bgs/1045.2 ft. amsl

Table 2 – Summary of Monitoring Well Water Levels provides seasonal water level fluctuations in the Mitchell Landfill WVDEP SW/NPDES and CCR GMS monitoring wells between October 30, 2014 and November 4, 2015. The hydraulic position of the Rush Run Sandstone and Fish Creek Sandstone monitoring wells relative to the limits of waste are provided in Figure 11 – Rush Run Sandstone Potentiometric Surface Map and Figure 12 – Fish Creek Sandstone Potentiometric Surface Map, respectively. Hydrographs of the Mitchell Landfill CCR GMS water level data are provided in Appendix B.

3.1.1.8 Background Groundwater Monitoring

At the request of AEP, CEC completed background groundwater monitoring in 2012 and 2013, which included 10 background sampling events from the 12 groundwater monitoring wells installed in 2011 for analytes required by WVDEP. Background monitoring for these wells was completed prior to acceptance of waste at the Mitchell Landfill. The objective of the background groundwater monitoring project was to develop and maintain a laboratory analytical database and perform appropriate groundwater statistical analyses to determine baseline background groundwater quality characteristics for future compliance monitoring of the landfill. Sampling and analysis procedures followed the FSAP. Background groundwater monitoring began in February 2012 and was completed in December 2013. The Mitchell Landfill construction began in November 2012 and began accepting waste in July 2014.

The Mitchell Landfill background groundwater monitoring program consisted of the following activities:

- Collection of 10 rounds of background groundwater samples from the monitoring well network prior to waste placement.
- Review and quality control evaluation of analytical data for the groundwater analytical results.

- Developed preliminary statistical evaluation of the background analytical results, including removal of data for outliers, determination of statistical trends and generation of intra-well prediction limits for the background data.

The Background Groundwater Monitoring Report (BGMR), dated February 2014, provides a summary of groundwater sampling procedures, field sampling data sheets, laboratory analytical results and statistical analyses used to evaluate background groundwater quality at the Mitchell Landfill in compliance with the WVDEP SW/NPDES permit, including the WVDEP groundwater analytical parameter list. Evaluation of the background groundwater quality data and geology of the site resulted in a recommendation for intra-well statistical analysis of future compliance groundwater monitoring data based on the variability (inter-bedding) of the rock types monitored in the monitoring wells, the discontinuous (incised) nature of the bedrock strata and the natural/spatial variation of groundwater quality at the Mitchell Landfill site. Intra-well statistical methods, which compare pre-operational, background groundwater quality data to post-operational, compliance monitoring data from individual monitoring wells, are as representative, or more representative, than that provided by upgradient wells. For the Mitchell Landfill GMS, intra-well statistical evaluation accurately represents the quality of groundwater passing the waste boundary of the CCR unit.

Additional background groundwater quality data, which will include the CCR groundwater analytes in Appendix III and IV, will be collected by October 2017 per 40 CFR §257.94 from the Mitchell GMS. Pre-operational background data are not available for the CCR analytes that are not included in the WVDEP SW/NPDES permit. However, based on the groundwater flow velocities included in Section 3.1.1.3, a potential leachate release from the southern-most limit of Phase 1 will not impact the nearest downgradient monitoring well, MW1502R (located approximately 1,000 feet south of Phase 1), prior to the completion of background monitoring of the Mitchell Landfill GMS by October 2017 per 40 CFR §257.94. Otherwise, there is the option to evaluate background data from downgradient wells using inter-well comparisons for the Rush Run Sandstone.

3.1.2 Compliance With §257.91(a) Through §257.91(c) Requirements

The Mitchell Landfill groundwater monitoring system consists of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples that: 1) accurately represent the quality of background groundwater that has not been affected by leakage from the Mitchell Landfill CCR unit; 2) accurately represent the quality of groundwater passing the waste boundary of the Mitchell Landfill CCR unit; and, 3) the monitoring well network consists of an appropriate number, spacing and depths of monitoring wells based on site-specific technical information (summarized in Section 3.1.1) that included thorough characterization of the saturated and unsaturated geologic units, aquifer thicknesses, groundwater flow rates, groundwater flow directions and seasonal/temporal fluctuations in groundwater flow. Thus, the Mitchell Landfill groundwater monitoring system complies with 40 CFR 257.91(a) through 40 CFR 257.91(c) requirements.

3.2 §257.91(d) RULE DESCRIPTION

40 CFR 257.91(d) states:

(d) ***The owner or operator of multiple CCR units may install a multiunit groundwater monitoring system instead of separate groundwater monitoring systems for each CCR unit.***

(1) The multiunit groundwater monitoring system must be equally as capable of detecting monitored constituents at the waste boundary of the CCR unit as the individual groundwater monitoring system specified in paragraphs (a) through (c) of this section for each CCR unit based on the following factors:

(i) ***Number, spacing and orientation of each CCR unit;***
(ii) ***Hydrogeologic setting;***
(iii) ***Site history; and,***
(iv) ***Engineering design of the CCR unit.***

(2) If the owner or operator elects to install a multiunit groundwater monitoring system and if the multiunit system includes at least one existing unlined CCR surface impoundment as determined by § 257.71(a) and if at any time after October 19, 2015 the owner or operator determines in any sampling event that the concentrations of one or more constituents listed in appendix IV to this part are detected at statistically significant levels above the groundwater protection standard established under § 257.95(h) for the multiunit system, then all unlined CCR surface impoundments comprising the multiunit groundwater monitoring system are subject to the closure requirements under § 257.101(a) to retrofit or close.

3.2.1 Information Supporting Rule Compliance

AEP is not proposing to install a multiunit groundwater monitoring system; therefore, this rule does not apply to Mitchell Landfill.

3.3 §257.91(e) AND §257.91(f) RULE DESCRIPTION

40 CFR 257.91(e) and (f) states:

(e) ***Monitoring wells must be cased in a manner that maintains the integrity of the***

monitoring well borehole. This casing must be screened or perforated and packed with gravel or sand, where necessary, to enable collection of groundwater samples. The annular space (i.e., the space between the borehole and well casing) above the sampling depth must be sealed to prevent contamination of samples and the groundwater.

> ***(1) The owner or operator of the CCR unit must document and include in the operating record the design, installation, development and decommissioning of any monitoring wells, piezometers and other measurement, sampling and analytical devices. The qualified professional engineer must be given access to this documentation when completing the groundwater monitoring system certification required under paragraph (f) of this section.***
>
> ***(2) The monitoring wells, piezometers and other measurement, sampling and analytical devices must be operated and maintained so that they perform to the design specifications throughout the life of the monitoring program.***

(f) The owner or operator must obtain a certification from a qualified professional engineer stating that the groundwater monitoring system has been designed and constructed to meet the requirements of this section. If the groundwater monitoring system includes the minimum number of monitoring wells specified in paragraph (c)(1) of this section, the certification must document the basis supporting this determination.

3.3.1 Information Supporting Rule Compliance

The Mitchell Landfill HGSIR describes the site hydrogeologic investigation, monitoring well installation field activities and the design, installation and development of the groundwater monitoring wells installed in 2011. Boring logs and as-built well diagrams for wells installed in 2011 and additional monitoring wells installed in 2015 are provided in Appendix A. Table 1 – Summary of Monitoring Well and Piezometer Construction provides monitoring well construction details (2011 and 2015 well installations) and the upgradient and downgradient hydraulic positions relative to the limits of waste. The Mitchell Landfill FSAP provides detailed sampling and analysis procedures for the collection and analysis of groundwater samples from the Mitchell Landfill GMS. Groundwater analytical parameters, sampling frequency and statistical evaluation procedures are prescribed in the WVDEP SW/NPDES Permit. The Mitchell Landfill BGMR provides sampling procedures, background groundwater monitoring data and initial statistical evaluations that apply to the Mitchell Landfill under the WVDEP SW/NPDES requirements, including the groundwater analytical parameter list. Additional background groundwater monitoring for the CCR analytes in Appendix III and IV will be completed by October 2017 per 40 CFR §257.94.

The Mitchell Landfill HGSIR and BGMR include detailed descriptions of the following investigations completed at the Mitchell Landfill, as summarized below.

Hydrogeologic and Geotechnical Subsurface Investigation Report

- Subsurface Exploration and Sampling Procedures
- Auger Drilling
- Rock Coring
- Test Pit Excavations
- Boring and Test Pit Logs
- Geophysical Logging
- Packer Testing
- Monitoring Well and Piezometer Installation
- Well Development
- Hydraulic Conductivity Testing
- Laboratory Testing
- Classification and Characterization of Subsurface Conditions
- Overburden Soil
- Bedrock
- Bedrock Outcrops
- Geologic Structure
- Hydrogeology
- Hydraulic Conductivity
- Groundwater Flow Direction
- Groundwater Flow Rate
- Surface Water Occurrence and Flow
- Conclusions

Background Groundwater Monitoring Report

- Groundwater Monitoring Network
- Monitoring Well Hydrographs
- Field and Laboratory Analytes
- Sample Collection Procedures

- Sampling Equipment
- Groundwater Purging and Sample Collection
- Documentation of Sampling Activities
- Field and Laboratory Analytical Results
- Statistical Evaluations
- Establishment of Background Data
- Outliers Removed
- Trend Analysis
- Burton Sandstone Trend Analysis
- Fish Creek Sandstone Trend Analysis
- Rush Run Sandstone Trend Analysis
- Hundred Sandstone Trend Analysis
- Intra-well Analysis

The FSAP provides detailed procedures for groundwater sampling and analysis at the Mitchell Landfill, as summarized below.

Field Sampling and Analysis Plan

- Data Quality Objectives Process
- Project Objectives and Intended Data Usage
- Field Parameters
- Laboratory Parameters
- Quality Assurance Objectives for Measurement Data
- Groundwater Sampling Procedures
- Sampling Equipment
- Equipment Calibration
- Decontamination
- Monitoring Well Inspection and Maintenance
- Water Level Monitoring
- Groundwater Sample Collection
- Sample Packaging and Transport
- Chain of Custody Procedures

- Quality Assurance/Quality Control Samples
- Laboratory Analytical Procedures
- Data Reduction, Validation and Reporting

3.3.2 Compliance With §257.91(e) And §257.91(f) Requirements

Mitchell Landfill groundwater monitoring wells were constructed and cased in a manner that maintains the integrity of the monitoring well borehole for the collection of groundwater samples, including: 1) the annular space above each well's sampling depth is sealed with bentonite to prevent contamination of samples and the groundwater; and 2) wells are constructed with slotted well screens surrounded by silica sand filter packs that reduce suspended solids and turbidity in the groundwater samples. Well design, installation, development and decommissioning of monitoring wells and piezometers and measurement, sampling and analytical devices are well documented in the HGSIR, FSAP, BGMR; and descriptions of additional monitoring wells installed in 2015 are documented in this report.

A CEC Certified Professional Geologist (CPG), under the supervision and direction of the certifying Professional Engineer, has been directly involved with the data collection, site characterization, well installation, and, background groundwater monitoring and has reviewed applicable information in the Operating Record. The information provided in Section 3.3.1 demonstrates that the Mitchell Landfill GMS complies with 40 CFR 257.91(e) and 40 CFR 257.91(f) requirements.

4.0 SUMMARY AND PROFESSIONAL ENGINEER'S CERTIFICATION

This CCR Groundwater Monitoring System Demonstration describes the Mitchell Landfill CCR unit, site geology and groundwater monitoring system in support of demonstrating compliance with 40 CFR §257.91 Groundwater Monitoring Systems. Section 3.0 of this report provides supporting information and conclusions demonstrating that the applicable Groundwater Monitoring System requirements have been met.

The following certification statement provides confirmation that this report was prepared by a qualified professional engineer and that there is sufficient information to demonstrate that the existing Mitchell Landfill and future expansion phases, meet the Groundwater Monitoring System requirements stated in 40 CFR §257.91.

Professional Engineer's Certification

By means of this certification, I certify that I have reviewed this CCR Groundwater Monitoring System Demonstration Report, Mitchell Landfill, Mitchell Power Generation Plant and the design, construction, operation and maintenance of Mitchell Landfill Groundwater Monitoring System meets the requirements of Section 40 CFR §257.91.

Anthony P. Amicon
Printed Name of Professional Engineer

ANTHONY P. AMICON REGISTERED APA 19206 3/16/16 STATE OF WEST VIRGINIA PROFESSIONAL ENGINEER

Signature

19206	West Virginia	06-23-2011
Registration No.	Registration State	Date

5.0 BIBLIOGRAPHY

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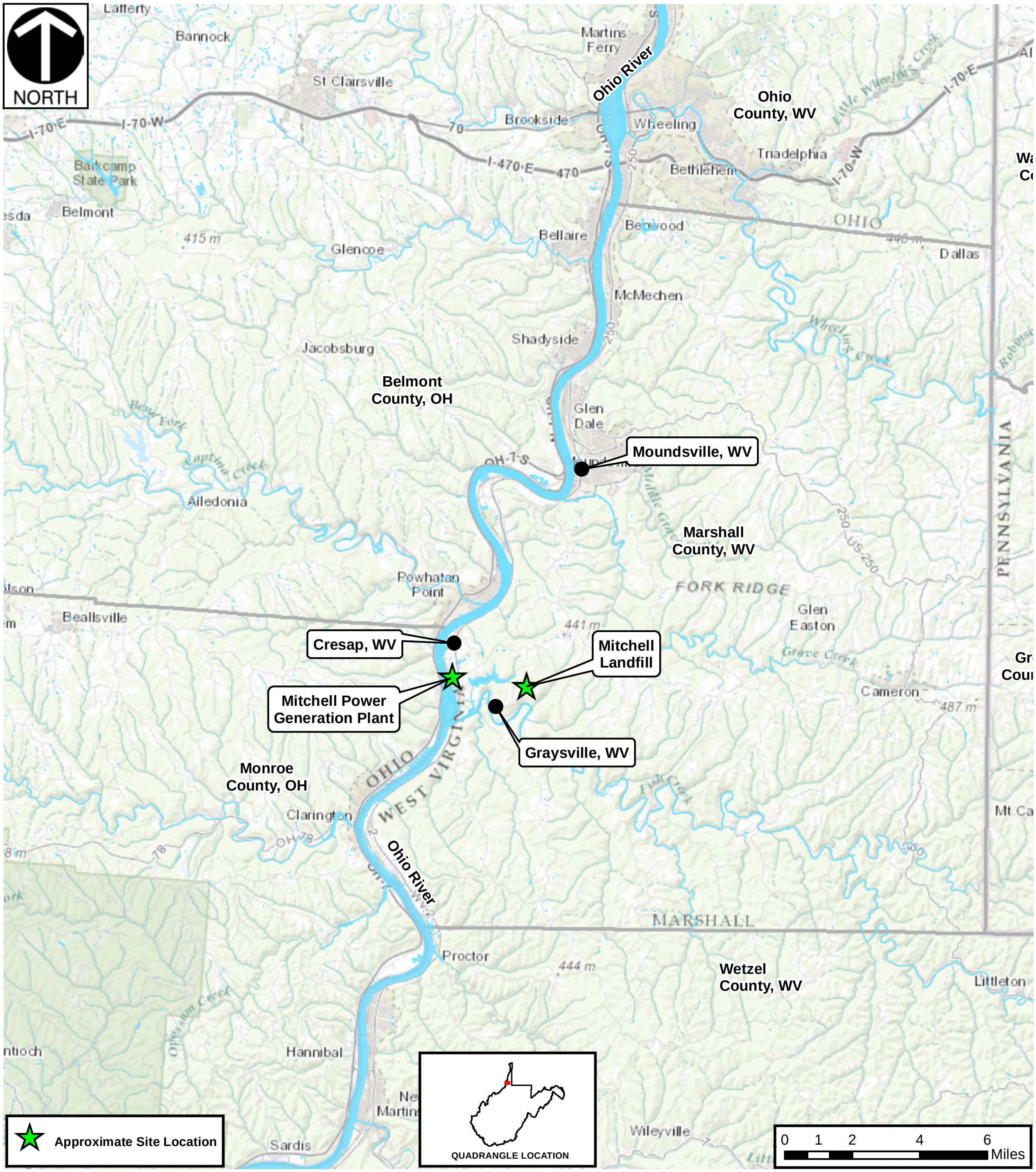
WVGES Publication: Map 25A, West Virginia Geological and Economic Survey Mont Chateau Research Center 1 Mont Chateau Road Morgantown, WV 26508-8079 Phone: (304) 594-2331 Web: www.wvgs.wvnet.edu, Map: Original 1968/1969 map revised, March 2011, Map Date: May 16, 2011

FIGURES



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MITCHELL POWER GENERATION PLANT
MARSHALL COUNTY, WEST VIRGINIA

GROUNDWATER MONITORING SYSTEM DEMONSTRATION
SITE LOCATION MAP

DRAWN BY: MAD	CHECKED BY: RAS	APPROVED BY: APA*	FIGURE NO:
DATE: DECEMBER 08, 2015	DWG SCALE: 1 " = 4 miles	PROJECT NO: 110-416-7601	1

Signature on File *

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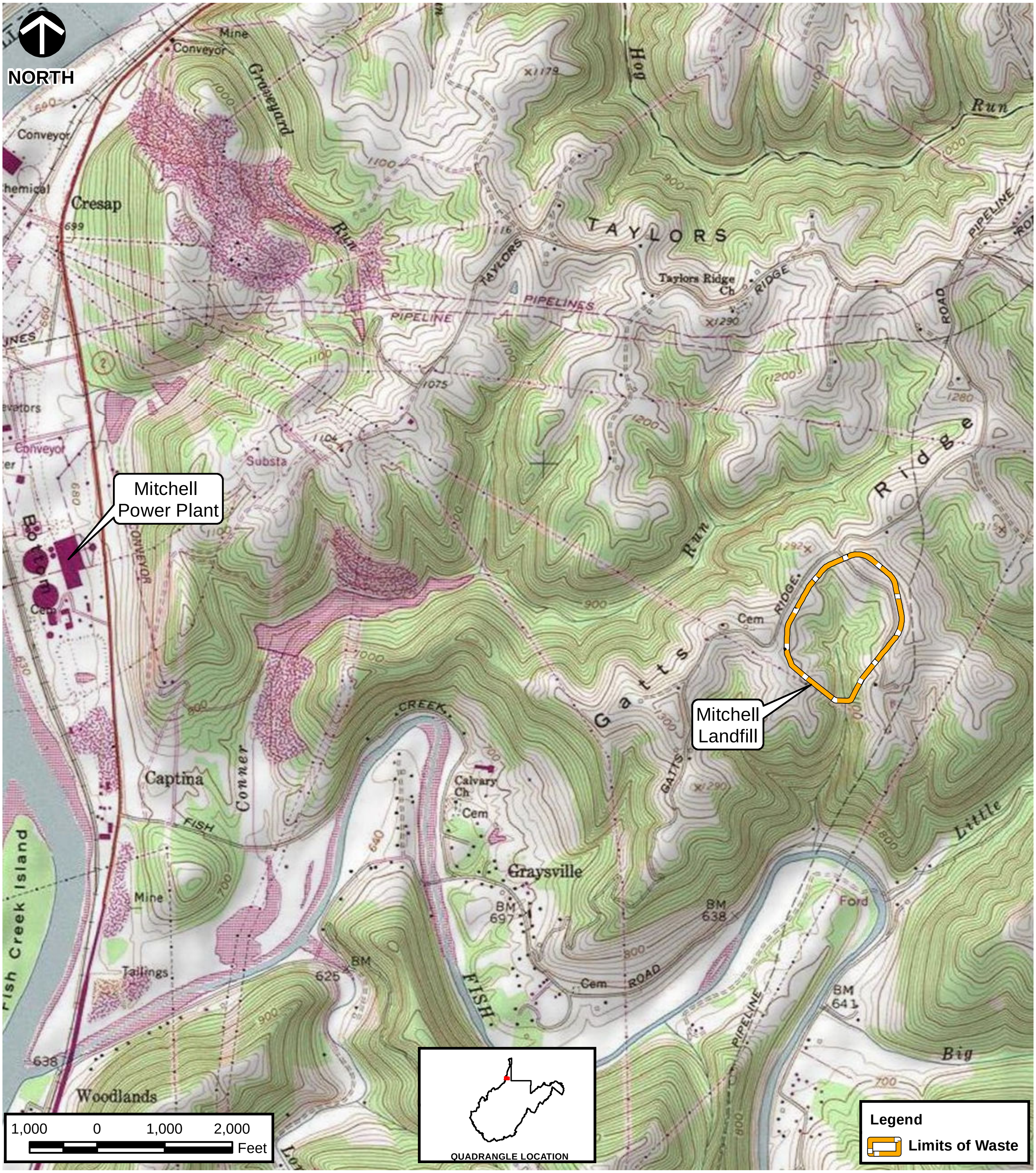

SOURCE: PORTION OF THE USGS 7.5-MINUTE SERIES TOPOGRAPHIC QUADRANGLE MAP - GLEN EASTON, WV - 1978 AND POWHATAN POINT, WV - 1978.

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GROUNDWATER MONITORING SYSTEM DEMONSTRATION
PLANT AND CCR UNIT LOCATION MAP

DRAWN BY: MGN/DNB	CHECKED BY: RAS	APPROVED BY: APA*	FIGURE NO: 2
DATE: DECEMBER 08, 2015	DWG SCALE: 1 " = 2,000 '	PROJECT NO: 110-416-7601	

Signature on File *

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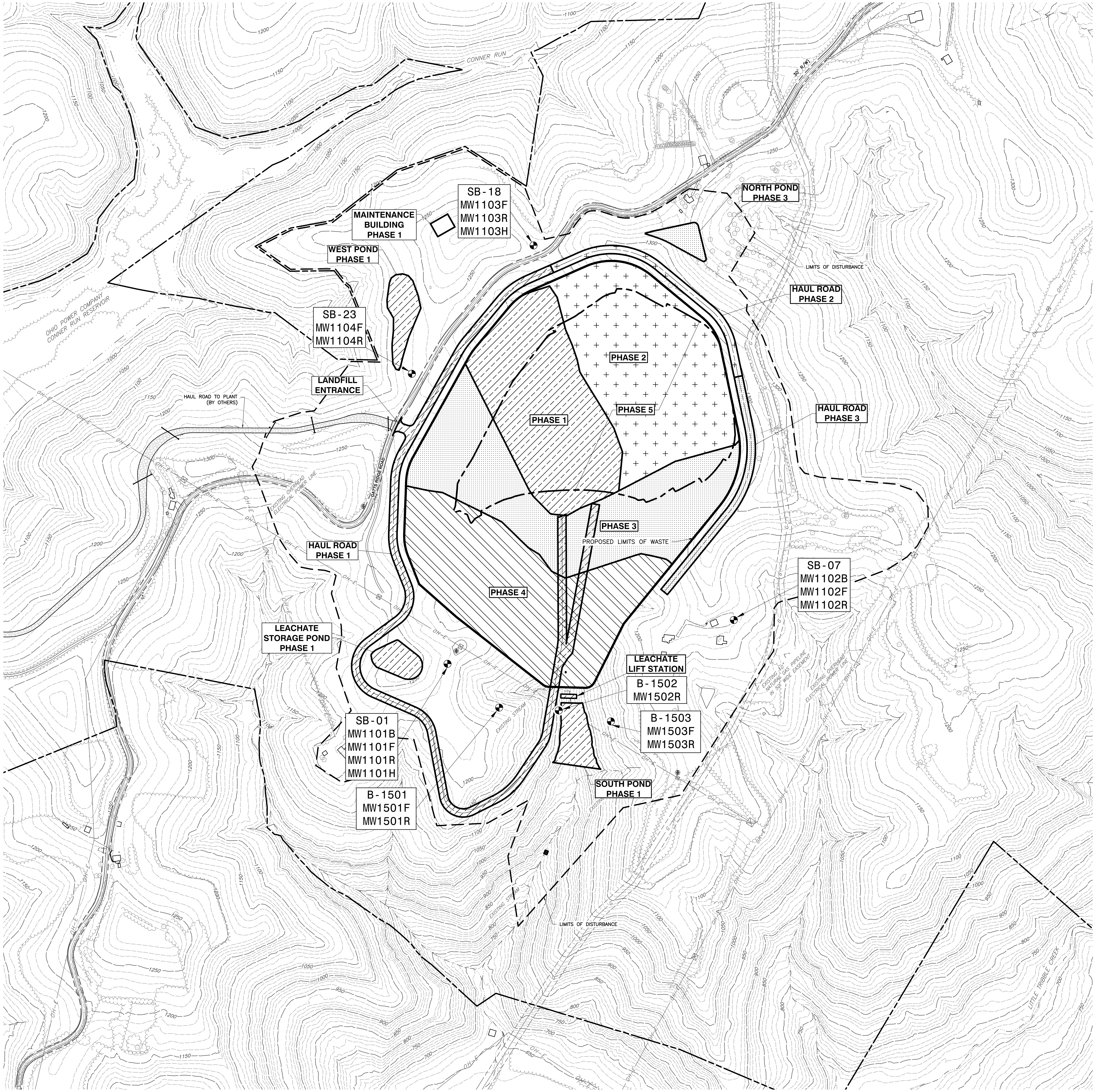

NORTH

SCALE IN FEET

0 200 400

CONTOUR INTERVAL = 10 FEET

LEGEND

- FACILITY BOUNDARY (AEP OWNED)
- EXISTING RIGHT-OF-WAY
- EXISTING EASEMENT
- EXISTING CONTOURS
- EXISTING STREAM
- EXISTING GAS PIPELINE
- EXISTING OVERHEAD ELECTRICAL POWER LINES
- EXISTING ELECTRICAL POLE AND TOWER
- EXISTING VEGETATION
- EXISTING ROADS
- EXISTING STRUCTURE
- LIMITS OF EARTHWORK
- LIMITS OF WASTE
- HAUL ROAD
- LIMITS OF PHASE 1 DEVELOPMENT
- LIMITS OF PHASE 2 DEVELOPMENT
- LIMITS OF PHASE 3 DEVELOPMENT
- LIMITS OF PHASE 4 DEVELOPMENT
- LIMITS OF PHASE 5 DEVELOPMENT (TO BE LOCATED ABOVE PHASES 1 THRU 4)
- SB-23 MW1104F MW1104R — SOIL BORING/MONITORING WELL LOCATION (COMPLETED 2011)
- B-1501 MW1501F MW1501R — BORING/MONITORING WELL LOCATION (COMPLETED 2015)
- B — BURTON SANDSTONE
- F — FISH CREEK SANDSTONE
- R — RUSH RUN SANDSTONE
- H — HUNDRED SANDSTONE

PHASE	WASTE CAPACITY (Cubic Yards)	ACRES
1	556,000	12.1
2	1,829,000	15.1
3	2,540,000	14.8
4	3,524,000	15.6
5	1,469,000	24.3
TOTAL	9,918,000	57.6

1. ACRES ARE PROJECTED ONTO HORIZONTAL PLANE
2. PHASE 5 IS ABOVE THE OTHER PHASES AND NOT INCLUDED IN THE TOTAL FOOTPRINT ACREAGE

REVISION RECORD

NO	DATE	DESCRIPTION

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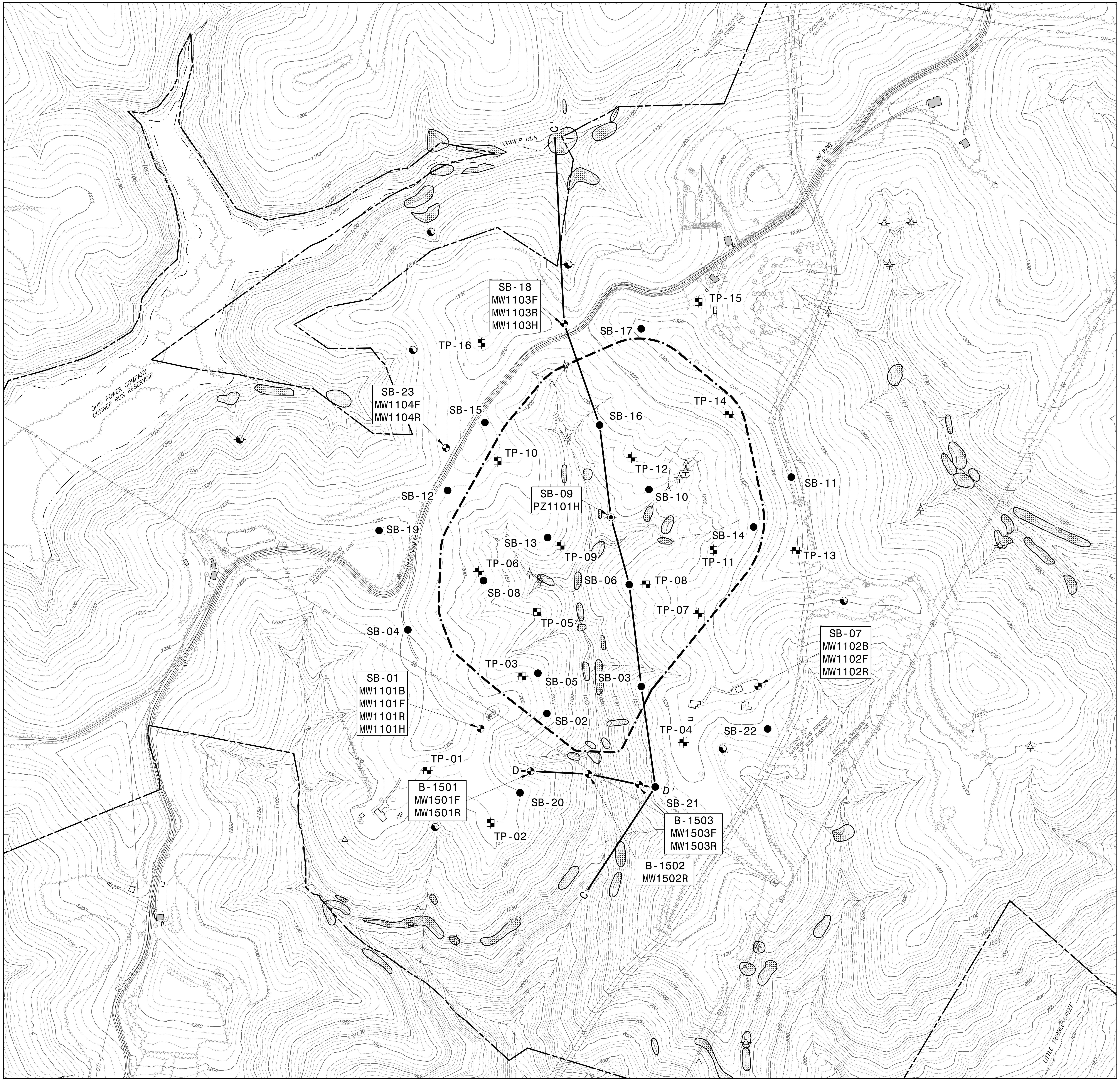
MITCHELL LANDFILL
MITCHELL POWER GENERATION PLANT
MARSHALL COUNTY, WEST VIRGINIA

GROUNDWATER MONITORING SYSTEM DEMONSTRATION
CCR UNIT AND MONITORING WELLS

DATE:	DECEMBER 2015	DRAWN BY:	DAR
DWG SCALE:	AS NOTED	CHECKED BY:	RAS
PROJECT NO:	110-416-7601	APPROVED BY:	APA

FIGURE NO.: 3



LEGEND

NOTES:

1. THE EXISTING CONDITION, TOPOGRAPHIC AND SURVEY INFORMATION SHOWN ON THESE DRAWINGS WAS FURNISHED BY AEP AND/OR ITS OTHER CONSULTANTS AND CONTRACTORS, OR OBTAINED FROM DATA UTILIZED ON PREVIOUS AEP PROJECTS. THE EXISTING CONDITIONS SHOWN ON THESE DRAWINGS ARE BELIEVED TO REPRESENT THE BEST KNOWN DATA AVAILABLE. ALTHOUGH THIS INFORMATION HAS BEEN INCLUDED IN THE CONSTRUCTION PLANS BY CIVIL AND ENVIRONMENTAL CONSULTANTS, INC. (CEC), IT IS NOT NECESSARILY THE WORK PRODUCT OF CEC AND HAS BEEN INCORPORATED IN RESPONSE TO CERTAIN ASSIGNED CONDITIONS. CEC HAS NOT SURVEYED OR FIELD VERIFIED ANY OF THE EXISTING CONDITION INFORMATION AND CANNOT BE HELD RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF THESE DATA.
2. TOPOGRAPHIC MAPPING WAS PROVIDED BY AEP AND IS BASED UPON AN AERIAL SURVEY DATED NOVEMBER 11, 2010. MAPPING IS BASED UPON THE FOLLOWING DATUM AND PROJECTION:

   HORIZONTAL DATUM: STATE PLANE COORDINATES, NAD 83 WEST VIRGINIA NORTH, U.S. FEET
   VERTICAL DATUM: NAVD 88

3. NATURAL GAS PIPELINE LOCATION AND ALIGNMENT PROVIDED BY DOMINION GAS (PROVIDED BY ROBERT C. ORNDORFF, DATED JUNE 15, 2011). LIMITED SURVEY OF GAS LINE LOCATION, AS MARKED IN THE FIELD BY DOMINION GAS, WAS PERFORMED BY EXLINE SURVEYING ON NOVEMBER 10, 2011.
4. OUTCROP, SPRING AND SEEP LOCATIONS WERE IDENTIFIED DURING CEC'S SITE RECONNAISANCE. THE SITE AND THE LOCATIONS OF BOUNDARIES ARE APPROXIMATE.

REVISION RECORD

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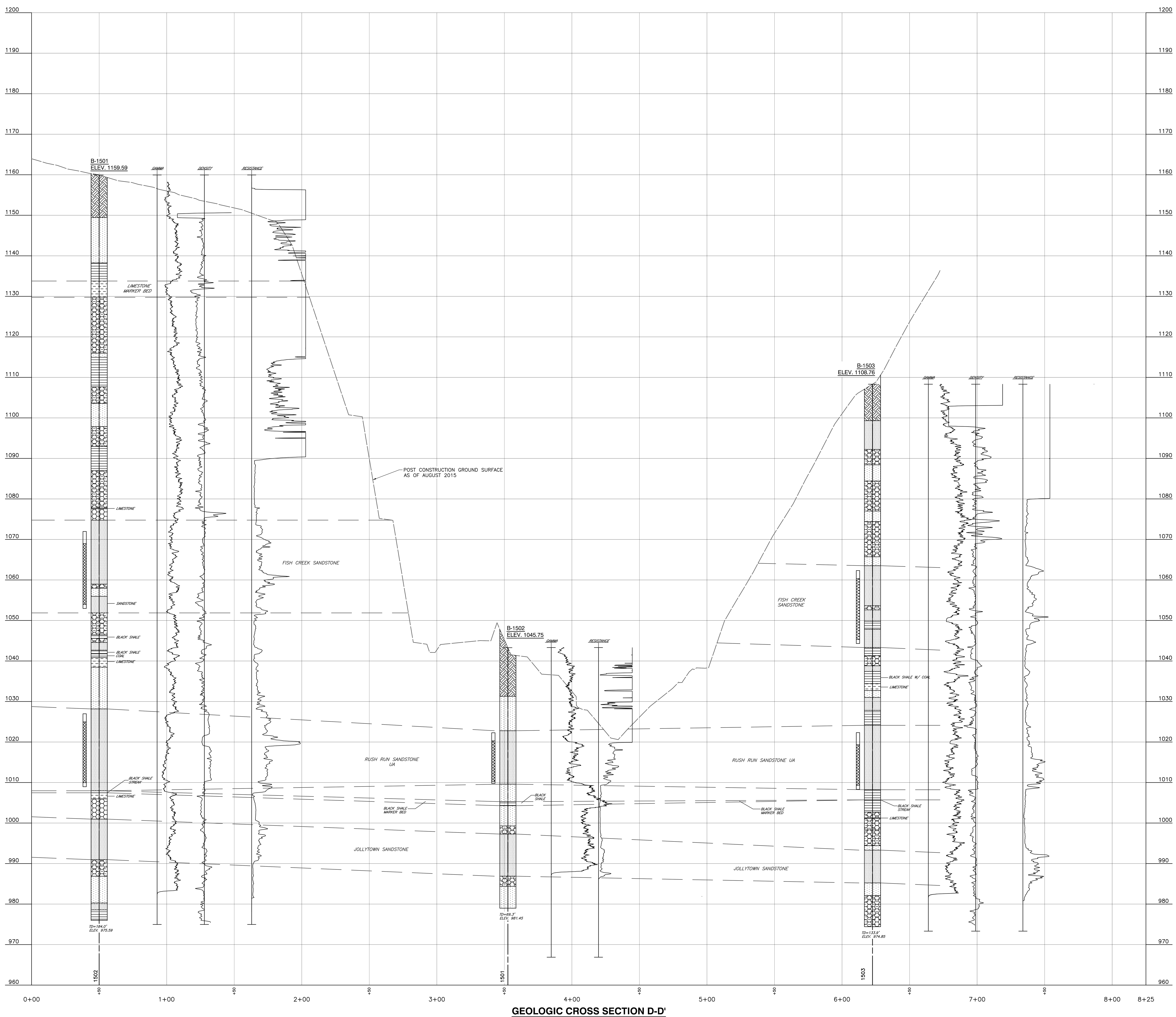
AMERICAN ELECTRIC POWER
MITCHELL LANDFILL
MITCHELL POWER GENERATION PLANT
MARSHALL COUNTY, WEST VIRGINIA

GROUNDWATER MONITORING SYSTEM DEMONSTRATION

GEOLOGIC CROSS SECTION LOCATION MAP

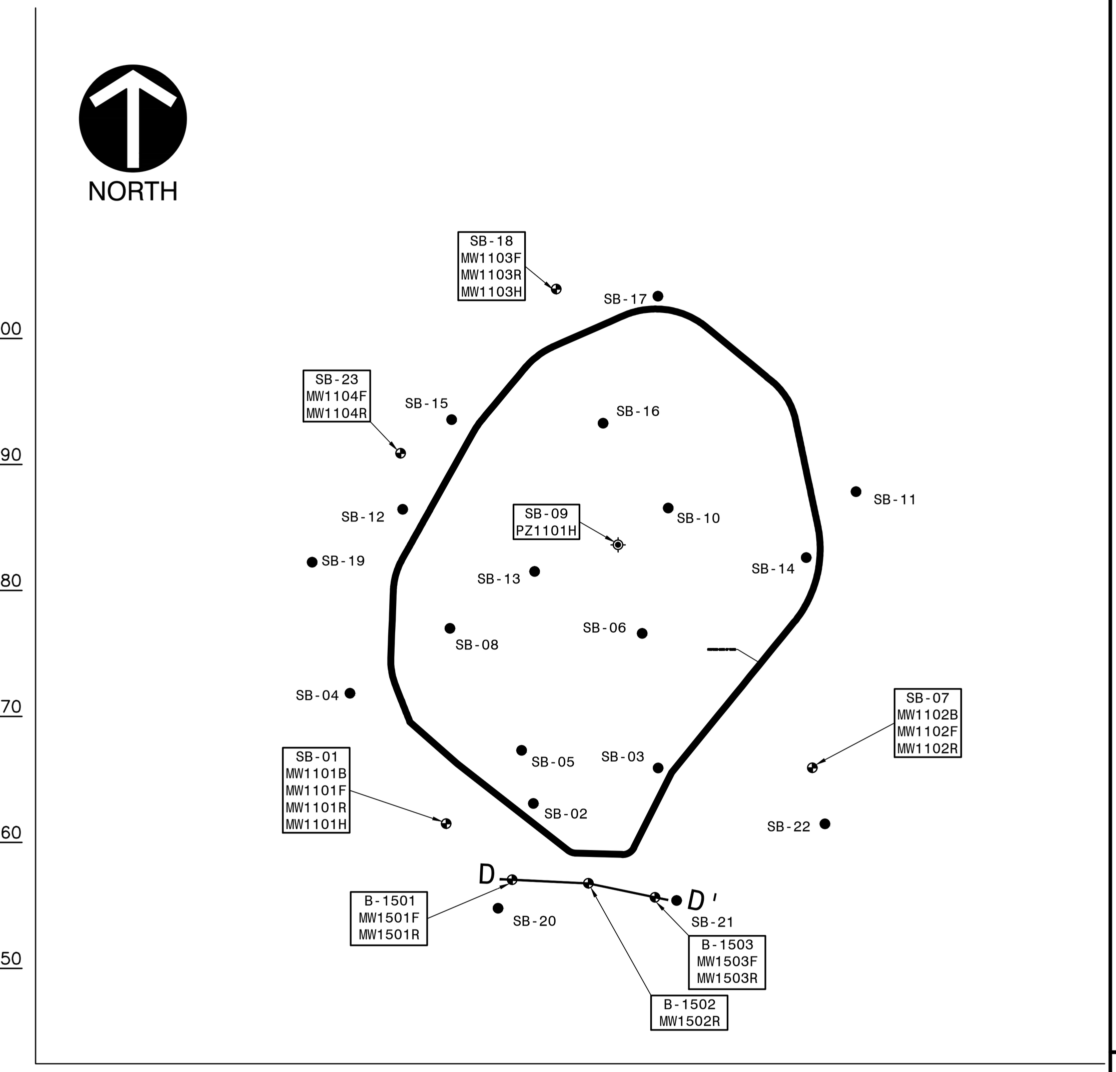
DATE:	DECEMBER 2015	DRAWN BY:	DAR
DWG SCALE:	AS NOTED	CHECKED BY:	RAS
PROJECT NO:	110-416-7601		
APPROVED BY:	APA		

FIGURE NO.: **4**

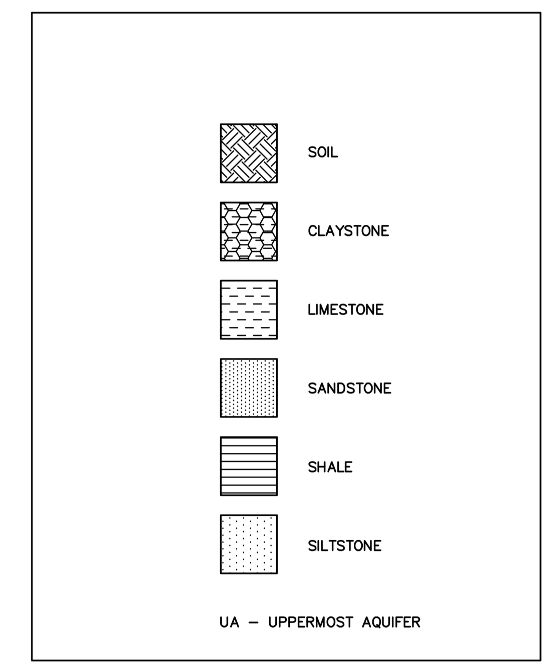


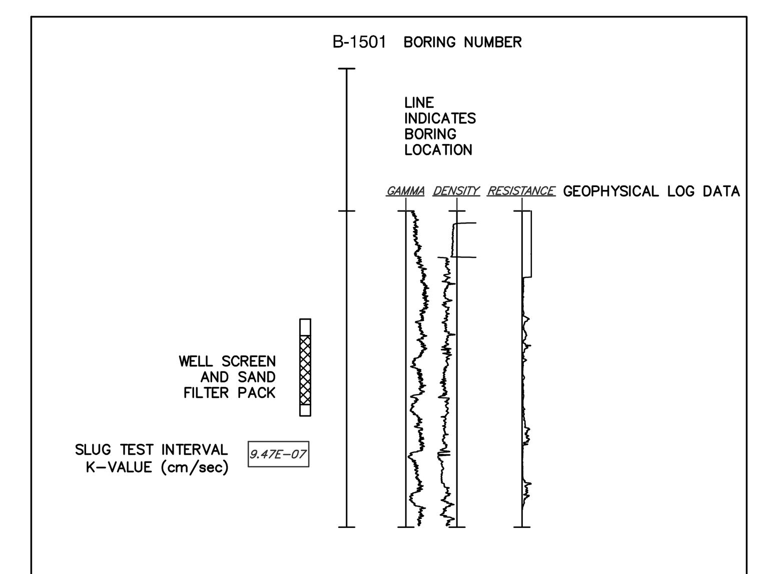
GEOLOGIC CROSS SECTION D-D'

SCALE H:1"=30'; V:1"=10'



KEY PLAN





MONITORING WELL DIAGRAM

NOTE:

1. THE BORING LOGS AND RELATED INFORMATION PRESENTED HEREIN DEPICT SUBSURFACE CONDITIONS AT THE TEST BORING LOCATIONS AND AT THE TIME OF DRILLING. SOIL CONDITIONS AT OTHER LOCATIONS MAY DIFFER.
2. GEOLOGIC CORRELATIONS SHOWN BETWEEN TEST BORINGS GENERALLY ARE BASED ON A STRAIGHT–LINE INTERPOLATION. ACTUAL CONDITIONS BETWEEN TEST BORINGS MAY DIFFER.

SCALE IN FEET 0 50 100

SCALE IN FEET 0 10 20

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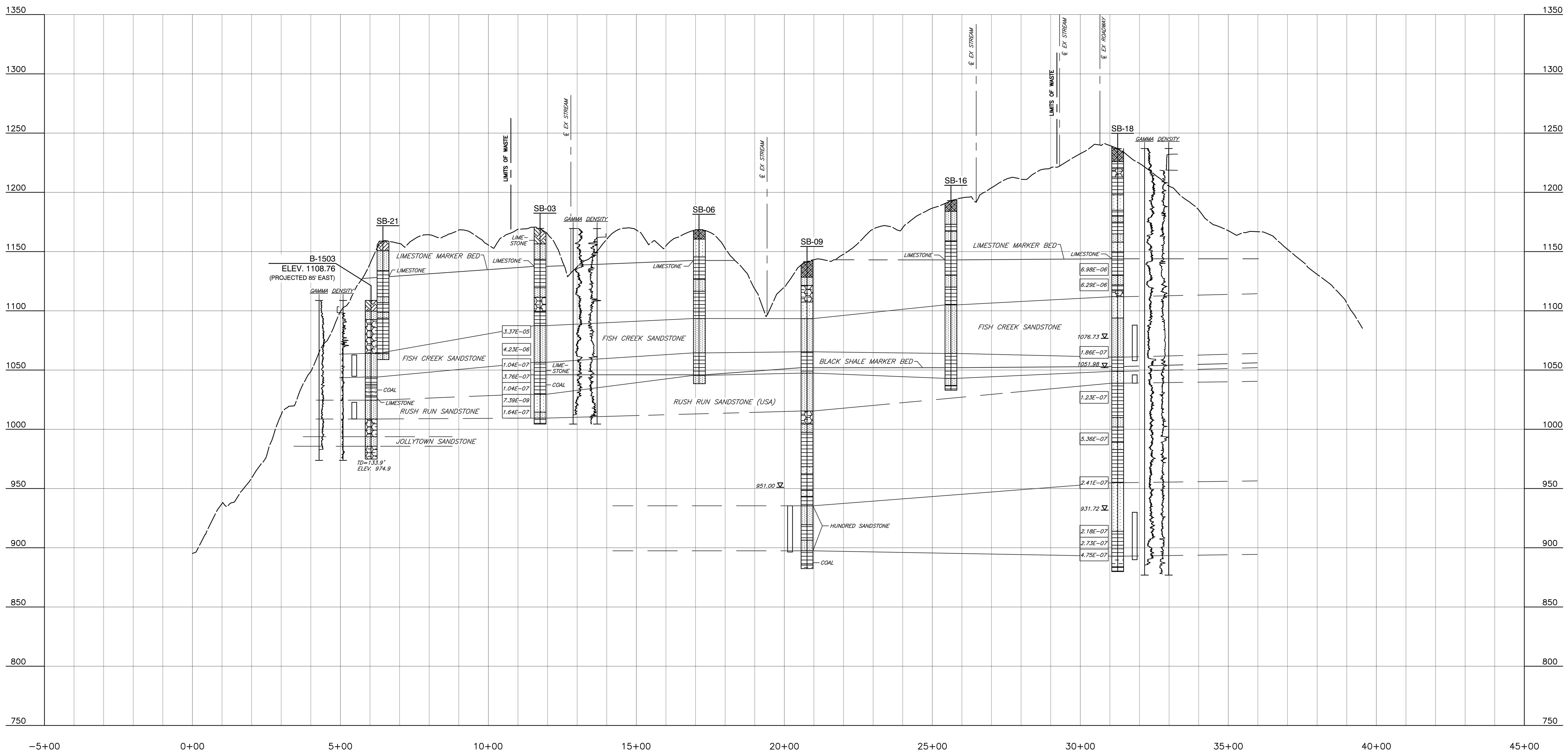
GROUNDWATER MONITORING SYSTEM DEMONSTRATION

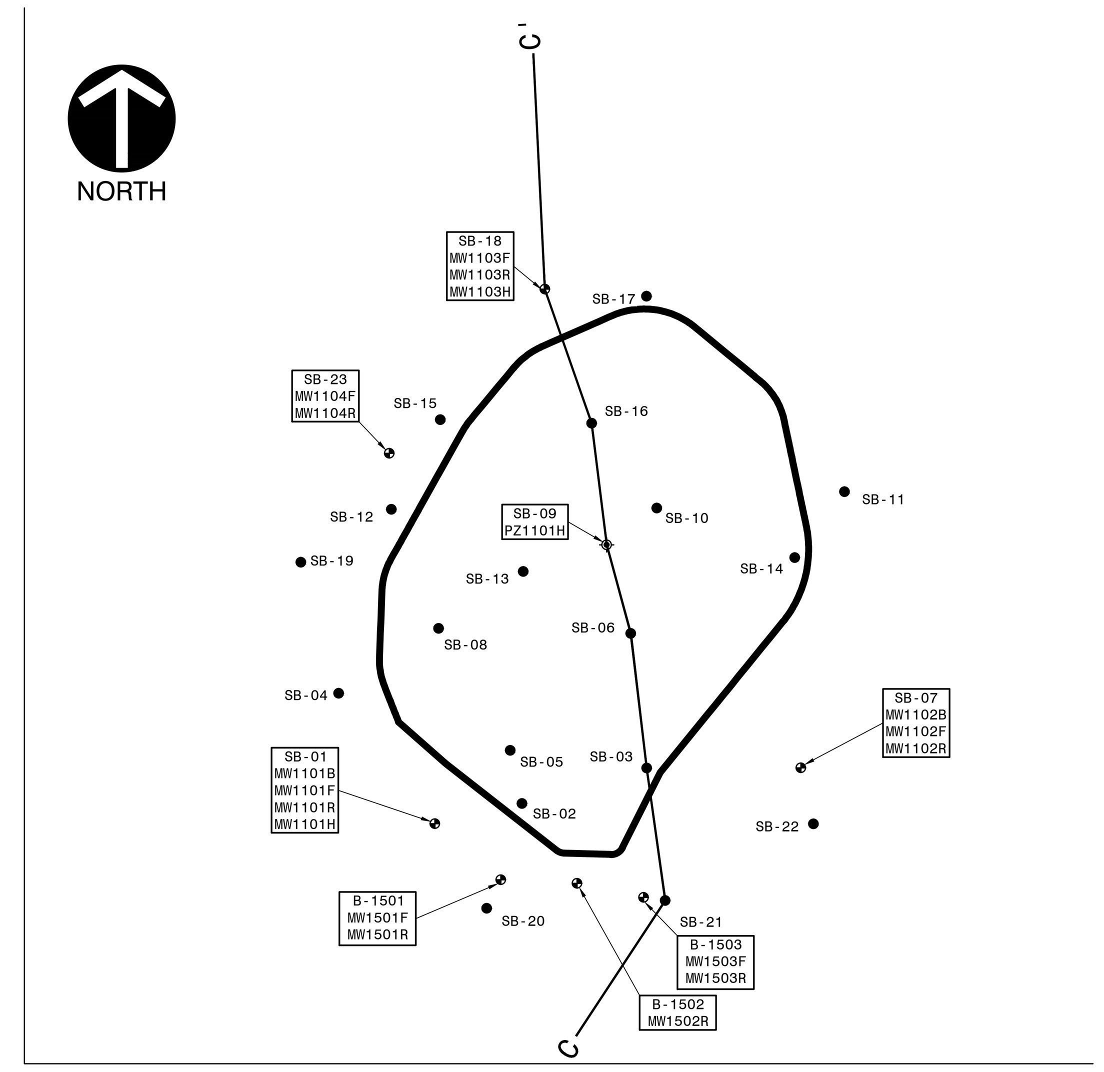
GEOLOGIC CROSS SECTION D-D'

DATE:	DECEMBER 2015	DRAWN BY:	DAR
DWG SCALE:	AS NOTED	CHECKED BY:	RAS
PROJECT NO:	110-416-7601		
APPROVED BY:	APA		

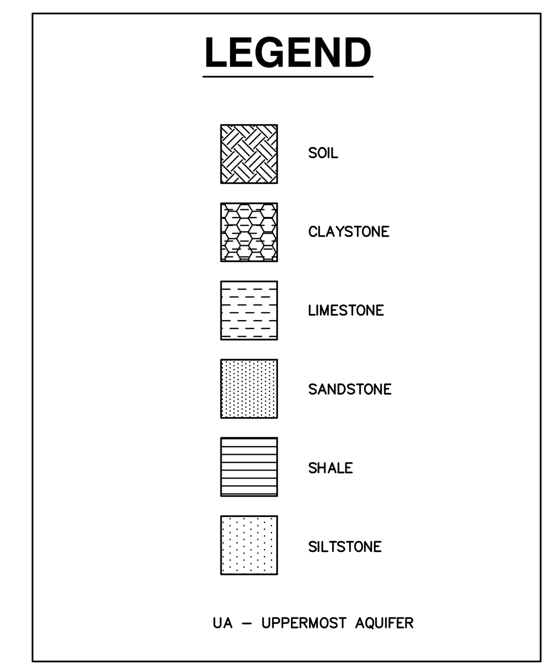
FIGURE NO.: **5**

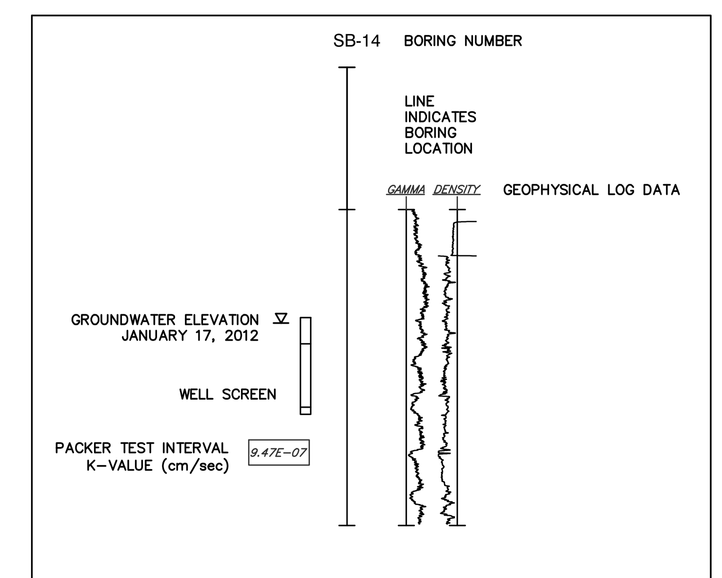


GEOLOGIC CROSS SECTION C - C'
SCALE H:1"=200'; V:1"=50'



KEY PLAN
N.T.S.





MONITORING WELL DIAGRAM

NOTE:

1. THE BORING LOGS AND RELATED INFORMATION PRESENTED HEREIN DEPICT SUBSURFACE CONDITIONS AT THE TEST BORING LOCATIONS AND AT THE TIME OF DRILLING. SOIL CONDITIONS AT OTHER LOCATIONS MAY DIFFER.
2. GEOLOGIC CORRELATIONS SHOWN BETWEEN TEST BORINGS GENERALLY ARE BASED ON A STRAIGHT-LINE INTERPOLATION. ACTUAL CONDITIONS BETWEEN TEST BORINGS MAY DIFFER.

HORZ. SCALE: 1"=200'
VERT. SCALE: 1"=50'

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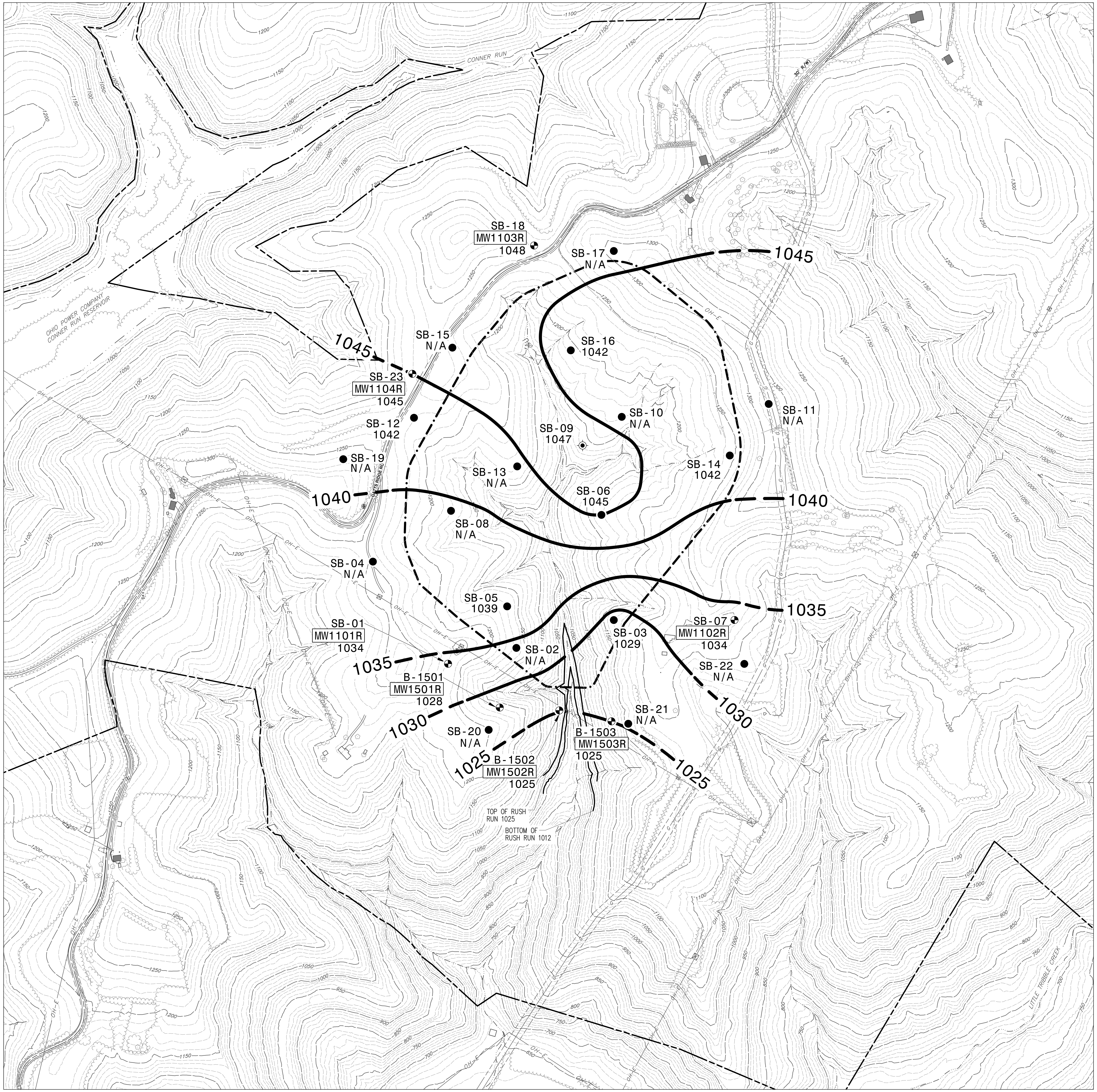
GROUNDWATER MONITORING SYSTEM DEMONSTRATION

GEOLOGIC CROSS SECTION C-C'

DATE:	DECEMBER 2015	DRAWN BY:	DAR
DWG SCALE:	AS NOTED	CHECKED BY:	RAS
PROJECT NO:	110-416-7601	APPROVED BY:	APA

FIGURE NO.: 6



NORTH

SCALE IN FEET

0 200 400

LEGEND

	FACILITY BOUNDARY (AEP OWNED)
	EXISTING RIGHT-OF-WAY
	EXISTING EASEMENT
580	EXISTING CONTOURS
	EXISTING STREAM
G	EXISTING GAS PIPELINE
OH-E	EXISTING OVERHEAD ELECTRICAL POWER LINES
	EXISTING ELECTRICAL POLE AND TOWER
	EXISTING VEGETATION
	EXISTING ROADS
	EXISTING STRUCTURE
	EXISTING OCCUPIED DWELLING
	LIMITS OF WASTE (OVERALL)
SB-01	SOIL BORING LOCATION
1134	TOP OF RUSH RUN SANDSTONE ELEVATION
SB-01 MW1101R	BORING/MONITORING WELL LOCATION (COMPLETED 2011)
1134	TOP OF RUSH RUN SANDSTONE ELEVATION
B-1501 MW1501R	BORING/MONITORING WELL LOCATION (COMPLETED 2015)
1028	TOP OF RUSH RUN SANDSTONE ELEVATION
SB-09	PIEZOMETER/SOIL BORING LOCATION (ABANDONED)
1047	TOP OF RUSH RUN SANDSTONE ELEVATION
	TOP OF RUSH RUN SANDSTONE CONTOURS (DASHED WHERE INFERRED)

NOTES:

BEDROCK CONTOURS AND ISOPACHS ARE CONSTRUCTED BY INTERPOLATION BETWEEN POINTS OF KNOW ELEVATIONS AND USING KNOWLEDGE OF GEOLOGY AND SITE-SPECIFIC CONDITIONS. ACTUAL ELEVATIONS MAY DIFFER AT LOCATIONS BETWEEN DATA POINTS FROM THOSE DEPICTED.

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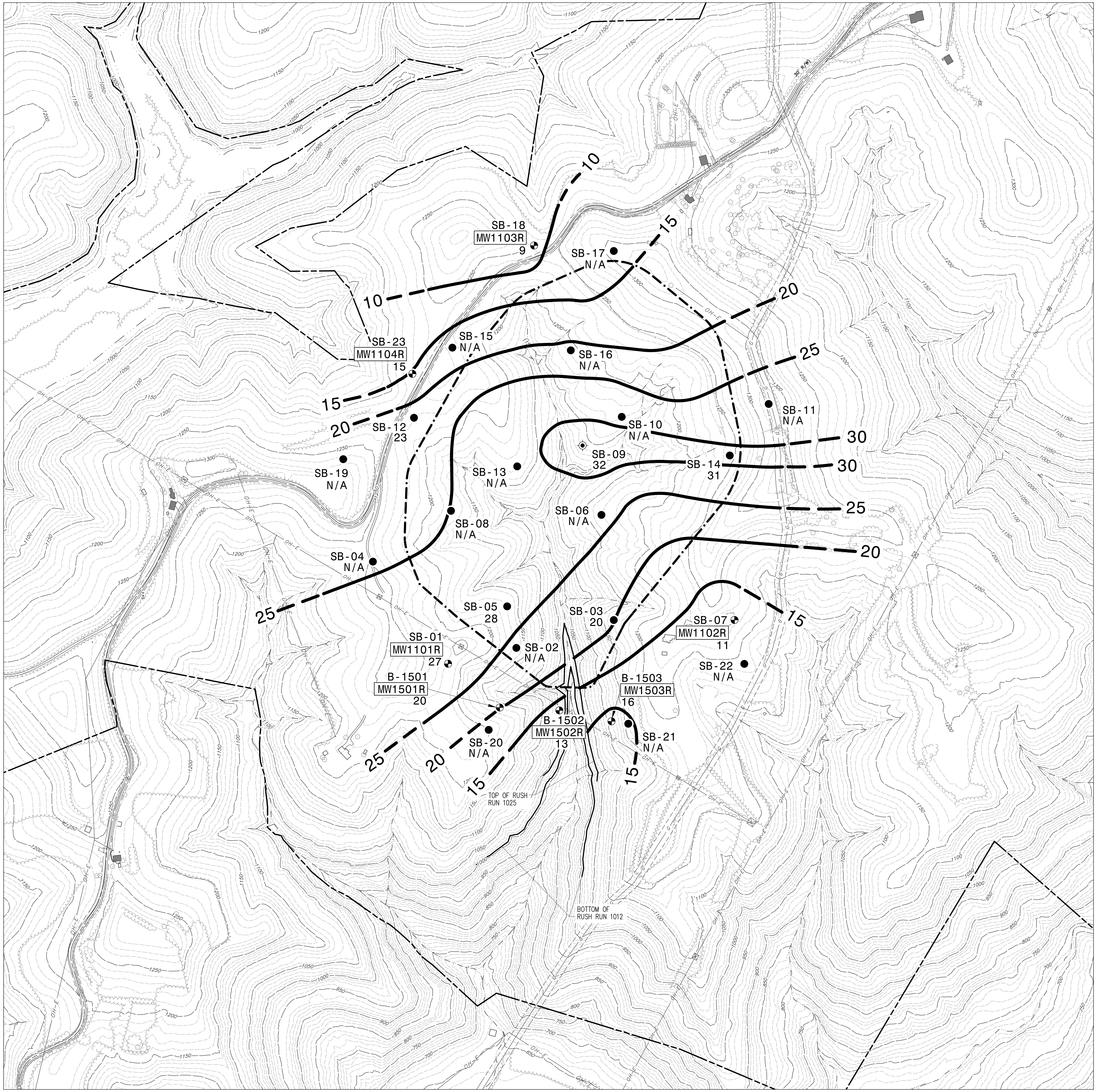
GROUNDWATER MONITORING SYSTEM DEMONSTRATION

TOP OF RUSH RUN SANDSTONE CONTOURS

DATE:	DECEMBER 2015	DRAWN BY:	DAR
DWG SCALE:	AS NOTED	CHECKED BY:	RAS
PROJECT NO:	110-416-7601	APPROVED BY:	APA

FIGURE NO.: 7



LEGEND

- FACILITY BOUNDARY (AEP OWNED)
- EXISTING RIGHT–OF–WAY
- EXISTING EASEMENT
- 580 EXISTING CONTOURS
- EXISTING STREAM
- G EXISTING GAS PIPELINE
- OH–E EXISTING OVERHEAD ELECTRICAL POWER LINES
- EXISTING ELECTRICAL POLE AND TOWER
- EXISTING VEGETATION
- EXISTING ROADS
- EXISTING STRUCTURE
- EXISTING OCCUPIED DWELLING
- LIMITS OF WASTE (OVERALL)
- SB-01 SOIL BORING LOCATION; 27 THICKNESS OF RUSH RUN SANDSTONE (FT)
- SB-01 MW1101R BORING/MONITORING WELL LOCATION (COMPLETED 2011); 27 THICKNESS OF RUSH RUN SANDSTONE (FT)
- B-1501 MW1501R BORING/MONITORING WELL LOCATION (COMPLETED 2015); 20 THICKNESS OF RUSH RUN SANDSTONE (FT)
- SB-09 PIEZOMETER/SOIL BORING LOCATION (ABANDONED); 32 THICKNESS OF RUSH RUN SANDSTONE (FT)
- ISOPACH CONTOUR OF RUSH RUN SANDSTONE (DASHED WHERE INFERRED)

NOTES:

BEDROCK CONTOURS AND ISOPACHS ARE CONSTRUCTED BY INTERPOLATION BETWEEN POINTS OF KNOW ELEVATIONS AND USING KNOWLEDGE OF GEOLOGY AND SITE–SPECIFIC CONDITIONS. ACTUAL ELEVATIONS MAY DIFFER AT LOCATIONS BETWEEN DATA POINTS FROM THOSE DEPICTED.

NORTH

SCALE IN FEET 0 200 400

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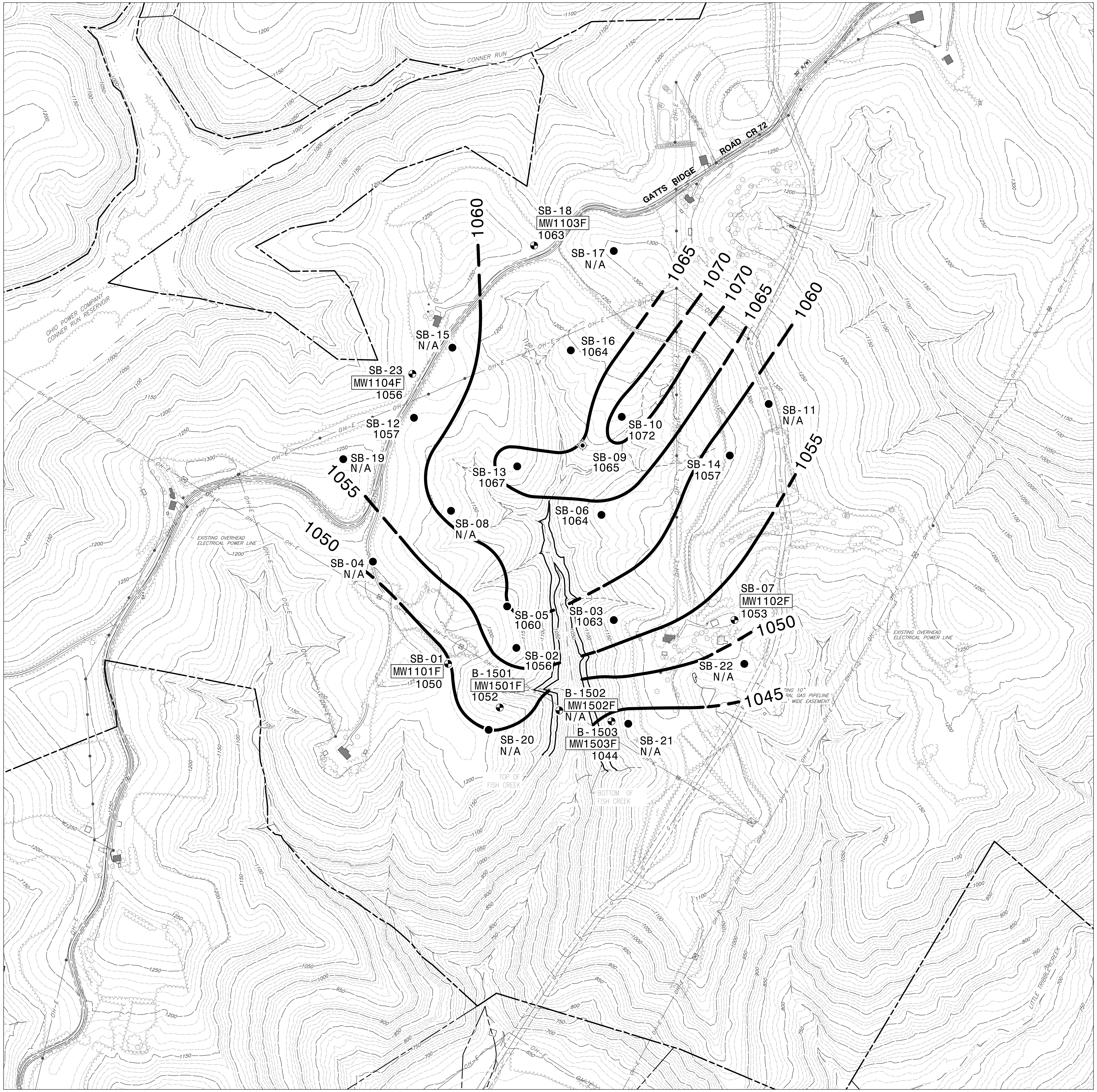
MARSHALL COUNTY, WEST VIRGINIA

GROUNDWATER MONITORING SYSTEM DEMONSTRATION

RUSH RUN SANDSTONE ISOPACH CONTOURS

DATE:	DECEMBER 2015	DRAWN BY:	DAR
DWG SCALE:	AS NOTED	CHECKED BY:	RAS
PROJECT NO:	110-416-7601		
APPROVED BY:	APA		

FIGURE NO.: **8**



LEGEND

- FACILITY BOUNDARY (AEP OWNED)
- EXISTING RIGHT-OF-WAY
- EXISTING EASEMENT
- EXISTING CONTOURS
- EXISTING STREAM
- EXISTING GAS PIPELINE
- EXISTING OVERHEAD ELECTRICAL POWER LINES
- EXISTING ELECTRICAL POLE AND TOWER
- EXISTING VEGETATION
- EXISTING ROADS
- EXISTING STRUCTURE
- EXISTING OCCUPIED DWELLING
- SB-16 — SOIL BORING LOCATION; 1064 — BASE OF FISH CREEK SANDSTONE ELEVATION
- SB-01 / MW1101F — BORING/MONITORING WELL LOCATION (COMPLETED 2011); 1050 — BASE OF FISH CREEK SANDSTONE ELEVATION
- B-1501 / MW1501F — BORING/MONITORING WELL LOCATION (COMPLETED 2015); 1052 — BASE OF FISH CREEK SANDSTONE ELEVATION
- SB-09 — PIEZOMETER/SOIL BORING LOCATION (ABANDONED); 1065 — BASE OF FISH CREEK SANDSTONE ELEVATION
- BASE OF FISH CREEK SANDSTONE ELEVATION CONTOUR (DASHED WHERE INFERRED)

NOTES:

BEDROCK CONTOURS AND ISOPACHS ARE CONSTRUCTED BY INTERPOLATION BETWEEN POINTS OF KNOW ELEVATIONS AND USING KNOWLEDGE OF GEOLOGY AND SITE-SPECIFIC CONDITIONS. ACTUAL ELEVATIONS MAY DIFFER AT LOCATIONS BETWEEN DATA POINTS FROM THOSE DEPICTED.

NORTH

SCALE IN FEET 0 200 400

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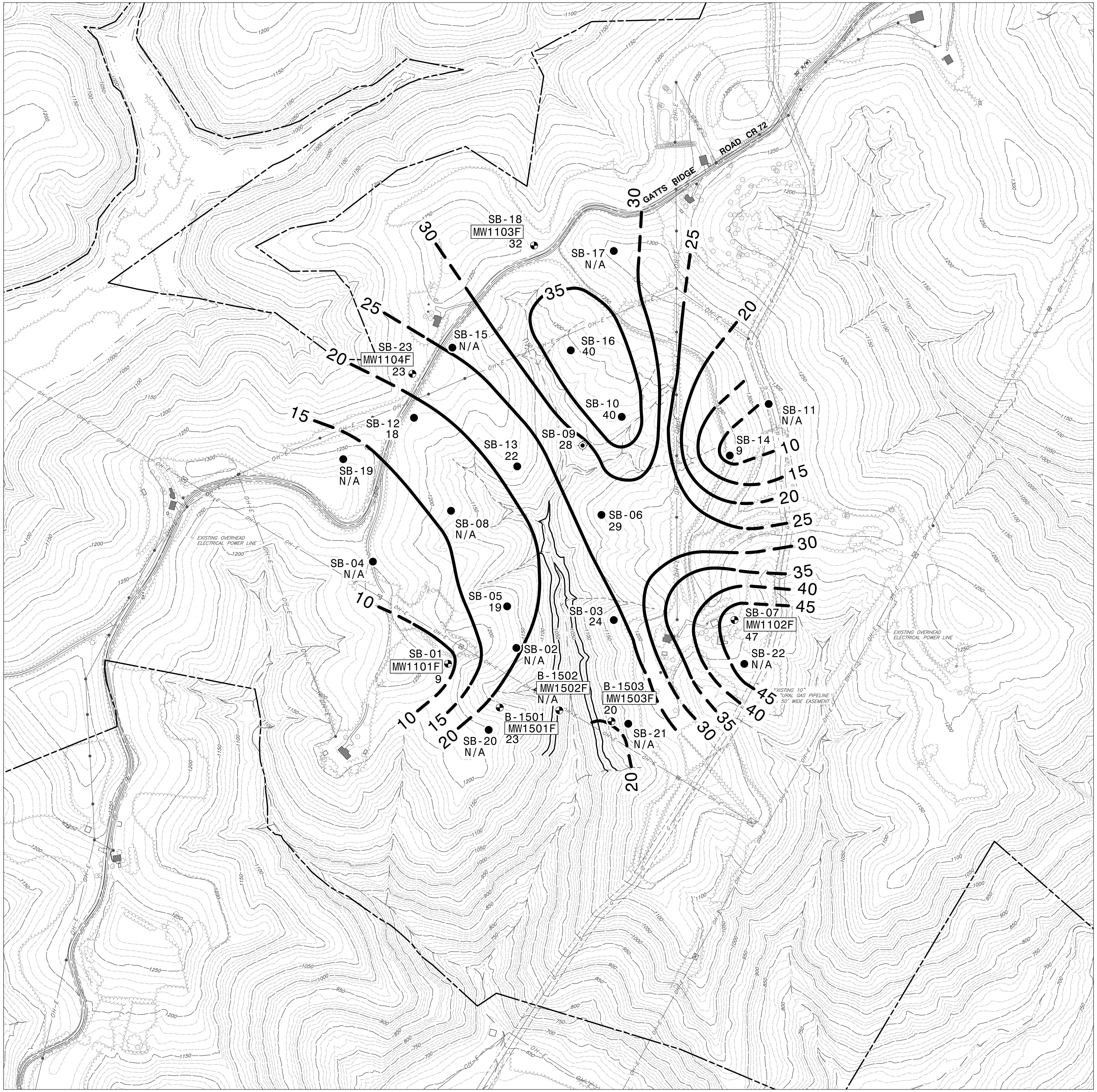
MARSHALL COUNTY, WEST VIRGINIA

GROUNDWATER MONITORING SYSTEM DEMONSTRATION
BASE OF FISH CREEK SANDSTONE CONTOURS

DATE:	DECEMBER 2015	DRAWN BY:	DAR
DWG SCALE:	AS NOTED	CHECKED BY:	RAS
PROJECT NO:	110-416-7601	APPROVED BY:	APA

FIGURE NO.: 9



LEGEND

- FACILITY BOUNDARY (AEP OWNED)
- EXISTING RIGHT-OF-WAY
- EXISTING EASEMENT
- EXISTING CONTOURS
- EXISTING STREAM
- EXISTING GAS PIPELINE
- EXISTING OVERHEAD ELECTRICAL POWER LINES
- EXISTING ELECTRICAL POLE AND TOWER
- EXISTING VEGETATION
- EXISTING ROADS
- EXISTING STRUCTURE
- EXISTING OCCUPIED DWELLING
- SB-01 / 9 — SOIL BORING LOCATION / THICKNESS OF FISH CREEK SANDSTONE (FT)
- SB-01 / MW1101F / 9 — BORING/MONITORING WELL LOCATION (COMPLETED 2011) / THICKNESS OF FISH CREEK SANDSTONE (FT)
- B-1501 / MW1501F / 23 — BORING/MONITORING WELL LOCATION (COMPLETED 2015) / THICKNESS OF FISH CREEK SANDSTONE (FT)
- SB-09 / 28 — PIEZOMETER/SOIL BORING LOCATION (ABANDONED) / THICKNESS OF FISH CREEK SANDSTONE (FT)
- ISOPACH CONTOUR OF FISH CREEK SANDSTONE (DASHED WHERE INFERRED)

NOTES:

BEDROCK CONTOURS AND ISOPACHS ARE CONSTRUCTED BY INTERPOLATION BETWEEN POINTS OF KNOW ELEVATIONS AND USING KNOWLEDGE OF GEOLOGY AND SITE-SPECIFIC CONDITIONS. ACTUAL ELEVATIONS MAY DIFFER AT LOCATIONS BETWEEN DATA POINTS FROM THOSE DEPICTED.

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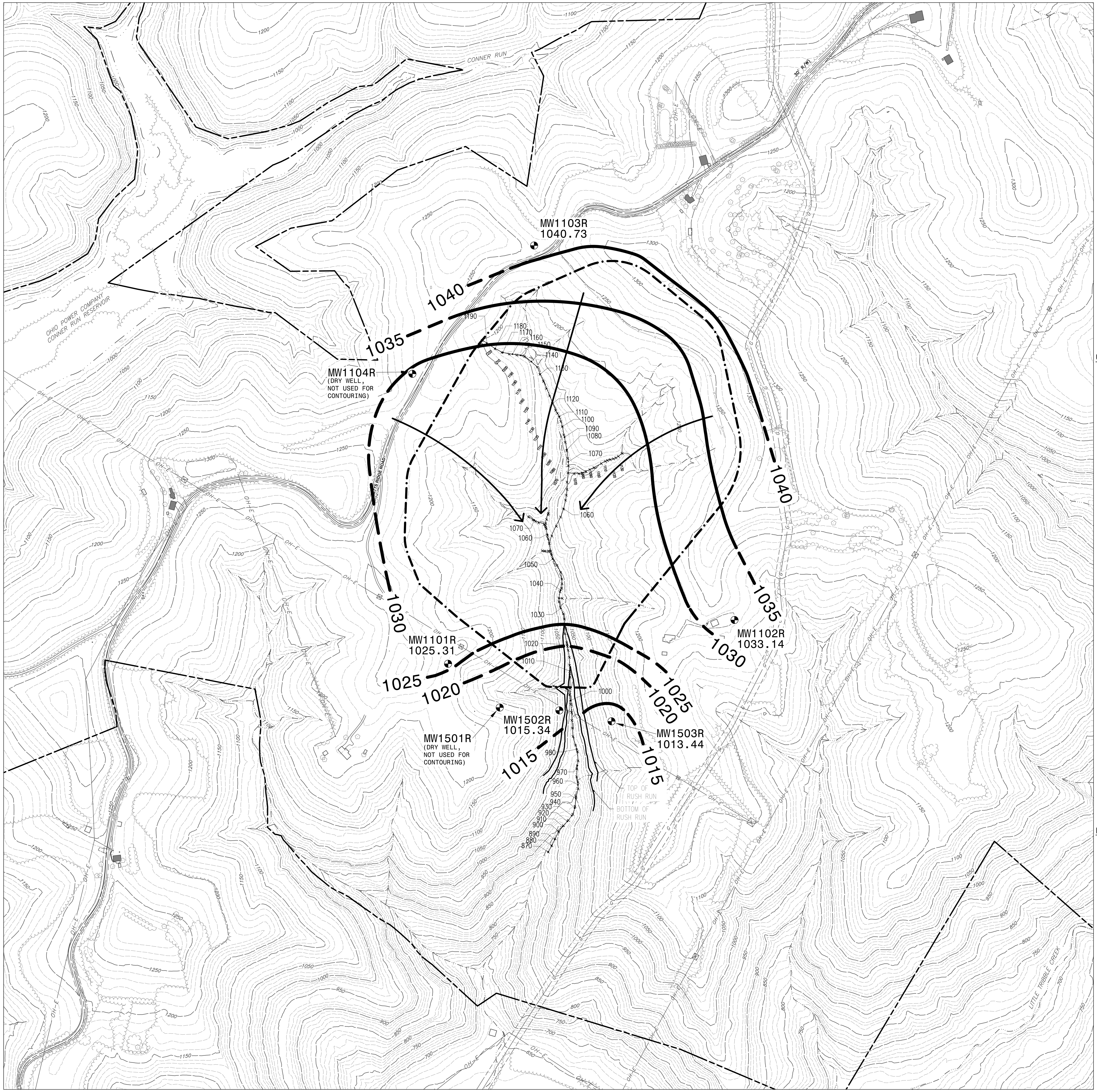
MARSHALL COUNTY, WEST VIRGINIA

GROUNDWATER MONITORING SYSTEM DEMONSTRATION

FISH CREEK SANDSTONE ISOPACH CONTOURS

DATE:	DECEMBER 2015	DRAWN BY:	DAR
DWG SCALE:	AS NOTED	CHECKED BY:	RAS
PROJECT NO:	110-416-7601		
APPROVED BY:	APA		

FIGURE NO.: **10**

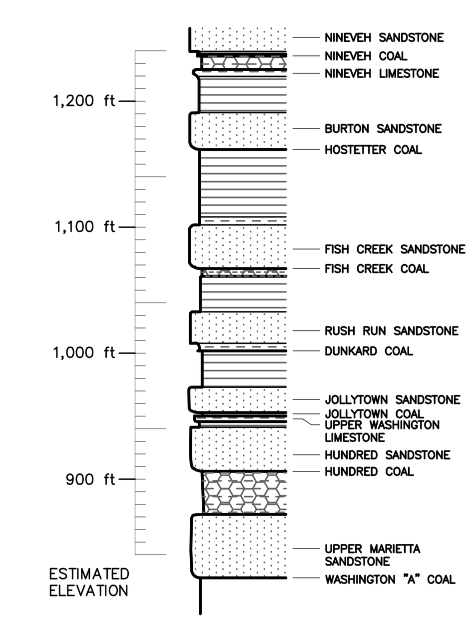


LEGEND

- FACILITY BOUNDARY (AEP OWNED)
- EXISTING RIGHT-OF-WAY
- EXISTING EASEMENT
- EXISTING CONTOURS (580)
- EXISTING STREAM
- EXISTING GAS PIPELINE (G)
- EXISTING OVERHEAD ELECTRICAL POWER LINES (OH-E)
- EXISTING ELECTRICAL POLE AND TOWER
- EXISTING VEGETATION
- EXISTING ROADS
- EXISTING STRUCTURE
- EXISTING OCCUPIED DWELLING
- LIMITS OF WASTE (OVERALL)
- 880 — UNDERDRAIN POSITION AND ELEVATION
- MW1103R 1040.73 — MONITORING WELL (COMPLETED 2011) STATIC WATER ELEVATION NOVEMBER 4, 2015.
- MW1503R 1013.44 — MONITORING WELL (COMPLETED 2015) STATIC WATER ELEVATION NOVEMBER 4, 2015.
- POTENTIOMETRIC CONTOUR LINES (DASHED WHERE INFERRED)
- GROUNDWATER FLOW DIRECTION

UNDERDRAIN REFERENCE DRAWINGS:

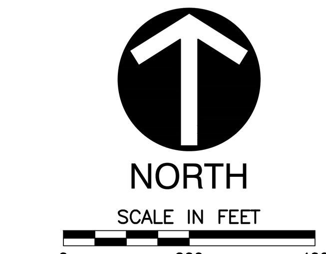
1. PHASE 1A BOTTOM OF ISOLATION LAYER/GROUNDWATER INTERCEPTOR PLAN, DWG. NO. AP0050.100.0014. HULL AND ASSOCIATES, INC., TOLEDO, OHIO, SUBMITTAL DATE JULY 2014
2. GROUNDWATER INTERCEPTOR/STORM PIPE PLAN–FROM PHASE 1A TO ENERGY DISSAPATER (SOUTH END). DWG. NO. AP0050.100.0008. HULL AND ASSOCIATES, INC., TOLEDO, OHIO. SUBMITTAL DATE JULY 2014.



BEDROCK STRATIGRAPHIC COLUMN

NOTES:

1. THE WATER LEVELS PRESENTED HEREIN ARE APPLICABLE TO THE LOCATION AND TIME OF MEASUREMENT. WATER LEVELS MAY FLUCTUATE THROUGH TIME.
2. POTENTIOMETRIC CONTOURS ARE CONSTRUCTED BY INTERPOLATION BETWEEN POINTS OF KNOWN STATIC WATER LEVEL ELEVATIONS AND USING KNOWLEDGE OF SPECIFIC–SITE CONDITIONS. ACTUAL STATIC WATER LEVELS AT LOCATIONS BETWEEN THE MONITORING POINTS MAY DIFFER FROM THOSE DEPICTED.



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NO | DATE | DESCRIPTION

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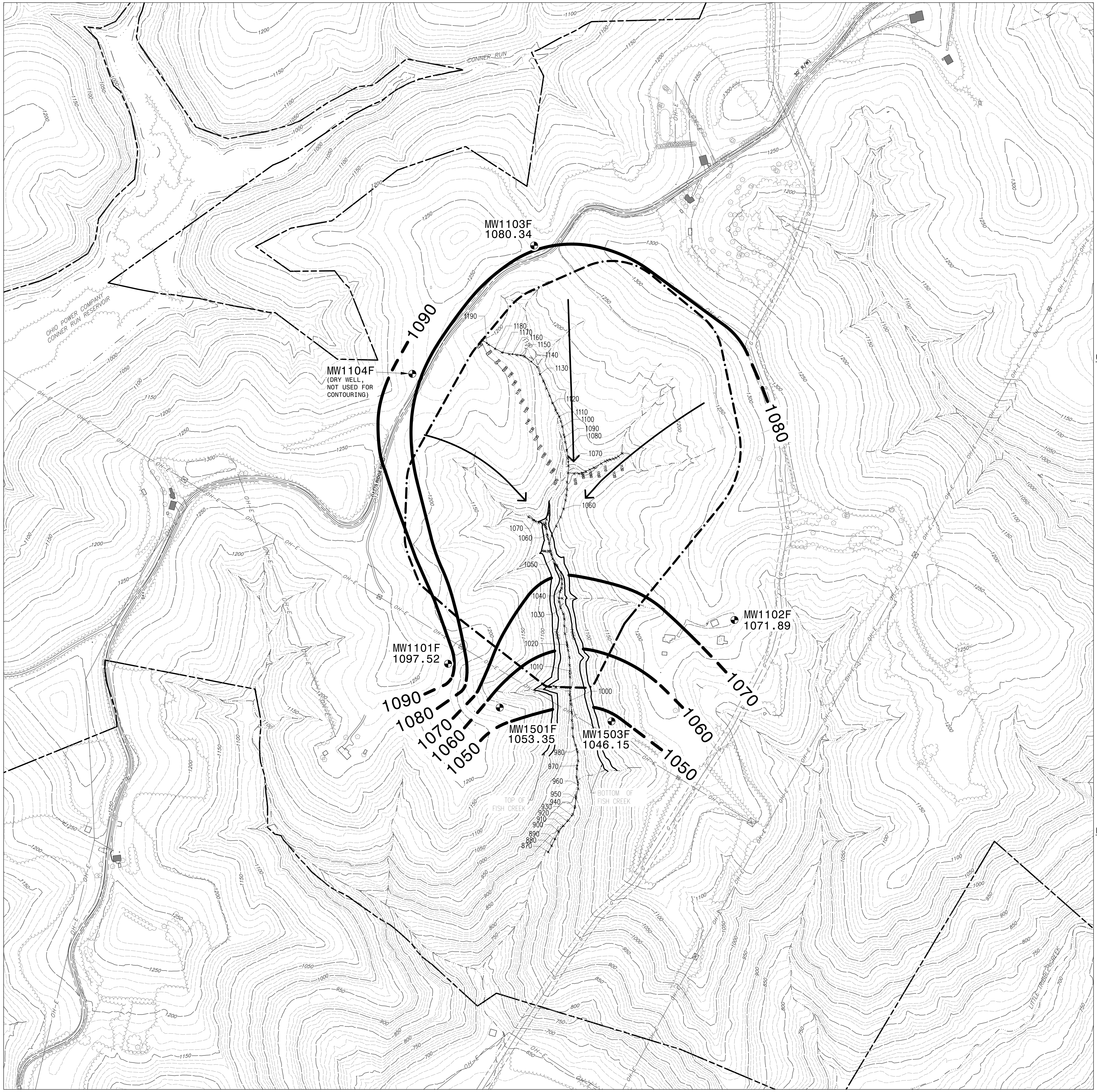
MARSHALL COUNTY, WEST VIRGINIA

GROUNDWATER MONITORING SYSTEM DEMONSTRATION
RUSH RUN SANDSTONE
POTENTIOMETRIC SURFACE MAP

DATE: DECEMBER 2015 | DRAWN BY: DAR
DWG SCALE: AS NOTED | CHECKED BY: RAS
PROJECT NO: 110-416-7601 | APPROVED BY: APA

FIGURE NO.: 11

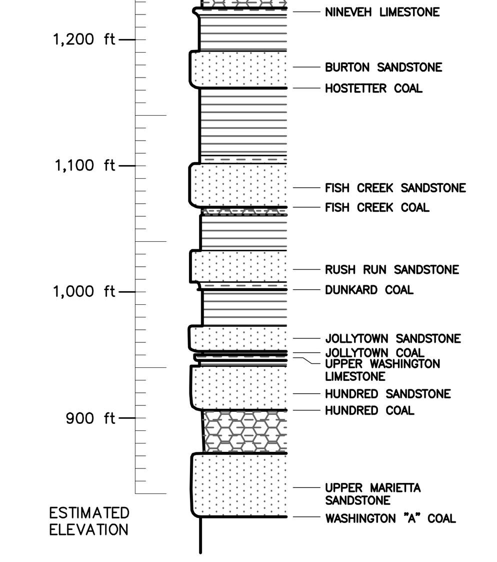


LEGEND

- FACILITY BOUNDARY (AEP OWNED)
- EXISTING RIGHT-OF-WAY
- EXISTING EASEMENT
- 580 EXISTING CONTOURS
- EXISTING STREAM
- G EXISTING GAS PIPELINE
- OH-E EXISTING OVERHEAD ELECTRICAL POWER LINES
- EXISTING ELECTRICAL POLE AND TOWER
- EXISTING VEGETATION
- EXISTING ROADS
- EXISTING STRUCTURE
- EXISTING OCCUPIED DWELLING
- LIMITS OF WASTE (OVERALL)
- 880 UNDERDRAIN POSITION AND ELEVATION
- MW1103F 1080.34 MONITORING WELL (COMPLETED 2011) STATIC WATER ELEVATION NOVEMBER 4, 2015.
- MW1503F 1046.15 MONITORING WELL (COMPLETED 2015) STATIC WATER ELEVATION NOVEMBER 4, 2015.
- POTENTIOMETRIC CONTOUR LINES (DASHED WHERE INFERRED)
- GROUNDWATER FLOW DIRECTION

UNDERDRAIN REFERENCE DRAWINGS:

1. PHASE 1A BOTTOM OF ISOLATION LAYER/GROUNDWATER INTERCEPTOR PLAN, DWG. NO. AP0050.100.0014. HULL AND ASSOCIATES, INC., TOLEDO, OHIO, SUBMITTAL DATE JULY 2014
2. GROUNDWATER INTERCEPTOR/STORM PIPE PLAN–FROM PHASE 1A TO ENERGY DISSAPATER (SOUTH END). DWG. NO. AP0050.100.0008. HULL AND ASSOCIATES, INC., TOLEDO, OHIO. SUBMITTAL DATE JULY 2014.



BEDROCK STRATIGRAPHIC COLUMN

NOTES:

1. THE WATER LEVELS PRESENTED HEREIN ARE APPLICABLE TO THE LOCATION AND TIME OF MEASUREMENT. WATER LEVELS MAY FLUCTUATE THROUGH TIME.
2. POTENTIOMETRIC CONTOURS ARE CONSTRUCTED BY INTERPOLATION BETWEEN POINTS OF KNOWN STATIC WATER LEVEL ELEVATIONS AND USING KNOWLEDGE OF SPECIFIC–SITE CONDITIONS. ACTUAL STATIC WATER LEVELS AT LOCATIONS BETWEEN THE MONITORING POINTS MAY DIFFER FROM THOSE DEPICTED.

NORTH

SCALE IN FEET

0 200 400

REVISION RECORD

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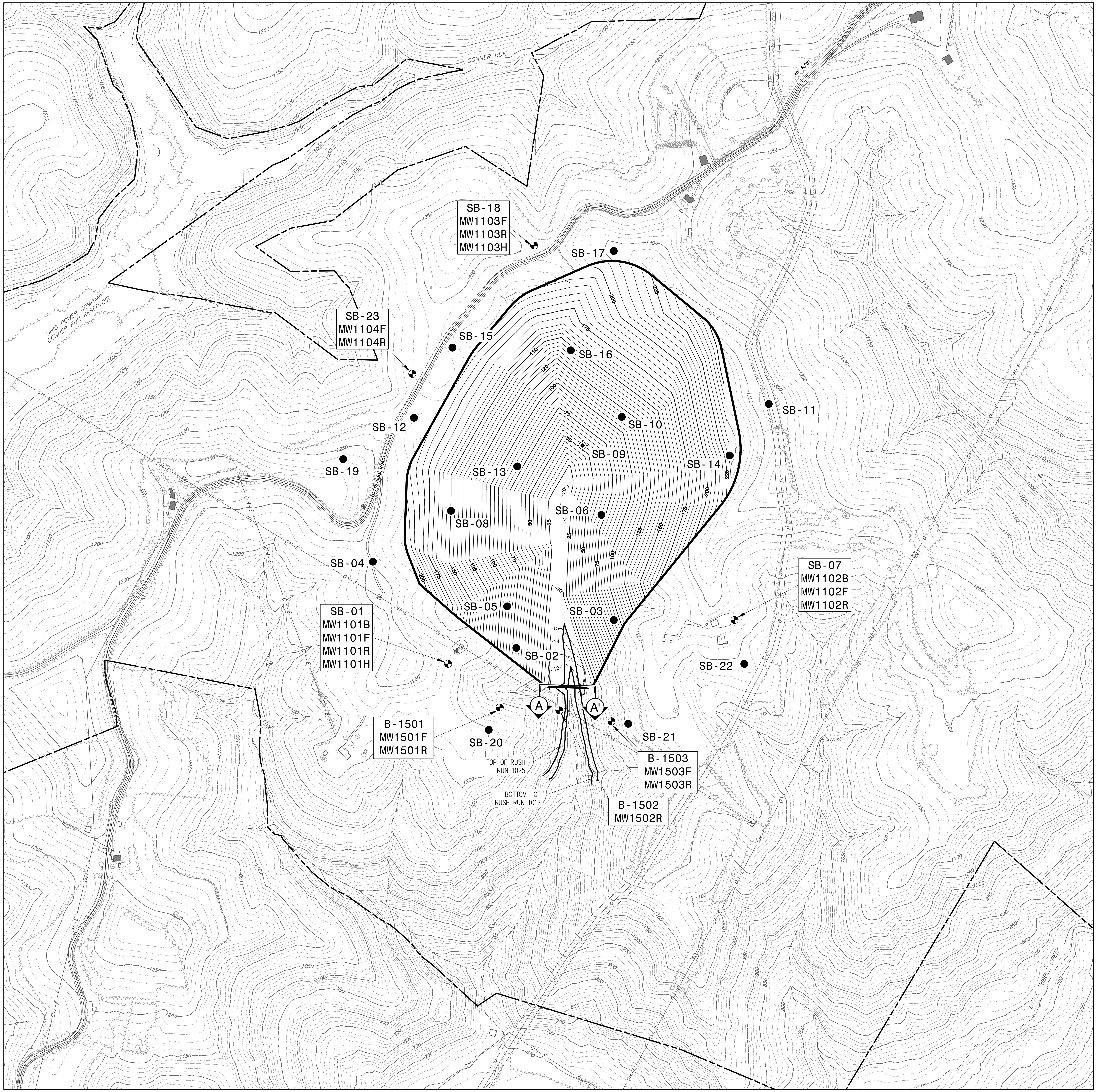
MARSHALL COUNTY, WEST VIRGINIA

GROUNDWATER MONITORING SYSTEM DEMONSTRATION

FISH CREEK SANDSTONE
POTENTIOMENTRIC SURFACE MAP

DATE:	DECEMBER 2015	DRAWN BY:	DAR
DWG SCALE:	AS NOTED	CHECKED BY:	RAS
PROJECT NO:			110-416-7601
APPROVED BY:			APA

FIGURE NO.: 12

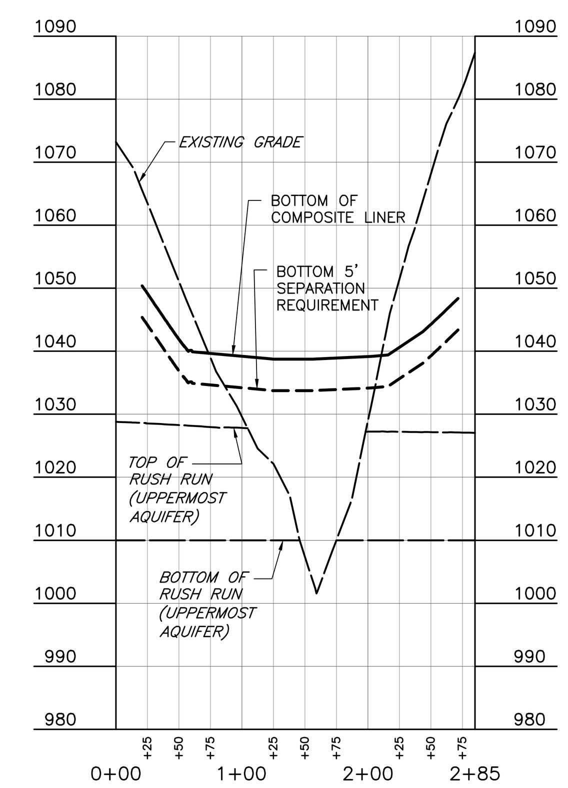


LEGEND

- PROPERTY BOUNDARY
- EXISTING RIGHT-OF-WAY
- EXISTING EASEMENT
- EXISTING CONTOURS (580)
- EXISTING STREAM
- EXISTING GAS PIPELINE (G)
- EXISTING OVERHEAD ELECTRICAL POWER LINES (OH-E)
- EXISTING ELECTRICAL POLE AND TOWER
- EXISTING VEGETATION
- EXISTING ROADS
- EXISTING STRUCTURE
- EXISTING OCCUPIED DWELLING
- LIMITS OF WASTE (OVERALL)
- ISOPACH CONTOUR (100)
- SB-01 — SOIL BORING LOCATION
- SB-23 MW1104F MW1104R — SOIL BORING/MONITORING WELL LOCATION (COMPLETED 2011)
- B-1501 MW1501F MW1501R — BORING/MONITORING WELL LOCATION (COMPLETED 2015)
- SB-09 — PIEZOMETER/SOIL BORING LOCATION (ABANDONED)

NOTES:

ISOPACH CONTOURS SHOWN ARE THE SEPARATION DISTANCES BETWEEN THE LANDFILL LINER SYSTEM AND THE TOP OF RUSH RUN SANDSTONE.



SECTION A-A'

SCALE: H:1"=100'; V:1"=20'

REVISION RECORD

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MARSHALL COUNTY, WEST VIRGINIA

GROUNDWATER MONITORING SYSTEM DEMONSTRATION

ISOLATION FROM UPPERMOST AQUIFER ISOPACH

DATE:	DECEMBER 2015	DRAWN BY:	DAR
DWG SCALE:	AS NOTED	CHECKED BY:	RAS
PROJECT NO:	110-416-7601	APPROVED BY:	APA

FIGURE NO.: 13

TABLES

Table 1 - Summary of Monitoring Well and Piezometer Construction
CCR Groundwater Monitoring System Demonstration
Mitchell Landfill
American Electric Power - Mitchell Generating Plant

Soil Boring ID	Monitoring Well ID	Monitoring Well Tag Number	Date Well Installed	Coordinates[1]		Ground Surface Elevation (ft amsl)[2]	Top of Riser Elevation (ft amsl)	Elevation Top of Bentonite Seal (ft amsl)	Elevation Top of Sand (ft amsl)	Depth to Top of Screen (ft amsl)	Top of Screen Elevation (ft bgs)	Screen Length (ft amsl)	Depth to Base of Screen (ft bgs)	Measured Total Depth[4] (feet)	Bottom of Screen Elevation (ft amsl)	Elevation Bottom of Sand/Top of Bentonite Back Fill (ft amsl)	Depth to Top of Dedicated Pump[5] (ft bgs)	Borehole Diameter Soil/Rock (inches)	Casing Type	Casing Diameter (inches)	Monitored Geologic Material	Monitored Stratigraphic Unit	Hydraulic Position Relative to Waste
				Northing	Easting																		
SB-01	MW1101H	0491-0003-2011	10/7/2011	484883.9	1609657.8	1218.7	1220.71	935.7	930.7	290.0	928.7	50.0	340.0	342.9	878.7	877.7	--	8.0/6.0	SCH 40 PVC	2.0	Very Fine to Fine, Micaceous SS w/ LS Inclusions & Interbedded ST Seams 287'-297'; Very Fine to Med., Micaceous SS w/ LS Inclusions 297'-310'; SH w/ Interbedded Slightly Micaceous ST Seams 310'-321'; ST w/ Interbedded, Slightly Micaceous SS Seams 321'-324'; SH w/ Interbedded ST 324'-327'; Very Fine to Med., Micaceous SS 327'-330'; Slightly Micaceous ST 330'-333'; SH w/ Few LS Inclusions 333'-338'; COAL Streak 338'-338.5'; Calcareous SH w/ LS Inclusions 338.5'-347'.	H and Interval Below	Down Gradient
	MW1101R	0491-0006-2011	10/28/2011	484877.8	1609656.4	1218.7	1221.23	1038.7	1033.7	187.0	1031.7	25.0	212.0	214.5	1006.7	1004.7	206.5	8.0/6.0	SCH 40 PVC	2.0	Very Fine to Medium Micaceous SS w/ few limestone inclusions; few ST seams 184.3' - 186.9'; Very fine to medium micaceous SS, very hard 186.9' - 211.0'; CT w/ few shale seams and limestone inclusions 211' - 214'.	R and Interval Below	Side Gradient
	MW1101F	0402-0006-2011	12/20/2011	484864.5	1609651.4	1219.0	1220.86	1066.0	1059.0	162.0	1057.0	7.0	169.0	171.1	1050.0	1049.0	167.5	8.0/6.0	SCH 40 PVC	2.0	SH thinly laminated to laminated 160' - 160.5'; ST w/ few LS inclusions, broken 160.5' - 161.3' Very Fine to Med SS w/ limestone inclusions, interbedded ST and SH 161.3' - 168.5'; Slightly Micaceous ST, few interbedded SH 168.5' - 169'; SH w/ few CT seams 168.5' - 170'.	F and Interval Above	Side Gradient
	MW1101B	0402-0005-2011	12/19/2011	484870.8	1609653.8	1218.8	1220.73	1136.8	1131.8	89.0	1129.8	18.0	107.0	109.2	1111.8	1110.8	101.5	8.0/6.0	SCH 40 PVC	2.0	Iron Stained LS 86' - 89'; Calcareous SH w/ few blocky CT seams 89' - 94.3'; CT w/ few shale seams, iron stained 94.3' - 103.3'; Calcareous SS, few ST seams 103.3' - 106.4'; Calcareous SH w/ few ST seams 106.4' - 108';	Unnamed Unit Above F	Undetermined
SB-07	MW1102R	0402-0002-2011	12/14/2011	485101.7	1611103.3	1226.7	1228.36	1037.7	1032.7	196.0	1030.7	8.0	204.0	205.8	1022.7	1021.7	--	8.0/6.0	SCH 40 PVC	2.0	ST w/ LS and calcite veins 194' - 197'; ST w/ LS interbeds and calcite veins 197' - 204.1'; Calcareous SH w/ few CT seams, some iron staining 204.1' - 205';	R	Side Gradient
	MW1102F	0491-0004-2011	10/25/2011	485106.1	1611110.1	1226.8	1228.67	1086.8	1081.8	147.0	1079.8	30.0	177.0	180.0	1049.8	1048.8	170.0	8.0/6.0	SCH 40 PVC	2.0	Micaceous Fine to Medium SS 145' - 147'; Micaceous Fine to Medium SS, few Calcite filled fractures 147' - 174.2'; SH 174.2' - 178';	F and Interval Below	Side Gradient
	MW1102B	0402-0003-2011	12/15/2011	485097.4	1611096.9	1226.9	1228.84	1159.9	1156.9	72.0	1154.9	17.0	89.0	90.9	1137.9	1136.9	83.0	8.0/6.0	SCH 40 PVC	2.0	SH few CT seams 70' 70.2'; ST w/ LS inclusions 70.2' - 73.3' Micaceous Fine to Med SS 73.3' - 76.1' Micaceous Fine to Medium SS 76.1' - 89.1'; SH 89.1' - 90'	Unnamed Unit Above F / Above Limestone	Undetermined
SB-18	MW1103H	0491-0002-2011	9/27/2011	487005.3	1610094.0	1237.4	1239.82	937.4	932.4	307.0	930.4	40.0	347.0	349.4	890.4	889.4	--	8.0/6.0	SCH 40 PVC	2.0	ST 305'-308'; Very Fine to Med. SS 308'-312'; ST 312'-317'; Very Fine to Med., Slightly Micaceous SS 317'-319'; Slightly Micaceous ST 319'-323'; SH 323'-327'; SH & Interbedded ST w/ LS Inclusions 327'-337'; SH & Interbedded ST/SS 337'-341'; SH w/Carbonaceous Streak 341'-345'; Interbedded LS and Calcareous SH 345'-347'.	H and Interval Below	Up Gradient
	MW1103R	0402-0004-2011	12/16/2011	486998.5	1610097.2	1238.1	1240.01	1053.1	1049.1	191.0	1047.1	7.0	198.0	200.3	1040.1	1039.1	--	8.0/6.0	SCH 40 PVC	2.0	ST slightly micaceous w/ few limestone inclusions 189' - 193'; Micaceous Very Fine to Medium SS w / few ST seams. 193' - 195.5'; ST w/ few LS inclusions, few SS seams 195.5' - 198' SH 198' - 199';	R	Up Gradient
	MW1103F	0491-0005-2011	10/26/2011	487011.2	1610102.2	1236.4	1239.19	1094.4	1089.4	149.0	1087.4	30.0	179.0	181.6	1057.4	1056.4	173.5	8.0/6.0	SCH 40 PVC	2.0	Micaceous Very Fine to Med. SS w/ interbedded ST 147' - 176.2' SH W/ COAL seam 0.042' thick 176.2' - 177'; SH w/ few CT seams 177' - 180'	F and Interval Below	Up Gradient
SB-23	MW1104R	0402-0008-2011	12/22/2011	486345.1	1609471.2	1228.7	1230.66	1046.7	1043.7	187.0	1041.7	25.0	212.0	213.8	1016.7	1015.7	--	8.0/6.0	SCH 40 PVC	2.0	Micaceous Very Fine to Med. SS, Calcareous 185' - 189'; Micaceous Very Fine to Med. SS w/ few LS inclusions 189' - 195.8'; ST few interbedded SH and few LS inclusions 195.8' 199'; SH w/ few LS inclusions 199' - 203.2'	R and Interval Below	Up Gradient
	MW1104F	0402-0007-2011	12/21/2011	486352.3	1609469.3	1228.5	1230.30	1083.5	1078.5	152.0	1076.5	20.0	172.0	174.1	1056.5	1055.5	--	8.0/6.0	SCH 40 PVC	2.0	ST w/ few interbedded SS and SH seams 150' - 150.8'; Micaceous Very Fine to Med. SS 150.8' - 154.4'; ST w interbedded SS seams 154.4' -159'; ST, calcareous few interbedded SH and SS seams 159' - 169.5'; Micaceous Very Fine to Med. w/ interbedded LS 169.5 ' - 171.4'; ST w /few SH and LS seams 171.4' - 172.5'; SH, calcareous w/ interbedded SS and LS 172.5' - 173'	F and Interval Below	Up Gradient
SB-09	PZ1101H[3]	0402-0001-2011	9/19/2011	485990.9	1610339.5	1141.3	1143.59	934.3	931.3	212.0	929.3	35.0	247.0	247.5	894.3	893.3	--	5.0	SCH 40 PVC	1.0	Micaceous Interbedded SS and SH trace Calcite inclusions 206' - 211.4'; Fine to Medium Micaceous SS some SH interbeds 211.4' - 222.8'; SH w/ some LS inclusions 222.8' - 229.8'; SH w/ trace calcite inclusions 229.8' - 235.8' Micaceous SS and SH interbeds, trace limestone inclusions 235.8' - 239.8'; Micaceous Fine to Medium SS 239.8' - 244.8'; SH w / some SS interbeds 244.8' - 247.2'; Micaceous Fine to Medium SS 247.2' - 247.8'; SH w/ some plant fossils 247.2' - 248'	H	Abandoned
B-1501	MW1501R		8/05/2015	484663.0	1609913.5	1158.80	1161.78	1033.1	1026.1	135.4	1023.4	14.6	150.0	153.5	1008.8	1007.8	--	8.0/6.0	SCH 40 PVC	4.0	Micaceous SS, well sorted, well cemented, slightly fractured to unfractured.	R	Down Gradient
	MW1501F		8/06/2015	484662.0	1609917.5	1158.84	1161.83	1078.6	1071.2	91.4	1067.4	14.6	106.0	109.7	1052.8	1051.84	--	8.0/6.0	SCH 40 PVC	4.0	Micaceous SS, very fine grained, thinly bedded, competent, well cemented, slightly to moderately fractured. CT near bottom of monitored interval, approximately 8 inches, underlain by approximately 14 inches of siltstone.	F	Down Gradient
B-1502	MW1502R		8/06/2015	484648.8	1610218.1	1045.23	1047.41	1027.5	1024.2	23.4	1021.83	9.6	33.0	36.0	1012.2	1011.6	--	6.0	SCH 40 PVC	4.0	Micaceous SS, well sorted, moderately fractured, iron-stained vertical fracture, sub-vertical fractures and horizontal fractures noted, interbedded ST zone noted, color change from gray to light brown.	R	Down Gradient
B-1503	MW1503R		8/15/2015	484596.7	1610487.6	1108.86	1111.96	1030.8	1023.3	89.4	1019.5	9.6	99.0	101.9	1009.3	1007.9	--	8.0/6.0	SCH 40 PVC	4.0	Micaceous SS, medium to thick bedded near top, very hard and finer grained in lower portion of monitored interval, trace pyrite noted, calcareous cement, slightly to moderately fractured, some brecciated siltstones and mudstone interbeds over 18 inch interval, iron-stained vertical and sub-vertical fractures noted.	R	Down Gradient
	MW1503F		8/15/2015	484591.4	1610488.5	1108.8	1111.93	1070.6	1062.8	48.4	1060.4	14.6	63.0	66.3	1045.2	1044.8	--	8.0/6.0	SCH 40 PVC	4.0	Micaceous SS, very fine grained, thin to thick beds, competent, well cemented; trace calcareous nodules, slightly fractured to unfractured. Interbedded SH, CT and SS in lower portion of monitored interval.	F	Down Gradient

Notes:
(1) Survey coordinates are US State Plane 1983 West Virginia North.
(2) amsl = average mean sea level. Vertical Datum is NAVD 1988, GEOID 03.
(3) Piezometer Abandoned in June 2013 due to encroaching landfill construction. One inch diameter piezometer.
(4) Measured from the top of riser.
(5) Dedicated bladder pumps installed December 2013.

Bedrock Unit Legend:
H = Hundred Sandstone
R = Rush Run Sandstone
F = Fish Creek Sandstone
B = Burton Sandstone/Shallow Bedrock

Rock Type Symbol Legend:
CL = Clay
CLSH = Clay shale
CT = Claystone
SS = Sandstone
ST = Siltstone
SH = Shale
LS = Limestone

Table 2 - Summary of Monitoring Well Water Levels
CCR Groundwater Monitoring System Demonstration
Mitchell Landfill
American Electric Power - Mitchell Generating Plant

Soil Boring ID	Monitoring Well ID	Monitoring Well Tag Number	Date Well Installed	Coordinates[1]		Top of Riser Elevation	Casing Diameter (inches)	Depth to Top of Screen	Screen Length	Measured Total Depth[4] (feet)	10/30/2014		11/11/2014		12/4/2014		1/22/2015		2/19/2015		3/19/2015		4/24/2015		5/20/2015	
				Northing	Easting	(ft amsl)		(ft amsl)	(ft amsl)		Water Level TOC	Elevation	Water Level TOC	Elevation	Water Level TOC	Elevation	Water Level TOC	Elevation	Water Level TOC	Elevation	Water Level TOC	Elevation	Water Level TOC	Elevation	Water Level TOC	Elevation
SB-01	MW1101H	0491-0003-2011	10/7/2011	484883.9	1609657.8	1220.71	2	290	50	342.9	331.64	889.07	331.24	889.47	330.61	890.10	329.13	891.58	329.10	891.61	327.56	893.15	326.52	894.19	325.80	894.91
	MW1101R	0491-0006-2011	10/28/2011	484877.8	1609656.4	1221.23	2	187	25	214.5	195.65	1025.58	195.63	1025.60	195.84	1025.39	195.68	1025.55	195.70	1025.53	195.69	1025.54	195.56	1025.67	195.69	1025.54
	MW1101F	0402-0006-2011	12/20/2011	484864.5	1609651.4	1220.86	2	162	7	171.1	139.86	1081.00	139.96	1080.90	140.31	1080.55	140.60	1080.26	140.55	1080.31	111.57	1109.29	98.32	1122.54	99.11	1121.75
	MW1101B	0402-0005-2011	12/19/2011	484870.8	1609653.8	1220.73	2	89	18	109.2	89.83	1130.90	89.91	1130.82	89.94	1130.79	88.65	1132.08	88.44	1132.29	87.49	1133.24	88.20	1132.53	89.10	1131.63
SB-07	MW1102R	0402-0002-2011	12/14/2011	485101.7	1611103.3	1228.36	2	196	8	205.8	198.64	1029.72	197.83	1030.53	196.17	1032.19	192.89	1035.47	192.73	1035.63	189.22	1039.14	187.87	1040.49	187.11	1041.25
	MW1102F	0491-0004-2011	10/25/2011	485106.1	1611110.1	1228.67	2	147	30	180	156.68	1071.99	156.61	1072.06	156.92	1071.75	156.67	1072.00	156.13	1072.54	156.64	1072.03	156.20	1072.47	156.44	1072.23
	MW1102B	0402-0003-2011	12/15/2011	485097.4	1611096.9	1228.84	2	72	17	90.9	64.36	1164.48	64.83	1164.01	65.32	1163.52	61.55	1167.29	61.43	1167.41	58.25	1170.59	59.54	1169.30	61.96	1166.88
SB-18	MW1103H	0491-0002-2011	9/27/2011	487005.3	1610094	1239.82	2	307	40	349.4	333.05	906.77	332.10	907.72	331.15	908.67					323.75	916.07	323.28	916.54	323.04	916.78
	MW1103R	0402-0004-2011	12/16/2011	486998.5	1610097.2	1240.01	2	191	7	200.3	198.60	1041.41	198.59	1041.42	198.51	1041.50	198.41	1041.60	198.32	1041.69	197.75	1042.26	197.63	1042.38	197.56	1042.45
	MW1103F	0491-0005-2011	10/26/2011	487011.2	1610102.2	1239.19	2	149	30	181.6	159.21	1079.98	158.60	1080.59	158.37	1080.82	158.03	1081.16	158.00	1081.19	157.95	1081.24	157.69	1081.50	157.22	1081.97
SB-23	MW1104R	0402-0008-2011	12/22/2011	486345.1	1609471.2	1230.66	2	187	25	213.8	205.30	1025.36	205.05	1025.61	204.92	1025.74	204.77	1025.89	204.51	1026.15	204.50	1026.16	204.32	1026.34	204.20	1026.46
	MW1104F	0402-0007-2011	12/21/2011	486352.3	1609469.3	1230.3	2	152	20	174.1	173.73	1056.57	173.75	1056.55	173.73	1056.57	173.74	1056.56	173.73	1056.57	173.72	1056.58	173.73	1056.57	173.68	1056.62
SB-09	PZ1101H[3]	0402-0001-2011	9/19/2011	485990.9	1610339.5	1143.59	1	212	35	247.5																
B-1501	MW1501R		8/5/2015	484663.0	1609913.5	1161.78	4	135.4	14.6	153.5																
	MW1501F		8/6/2015	484662.0	1609917.5	1161.83	4	91.4	14.6	109.7																
B-1502	MW1502R		8/6/2015	484648.8	1610218.1	1047.41	4	23.4	9.6	36.0																
B-1503	MW1503R		8/15/2015	484596.7	1610487.6	1111.96	4	89.4	9.6	101.9																
	MW1503F		8/15/2015	484591.4	1610488.5	1111.93	4	48.4	14.6	66.3																

(1) Survey coordinates are US State Plane 1983 West Virginia North.
(2) amsl = average mean sea level. Vertical Datum is NAVD 1988, GEOID 03.
(3) Piezometer Abandoned in June 2013 due to encroaching landfill construction. One inch diameter piezometer.
(4) Measured from the top of riser.

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American Electric Power - Mitchell Generating Plant

Soil Boring ID	Monitoring Well ID	Monitoring Well Tag Number	Date Well Installed	Coordinates[1]		Top of Riser Elevation (ft amsl)	Casing Diameter (inches)	Depth to Top of Screen (ft amsl)	Screen Length (ft amsl)	Measured Total Depth[4] (feet)	6/15/2015		7/29/2015		8/26/2015		9/15/2015		9/30/2015		10/13/2015		11/3/2015		11/4/2015	
				Northing	Easting						Water Level TOC	Elevation	Water Level TOC	Elevation	Water Level TOC	Elevation	Water Level TOC	Elevation	Water Level TOC	Elevation	Water Level TOC	Elevation	Water Level TOC	Elevation	Water Level TOC	Elevation
SB-01	MW1101H	0491-0003-2011	10/7/2011	484883.9	1609657.8	1220.71	2	290	50	342.9	325.10	895.61	326.52	894.19	325.82	894.89	325.30	895.41			331.32	889.39			330.78	889.93
	MW1101R	0491-0006-2011	10/28/2011	484877.8	1609656.4	1221.23	2	187	25	214.5	195.59	1025.64	195.67	1025.56	195.78	1025.45	195.83	1025.40			196.10	1025.13			195.92	1025.31
	MW1101F	0402-0006-2011	12/20/2011	484864.5	1609651.4	1220.86	2	162	7	171.1	102.07	1118.79	107.21	1113.65	109.07	1111.79	110.17	1110.69			122.83	1098.03			123.34	1097.52
	MW1101B	0402-0005-2011	12/19/2011	484870.8	1609653.8	1220.73	2	89	18	109.2			89.02	1131.71	89.59	1131.14	89.82	1130.91			89.08	1131.65			88.93	1131.80
SB-07	MW1102R	0402-0002-2011	12/14/2011	485101.7	1611103.3	1228.36	2	196	8	205.8	186.58	1041.78	194.35	1034.01	193.37	1034.99	192.80	1035.56			196.98	1031.38	195.22	1033.14		
	MW1102F	0491-0004-2011	10/25/2011	485106.1	1611110.1	1228.67	2	147	30	180	156.53	1072.14	156.64	1072.03	156.69	1071.98	156.78	1071.89			156.62	1072.05	156.78	1071.89		
	MW1102B	0402-0003-2011	12/15/2011	485097.4	1611096.9	1228.84	2	72	17	90.9			61.27	1167.57	64.24	1164.60	65.23	1163.61			65.19	1163.65			65.49	1163.35
SB-18	MW1103H	0491-0002-2011	9/27/2011	487005.3	1610094	1239.82	2	307	40	349.4	322.95	916.87	333.80	906.02	333.58	906.24	333.19	906.63			338.42	901.40			337.77	902.05
	MW1103R	0402-0004-2011	12/16/2011	486998.5	1610097.2	1240.01	2	191	7	200.3	197.49	1042.52	199.35	1040.66	199.32	1040.69	199.14	1040.87			199.29	1040.72			199.28	1040.73
	MW1103F	0491-0005-2011	10/26/2011	487011.2	1610102.2	1239.19	2	149	30	181.6	157.70	1081.49	158.60	1080.59	158.19	1081.00	157.96	1081.23			160.29	1078.90			158.85	1080.34
SB-23	MW1104R	0402-0008-2011	12/22/2011	486345.1	1609471.2	1230.66	2	187	25	213.8	204.10	1026.56	211.04	1019.62	210.87	1019.79	210.76	1019.90			211.72	1018.94			211.52	1019.14
	MW1104F	0402-0007-2011	12/21/2011	486352.3	1609469.3	1230.3	2	152	20	174.1	173.62	1056.68	173.55	1056.75	173.49	1056.81	173.46	1056.84			173.48	1056.82			173.42	1056.88
SB-09	PZ1101H[3]	0402-0001-2011	9/19/2011	485990.9	1610339.5	1143.59	1	212	35	247.5																
B-1501	MW1501R		8/5/2015	484663.0	1609913.5	1161.78	4	135.4	14.6	153.5									152.07	1009.71	152.10	1009.68			152.14	1009.64
	MW1501F		8/6/2015	484662.0	1609917.5	1161.83	4	91.4	14.6	109.7									108.47	1053.36	108.45	1053.38			108.48	1053.35
B-1502	MW1502R		8/6/2015	484648.8	1610218.1	1047.41	4	23.4	9.6	36.0									25.25	1022.16	32.61	1014.80			32.07	1015.34
B-1503	MW1503R		8/15/2015	484596.7	1610487.6	1111.96	4	89.4	9.6	101.9									98.06	1013.90	98.21	1013.75			98.52	1013.44
	MW1503F		8/15/2015	484591.4	1610488.5	1111.93	4	48.4	14.6	66.3									65.74	1046.19	65.75	1046.18			65.78	1046.15

(1) Survey coordinates are US State Plane 1983 West Virginia North.
(2) amsl = average mean sea level. Vertical Datum is NAVD 1988, GEOID 03.
(3) Piezometer Abandoned in June 2013 due to encroaching landfill construction. One inch diameter piezometer.
(4) Measured from the top of riser.

Bedrock Unit Legend:
H = Hundred Sandstone
R = Rush Run Sandstone
F = Fish Creek Sandstone
B = Burton Sandstone/Shallow Bedrock

APPENDIX A

Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

BORING NUMBER SB-01/ MW1101H

CLIENT American Electric Power	**PROJECT NAME** Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416	**PROJECT LOCATION** Gatts Ridge Road, Cresap, West Virginia
DATE STARTED 9/16/11 **COMPLETED** 10/4/11	**GROUND ELEVATION** 1218.7 ft **HOLE SIZE** 0.5 ft
DRILLING CONTRACTOR Frontz Drilling, Inc.	**GROUND WATER LEVELS:**
DRILLING METHOD 4.25" I.D. HSA: Auto Hammer & Air Rotary Rock Core	**AT TIME OF DRILLING** Refer to notes throughout log
LOGGED BY R. Mahle / M. McCoy **CHECKED BY** M. McCoy	**AT END OF DRILLING** Refer to notes at bottom of log
LOCATION N 484883.9, E 1609657.8	**13 hours AFTER DRILLING** Well installed

ELEVATION (ft)	MATERIAL DESCRIPTION
1218.7	Brown LEAN CLAY (CL), trace roots, moist, medium stiff (RESIDUAL)
1217.2	Brown LEAN CLAY WITH SAND (CL), trace roots, noted iron oxide concretions, moist, medium stiff to stiff (RESIDUAL)
1213.8	Light brown and gray LEAN CLAY WITH SAND (CL), trace roots, few interbedded reddish-brown lean clay seams, moist, stiff (RESIDUAL)
1212.7	Shelby Tube sample obtained from 4'-6' (Recovery = 20")
1210.8	Brown LEAN CLAY (CL), moist, stiff (RESIDUAL)
	Shelby Tube sample obtained from 6'-8' (Recovery = 22")
1209.2	Gray, light gray and reddish-brown LEAN CLAY (CL), few thin (less than 1/8" thick) sandy silt seams, moist, stiff to hard (RESIDUAL)
	Reddish-brown, gray and grayish-brown SHALE, completely to highly weathered, very broken, very soft, thinly laminated to laminated
1205.2	Reddish-brown CLAYSTONE, highly weathered, very broken, very soft
1202.2	Gray SHALE, highly weathered, very broken, very soft, laminated
1200.7	Dark burgundy to gray CLAYSTONE, becomes harder with depth, calcite filled fractures from 18.5' to 18.8', slickensides at 19.3', 19.7' and 21.5', mottled below 20.2' to dark gray below 21.6', moderately weathered to highly weathered, very broken, moderately soft
	0.1' thick seam of black shale at 28.6'. Fracture with iron staining from 29' to 29.3'. Iron stained below 31.6'.
	Silty with vertical fracture from 32.2' to 33.9', iron stained, partially healed
1185	

SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)
SS 1	47	0-2-3 (5)	1.25-2
SS 2	80	3-3-2 (5)	0.5-2.25
SS 3	87	3-5-3 (8)	1.25-2.5
SS 4	87	6-5-8 (13)	1.25-2.25, 2.5-3.75
SS 5	20	3-6-5 (11)	1.25-2.25
SS 6	87	6-7-6 (13)	1-1.25, 2.75-4.5+
SS 7	100	49-38-50/3"	4.5+, 4.5+
SS 8	100	41-50/3"	4.5+
SS 9	100	43-50/1"	4.5+
SS 10	71	16-41-50/5"	4.5+
SS 11	100	18-50/3"	4.5+
SS 12	100	50/5"	
RC 1	62 (9)		
RC 2	71 (31)		

Depth (ft): 0.0, 5.0, 10.0, 15.0, 20.0, 25.0, 30.0, 35.0

WELL DIAGRAM: 2.0' Stickup; Concrete Seal; 2-Inch Solid PVC Riser Sealed with Bentonite Grout

(Continued Next Page)

Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

BORING NUMBER SB-01/ MW1101H

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray to orangish-brown SANDSTONE, noted calcite, cemented, very fine to medium grained, noted iron staining and iron stained fractures, micaceous, moderately weathered, moderately broken to slightly broken, hard, very thin bedded to medium bedded *(continued)*	35.0					
1182.1		Orangish-brown SILTSTONE, noted iron staining, some calcite inclusions, moderately weathered, very broken at top to moderately broken, very thin bedded Groundwater level reading = dry (borehole depth =38' bgs) on 9/30/2011 at 7:35 AM. Very fine to fine sandstone from 40.3' to 40.7' and 44.6' to 44.9'. Sandstone from 44.3' to 45.9'. Iron stained vertical fracture from 44.6' to 45'.	40.0 45.0	RC 3	99 (35)			2-Inch Solid PVC Riser Sealed with Bentonite Grout
1172.7		Burgundy and gray SHALE, few claystone seams, pyrite from 46' and 47' and 49.9' to 50', vertical fracture from 49.1' to 49.3', slickenside at 48', vertical fracture and iron stained at 49', moderately weathered, very broken at top, laminated	50.0					
1168.7		Gray and orange SANDSTONE, very fine to fine grained, pyrite from 50' to 50.3', vertical fractures and iron stains from 50.5' to 50.9' and from 51.8' to 52.5', slightly weathered, moderately broken, hard, very thin bedded		RC 4	98 (50)			
1166.2		Gray SHALE, few siltstone seams, iron stained fractures at 53.3', 53.9' and 54.4', slightly weathered, slightly broken, hard, laminated Very brown from 56' to 58.5' and 60.3' to 60.8'. Pyrite from 56.6' to 58.5'.	55.0 60.0					
1157.9		Burgundy to gray CLAYSTONE, few shale laminations, moderately weathered, broken, moderately soft	65.0	RC 5	62 (21)			
1152.7		Dark gray to light gray LIMESTONE, slightly weathered, moderately broken, hard, thick bedded						
1151		Black SHALE, slightly weathered, broken, soft, laminated						
1150.9		Gray SHALE, slightly weathered, very broken, soft, laminated						
1150		Gray SANDSTONE, fine to medium grained, slightly weathered, hard, very thin bedded	70.0					
1149.7		Gray SILTSTONE, calcareous, calcite veins, occasional shale laminations, slightly weathered, moderately broken, medium hard to hard, very thin bedded		RC 6	80 (39)			
1144.7			75.0					

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BORING NUMBER SB-01/ MW1101H

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SHALE, calcareous, siltstone interbeds, very brown from 76' to 79.5', calcite lined vertical fracture from 77.6' to 78', slightly weathered, moderately broken, hard, laminated *(continued)*	75.0					
			80.0	RC 7	87 (32)			
			85.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1133.3		Black and gray LIMESTONE, black shale interbeds at 87.7', 88.3' and 88.8', iron stained horizontal fractures at 86.5', 86.8' and 88.1', slightly weathered, medium bedded, hard, broken to moderately broken Water at 88.7'.						
1129.7		Gray SHALE, few blocky claystone seams, calcareous, iron stained vertical fractures at 89.5', 90.1', 90.7', and 91.2' to 91.7', slightly weathered to fresh, broken, moderately hard, laminated	90.0	RC 8	66 (8)			
1124.4		Burgundy CLAYSTONE, few shale seams, iron stained fractures, fresh, slightly broken, hard	95.0					
			100.0	RC 9	100 (64)			
1115.4		Gray SANDSTONE, very fine to fine grained, calcareous, iron stained, fresh, slightly broken, hard, very thin bedded	105.0					
1112.3		Gray SHALE, few siltstone seams, calcareous infills, fresh, moderately broken, very broken from 106.4' to 107.4' and from 109.4' to 109.7', moderately hard, thinly laminated to laminated	110.0	RC 10	80 (41)			
1107.7		Burgundy to gray CLAYSTONE, fresh, moderately broken, moderately hard	115.0					

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Civil & Environmental Consultants, Inc.
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BORING NUMBER SB-01/ MW1101H

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Burgundy to gray CLAYSTONE, fresh, moderately broken, moderately hard *(continued)*	115.0					
1102.3		Gray SANDSTONE, iron stained vertical fractures from 116.4' to 117.4', fresh, moderately broken, hard, very thin bedded						
1099.7		Gray and burgundy SHALE, few claystone seams, iron stained vertical fracture from 119.5' to 120', fresh, slightly to moderately broken, hard, laminated	120.0	RC 11	64 (25)			
1094.5		Gray SILTSTONE, few claystone seams, fresh, moderately broken, moderately hard, thin bedded	125.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1092.2		Gray and burgundy SHALE, few claystone seams, transitioning to claystone with depth, occasional thin siltstone interbeds, fresh, moderately broken, moderately hard, thinly laminated to laminated	130.0	RC 12	90 (66)			
			135.0					
1083.2		Gray and burgundy CLAYSTONE, occasional thin siltstone and shale interbeds, iron stained fracture at 140.1', fresh, very broken, moderately hard						
1078.6		Gray SILTSTONE, fresh, moderately broken, hard, thin bedded to medium bedded Limestone interbeds from 142.5' to 142.8'	140.0	RC 13	70 (38)			
1074.2		Gray LIMESTONE, fresh, moderately broken, hard, thick bedded	145.0	RC 14				
1071.7		Gray SILTSTONE, slightly micaceous, few limestone inclusions from 147' to 147.4', interbedded shale from 151.3' to 152.4', fresh, moderately broken, moderately hard to hard, thin bedded	150.0	RC 15	82 (61)			
1066.3			155.0					

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CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		155.0					
	Gray SHALE, interbedded siltstone from 155.4' to 155.8', slightly reddish-gray from 155.4' to 156.7' with claystone seams, interbedded slightly micaceous siltstone seams less than 1/8" thick from 157' to 160.5, fresh, moderately broken, moderately hard, thinly laminated to laminated *(continued)*	160.0					
1058.2	Gray SILTSTONE, few limestone inclusions, fresh, moderately broken to broken, hard, medium bedded		RC 16	100 (84)			
1057.4	Gray SANDSTONE, very fine to medium grained, limestone inclusions, interbedded siltstone seams throughout less than 1/16" thick, interbedded shale and siltstone layers from 163.6' to 164', fresh, moderately broken to slightly broken, hard, thin bedded to medium bedded	165.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1050.2	Gray SILTSTONE, slightly micaceous, few interbedded shale seams throughout less than 1/8" thick, fresh, moderately broken, hard, very thin bedded	170.0					
1049.7	Gray becoming reddish-gray and dark gray SHALE, few claystone seams, interbedded siltstone seams throughout less than 1/8" thick, pyrite specks observed at 170.3', iron staining from 171' to 171.1', fresh, moderately broken, moderately hard, thinly laminated to laminated		RC 17	90 (58)			
1044.9	Gray becoming dark gray SANDSTONE, micaceous, very fine to medium grained, interbedded with siltstone seams throughout less than 1/8" thick, few limestone inclusions, fresh, moderately broken, hard, very thin bedded becoming thick bedded	175.0					
1042.2	Dark gray SHALE, fresh, moderately broken to broken, hard, laminated						
1041.2	Gray to slightly reddish-gray SHALE, few claystone and siltstone seams, calcareous, few limestone inclusions, fresh, broken, hard, laminated	180.0					
1037.9	Gray SILTSTONE, slightly micaceous, calcareous, few limestone inclusions, few shale seams throughout less than 1/8" thick, fresh, broken, hard, very thin bedded to thin bedded		RC 18	98 (84)			
1034.4	Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions, few interbedded siltstone seams less than 1/16" thick, fresh, moderately broken to slightly broken, hard, very thin bedded to thin bedded	185.0					
1031.8	Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions, dark gray fine to coarse grained seams less than 1/8" thick from 197' to 207', fresh, moderately broken to slightly broken, very hard, very thin bedded to thick bedded	190.0	RC 19	100 (76)			
		195.0					

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CLIENT American Electric Power **PROJECT NAME** Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416 **PROJECT LOCATION** Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions, dark gray fine to coarse grained seams less than 1/8" thick from 197' to 207', fresh, moderately broken to slightly broken, very hard, very thin bedded to thick bedded *(continued)*	195.0					
			200.0	RC 20	100 (74)			
			205.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
			210.0					
1007.7		Gray becoming reddish-gray CLAYSTONE, few shale seams, limestone inclusions, fresh, moderately broken, moderately hard to hard		RC 21	88 (60)			
			215.0					
1001.7		Reddish-brown CLAYSTONE, gray seam from 220.1' to 220.4', 0.5" thick dark gray lens at 221.7', fresh, moderately broken, hard						
			220.0					
996.9		Gray SILTSTONE, slightly micaceous, few limestone inclusions, interbedded shale seams less than 1/16" thick from 221.8' to 222.2', fresh, moderately broken, hard, very thin bedded		RC 22	87 (71)			
995.2		Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions throughout, fresh, slightly broken, very hard, very thin bedded	225.0					
991.7		Gray and reddish-brown CLAYSTONE, blocky, fresh, moderately broken, hard						
989.4		Gray SILTSTONE, slightly micaceous, interbedded shale seams less than 1/8" thick, few limestone inclusions, fresh, moderately broken, hard, very thin bedded to thin bedded	230.0	RC 23	77 (56)			
984.7			235.0					

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CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SANDSTONE, micaceous, very fine to medium grained, interbedded siltstone seams throughout less than 1/8" thick, fresh, slightly broken, very hard, very thin bedded *(continued)*	235.0					
981.7		Gray SHALE, few siltstone seams, slightly micaceous, interbedded shale lenses throughout less than 1/8" thick, interbedded sandstone layer, reddish-brown seams from 237.8' to 237.9', from 238.7' to 238.8', from 239' to 239.3', and from 241.3' to 241.4', pyrite at 238.1', fresh, moderately broken, hard, thinly laminated to laminated	240.0	RC 24	88 (50)			
976.8		Gray and reddish-brown SHALE, few interbedded slightly micaceous siltstone seams throughout less than 1/16" thick, fresh, slightly broken, hard, thinly laminated to laminated	245.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
971.7		Reddish-brown becoming gray SHALE, few claystone seams, fresh, broken, moderately hard to hard, thinly laminated to laminated	250.0					
968		Black COAL, fresh, broken, moderately hard, thinly laminated		RC 25	84 (59)			
967.4		Gray SILTSTONE, slightly micaceous, calcareous, interbedded shale seams throughout less than 1/8" thick, limestone inclusions throughout, fresh, slightly broken, hard, very thin bedded	255.0					
961.7		Gray SILTSTONE, slightly micaceous, calcareous, limestone inclusions, interbedded shale seams throughout less than 1/8" thick, gray and reddish-brown and gray claystone seams from 264.4' to 267' and 270.1' to 276', fresh, moderately broken to slightly broken, hard to very hard, medium bedded	260.0	RC 26	92 (77)			
			265.0					
			270.0	RC 27	78 (42)			
			275.0					

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Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

BORING NUMBER SB-01/ MW1101H

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			275.0					
941.7		Gray SILTSTONE, slightly micaceous, few limestone inclusions throughout, few shale seams from 285.8' to 287' less than 1/16" thick, few interbedded sandstone seams from 287.8' to 288.4', fresh, moderately broken, hard to very hard, very thin bedded to thin bedded	280.0	RC 28	99 (72)			
			285.0					Hole Plug (Bentonite Chips)
930.3		Gray SANDSTONE, micaceous, very fine to fine grained, few limestone inclusions throughout, interbedded siltstone seams throughout ranging from 1/8" to 1" thick, few interbedded shale seams less than 1/8" thick from 292.8' to 293.1' and 293.8' to 294.3', interbedded dark gray very fine to medium grained seams less than 1/16" thick from 291' to 296.3', fresh, moderately broken, very hard, very thin bedded to thin bedded	290.0	RC 29	100 (96)			Filter Sand
			295.0					
921.7		Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions throughout, few interbedded siltstone seams less than 1/8" thick from 297.3' to 298.6', fresh, moderately broken, very hard, very thin bedded to thin bedded	300.0	RC 30	100 (63)			2-Inch Slotted Screen
			305.0					
909.2		Gray SHALE, interbedded slightly micaceous siltstone seams less than 1/8" thick from 309.5' to 314.6', decreasing percentage of siltstone with depth, gray and reddish-gray layers from 315.2' to 315.4' and 316.2' to 317', fresh, moderately broken, hard becoming moderately hard, thinly laminated to laminated	310.0	RC 31	96 (70)			
			315.0					

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Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			315.0					
901.7		Reddish-gray becoming gray SHALE, few claystone seams, interbedded siltstone from 318.4' to 320.6', percentage of siltstone increasing with depth, 1/8" thick dark gray seams at 318.8', fresh, moderately broken, moderately hard to hard, thinly laminated to laminated	320.0					
898.1		Gray SILTSTONE, few interbedded sandstone seams, slightly micaceous, interbedded calcareous limestone throughout, fresh, slightly broken, very hard, very thin bedded to thin bedded		RC 32	100 (87)			
894.4		Gray SHALE, interbedded siltstone seams less than 0.5" thick throughout, fresh, moderately broken, hard, thinly laminated to laminated	325.0					2-Inch Slotted Screen
892		Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions from 329.8' to 330', fresh, broken, very hard, very thin bedded	330.0					
888.7		Gray SILTSTONE, slightly micaceous interbedded shale seams less than 1/16" thick from 330' to 331.5', interbedded sandstone from 331.5' to 332.9', fresh, moderately broken, hard, very thin bedded		RC 33	85 (46)			
885.8		Gray SHALE, few limestone inclusions, pyrite specks observed at 336.7', fresh, moderately broken, hard, thinly laminated to laminated	335.0					
880.5		Black COAL, fresh, broken, moderately hard, thinly laminated						
880.2		Dark gray SHALE, many limestone inclusions, calcareous from 338.5' to 341.6' and 342.3' to 347' with the exception of a dark gray lens from 343.3' to 343.5', noted increased percentage of limestone inclusions from 343.5' to 347', fresh, moderately broken, hard to very hard, thinly laminated to laminated Geophysical logging and packer testing were performed upon completion. The following groundwater level readings were taken for geophysical logging after filling borehole with water (note: borehole would not fill completely): Before logging, 10/4/2011 4:43 PM 52.03' bgs After first tooling, 10/4/2011 5:41 PM 62.85' bgs At completion, 10/4/2011 7:15 PM 95.19' bgs	340.0 345.0	RC 34	93 (63)			Filter Sand
871.7		Bottom of hole at 347.0 feet. Approximate 0.5' bench cut for access. Cut soil described as 0.2' of topsoil over 0.3' of brown lean clay with sand (CL). The following groundwater level reading was taken after drilling: 10/5/2011 8:44 AM at 96.4' bgs (borehole depth = 347' bgs) prior to well installation Well MW1101H installed following geophysical logging and packer testing.						

BORING NUMBER SB-01/ MW1101R

Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

CLIENT American Electric Power	**PROJECT NAME** Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416	**PROJECT LOCATION** Gatts Ridge Road, Cresap, West Virginia
DATE STARTED 9/16/11 **COMPLETED** 10/4/11	**GROUND ELEVATION** 1218.7 ft **HOLE SIZE** 0.5 ft
DRILLING CONTRACTOR Frontz Drilling, Inc.	**GROUND WATER LEVELS:**
DRILLING METHOD 4.25" I.D. HSA: Auto Hammer & Air Rotary Rock Core	**AT TIME OF DRILLING** Refer to notes throughout log
LOGGED BY R. Mahle / M. McCoy **CHECKED BY** M. McCoy	**AT END OF DRILLING** Refer to notes at bottom of log
LOCATION N 484877.8, E 1609656.4	**13 hours AFTER DRILLING** Well installed

ELEVATION (ft)	MATERIAL DESCRIPTION
1218.7	Brown LEAN CLAY (CL), trace roots, moist, medium stiff (RESIDUAL)
1217.2	Brown LEAN CLAY WITH SAND (CL), trace roots, noted iron oxide concretions, moist, medium stiff to stiff (RESIDUAL)
1213.8	Light brown and gray LEAN CLAY WITH SAND (CL), trace roots, few interbedded reddish-brown lean clay seams, moist, stiff (RESIDUAL)
1212.7	Shelby Tube sample obtained from 4'-6' (Recovery = 20")
1210.8	Brown LEAN CLAY (CL), moist, stiff (RESIDUAL)
	Shelby Tube sample obtained from 6'-8' (Recovery = 22")
1209.2	Gray, light gray and reddish-brown LEAN CLAY (CL), few thin (less than 1/8" thick) sandy silt seams, moist, stiff to hard (RESIDUAL)
	Reddish-brown, gray and grayish-brown SHALE, completely to highly weathered, very broken, very soft, thinly laminated to laminated
1205.2	Reddish-brown CLAYSTONE, highly weathered, very broken, very soft
1202.2	Gray SHALE, highly weathered, very broken, very soft, laminated
1200.7	Dark burgundy to gray CLAYSTONE, becomes harder with depth, calcite filled fractures from 18.5' to 18.8', slickensides at 19.3', 19.7' and 21.5', mottled below 20.2' to dark gray below 21.6', moderately weathered to highly weathered, very broken, moderately soft
	0.1' thick seam of black shale at 28.6'. Fracture with iron staining from 29' to 29.3'. Iron stained below 31.6'.
	Silty with vertical fracture from 32.2' to 33.9', iron stained, partially healed
1185	

Depth (ft): 0.0, 5.0, 10.0, 15.0, 20.0, 25.0, 30.0, 35.0

SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)
SS 1	47	0-2-3 (5)	1.25-2
SS 2	80	3-3-2 (5)	0.5-2.25
SS 3	87	3-5-3 (8)	1.25 -2.5
SS 4	87	6-5-8 (13)	1.25-2.25 2.5-
SS 5	20	3-6-5 (11)	3.75 1.25-2.25
SS 6	87	6-7-6 (13)	1-1.25 2.75 -4.5+
SS 7	100	49-38-50/3"	4.5+ 4.5+
SS 8	100	41-50/3"	4.5+
SS 9	100	43-50/1"	4.5+
SS 10	71	16-41-50/5"	4.5+
SS 11	100	18-50/3"	4.5+
SS 12	100	50/5"	
RC 1	62 (9)		
RC 2	71 (31)		

WELL DIAGRAM: 2.5' Stickup; Concrete Seal; 2-Inch Solid PVC Riser Sealed with Bentonite Grout

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CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray to orangish-brown SANDSTONE, noted calcite, cemented, very fine to medium grained, noted iron staining and iron stained fractures, micaceous, moderately weathered, moderately broken to slightly broken, hard, very thin bedded to medium bedded *(continued)*	35.0					
1182.1		Orangish-brown SILTSTONE, noted iron staining, some calcite inclusions, moderately weathered, very broken at top to moderately broken, very thin bedded	40.0	RC 3	99 (35)			
		Groundwater level reading = dry (borehole depth =38' bgs) on 9/30/2011 at 7:35 AM.						
		Very fine to fine sandstone from 40.3' to 40.7' and 44.6' to 44.9'.	45.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1172.7		Sandstone from 44.3' to 45.9'. Iron stained vertical fracture from 44.6' to 45'.						
		Burgundy and gray SHALE, few claystone seams, pyrite from 46' and 47' and 49.9' to 50', vertical fracture from 49.1' to 49.3', slickenside at 48', vertical fracture and iron stained at 49', moderately weathered, very broken at top, laminated	50.0					
1168.7		Gray and orange SANDSTONE, very fine to fine grained, pyrite from 50' to 50.3', vertical fractures and iron stains from 50.5' to 50.9' and from 51.8' to 52.5', slightly weathered, moderately broken, hard very thin bedded		RC 4	98 (50)			
1166.2		Gray SHALE, few siltstone seams, iron stained fractures at 53.3', 53.9' and 54.4', slightly weathered, slightly broken, hard, laminated	55.0					
		Very brown from 56' to 58.5' and 60.3' to 60.8'. Pyrite from 56.6' to 58.5'.	60.0					
1157.9		Burgundy to gray CLAYSTONE, few shale laminations, moderately weathered, broken, moderately soft	65.0	RC 5	62 (21)			
1152.7		Dark gray to light gray LIMESTONE, slightly weathered, moderately broken, hard, thick bedded						
1151		Black SHALE, slightly weathered, broken, soft, laminated						
1150.9		Gray SHALE, slightly weathered, very broken, soft, laminated						
1150		Gray SANDSTONE, fine to medium grained, slightly weathered, hard, very thin bedded	70.0					
1149.7		Gray SILTSTONE, calcareous, calcite veins, occasional shale laminations, slightly weathered, moderately broken, medium hard to hard, very thin bedded		RC 6	80 (39)			
1144.7			75.0					

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BORING NUMBER SB-01/ MW1101R

Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SHALE, calcareous, siltstone interbeds, very brown from 76' to 79.5', calcite lined vertical fracture from 77.6' to 78', slightly weathered, moderately broken, hard, laminated *(continued)*	75.0					
			80.0	RC 7	87 (32)			
			85.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1133.3		Black and gray LIMESTONE, black shale interbeds at 87.7', 88.3' and 88.8', iron stained horizontal fractures at 86.5', 86.8' and 88.1', slightly weathered, medium bedded, hard, broken to moderately broken Water at 88.7'.						
1129.7		Gray SHALE, few blocky claystone seams, calcareous, iron stained vertical fractures at 89.5', 90.1', 90.7', and 91.2' to 91.7', slightly weathered to fresh, broken, moderately hard, laminated	90.0	RC 8	66 (8)			
1124.4		Burgundy CLAYSTONE, few shale seams, iron stained fractures, fresh, slightly broken, hard	95.0					
			100.0	RC 9	100 (64)			
1115.4		Gray SANDSTONE, very fine to fine grained, calcareous, iron stained, fresh, slightly broken, hard, very thin bedded	105.0					
1112.3		Gray SHALE, few siltstone seams, calcareous infills, fresh, moderately broken, very broken from 106.4' to 107.4' and from 109.4' to 109.7', moderately hard, thinly laminated to laminated						
			110.0	RC 10	80 (41)			
1107.7		Burgundy to gray CLAYSTONE, fresh, moderately hard, moderately broken						
			115.0					

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CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	MATERIAL DESCRIPTION
	Burgundy to gray CLAYSTONE, fresh, moderately hard, moderately broken *(continued)*
1102.3	Gray SANDSTONE, iron stained vertical fractures from 116.4' to 117.4', fresh, moderately broken, hard, very thin bedded
1099.7	Gray and burgundy SHALE, few claystone seams, iron stained vertical fracture from 119.5' to 120', fresh, slightly to moderately broken, hard, laminated
1094.5	Gray SILTSTONE, few claystone seams, fresh, moderately broken, moderately hard, thin bedded
1092.2	Gray and burgundy SHALE, few claystone seams, transitioning to claystone with depth, occasional thin siltstone interbeds, fresh, moderately broken, moderately hard, thinly laminated to laminated
1083.2	Gray and burgundy CLAYSTONE, occasional thin siltstone and shale interbeds, iron stained fracture at 140.1', fresh, very broken, moderately hard
1078.6	Gray SILTSTONE, fresh, moderately broken, hard, thin bedded to medium bedded Limestone interbeds from 142.5' to 142.8'
1074.2	Gray LIMESTONE, fresh, moderately broken, hard, thick bedded
1071.7	Gray SILTSTONE, slightly micaceous, few limestone inclusions from 147' to 147.4', interbedded shale from 151.3' to 152.4', fresh, moderately broken, moderately hard to hard, thin bedded
1066.3	

Depth scale (ft): 115.0, 120.0, 125.0, 130.0, 135.0, 140.0, 145.0, 150.0, 155.0

SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)
RC 11	64 (25)		
RC 12	90 (66)		
RC 13	70 (38)		
RC 14			
RC 15	82 (61)		

WELL DIAGRAM: 2-Inch Solid PVC Riser Sealed with Bentonite Grout

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CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SHALE, interbedded siltstone from 155.4' to 155.8', slightly reddish-gray from 155.4' to 156.7' with claystone seams, interbedded slightly micaceous siltstone seams less than 1/8" thick from 157' to 160.5, fresh, moderately broken, moderately hard, thinly laminated to laminated *(continued)*	155.0					
1058.2		Gray SILTSTONE, few limestone inclusions, fresh, moderately broken to broken, hard, medium bedded	160.0	RC 16	100 (84)			
1057.4		Gray SANDSTONE, very fine to medium grained, limestone inclusions, interbedded siltstone seams throughout less than 1/16" thick, interbedded shale and siltstone layers from 163.6' to 164', fresh, moderately broken to slightly broken, hard, thin bedded to medium bedded	165.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1050.2		Gray SILTSTONE, slightly micaceous, few interbedded shale seams throughout less than 1/8" thick, fresh, moderately broken, hard, very thin bedded						
1049.7		Gray becoming reddish-gray and dark gray SHALE, few claystone seams, interbedded siltstone seams throughout less than 1/8" thick, pyrite specks observed at 170.3', iron staining from 171' to 171.1', fresh, moderately broken, moderately hard, thinly laminated to laminated	170.0	RC 17	90 (58)			
1044.9		Gray becoming dark gray SANDSTONE, micaceous, very fine to medium grained, interbedded with siltstone seams throughout less than 1/8" thick, few limestone inclusions, fresh, moderately broken, hard, very thin bedded becoming thick bedded	175.0					
1042.2		Dark gray SHALE, fresh, moderately broken to broken, hard, laminated						
1041.2		Gray to slightly reddish-gray SHALE, few claystone and siltstone seams, calcareous, few limestone inclusions, fresh, broken, hard, laminated	180.0					
1037.9		Gray SILTSTONE, slightly micaceous, calcareous, few limestone inclusions, few shale seams throughout less than 1/8" thick, fresh, broken, hard, very thin bedded to thin bedded		RC 18	98 (84)			Hole Plug (Bentonite Chips)
1034.4		Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions, few interbedded siltstone seams less than 1/16" thick, fresh, moderately broken to slightly broken, hard, very thin bedded to thin bedded	185.0					Filter Sand
1031.8		Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions, dark gray fine to coarse grained seams less than 1/8" thick from 197' to 207', fresh, moderately broken to slightly broken, very hard, very thin bedded to thick bedded	190.0	RC 19	100 (76)			
			195.0					

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CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions, dark gray fine to coarse grained seams less than 1/8" thick from 197' to 207', fresh, moderately broken to slightly broken, very hard, very thin bedded to thick bedded *(continued)*	195.0					
			200.0	RC 20	100 (74)			2-Inch Slotted Screen
			205.0					
			210.0					
1007.7		Gray becoming reddish-gray CLAYSTONE, few shale seams, limestone inclusions, fresh, moderately broken, moderately hard to hard		RC 21	88 (60)			Filter Sand
			215.0					
1001.7		Reddish-brown CLAYSTONE, gray seam from 220.1' to 220.4', 0.5" thick dark gray lens at 221.7', fresh, moderately broken, hard						
			220.0					
996.9		Gray SILTSTONE, slightly micaceous, few limestone inclusions, interbedded shale seams less than 1/16" thick from 221.8' to 222.2', fresh, moderately broken, hard, very thin bedded		RC 22	87 (71)			
995.2		Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions throughout, fresh, slightly broken, very hard, very thin bedded	225.0					
991.7		Gray and reddish-brown CLAYSTONE, blocky, fresh, moderately broken, hard						
989.4		Gray SILTSTONE, slightly micaceous, interbedded shale seams less than 1/8" thick, few limestone inclusions, fresh, moderately broken, hard, very thin bedded to thin bedded	230.0	RC 23	77 (56)			
984.7			235.0					

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Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SANDSTONE, micaceous, very fine to medium grained, interbedded siltstone seams throughout less than 1/8" thick, fresh, slightly broken, very hard, very thin bedded *(continued)*	235.0					
981.7		Gray SHALE, few siltstone seams, slightly micaceous, interbedded shale lenses throughout less than 1/8" thick, interbedded sandstone layer, reddish-brown seams from 237.8' to 237.9', from 238.7' to 238.8', from 239' to 239.3', and from 241.3' to 241.4', pyrite at 238.1', fresh, moderately broken, hard, thinly laminated to laminated	240.0	RC 24	88 (50)			
976.8		Gray and reddish-brown SHALE, few interbedded slightly micaceous siltstone seams throughout less than 1/16" thick, fresh, slightly broken, hard, thinly laminated to laminated	245.0					
971.7		Reddish-brown becoming gray SHALE, few claystone seams, fresh, broken, moderately hard to hard, thinly laminated to laminated	250.0					
968		Black COAL, fresh, broken, moderately hard, thinly laminated		RC 25	84 (59)			
967.4		Gray SILTSTONE, slightly micaceous, calcareous, interbedded shale seams throughout less than 1/8" thick, limestone inclusions throughout, fresh, slightly broken, hard, very thin bedded	255.0					
961.7		Gray SILTSTONE, slightly micaceous, calcareous, limestone inclusions, interbedded shale seams throughout less than 1/8" thick, gray and reddish-brown and gray claystone seams from 264.4' to 267' and 270.1' to 276', fresh, moderately broken to slightly broken, hard to very hard, medium bedded	260.0	RC 26	92 (77)			
			265.0					
			270.0	RC 27	78 (42)			
			275.0					

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CLIENT American Electric Power **PROJECT NAME** Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416 **PROJECT LOCATION** Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			275.0					
941.7		Gray SILTSTONE, slightly micaceous, few limestone inclusions throughout, few shale seams from 285.8' to 287' less than 1/16" thick, few interbedded sandstone seams from 287.8' to 288.4', fresh, moderately broken, hard to very hard, very thin bedded to thin bedded	280.0 285.0	RC 28	99 (72)			
930.3		Gray SANDSTONE, micaceous, very fine to fine grained, few limestone inclusions throughout, interbedded siltstone seams throughout ranging from 1/8" to 1" thick, few interbedded shale seams less than 1/8" thick from 292.8' to 293.1' and 293.8' to 294.3', interbedded dark gray very fine to medium grained seams less than 1/16" thick from 291' to 296.3', fresh, moderately broken, very hard, very thin bedded to thin bedded	290.0 295.0	RC 29	100 (96)			
921.7		Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions throughout, few interbedded siltstone seams less than 1/8" thick from 297.3' to 298.6', fresh, moderately broken, very hard, very thin bedded to thin bedded	300.0 305.0	RC 30	100 (63)			
909.2		Gray SHALE, interbedded slightly micaceous siltstone seams less than 1/8" thick from 309.5' to 314.6', decreasing percentage of siltstone with depth, gray and reddish-gray layers from 315.2' to 315.4' and 316.2' to 317', fresh, moderately broken, hard becoming moderately hard, thinly laminated to laminated	310.0 315.0	RC 31	96 (70)			

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Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

BORING NUMBER SB-01/ MW1101R

CLIENT American Electric Power **PROJECT NAME** Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416 **PROJECT LOCATION** Gatts Ridge Road, Cresap, West Virginia

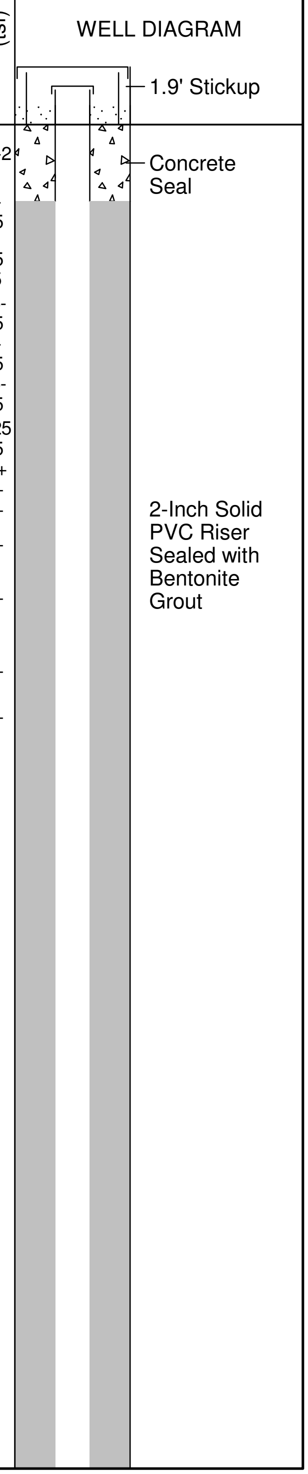
ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			315.0					
901.7		Reddish-gray becoming gray SHALE, few claystone seams, interbedded siltstone from 318.4' to 320.6', percentage of siltstone increasing with depth, 1/8" thick dark gray seams at 318.8', fresh, moderately broken, moderately hard to hard, thinly laminated to laminated	320.0					
898.1		Gray SILTSTONE, few interbedded sandstone seams, slightly micaceous, interbedded calcareous limestone throughout, fresh, slightly broken, very hard, very thin bedded to thin bedded		RC 32	100 (87)			
894.4		Gray SHALE, interbedded siltstone seams less than 0.5" thick throughout, fresh, moderately broken, hard, thinly laminated to laminated	325.0					
892		Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions from 329.8' to 330', fresh, broken, very hard, very thin bedded	330.0					
888.7		Gray SILTSTONE, slightly micaceous interbedded shale seams less than 1/16" thick from 330' to 331.5', interbedded sandstone from 331.5' to 332.9', fresh, moderately broken, hard, very thin bedded		RC 33	85 (46)			
885.8		Gray SHALE, few limestone inclusions, pyrite specks observed at 336.7', fresh, moderately broken, hard, thinly laminated to laminated	335.0					
880.5		Black COAL, fresh, broken, moderately hard, thinly laminated						
880.2		Dark gray SHALE, many limestone inclusions, calcareous from 338.5' to 341.6' and 342.3' to 347' with the exception of a dark gray lens from 343.3' to 343.5', noted increased percentage of limestone inclusions from 343.5' to 347', fresh, moderately broken, hard to very hard, thinly laminated to laminated Geophysical logging and packer testing were performed upon completion. The following groundwater level readings were taken for geophysical logging after filling borehole with water (note: borehole would not fill completely): Before logging, 10/4/2011 4:43 PM 52.03' bgs After first tooling, 10/4/2011 5:41 PM 62.85' bgs At completion, 10/4/2011 7:15 PM 95.19' bgs	340.0 345.0	RC 34	93 (63)			
871.7		Bottom of hole at 347.0 feet. Approximate 0.5' bench cut for access. Cut soil described as 0.2' of topsoil over 0.3' of brown lean clay with sand (CL). The following groundwater level reading was taken after drilling: 10/5/2011 8:44 AM at 96.4' bgs (borehole depth = 347' bgs) prior to well installation Well MW1101R installed after completion in an offset boring. The above-noted ground elevation corresponds to the ground elevation at which soil and rock sampling was initiated at SB-01. The ground elevation for MW1101R = 1218.7 ft.						

BORING NUMBER SB-01/ MW1101F

Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia
DATE STARTED 9/16/11 **COMPLETED** 10/4/11
GROUND ELEVATION 1218.7 ft **HOLE SIZE** 0.5 ft
DRILLING CONTRACTOR Frontz Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD 4.25" I.D. HSA: Auto Hammer & Air Rotary Rock Core
AT TIME OF DRILLING Refer to notes throughout log
LOGGED BY R. Mahle / M. McCoy **CHECKED BY** M. McCoy
AT END OF DRILLING Refer to notes at bottom of log
LOCATION N 484864.5, E 1609651.4
13 hours AFTER DRILLING Well installed

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)
1218.7	Brown LEAN CLAY (CL), trace roots, moist, medium stiff (RESIDUAL)	0.0	SS 1	47	0-2-3 (5)	1.25-2
1217.2	Brown LEAN CLAY WITH SAND (CL), trace roots, noted iron oxide concretions, moist, medium stiff to stiff (RESIDUAL)		SS 2	80	3-3-2 (5)	0.5-2.25
			SS 3	87	3-5-3 (8)	1.25 -2.5
1213.8	Light brown and gray LEAN CLAY WITH SAND (CL), trace roots, few interbedded reddish-brown lean clay seams, moist, stiff (RESIDUAL)	5.0	SS 4	87	6-5-8 (13)	1.25-2.25 2.5-3.75
1212.7	Shelby Tube sample obtained from 4'-6' (Recovery = 20")		SS 5	20	3-6-5 (11)	1.25-2.25
1210.8	Brown LEAN CLAY (CL), moist, stiff (RESIDUAL)		SS 6	87	6-7-6 (13)	1-1.25 2.75 -4.5+
	Shelby Tube sample obtained from 6'-8' (Recovery = 22")	10.0	SS 7	100	49-38-50/3"	4.5+ 4.5+
1209.2	Gray, light gray and reddish-brown LEAN CLAY (CL), few thin (less than 1/8" thick) sandy silt seams, moist, stiff to hard (RESIDUAL)		SS 8	100	41-50/3"	4.5+
	Reddish-brown, gray and grayish-brown SHALE, completely to highly weathered, very broken, very soft, thinly laminated to laminated		SS 9	100	43-50/1"	4.5+
1205.2	Reddish-brown CLAYSTONE, highly weathered, very broken, very soft	15.0	SS 10	71	16-41-50/5"	4.5+
			SS 11	100	18-50/3"	4.5+
1202.2	Gray SHALE, highly weathered, very broken, very soft, laminated		SS 12	100	50/5"	
1200.7	Dark burgundy to gray CLAYSTONE, becomes harder with depth, calcite filled fractures from 18.5' to 18.8', slickensides at 19.3', 19.7' and 21.5', mottled below 20.2' to dark gray below 21.6', moderately weathered to highly weathered, very broken, moderately soft	20.0				
		25.0	RC 1	62 (9)		
	0.1' thick seam of black shale at 28.6'. Fracture with iron staining from 29' to 29.3'. Iron stained below 31.6'.	30.0				
	Silty with vertical fracture from 32.2' to 33.9', iron stained, partially healed		RC 2	71 (31)		
1185		35.0				



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CLIENT American Electric Power **PROJECT NAME** Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416 **PROJECT LOCATION** Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
	Gray to orangish-brown SANDSTONE, noted calcite, cemented, very fine to medium grained, noted iron staining and iron stained fractures, micaceous, moderately weathered, moderately broken to slightly broken, hard, very thin bedded to medium bedded *(continued)*	35.0					
1182.1	Orangish-brown SILTSTONE, noted iron staining, some calcite inclusions, moderately weathered, very broken at top to moderately broken, very thin bedded Groundwater level reading = dry (borehole depth =38' bgs) on 9/30/2011 at 7:35 AM. Very fine to fine sandstone from 40.3' to 40.7' and 44.6' to 44.9'.	40.0	RC 3	99 (35)			
1172.7	Sandstone from 44.3' to 45.9'. Iron stained vertical fracture from 44.6' to 45'. Burgundy and gray SHALE, few claystone seams, pyrite from 46' and 47' and 49.9' to 50', vertical fracture from 49.1' to 49.3', slickenside at 48', vertical fracture and iron stained at 49', moderately weathered, very broken at top, laminated	45.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1168.7	Gray and orange SANDSTONE, very fine to fine grained, pyrite from 50' to 50.3', vertical fractures and iron stains from 50.5' to 50.9' and from 51.8' to 52.5', slightly weathered, moderately broken, hard very thin bedded	50.0	RC 4	98 (50)			
1166.2	Gray SHALE, few siltstone seams, iron stained fractures at 53.3', 53.9' and 54.4', slightly weathered, slightly broken, hard, laminated Very brown from 56' to 58.5' and 60.3' to 60.8'. Pyrite from 56.6' to 58.5'.	55.0					
1157.9	Burgundy to gray CLAYSTONE, few shale laminations, moderately weathered, broken, moderately soft	60.0	RC 5	62 (21)			
1152.7	Dark gray to light gray LIMESTONE, slightly weathered, moderately broken, hard, thick bedded	65.0					
1151	Black SHALE, slightly weathered, broken, soft, laminated						
1150.9	Gray SHALE, slightly weathered, very broken, soft, laminated						
1150	Gray SANDSTONE, fine to medium grained, slightly weathered, hard, very thin bedded						
1149.7	Gray SILTSTONE, calcareous, calcite veins, occasional shale laminations, slightly weathered, moderately broken, medium hard to hard, very thin bedded	70.0	RC 6	80 (39)			
1144.7		75.0					

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CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SHALE, calcareous, siltstone interbeds, very brown from 76' to 79.5', calcite lined vertical fracture from 77.6' to 78', slightly weathered, moderately broken, hard, laminated *(continued)*	75.0					
			80.0	RC 7	87 (32)			
			85.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1133.3		Black and gray LIMESTONE, black shale interbeds at 87.7', 88.3' and 88.8', iron stained horizontal fractures at 86.5', 86.8' and 88.1', slightly weathered, medium bedded, hard, broken to moderately broken Water at 88.7'.						
1129.7		Gray SHALE, few blocky claystone seams, calcareous, iron stained vertical fractures at 89.5', 90.1', 90.7', and 91.2' to 91.7', slightly weathered to fresh, broken, moderately hard, laminated	90.0	RC 8	66 (8)			
1124.4		Burgundy CLAYSTONE, few shale seams, iron stained fractures, fresh, slightly broken, hard	95.0					
			100.0	RC 9	100 (64)			
1115.4		Gray SANDSTONE, very fine to fine grained, calcareous, iron stained, fresh, slightly broken, hard, very thin bedded	105.0					
1112.3		Gray SHALE, few siltstone seams, calcareous infills, fresh, moderately broken, very broken from 106.4' to 107.4' and from 109.4' to 109.7', moderately hard, thinly laminated to laminated	110.0	RC 10	80 (41)			
1107.7		Burgundy to gray CLAYSTONE, fresh, moderately hard, moderately broken	115.0					

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Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
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BORING NUMBER SB-01/ MW1101F

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
	Burgundy to gray CLAYSTONE, fresh, moderately hard, moderately broken *(continued)*	115.0					
1102.3	Gray SANDSTONE, iron stained vertical fractures from 116.4' to 117.4', fresh, moderately broken, hard, very thin bedded						
1099.7	Gray and burgundy SHALE, few claystone seams, iron stained vertical fracture from 119.5' to 120', fresh, slightly to moderately broken, hard, laminated	120.0	RC 11	64 (25)			
1094.5	Gray SILTSTONE, few claystone seams, fresh, moderately broken, moderately hard, thin bedded	125.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1092.2	Gray and burgundy SHALE, few claystone seams, transitioning to claystone with depth, occasional thin siltstone interbeds, fresh, moderately broken, moderately hard, thinly laminated to laminated	130.0	RC 12	90 (66)			
1083.2	Gray and burgundy CLAYSTONE, occasional thin siltstone and shale interbeds, iron stained fracture at 140.1', fresh, very broken, moderately hard	135.0					
1078.6	Gray SILTSTONE, fresh, moderately broken, hard, thin bedded to medium bedded Limestone interbeds from 142.5' to 142.8'	140.0	RC 13	70 (38)			
1074.2	Gray LIMESTONE, fresh, moderately broken, hard, thick bedded	145.0	RC 14				
1071.7	Gray SILTSTONE, slightly micaceous, few limestone inclusions from 147' to 147.4', interbedded shale from 151.3' to 152.4', fresh, moderately broken, moderately hard to hard, thin bedded	150.0	RC 15	82 (61)			
1066.3		155.0					

(Continued Next Page)

CLIENT American Electric Power

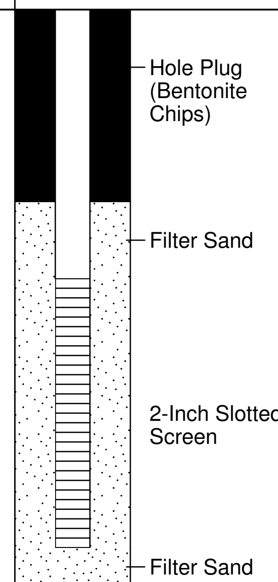
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)
	Gray SHALE, interbedded siltstone from 155.4' to 155.8', slightly reddish-gray from 155.4' to 156.7' with claystone seams, interbedded slightly micaceous siltstone seams less than 1/8" thick from 157' to 160.5, fresh, moderately broken, moderately hard, thinly laminated to laminated *(continued)*	155.0				
1058.2	Gray SILTSTONE, few limestone inclusions, fresh, moderately broken to broken, hard, medium bedded	160.0	RC 16	100 (84)		
1057.4	Gray SANDSTONE, very fine to medium grained, limestone inclusions, interbedded siltstone seams throughout less than 1/16" thick, interbedded shale and siltstone layers from 163.6' to 164', fresh, moderately broken to slightly broken, hard, thin bedded to medium bedded	165.0				
1050.2	Gray SILTSTONE, slightly micaceous, few interbedded shale seams throughout less than 1/8" thick, fresh, moderately broken, hard, very thin bedded					
1049.7	Gray becoming reddish-gray and dark gray SHALE, few claystone seams, interbedded siltstone seams throughout less than 1/8" thick, pyrite specks observed at 170.3', iron staining from 171' to 171.1', fresh, moderately broken, moderately hard, thinly laminated to laminated	170.0	RC 17	90 (58)		
1044.9	Gray becoming dark gray SANDSTONE, micaceous, very fine to medium grained, interbedded with siltstone seams throughout less than 1/8" thick, few limestone inclusions, fresh, moderately broken, hard, very thin bedded becoming thick bedded	175.0				
1042.2	Dark gray SHALE, fresh, moderately broken to broken, hard, laminated					
1041.2	Gray to slightly reddish-gray SHALE, few claystone and siltstone seams, calcareous, few limestone inclusions, fresh, broken, hard, laminated	180.0				
1037.9	Gray SILTSTONE, slightly micaceous, calcareous, few limestone inclusions, few shale seams throughout less than 1/8" thick, fresh, broken, hard, very thin bedded to thin bedded		RC 18	98 (84)		
1034.4	Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions, few interbedded siltstone seams less than 1/16" thick, fresh, moderately broken to slightly broken, hard, very thin bedded to thin bedded	185.0				
1031.8	Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions, dark gray fine to coarse grained seams less than 1/8" thick from 197' to 207', fresh, moderately broken to slightly broken, very hard, very thin bedded to thick bedded	190.0	RC 19	100 (76)		
		195.0				

WELL DIAGRAM



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CLIENT American Electric Power **PROJECT NAME** Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416 **PROJECT LOCATION** Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions, dark gray fine to coarse grained seams less than 1/8" thick from 197' to 207', fresh, moderately broken to slightly broken, very hard, very thin bedded to thick bedded *(continued)*	195.0					
			200.0	RC 20	100 (74)			
			205.0					
			210.0					
1007.7		Gray becoming reddish-gray CLAYSTONE, few shale seams, limestone inclusions, fresh, moderately broken, moderately hard to hard		RC 21	88 (60)			
			215.0					
1001.7		Reddish-brown CLAYSTONE, gray seam from 220.1' to 220.4', 0.5" thick dark gray lens at 221.7', fresh, moderately broken, hard						
			220.0					
996.9		Gray SILTSTONE, slightly micaceous, few limestone inclusions, interbedded shale seams less than 1/16" thick from 221.8' to 222.2', fresh, moderately broken, hard, very thin bedded		RC 22	87 (71)			
995.2		Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions throughout, fresh, slightly broken, very hard, very thin bedded	225.0					
991.7		Gray and reddish-brown CLAYSTONE, blocky, fresh, moderately broken, hard						
989.4		Gray SILTSTONE, slightly micaceous, interbedded shale seams less than 1/8" thick, few limestone inclusions, fresh, moderately broken, hard, very thin bedded to thin bedded	230.0	RC 23	77 (56)			
984.7			235.0					

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BORING NUMBER SB-01/ MW1101F

Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SANDSTONE, micaceous, very fine to medium grained, interbedded siltstone seams throughout less than 1/8" thick, fresh, slightly broken, very hard, very thin bedded *(continued)*	235.0					
981.7		Gray SHALE, few siltstone seams, slightly micaceous, interbedded shale lenses throughout less than 1/8" thick, interbedded sandstone layer, reddish-brown seams from 237.8' to 237.9', from 238.7' to 238.8', from 239' to 239.3', and from 241.3' to 241.4', pyrite at 238.1', fresh, moderately broken, hard, thinly laminated to laminated	240.0	RC 24	88 (50)			
976.8		Gray and reddish-brown SHALE, few interbedded slightly micaceous siltstone seams throughout less than 1/16" thick, fresh, slightly broken, hard, thinly laminated to laminated	245.0					
971.7		Reddish-brown becoming gray SHALE, few claystone seams, fresh, broken, moderately hard to hard, thinly laminated to laminated	250.0					
968		Black COAL, fresh, broken, moderately hard, thinly laminated						
967.4		Gray SILTSTONE, slightly micaceous, calcareous, interbedded shale seams throughout less than 1/8" thick, limestone inclusions throughout, fresh, slightly broken, hard, very thin bedded	255.0	RC 25	84 (59)			
961.7		Gray SILTSTONE, slightly micaceous, calcareous, limestone inclusions, interbedded shale seams throughout less than 1/8" thick, gray and reddish-brown and gray claystone seams from 264.4' to 267' and 270.1' to 276', fresh, moderately broken to slightly broken, hard to very hard, medium bedded	260.0	RC 26	92 (77)			
			265.0					
			270.0	RC 27	78 (42)			
			275.0					

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Civil & Environmental Consultants, Inc.
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BORING NUMBER SB-01/ MW1101F

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			275.0					
941.7		Gray SILTSTONE, slightly micaceous, few limestone inclusions throughout, few shale seams from 285.8' to 287' less than 1/16" thick, few interbedded sandstone seams from 287.8' to 288.4', fresh, moderately broken, hard to very hard, very thin bedded to thin bedded	280.0 285.0	RC 28	99 (72)			
930.3		Gray SANDSTONE, micaceous, very fine to fine grained, few limestone inclusions throughout, interbedded siltstone seams throughout ranging from 1/8" to 1" thick, few interbedded shale seams less than 1/8" thick from 292.8' to 293.1' and 293.8' to 294.3', interbedded dark gray very fine to medium grained seams less than 1/16" thick from 291' to 296.3', fresh, moderately broken, very hard, very thin bedded to thin bedded	290.0 295.0	RC 29	100 (96)			
921.7		Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions throughout, few interbedded siltstone seams less than 1/8" thick from 297.3' to 298.6', fresh, moderately broken, very hard, very thin bedded to thin bedded	300.0 305.0	RC 30	100 (63)			
909.2		Gray SHALE, interbedded slightly micaceous siltstone seams less than 1/8" thick from 309.5' to 314.6', decreasing percentage of siltstone with depth, gray and reddish-gray layers from 315.2' to 315.4' and 316.2' to 317', fresh, moderately broken, hard becoming moderately hard, thinly laminated to laminated	310.0 315.0	RC 31	96 (70)			

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BORING NUMBER SB-01/ MW1101F

Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
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CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			315.0					
901.7		Reddish-gray becoming gray SHALE, few claystone seams, interbedded siltstone from 318.4' to 320.6', percentage of siltstone increasing with depth, 1/8" thick dark gray seams at 318.8', fresh, moderately broken, moderately hard to hard, thinly laminated to laminated	320.0					
898.1		Gray SILTSTONE, few interbedded sandstone seams, slightly micaceous, interbedded calcareous limestone throughout, fresh, slightly broken, very hard, very thin bedded to thin bedded		RC 32	100 (87)			
894.4		Gray SHALE, interbedded siltstone seams less than 0.5" thick throughout, fresh, moderately broken, hard, thinly laminated to laminated	325.0					
892		Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions from 329.8' to 330', fresh, broken, very hard, very thin bedded	330.0					
888.7		Gray SILTSTONE, slightly micaceous interbedded shale seams less than 1/16" thick from 330' to 331.5', interbedded sandstone from 331.5' to 332.9', fresh, moderately broken, hard, very thin bedded		RC 33	85 (46)			
885.8		Gray SHALE, few limestone inclusions, pyrite specks observed at 336.7', fresh, moderately broken, hard, thinly laminated to laminated	335.0					
880.5		Black COAL, fresh, broken, moderately hard, thinly laminated						
880.2		Dark gray SHALE, many limestone inclusions, calcareous from 338.5' to 341.6' and 342.3' to 347' with the exception of a dark gray lens from 343.3' to 343.5', noted increased percentage of limestone inclusions from 343.5' to 347', fresh, moderately broken, hard to very hard, thinly laminated to laminated Geophysical logging and packer testing were performed upon completion. The following groundwater level readings were taken for geophysical logging after filling borehole with water (note: borehole would not fill completely): Before logging, 10/4/2011 4:43 PM 52.03' bgs After first tooling, 10/4/2011 5:41 PM 62.85' bgs At completion, 10/4/2011 7:15 PM 95.19' bgs	340.0 345.0	RC 34	93 (63)			
871.7		Bottom of hole at 347.0 feet. Approximate 0.5' bench cut for access. Cut soil described as 0.2' of topsoil over 0.3' of brown lean clay with sand (CL). The following groundwater level reading was taken after drilling: 10/5/2011 8:44 AM at 96.4' bgs (borehole depth = 347' bgs) prior to well installation Well MW1101F installed after completion in an offset boring. The above-noted ground elevation corresponds to the ground elevation at which soil and rock sampling was initiated at SB-01. The ground elevation for MW1101F = 1219.0 ft.						

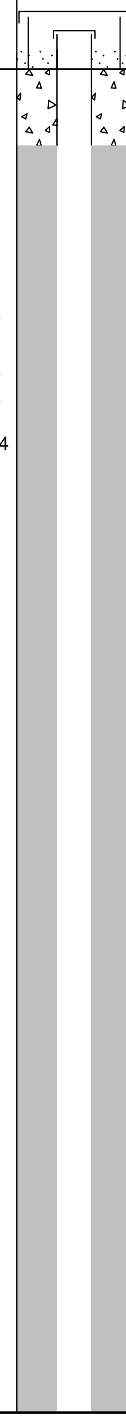
Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

BORING NUMBER SB-07/ MW1102R

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia
DATE STARTED 9/7/11 **COMPLETED** 10/12/11
GROUND ELEVATION 1226.8 ft **HOLE SIZE** 0.5 ft
DRILLING CONTRACTOR Frontz Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD HSA: Auto Hammer & Air Rotary Rock Core
AT TIME OF DRILLING Refer to notes throughout log
LOGGED BY M. McCoy **CHECKED BY** A. Amicon
AT END OF DRILLING Refer to notes at bottom of log
LOCATION N 485101.7, E 1611103.3
AFTER DRILLING Well installed

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)
1226.8	Brown and dark brown LEAN CLAY (CL), trace roots, moist, soft to medium stiff (RESIDUAL) Noted hard fine grained sandstone fragments in shoe of SS-1 and SS-2.	0.0	SS 1	67	3-3-3 (6)	1
			SS 2	27	2-3-2 (5)	
			SS 3	27	3-2-2 (4)	
1222.5	Brown LEAN CLAY (CL), few shale fragments, noted iron staining, moist, medium stiff (RESIDUAL)	5.0	SS 4	67	1-2-4 (6)	1
1220.5	Light brownish-gray SILTSTONE, completely weathered, very broken, very soft, very thin bedded, slightly micaceous		SS 5	80	4-19-29 (48)	2.5
1219.4	Reddish-brown CLAYSTONE, highly weathered, very broken, very soft, interbedded shale		SS 6	53	12-16-18 (34)	1.5 1.5
1218.1	Reddish-brown CLAYSTONE, highly weathered, very broken, very soft, blocky, fracture fills, few shale seams	10.0	SS 7	73	15-22-25 (47)	3.5-4
1216.5	Light olive gray CLAYSTONE, moderately weathered, very broken, moderately soft, friable, noted hard drilling at 12'		SS 8	100	50/4"	
1215.3	Gray SHALE, moderately weathered, very broken, moderately hard, laminated		SS 9	60	50/2"	
		15.0				
1210.8	Brown and orange SILTSTONE, iron stained, moderately weathered, very broken, hard, very thin bedded					
1208.2	Gray to burgundy CLAYSTONE, iron stained, slickenside at 19.3', vertical fracture at 19.4', vertical fracture and iron stained at 20.2', moderately weathered, broken, very broken from 19.4' to 20.4', moderately soft	20.0	RC 1	28 (6)		
		25.0				
1198.8	Brown SANDSTONE, fine grained, iron stained, with iron stained fractures, moderately weathered, moderately broken, hard, medium bedded	30.0				
1195.8	Bluish-gray SHALE, some iron stains, moderately weathered, moderately broken, moderately hard, thinly laminated to laminated		RC 2	35 (5)		
		35.0				

WELL DIAGRAM



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Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

BORING NUMBER SB-07/ MW1102R

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		35.0					
1192	Gray SHALE, some iron stains, moderately weathered, moderately broken, very broken from 40.2' to 40.6', hard, laminated *(continued)*	40.0					
1186.2	Black COAL, moderately weathered, slightly broken, hard, laminated						
1186	Black to gray SHALE, few claystone seams, moderately weathered, moderately hard to soft, very broken from 40.8' to 41.2', moderately broken below 41.2', laminated	45.0	RC 3	41 (16)			2-Inch Solid PVC Riser Sealed with Bentonite Grout
1178.2	Gray SILTSTONE, slightly weathered, moderately broken, hard, very thin bedded						
1177.6	Gray and orange SANDSTONE, micaceous, fine grained, iron staining with fractures from 50.4' to 52', moderately weathered, moderately broken to very broken zones, moderately hard, medium bedded	50.0					
1175.2	Gray SHALE, few claystone and siltstone seams, calcareous, burgundy mottling below 54.2', moderately weathered, moderately broken, moderately hard, laminated	55.0	RC 4	83 (57)			
1169.6	Gray SHALE, few siltstone seams, burgundy mottling, calcite veins, pyrite, moderately weathered, slightly broken, moderately hard, laminated						
1168.2	Gray SILTSTONE, iron stained below 60.5' with fractures, slightly weathered, slightly broken to moderately broken, hard, very thin bedded to thin bedded	60.0	RC 5	32 (11)			
1162.2	Gray and burgundy SHALE, few claystone seams, slightly weathered, moderately to very broken, moderately hard, laminated	65.0					
1156.6	Gray SILTSTONE, limestone inclusions at 70.3' and 71.1', slightly weathered, slightly to moderately broken, hard, medium bedded	70.0	RC 6	71 (39)			
1153.5		75.0					

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Civil & Environmental Consultants, Inc.
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CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		75.0					
1150.7	Gray SANDSTONE, few interbedded siltstone seams, micaceous, fine grained, slightly weathered, slightly broken, hard, very thin bedded *(continued)*						
	Gray SANDSTONE, micaceous, very fine to fine grained, slightly weathered, moderately broken, hard, very thin bedded	80.0					
	Shaley interbeds from 82' to 82.5' and from 84.5' to 85.5'.		RC 7	100 (76)			
		85.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
	Very broken from 88.4' to 89.1'.						
1137.7	Gray SHALE, slightly fissile, slightly weathered, moderately broken, medium hard, laminated	90.0	RC 8	97 (53)			
1132.4	Gray and dark gray LIMESTONE, slightly weathered, broken, moderately broken from 94.4' to 95', hard, thick bedded	95.0					
1128.3	Dark red SHALE, few claystone seams, calcite veins, noted iron staining, fractures with iron stains at 100.3', 101.3', 102.5' and 102.9', slightly weathered, moderately broken, moderately hard, laminated	100.0	RC 9	70 (38)			
	Water at 102'.						
		105.0					
	Very broken from 107' to 109'. Mottled brown and gray from 109' to 111.2'.						
	RQD length not measured for RC-10. Sample recovered from barrel after tripping rods.	110.0					
1115.6	Gray SANDSTONE, micaceous, fine to medium grained, fresh, slightly broken, hard, very thin bedded to thin bedded		RC 10	95			
1113.6	Gray SHALE, few interbedded siltstone seams, broken to very broken, laminated	115.0					

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CLIENT American Electric Power
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PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SHALE, few interbedded siltstone seams, broken to very broken, laminated *(continued)*	115.0					
1109.8		Gray and red SHALE, few claystone seams, calcareous, fissile, occasional siltstone interbeds between 0.1' and 0.3' thick, fresh, very broken to moderately broken, soft, thinly laminated to laminated	120.0					
		Some iron mottling between 121' and 125'.		RC 11	87 (51)			
			125.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1099.8		Gray SANDSTONE, micaceous, very fine to medium grained, well cemented, some calcite inclusions, few thin shale partings 0.1' thick, fresh, slightly broken, hard, very thin bedded to thin bedded	130.0					
		Very broken zone from 130.4' to 131.8'.		RC 12	90 (59)			
			135.0					
1090.3		Gray SANDSTONE, micaceous, fine to medium grained, well cemented, fresh, slightly to moderately broken, hard, very thin bedded to thin bedded	140.0	RC 13	100 (65)			
		Trace pyrite at 145.5'.	145.0					
1079.8		Gray SANDSTONE, micaceous, fine to medium grained, thin shale partings, well cemented, few calcite filled fractures, micaceous partings, calcite veins from 162' to 162.7', fresh, moderately broken, very broken from 157' to 167', slightly broken to moderately broken near bottom, hard, very thin bedded to thin bedded	150.0	RC 14	100 (66)			
			155.0					

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CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SANDSTONE, micaceous, fine to medium grained, thin shale partings, well cemented, few calcite filled fractures, micaceous partings, calcite veins from 162' to 162.7', fresh, moderately broken, very broken from 157' to 167', slightly broken to moderately broken near bottom, hard, very thin bedded to thin bedded *(continued)*	155.0					
			160.0	RC 15	100 (62)			
			165.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
			170.0	RC 16	100 (78)			
1052.6		Gray SHALE, fresh, slightly broken, very broken from 177' to 178', hard, thinly laminated to laminated	175.0					
1048.8		Gray SILTSTONE, few interbedded sandstone seams, micaceous, fresh, moderately broken, hard, very thin bedded						
1047.5		Gray SHALE, silty, siltstone interbeds at 186', fresh, moderately broken, hard, laminated	180.0	RC 17	91 (23)			
		Blue, green and black and very broken from 187' to 188'.	185.0					
1038.8		Gray SILTSTONE, few interbedded sandstone seams, calcareous at 190.5', fresh, very broken, hard, very thin bedded	190.0					
1036.3		Black and gray SHALE, grades to siltstone, fresh, moderately broken, hard, thinly laminated		RC 18	100 (58)			Hole Plug (Bentonite Chips)
1033.8		Gray SILTSTONE, calcite veins, limestone interbeds, fresh, slightly broken, hard, very thin bedded	195.0					

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CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SILTSTONE, calcite veins, limestone interbeds, fresh, slightly broken, hard, very thin bedded *(continued)*	195.0					
1029.8		Gray SILTSTONE, interbedded shale and limestone, limestone at 197.6', from 198.3' to 198.5', 199.8', 201.4', 202', 203' and 204', fresh, moderately to very broken, hard, very thin bedded to thin bedded	200.0	RC 19	100 (60)			2-Inch Slotted Screen
1022.7		Gray SHALE, few claystone seams, calcareous, black zones 0.2' thick, some iron staining, fresh, moderately broken, hard, laminated Very hard near 207'. Very broken from 207' to 212'. Fissile beds below 208.5'	205.0 210.0					Filter Sand
1014.8		Gray SILTSTONE, micaceous, trace calcite, fresh, moderately broken, hard, very thin bedded	215.0	RC 20	87 (50)			
1010.4		Dark gray SHALE, very few claystone seams, fissile, few limestone inclusions, fresh, broken, moderately hard, thinly laminated to laminated Black from 222' to 224'. Burgundy and gray claystone from 227' to 228.7', very broken.	220.0 225.0	RC 21	100 (34)			
998.1		Gray SILTSTONE, calcareous, calcite veins, fresh, moderately broken, hard, very thin bedded	230.0					
995.4		Gray SHALE, fissile, fresh, moderately broken, hard, thinly laminated to laminated		RC 22	100 (67)			
994.3		Light gray SANDSTONE, micaceous, fine to medium grained, fine grained from 238' to 241.7', well cemented, fresh, moderately broken, very broken from 237' to 241.7', hard, very thin bedded to	235.0					

(Continued Next Page)

Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

BORING NUMBER SB-07/ MW1102R

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
	thin bedded Light gray SANDSTONE, micaceous, fine to medium grained, fine grained from 238' to 241.7', well cemented, fresh, moderately broken, very broken from 237' to 241.7', hard, very thin bedded to thin bedded *(continued)*	235.0 240.0					
985.1	Gray and dark red SHALE, few claystone seams, fissile, iron stained from 244.3' to 247' and at 252.1', fresh, moderately broken to very broken, moderately hard, thinly laminated to laminated Burgundy, calcareous and silty between 247' and 248.7' with claystone and siltstone seams. Thin limestone beds from 251.5' to 253'.	245.0 250.0	RC 23 RC 24	100 (19) 74 (38)			
973.5	Gray SANDSTONE, very fine to fine grained, well cemented, few interbedded siltstone seams, fresh, moderately broken, hard, very thin bedded	255.0					
971.1	Burgundy and gray SHALE, fissile, iron stained bands throughout, fresh, very broken, moderately hard, thinly laminated to laminated May have rock in borehole from Runs 24 and 25.	260.0	RC 25	81 (11)			
963.8	Black SHALE, few coal seams, fresh, very broken, moderately hard to hard, thinly laminated to laminated	265.0					
961.7	Dark gray SILTSTONE, few interbedded shale and sandstone seams, micaceous, fresh, moderately broken, hard, very thin bedded						
960	Dark gray SHALE, few interbedded siltstone seams, micaceous, fresh, moderately broken, moderately hard, laminated	270.0	RC 26	95 (45)			
953.4	Gray SILTSTONE, fresh, moderately broken, hard, thick bedded	275.0					

(Continued Next Page)

Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

BORING NUMBER SB-07/ MW1102R

CLIENT American Electric Power **PROJECT NAME** Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416 **PROJECT LOCATION** Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SILTSTONE, fresh, moderately broken, hard, thick bedded *(continued)*	275.0					
950.5		Burgundy and gray CLAYSTONE, fresh, moderately broken, hard						
949.8		Gray SHALE, few burgundy claystone seams, moderately broken, moderately hard, laminated Slickensides at 279' and 280.5'.	280.0	RC 27	100 (66)			
941.8		Gray to reddish-brown CLAYSTONE, few shale seams, calcareous, well-cemented, trace pyrite less than 1 mm thick, fresh, moderately broken, hard	285.0					
938.8		Gray SILTSTONE, calcareous, micaceous, fresh, slightly broken becoming moderately broken, hard, thick bedded	290.0	RC 28	98 (81)			
			295.0					
930.8		Gray LIMESTONE, few interbedded siltstone seams, shaley at top, fresh, moderately broken, hard, thin bedded to medium bedded						
926.8		Gray SHALE, few interbedded siltstone seams, calcareous, fresh, slightly broken, very hard, thinly laminated to laminated	300.0	RC 29	90 (39)			
925.3		Gray LIMESTONE, micaceous, some thin shale interbeds increasing with depth, fresh, slightly broken, very hard, medium bedded						
921.8		Gray SANDSTONE, micaceous, fine grained, many shale partings increasing with depth, fresh, very broken, hard, very thin bedded to thin bedded	305.0					
919.4		Gray LIMESTONE, calcareous, shaley at bottom with interbedded siltstone seams, fresh, moderately broken, very hard, medium bedded Black at 310.2'	310.0	RC 30	100 (54)			
			315.0					

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Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

BORING NUMBER SB-07/ MW1102R

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
911.8		Gray SHALE, few interbedded siltstone seams, calcareous, occasional limestone interbeds, trace pyrite less than 1 mm thick, fresh, moderately broken, hard, thinly laminated to laminated 4 feet of Run 31 fell into hole, unable to retrieve. Few reddish-brown and gray claystone seams beginning at 321'. Dark red and very broken from 325' to 328'.	315.0 320.0 325.0	RC 31 RC 32	60 (35) 100 (27)			
898.8		Bottom of hole at 328.0 feet.						

Soil sampling completed on 9/7/2011. Boring offset on 10/10/2011 for rock coring. Augered to 18' to begin rock core sampling.

The following groundwater level readings were taken during drilling:
9/7/2011 3:30 PM, Dry (borehole depth = 12.2')
10/11/2011 7:45 AM at approximately 38' bgs
10/12/2011 7:50 AM at approximately 39' bgs
10/13/2011 7:20 AM at approximately 35' bgs

Geophysical logging and packer testing were performed upon completion.

Well MW1102R installed after completion in an offset boring. The above-noted ground elevation corresponds to the ground elevation at which soil and rock sampling was initiated at SB-07. The ground elevation for MW1102R = 1226.7 ft.

Civil & Environmental Consultants, Inc.
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Cincinnati, Ohio 45242

BORING NUMBER SB-07/ MW1102F

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia
DATE STARTED 9/7/11 **COMPLETED** 10/12/11
GROUND ELEVATION 1226.8 ft **HOLE SIZE** 0.5 ft
DRILLING CONTRACTOR Frontz Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD HSA: Auto Hammer & Air Rotary Rock Core
AT TIME OF DRILLING Refer to notes throughout log
LOGGED BY M. McCoy **CHECKED BY** A. Amicon
AT END OF DRILLING Refer to notes at bottom of log
LOCATION N 485106.1, E 1611110.1
AFTER DRILLING Well installed

ELEVATION (ft)	MATERIAL DESCRIPTION
1226.8	Brown and dark brown LEAN CLAY (CL), trace roots, moist, soft to medium stiff (RESIDUAL) Noted hard fine grained sandstone fragments in shoe of SS-1 and SS-2.
1222.5	Brown LEAN CLAY (CL), few shale fragments, noted iron staining, moist, medium stiff (RESIDUAL)
1220.5	Light brownish-gray SILTSTONE, completely weathered, very broken, very soft, very thin bedded, slightly micaceous
1219.4	Reddish-brown CLAYSTONE, highly weathered, very broken, very soft, interbedded shale
1218.1	Reddish-brown CLAYSTONE, highly weathered, very broken, very soft, blocky, fracture fills, few shale seams
1216.5	Light olive gray CLAYSTONE, moderately weathered, very broken, moderately soft, friable, noted hard drilling at 12'
1215.3	Gray SHALE, moderately weathered, very broken, moderately hard, laminated
1210.8	Brown and orange SILTSTONE, iron stained, moderately weathered, very broken, hard, very thin bedded
1208.2	Gray to burgundy CLAYSTONE, iron stained, slickenside at 19.3', vertical fracture at 19.4', vertical fracture and iron stained at 20.2', moderately weathered, broken, very broken from 19.4' to 20.4', moderately soft
1198.8	Brown SANDSTONE, fine grained, iron stained, with iron stained fractures, moderately weathered, moderately broken, hard, medium bedded
1195.8	Bluish-gray SHALE, some iron stains, moderately weathered, moderately broken, moderately hard, thinly laminated to laminated

SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)
SS 1	67	3-3-3 (6)	1
SS 2	27	2-3-2 (5)	
SS 3	27	3-2-2 (4)	
SS 4	67	1-2-4 (6)	1
SS 5	80	4-19-29 (48)	2.5
SS 6	53	12-16-18 (34)	1.5 1.5
SS 7	73	15-22-25 (47)	3.5-4
SS 8	100	50/4"	
SS 9	60	50/2"	
RC 1	28 (6)		
RC 2	35 (5)		

DEPTH (ft): 0.0, 5.0, 10.0, 15.0, 20.0, 25.0, 30.0, 35.0

WELL DIAGRAM
1.9' Stickup
Concrete Seal
2-Inch Solid PVC Riser Sealed with Bentonite Grout

(Continued Next Page)

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		35.0					
1192	Gray SHALE, some iron stains, moderately weathered, moderately broken, very broken from 40.2' to 40.6', hard, laminated *(continued)*						
		40.0					
1186.2	Black COAL, moderately weathered, slightly broken, hard, laminated						
1186	Black to gray SHALE, few claystone seams, moderately weathered, moderately hard to soft, very broken from 40.8' to 41.2', moderately broken below 41.2', laminated		RC 3	41 (16)			
		45.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1178.2	Gray SILTSTONE, slightly weathered, moderately broken, hard, very thin bedded						
1177.6	Gray and orange SANDSTONE, micaceous, fine grained, iron staining with fractures from 50.4' to 52', moderately weathered, moderately broken to very broken zones, moderately hard, medium bedded	50.0					
1175.2	Gray SHALE, few claystone and siltstone seams, calcareous, burgundy mottling below 54.2', moderately weathered, moderately broken, moderately hard, laminated		RC 4	83 (57)			
		55.0					
1169.6	Gray SHALE, few siltstone seams, burgundy mottling, calcite veins, pyrite, moderately weathered, slightly broken, moderately hard, laminated						
1168.2	Gray SILTSTONE, iron stained below 60.5' with fractures, slightly weathered, slightly broken to moderately broken, hard, very thin bedded to thin bedded	60.0					
			RC 5	32 (11)			
1162.2	Gray and burgundy SHALE, few claystone seams, slightly weathered, moderately to very broken, moderately hard, laminated	65.0					
		70.0					
1156.6	Gray SILTSTONE, limestone inclusions at 70.3' and 71.1', slightly weathered, slightly to moderately broken, hard, medium bedded						
			RC 6	71 (39)			
1153.5		75.0					

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BORING NUMBER SB-07/ MW1102F

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SANDSTONE, few interbedded siltstone seams, micaceous, fine grained, slightly weathered, slightly broken, hard, very thin bedded *(continued)*	75.0					
1150.7		Gray SANDSTONE, micaceous, very fine to fine grained, slightly weathered, moderately broken, hard, very thin bedded	80.0					
		Shaley interbeds from 82' to 82.5' and from 84.5' to 85.5'.	85.0	RC 7	100 (76)			2-Inch Solid PVC Riser Sealed with Bentonite Grout
		Very broken from 88.4' to 89.1'.						
1137.7		Gray SHALE, slightly fissile, slightly weathered, moderately broken, medium hard, laminated	90.0	RC 8	97 (53)			
1132.4		Gray and dark gray LIMESTONE, slightly weathered, broken, moderately broken from 94.4' to 95', hard, thick bedded	95.0					
1128.3		Dark red SHALE, few claystone seams, calcite veins, noted iron staining, fractures with iron stains at 100.3', 101.3', 102.5' and 102.9', slightly weathered, moderately broken, moderately hard, laminated	100.0	RC 9	70 (38)			
		Water at 102'.	105.0					
		Very broken from 107' to 109'. Mottled brown and gray from 109' to 111.2'.						
		RQD length not measured for RC-10. Sample recovered from barrel after tripping rods.	110.0					
1115.6		Gray SANDSTONE, micaceous, fine to medium grained, fresh, slightly broken, hard, very thin bedded to thin bedded		RC 10	95			
1113.6		Gray SHALE, few interbedded siltstone seams, broken to very broken, laminated	115.0					

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BORING NUMBER SB-07/ MW1102F

Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SHALE, few interbedded siltstone seams, broken to very broken, laminated *(continued)*	115.0					
1109.8		Gray and red SHALE, few claystone seams, calcareous, fissile, occasional siltstone interbeds between 0.1' and 0.3' thick, fresh, very broken to moderately broken, soft, thinly laminated to laminated	120.0	RC 11	87 (51)			
		Some iron mottling between 121' and 125'.	125.0					
1099.8		Gray SANDSTONE, micaceous, very fine to medium grained, well cemented, some calcite inclusions, few thin shale partings 0.1' thick, fresh, slightly broken, hard, very thin bedded to thin bedded	130.0	RC 12	90 (59)			
		Very broken zone from 130.4' to 131.8'.	135.0					
1090.3		Gray SANDSTONE, micaceous, fine to medium grained, well cemented, fresh, slightly to moderately broken, hard, very thin bedded to thin bedded	140.0	RC 13	100 (65)			
		Trace pyrite at 145.5'.	145.0					
1079.8		Gray SANDSTONE, micaceous, fine to medium grained, thin shale partings, well cemented, few calcite filled fractures, micaceous partings, calcite veins from 162' to 162.7', fresh, moderately broken, very broken from 157' to 167', slightly broken to moderately broken near bottom, hard, very thin bedded to thin bedded	150.0	RC 14	100 (66)			
			155.0					

Well diagram:
- 2-Inch Solid PVC Riser Sealed with Bentonite Grout
- Hole Plug (Bentonite Chips)
- Filter Sand

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CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SANDSTONE, micaceous, fine to medium grained, thin shale partings, well cemented, few calcite filled fractures, micaceous partings, calcite veins from 162' to 162.7', fresh, moderately broken, very broken from 157' to 167', slightly broken to moderately broken near bottom, hard, very thin bedded to thin bedded *(continued)*	155.0					
			160.0	RC 15	100 (62)			2-Inch Slotted Screen
			165.0					
			170.0	RC 16	100 (78)			
1052.6		Gray SHALE, fresh, slightly broken, very broken from 177' to 178', hard, thinly laminated to laminated	175.0					Filter Sand
1048.8		Gray SILTSTONE, few interbedded sandstone seams, micaceous, fresh, moderately broken, hard, very thin bedded						
1047.5		Gray SHALE, silty, siltstone interbeds at 186', fresh, moderately broken, hard, laminated	180.0	RC 17	91 (23)			Hole Plug (Bentonite Chips)
		Blue, green and black and very broken from 187' to 188'.	185.0					
1038.8		Gray SILTSTONE, few interbedded sandstone seams, calcareous at 190.5', fresh, very broken, hard, very thin bedded	190.0					
1036.3		Black and gray SHALE, grades to siltstone, fresh, moderately broken, hard, thinly laminated		RC 18	100 (58)			
1033.8		Gray SILTSTONE, calcite veins, limestone interbeds, fresh, slightly broken, hard, very thin bedded	195.0					

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CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			195.0					
		Gray SILTSTONE, calcite veins, limestone interbeds, fresh, slightly broken, hard, very thin bedded *(continued)*						
1029.8		Gray SILTSTONE, interbedded shale and limestone, limestone at 197.6', from 198.3' to 198.5', 199.8', 201.4', 202', 203' and 204', fresh, moderately to very broken, hard, very thin bedded to thin bedded	200.0	RC 19	100 (60)			
1022.7		Gray SHALE, few claystone seams, calcareous, black zones 0.2' thick, some iron staining, fresh, moderately broken, hard, laminated	205.0					
		Very hard near 207'. Very broken from 207' to 212'. Fissile beds below 208.5'	210.0	RC 20	87 (50)			
1014.8		Gray SILTSTONE, micaceous, trace calcite, fresh, moderately broken, hard, very thin bedded	215.0					
1010.4		Dark gray SHALE, very few claystone seams, fissile, few limestone inclusions, fresh, broken, moderately hard, thinly laminated to laminated	220.0	RC 21	100 (34)			Hole Plug (Bentonite Chips)
		Black from 222' to 224'.	225.0					
		Burgundy and gray claystone from 227' to 228.7', very broken.						
998.1		Gray SILTSTONE, calcareous, calcite veins, fresh, moderately broken, hard, very thin bedded	230.0	RC 22	100 (67)			
995.4		Gray SHALE, fissile, fresh, moderately broken, hard, thinly laminated to laminated						
994.3		Light gray SANDSTONE, micaceous, fine to medium grained, fine grained from 238' to 241.7', well cemented, fresh, moderately broken, very broken from 237' to 241.7', hard, very thin bedded to	235.0					

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Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		thin bedded Light gray SANDSTONE, micaceous, fine to medium grained, fine grained from 238' to 241.7', well cemented, fresh, moderately broken, very broken from 237' to 241.7', hard, very thin bedded to thin bedded *(continued)*	235.0 240.0	RC 23	100 (19)			
985.1		Gray and dark red SHALE, few claystone seams, fissile, iron stained from 244.3' to 247' and at 252.1', fresh, moderately broken to very broken, moderately hard, thinly laminated to laminated Burgundy, calcareous and silty between 247' and 248.7' with claystone and siltstone seams. Thin limestone beds from 251.5' to 253'.	245.0 250.0	RC 24	74 (38)			
973.5		Gray SANDSTONE, very fine to fine grained, well cemented, few interbedded siltstone seams, fresh, moderately broken, hard, very thin bedded	255.0					
971.1		Burgundy and gray SHALE, fissile, iron stained bands throughout, fresh, very broken, moderately hard, thinly laminated to laminated May have rock in borehole from Runs 24 and 25.	260.0	RC 25	81 (11)			Hole Plug (Bentonite Chips)
963.8		Black SHALE, few coal seams, fresh, very broken, moderately hard to hard, thinly laminated to laminated	265.0					
961.7		Dark gray SILTSTONE, few interbedded shale and sandstone seams, micaceous, fresh, moderately broken, hard, very thin bedded						
960		Dark gray SHALE, few interbedded siltstone seams, micaceous, fresh, moderately broken, moderately hard, laminated	270.0	RC 26	95 (45)			
953.4		Gray SILTSTONE, fresh, moderately broken, hard, thick bedded	275.0					

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CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			275.0					
		Gray SILTSTONE, fresh, moderately broken, hard, thick bedded *(continued)*						
950.5		Burgundy and gray CLAYSTONE, fresh, moderately broken, hard						
949.8		Gray SHALE, few burgundy claystone seams, moderately broken, moderately hard, laminated Slickensides at 279' and 280.5'.	280.0	RC 27	100 (66)			
			285.0					
941.8		Gray to reddish-brown CLAYSTONE, few shale seams, calcareous, well-cemented, trace pyrite less than 1 mm thick, fresh, moderately broken, hard						
938.8		Gray SILTSTONE, calcareous, micaceous, fresh, slightly broken becoming moderately broken, hard, thick bedded	290.0	RC 28	98 (81)			
			295.0					
930.8		Gray LIMESTONE, few interbedded siltstone seams, shaley at top, fresh, moderately broken, hard, thin bedded to medium bedded						
			300.0	RC 29	90 (39)			Hole Plug (Bentonite Chips)
926.8		Gray SHALE, few interbedded siltstone seams, calcareous, fresh, slightly broken, very hard, thinly laminated to laminated						
925.3		Gray LIMESTONE, micaceous, some thin shale interbeds increasing with depth, fresh, slightly broken, very hard, medium bedded						
			305.0					
921.8		Gray SANDSTONE, micaceous, fine grained, many shale partings increasing with depth, fresh, very broken, hard, very thin bedded to thin bedded						
919.4		Gray LIMESTONE, calcareous, shaley at bottom with interbedded siltstone seams, fresh, moderately broken, very hard, medium bedded Black at 310.2'	310.0	RC 30	100 (54)			
			315.0					

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CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			315.0					
911.8		Gray SHALE, few interbedded siltstone seams, calcareous, occasional limestone interbeds, trace pyrite less than 1 mm thick, fresh, moderately broken, hard, thinly laminated to laminated 4 feet of Run 31 fell into hole, unable to retrieve.						
			320.0	RC 31	60 (35)			
		Few reddish-brown and gray claystone seams beginning at 321'.						
			325.0					
		Dark red and very broken from 325' to 328'.		RC 32	100 (27)			Hole Plug (Bentonite Chips)
898.8		Bottom of hole at 328.0 feet.						

Soil sampling completed on 9/7/2011. Boring offset on 10/10/2011 for rock coring. Augered to 18' to begin rock core sampling.

The following groundwater level readings were taken during drilling:
9/7/2011 3:30 PM, Dry (borehole depth = 12.2')
10/11/2011 7:45 AM at approximately 38' bgs
10/12/2011 7:50 AM at approximately 39' bgs
10/13/2011 7:20 AM at approximately 35' bgs

Geophysical logging and packer testing were performed upon completion.

Well MW1102F installed following geophysical logging and packer testing.

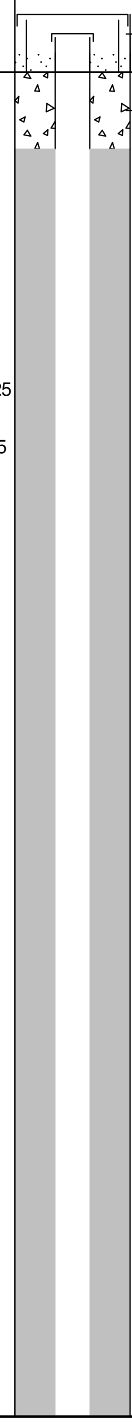
Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

BORING NUMBER SB-18/ MW1103H

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia
DATE STARTED 9/6/11 **COMPLETED** 9/23/11
GROUND ELEVATION 1237.4 ft **HOLE SIZE** 0.5 ft
DRILLING CONTRACTOR Frontz Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD HSA: Auto Hammer & Air Rotary Rock Core (NX)
AT TIME OF DRILLING Refer to notes at bottom of log
LOGGED BY M. McCoy / R. Mahle **CHECKED BY** A. Amicon
AT END OF DRILLING Refer to notes at bottom of log
LOCATION N 487005.3, E 1610094.0
AFTER DRILLING Well installed

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)
1237.4	Brown LEAN CLAY WITH SAND (CL), trace roots, noted iron oxide concretions, moist, medium stiff to stiff (RESIDUAL)	0.0	SS 1	93	3-4-5 (9)	2
			SS 2	73	2-2-3 (5)	2
1234.4	Light olive gray and reddish-brown to olive brown LEAN CLAY (CL), few shale fragments, slightly fissile to fissile, moist, medium stiff to very stiff (RESIDUAL)		SS 3	60	3-3-4 (7)	1
		5.0	SS 4	53	5-10-11 (21)	1.5
			SS 5	47	12-10-14 (24)	1.5
1229.9	Reddish-brown CLAYSTONE, completely to highly weathered, very broken, very soft, few limestone seams, blocky, few gray blocky siltstone partings		SS 6	60	11-12-26 (38)	1-2.25
		10.0	SS 7	80	8-11-33 (44)	3-3.5
			SS 8	100	50/5"	1
1225.9	Light gray to brown SHALE, highly weathered, very broken, very soft, laminated, very fissile		SS 9	60	31-22-25 (47)	1
			SS 10	100	14-50/5"	1
1222.6	Light gray SILTSTONE, highly weathered, very broken, very soft, very thin bedded	15.0	SS 11	93	25-34-36 (70)	
1221.9	Reddish-brown to light brown SHALE, highly weathered, very broken, very soft, laminated, fissile		SS 12	100	50/5"	
1219.9	Reddish-brown CLAYSTONE, few interbedded shale seams, highly weathered to moderately weathered, slightly broken, very soft to moderately soft	20.0	RC 1	72 (65)		
1212.6	Gray SHALE, few interbedded slightly micaceous siltstone seams, reddish brown and gray from 27.3' to 28' with claystone seams, moderately weathered, slightly broken, moderately soft, laminated	25.0				
1209.4	Gray SHALE, many interbedded sandstone seams, few discontinuous slightly micaceous siltstone seams throughout, few limestone inclusions, highly to moderately weathered, moderately broken, moderately soft, laminated	30.0	RC 2	80 (43)		
		35.0				

WELL DIAGRAM



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CLIENT American Electric Power **PROJECT NAME** Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416 **PROJECT LOCATION** Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SHALE, many interbedded sandstone seams, few discontinuous slightly micaceous siltstone seams throughout, few limestone inclusions, highly to moderately weathered, moderately broken, moderately soft, laminated *(continued)*	35.0					
1199.4		Gray and reddish brown CLAYSTONE, few discontinuous slightly micaceous siltstone seams, few limestone inclusions, moderately weathered, moderately broken, moderately soft	40.0					
1197.7		Gray SILTSTONE, slightly micaceous, few discontinuous shale and sandstone seams, noted pyritic specs at 31.6', increasing in grain size with depth, iron stained fractures from 39.7' to 41.4', moderately weathered, moderately broken, moderately hard, very thin bedded	45.0	RC 3	97 (76)			2-Inch Solid PVC Riser Sealed with Bentonite Grout
1192.1		Gray SANDSTONE, moderately weathered, moderately broken, moderately hard, very thin bedded to thin bedded, micaceous, very fine to fine grained, few limestone inclusions, few discontinuous siltstone seams, brownish-gray from 46.4' to 47', vertical iron stained fracturing from 46.6' to 47'						
1190.4								
1189.6		Gray to brownish-gray SANDSTONE, micaceous, very fine to fine grained, few limestone inclusions, few discontinuous siltstone seams, vertical iron stained fracture from 47' to 47.3', moderately weathered, moderately broken, moderately hard, very thin bedded to thin bedded	50.0					
1185.4		Gray SILTSTONE, slightly micaceous, few interbedded sandstone seams throughout, few limestone inclusions, sandstone lens from 49.2' to 50.1', moderately weathered, moderately broken, moderately soft to moderately hard, very thin bedded to thin bedded		RC 4	79 (46)			
		Gray SHALE, discontinuous and slightly micaceous siltstone seams throughout, reddish-brown from 52.5' to 53.2' with claystone seams and limestone inclusions, pyritic specs observed, highly to moderately weathered, moderately broken, moderately soft, thinly laminated to laminated	55.0					
1180.4		Gray SILTSTONE, slightly micaceous, interbedded sandstone seams throughout, few limestone inclusions, pyritic specs observed, moderately weathered, moderately broken, moderately hard, very thin bedded						
1178.9		Gray SANDSTONE, micaceous, very fine to medium grained, slightly weathered, moderately broken, moderately hard, very thin bedded	60.0	RC 5	93 (29)			
1174.6		Gray SHALE, few limestone inclusions, interbedded slightly micaceous siltstone throughout, pyritic specs observed, moderately to slightly weathered, moderately broken, moderately soft, thinly laminated to laminated	65.0					
1170.4		Gray SHALE, discontinuous slightly micaceous siltstone seams throughout, few limestone inbeds, pyritic specs observed throughout, reddish brown claystone seams from 67.9' to 68.2', 68.4' to 68.7', 69.3' to 70.1', and 71.3' to 71.6', moderately weathered, moderately broken, moderately soft, thinly laminated to laminated	70.0	RC 6	93 (64)			
1165.3		Light gray LIMESTONE, calcareous, few shale inclusions, slightly weathered, moderately broken, hard, thick bedded						
1164.3			75.0					

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Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SANDSTONE, very fine to medium grained, micaceous interbedded limestone, slightly weathered, slightly broken to broken, hard, very thin bedded to thin bedded *(continued)*	75.0					
1157.9		Gray SILTSTONE, slightly micaceous, few interbedded sandstone seams, interbedded limestone, slightly weathered, moderately broken, moderately hard, very thin bedded	80.0	RC 7	100 (7)			
			85.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1150.4		Gray SILTSTONE, slightly micaceous, few interbedded shale seams, interbedded limestone, slightly weathered, moderately broken, moderately hard, very thin bedded						
1149.5		Gray SHALE, slightly to moderately weathered, broken, moderately soft, laminated to thinly laminated	90.0	RC 8	100 (30)			
		Reddish-gray discoloration from 92.2' to 92.4'. Pyritic specks observed at 93.7'.						
1143.6		Gray to dark gray LIMESTONE, calcareous, slightly weathered, moderately broken, hard, medium bedded	95.0					
1140.4		Gray SHALE, with calcareous limestone inclusions, slightly weathered, moderately broken, moderately soft, laminated	100.0	RC 9	100 (56)			
		Gray and reddish-gray from 101.6' to 107' with few claystone seams.	105.0					
1130.4		Gray SILTSTONE, moderately to slightly micaceous, fresh, moderately broken, moderately hard, very thin bedded						
1128.2		Gray SANDSTONE, micaceous, very fine to medium grained, interbedded calcareous limestone, fresh, moderately broken, hard, very thin bedded	110.0	RC 10	88 (68)			
			115.0					

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Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

BORING NUMBER SB-18/ MW1103H

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			115.0					
1122.1		Gray SHALE, few interbedded siltstone seams, fresh, moderately broken, moderately soft, thinly laminated to laminated	120.0					
1117.1		Reddish-brown and gray CLAYSTONE, few interbedded shale seams, fresh, moderately broken, moderately soft	125.0	RC 11	74 (33)			2-Inch Solid PVC Riser Sealed with Bentonite Grout
1111.6		Gray SILTSTONE, interbedded limestone, fresh, slightly broken, moderately hard, very thin bedded						
1110.4		Gray SILTSTONE, slightly micaceous, interbedded throughout with sandstone seams less than 1/8" thick, limestone inclusions throughout, fresh, moderately broken, moderately hard, very thin bedded	130.0 135.0	RC 12	100 (83)			
1100.4		Gray SILTSTONE, slightly micaceous, discontinuous sandstone seams less than 1/10" thick, sporadic limestone inclusions throughout, fresh, moderately broken, moderately hard, very thin bedded	140.0	RC 13	100 (50)			
1093.9		Gray SANDSTONE, micaceous, very fine to medium grained, interbedded throughout with siltstone seams which decrease in frequency with depth and are less than 1/10" thick, fresh, moderately broken, moderately hard to hard, very thin bedded to thin bedded	145.0					
1090.4		Gray SANDSTONE, micaceous, very fine to medium grained, interbedded with siltstone lenses less than 1/16" thick from 147' to 152.3', siltstone seam approximately 1/16" thick at 159.5', discontinuous siltstone lenses from 174.5' to 176.2', fresh, slightly broken, hard, thick bedded	150.0 155.0	RC 14	100 (90)			

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CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
	Gray SANDSTONE, micaceous, very fine to medium grained, interbedded with siltstone lenses less than 1/16" thick from 147' to 152.3', siltstone seam approximately 1/16" thick at 159.5', discontinuous siltstone lenses from 174.5' to 176.2', fresh, slightly broken, hard, thick bedded *(continued)*	155.0					
		160.0	RC 15	100 (100)			
		165.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
		170.0	RC 16	100 (68)			
		175.0					
1061.2	Gray SHALE, 0.5" coal seam at 176.5', hairline coal fractures at 176.3' and 178.4', fresh, broken, moderately hard, thinly laminated to laminated						
1060.4	Gray and dark gray SHALE, few claystone seams, fresh, moderately broken, moderately soft, laminated to thinly laminated	180.0					
1056.1	Gray SANDSTONE, micaceous, very fine to medium grained, interbedded siltstone seams throughout, noted calcareous limestone inclusions throughout, fresh, moderately broken, hard, very thin bedded		RC 17	87 (59)			
1054.1	Gray SILTSTONE, interbedded with sandstone and shale seams less than 1/16" thick, fresh, moderately broken, hard, very thin bedded						
1053.4	Black SHALE, few limestone inclusions, gray shale from 184' to 184.2' and 186.7' to 186.9', fresh, moderately broken, moderately soft, thinly laminated to laminated	185.0					
1050.4	Dark gray SHALE, calcareous with limestone inclusions, fresh, slightly broken, hard, laminated						
1048.5	Gray SILSTONE, slighlty micaceous, few limestone inclusions, sandstone layer from 191.7' to 192', fresh, moderately broken, moderately hard to hard, very thin bedded	190.0	RC 18	100 (56)			
1044.4	Gray SANDSTONE, very fine to medium grained, micaceous, few interbedded siltstone seams throughout, fresh, moderately broken, hard, very thin bedded	195.0					

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Civil & Environmental Consultants, Inc.
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Cincinnati, Ohio 45242

BORING NUMBER SB-18/ MW1103H

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			195.0					
1041.9		Gray SILTSTONE, slightly micaceous, limestone inclusions, few interbedded sandstone seams throughout, fresh, moderately broken to broken, hard, very thin bedded						
1039.4		Gray SHALE, fresh, moderately broken, moderately soft to moderately hard, thinly laminated to laminated	200.0	RC 19	100 (86)			
1033.1		Gray SILTSTONE, slightly micaceous, few discontinuous sandstone and shale lenses less than 1/10" thick, fresh, moderately broken, hard, very thin bedded	205.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1029.8		Gray SHALE, few limestone inclusions, interbedded slightly micaceous siltstone seams less than 1/8" in thickness, slightly micaceous siltstone layer from 210.7' to 211.2', fresh, broken, moderately soft, thinly laminated to laminated Few pyritic specks observed from 212' to 214'.	210.0 215.0	RC 20	95 (56)			
1021.7		Gray and reddish-gray to reddish-brown SHALE, fresh, broken, moderately hard, thinly laminated to laminated						
1019.1		Gray becoming reddish-brown and gray SHALE, few claystone seams, calcareous, limestone inclusions throughout, fresh, moderately broken, hard, laminated	220.0 225.0	RC 21	75 (60)			
1010.4		Gray SILTSTONE, fresh, broken, moderately hard, very thin bedded						
1009.6		Gray SANDSTONE, micaceous, very fine to fine grained, interbedded siltstone layers throughout, few limestone inclusions, fresh, moderately broken, very hard, very thin bedded	230.0					
1006.7		Gray SILTSTONE, slightly micaceous, interbedded throughout with sandstone seams less than about 1/8" thick, fresh, broken, moderately hard, very thin bedded		RC 22	93 (59)			
1004.6			235.0					

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Civil & Environmental Consultants, Inc.
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BORING NUMBER SB-18/ MW1103H

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
1002.1	Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions, interbedded siltstone seams throughout which decrease in frequency with depth, fresh, moderately broken, hard, very thin bedded *(continued)*	235.0					
1000.4	Gray SHALE, fresh, broken, moderately hard, thinly laminated to laminated						
	Gray SHALE, few claystone seams, gray and light reddish-gray from 240.8' to 243.2', fresh, broken, moderately broken from 240.8' to 247', moderately hard, thinly laminated to laminated	240.0	RC 23	85 (48)			
		245.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
989.1	Gray SILTSTONE, slightly micaceous, interbedded sandstone seams generally less than 1/8" thick, fresh, very thin bedded	250.0	RC 24	92 (36)			
983.1	Gray and reddish-brown SHALE, few claystone seams, thinly laminated to laminated, few interbedded siltstone seams from 254.3' to 254.9', fresh, moderately broken to broken, moderately hard	255.0					
979.3	Coal seam at 258'.						
	Gray SILTSTONE, slightly micaceous, fresh, moderately broken, hard, very thin bedded						
977.9	Gray SHALE, calcareous, interbedded slightly micaceous siltstone throughout, few limestone inclusions throughout, very hard shale from 263.6' to 267' with limestone, fresh, moderately broken, moderately hard to hard, thinly laminated to laminated	260.0	RC 25	87 (62)			
		265.0					
970.4	Gray becoming gray and reddish-brown SHALE, many interbedded claystone seams, very calcareous throughout with limestone inclusions, pyritic specks observed at 275.7', predominantly reddish-brown claystone from 280.5' to 282.5', fresh, moderately broken, hard to very hard, thinly laminated to laminated	270.0	RC 26	93 (56)			
		275.0					

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CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		275.0					
	Gray becoming gray and reddish-brown SHALE, many interbedded claystone seams, very calcareous throughout with limestone inclusions, pyritic specks observed at 275.7', predominantly reddish-brown claystone from 280.5' to 282.5', fresh, moderately broken, hard to very hard, thinly laminated to laminated *(continued)*	280.0	RC 27	99 (74)			
954.9	Gray SILTSTONE, slightly micaceous, few limestone inclusions throughout, fresh, slightly broken, very hard, very thin bedded	285.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
952.2	Gray SANDSTONE, micaceous, very fine to medium grained, fresh, slightly broken, very hard, thin bedded						
950.4	Gray SILTSTONE, few limestone inclusions, slightly micaceous, interbedded sandstone seams 1/16" thick from 291.4' to 297', fresh, slightly broken, hard to very hard, very thin bedded	290.0 / 295.0	RC 28	97 (76)			
940.4	Gray SILTSTONE, slightly micaceous, interbedded with shale, pyritic specks observed at 298.2' and 298.5', fresh, broken, hard, very thin bedded						
938.8	Gray SILTSTONE, few limestone inclusions throughout, slightly micaceous, pyritic specks observed at 298.7', fresh, slightly broken, hard to very hard, very thin bedded	300.0					
937.9	Gray SANDSTONE, micaceous, very fine to fine grained, few interbedded siltstone seams less than 1/16" thick, fresh, slightly broken, very hard, thin bedded		RC 29	96 (79)			Hole Plug (Bentonite Chips)
936	Gray SILTSTONE, few limestone inclusions throughout, slightly micaceous, fresh, slightly broken, hard to very hard, very thin bedded	305.0					Filter Sand
930.4	Gray SILTSTONE, slightly micaceous, few limestone inclusions, few interbedded sandstone seams less than 1/16" in thickness from 307.6' to 307.8', fresh, broken, hard, very thin bedded						
929.6	Gray SANDSTONE, very fine to medium grained, interbedded siltstone seams throughout less than 1/4" thick, few limestone inclusions, fresh, moderately broken, hard, very thin bedded	310.0					
925.7	Gray SILTSTONE, slightly micaceous, interbedded sandstone and shale seams throughout less than 1/16" thick, fresh, broken, hard, very thin bedded	315.0	RC 30	55 (11)			

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CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			315.0					
		Gray SILTSTONE, slightly micaceous, interbedded sandstone and shale seams throughout less than 1/16" thick, fresh, broken, hard, very thin bedded *(continued)*						
920.4		Gray SANDSTONE, slightly micaceous, few interbedded sandstone seams less than 1/16" thick, fresh, broken, hard, very thin bedded						
919.6		Gray SANDSTONE, micaceous, very fine to medium coarse grained, few limestone inclusions, interbedded siltstone seams less than 1/8" thick, fresh, moderately broken, very hard, thin bedded	320.0					
918.5		Gray SILTSTONE, slightly micaceous, interbedded throughout with shale seams less than 1/8" thick, fresh, moderately broken, hard to very hard, very thin bedded		RC 31	98 (77)			
914.4		Gray SHALE, dark gray shale zone from 325.8' to 326', fresh, moderately broken, hard becoming moderately hard, thinly laminated to laminated	325.0					
910.4		Gray to dark gray SHALE, interbedded siltstone throughout, few limestone inclusions, fresh, moderately broken, hard, laminated	330.0 335.0	RC 32	100 (55)			2-Inch Slotted Screen
900.4		Gray SHALE, interbedded siltstone and sandstone seams throughout, interbedded hard siltstone layers with micaceous sandstone inclusions from 337.4' to 338.1' and 339' to 339.2', fresh, broken, moderately hard to hard, laminated	340.0					
897.4		Gray SANDSTONE, interbedded siltstone seams througout less than 1/16" thick, micaceous, very fine to medium grained, interbedded limestone, fresh, moderately broken, hard, very thin bedded		RC 33	100 (50)			
896.2		Gray SHALE, black shale lens 3/4" thick at 344.5', fresh, moderately hard, broken, thinly laminated to laminated						
892.8		Gray and dark gray LIMESTONE, calcareous, fresh, moderately broken, very hard, thick bedded	345.0					
890.4		Gray and dark gray SHALE, calcareous, limestone seam 3/4" thick at 347.8', fresh, broken, moderately hard, laminated						Filter Sand
888.5		Gray LIMESTONE, calcareous, shale inclusions throughout, fresh, moderately broken, very hard, thick bedded	350.0					
885.7		Gray and dark gray SHALE, calcareous, interbedded limestone seams throughout less than 1/8" thick, few limestone inclusions, fresh, moderately broken, moderately hard to hard, thinly laminated to laminated		RC 34	96 (50)			Hole Plug (Bentonite Chips)
883.6		Gray LIMESTONE, calcareous, shale inclusions throughout,	355.0					
883.1								

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Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

BORING NUMBER SB-18/ MW1103H

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		fresh, moderately broken, very hard, medium bedded	355.0					
880.4		Gray and dark gray SHALE, calcareous, interbedded limestone seams throughout less than 1/8" thick, few limestone inclusions, fresh, moderately broken, moderately hard to hard, thinly laminated to laminated *(continued)*						

Bottom of hole at 357.0 feet.

Soil sampling completed on 9/6/11. Boring offset on 9/20/11 for rock coring. Augered to 17.5' to begin rock core sampling.

The following groundwater level readings were taken during drilling:
9/21/2011 7:45 AM at 91.2' bgs (borehole depth = 107' bgs)
9/22/2011 8:25 AM at 223.1' bgs (borehole depth = 227' bgs)
9/23/2011 7:45 AM at 333.1' bgs (borehole depth = 347' bgs)

Geophysical logging and packer testing were performed upon completion.

Well MW1103H installed following geophysical logging and packer testing.

BORING NUMBER SB-18/ MW1103R

Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia
DATE STARTED 9/6/11 **COMPLETED** 9/23/11
GROUND ELEVATION 1237.4 ft **HOLE SIZE** 0.5 ft
DRILLING CONTRACTOR Frontz Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD HSA: Auto Hammer & Air Rotary Rock Core (NX)
AT TIME OF DRILLING Refer to notes at bottom of log
LOGGED BY M. McCoy / R. Mahle **CHECKED BY** A. Amicon
AT END OF DRILLING Refer to notes at bottom of log
LOCATION N 486998.5, E 1610097.2
AFTER DRILLING Well installed

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			0.0					1.9' Stickup
1237.4		Brown LEAN CLAY WITH SAND (CL), trace roots, noted iron oxide concretions, moist, medium stiff to stiff (RESIDUAL)		SS 1	93	3-4-5 (9)	2	Concrete Seal
				SS 2	73	2-2-3 (5)	2	
1234.4		Light olive gray and reddish-brown to olive brown LEAN CLAY (CL), few shale fragments, slightly fissile to fissile, moist, medium stiff to very stiff (RESIDUAL)		SS 3	60	3-3-4 (7)	1	
			5.0	SS 4	53	5-10-11 (21)	1.5	
				SS 5	47	12-10-14 (24)	1.5	
1229.9		Reddish-brown CLAYSTONE, completely to highly weathered, very broken, very soft, few limestone seams, blocky, few gray blocky siltstone partings		SS 6	60	11-12-26 (38)	1-2.25	
			10.0	SS 7	80	8-11-33 (44)	3-3.5	2-Inch Solid PVC Riser Sealed with Bentonite Grout
				SS 8	100	50/5"	1	
1225.9		Light gray to brown SHALE, highly weathered, very broken, very soft, laminated, very fissile		SS 9	60	31-22-25 (47)	1	
				SS 10	100	14-50/5"	1	
1222.6		Light gray SILTSTONE, highly weathered, very broken, very soft, very thin bedded	15.0	SS 11	93	25-34-36 (70)		
1221.9		Reddish-brown to light brown SHALE, highly weathered, very broken, very soft, laminated, fissile		SS 12	100	50/5"		
1219.9		Reddish-brown CLAYSTONE, few interbedded shale seams, highly weathered to moderately weathered, slightly broken, very soft to moderately soft	20.0	RC 1	72 (65)			
1212.6		Gray SHALE, few interbedded slightly micaceous siltstone seams, reddish brown and gray from 27.3' to 28' with claystone seams, moderately weathered, slightly broken, moderately soft, laminated	25.0					
1209.4		Gray SHALE, many interbedded sandstone seams, few discontinuous slightly micaceous siltstone seams throughout, few limestone inclusions, highly to moderately weathered, moderately broken, moderately soft, laminated	30.0	RC 2	80 (43)			
			35.0					

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Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

BORING NUMBER SB-18/ MW1103R

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
	Gray SHALE, many interbedded sandstone seams, few discontinuous slightly micaceous siltstone seams throughout, few limestone inclusions, highly to moderately weathered, moderately broken, moderately soft, laminated *(continued)*	35.0					
1199.4	Gray and reddish brown CLAYSTONE, few discontinuous slightly micaceous siltstone seams, few limestone inclusions, moderately weathered, moderately broken, moderately soft						
1197.7	Gray SILTSTONE, slightly micaceous, few discontinuous shale and sandstone seams, noted pyritic specs at 31.6', increasing in grain size with depth, iron stained fractures from 39.7' to 41.4', moderately weathered, moderately broken, moderately hard, very thin bedded	40.0	RC 3	97 (76)			
1192.1	Gray SANDSTONE, moderately weathered, moderately broken, moderately hard, very thin bedded to thin bedded, micaceous, very fine to fine grained, few limestone inclusions, few discontinuous siltstone seams, brownish-gray from 46.4' to 47', vertical iron stained fracturing from 46.6' to 47'	45.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1190.4	Gray to brownish-gray SANDSTONE, micaceous, very fine to fine grained, few limestone inclusions, few discontinuous siltstone seams, vertical iron stained fracture from 47' to 47.3', moderately weathered, moderately broken, moderately hard, very thin bedded to thin bedded						
1189.6	Gray SILTSTONE, slightly micaceous, few interbedded sandstone seams throughout, few limestone inclusions, sandstone lens from 49.2' to 50.1', moderately weathered, moderately broken, moderately soft to moderately hard, very thin bedded to thin bedded	50.0	RC 4	79 (46)			
1185.4	Gray SHALE, discontinuous and slightly micaceous siltstone seams throughout, reddish-brown from 52.5' to 53.2' with claystone seams and limestone inclusions, pyritic specs observed, highly to moderately weathered, moderately broken, moderately soft, thinly laminated to laminated	55.0					
1180.4	Gray SILTSTONE, slightly micaceous, interbedded sandstone seams throughout, few limestone inclusions, pyritic specs observed, moderately weathered, moderately broken, moderately hard, very thin bedded						
1178.9	Gray SANDSTONE, micaceous, very fine to medium grained, slightly weathered, moderately broken, moderately hard, very thin bedded	60.0	RC 5	93 (29)			
1174.6	Gray SHALE, few limestone inclusions, interbedded slightly micaceous siltstone throughout, pyritic specs observed, moderately to slightly weathered, moderately broken, moderately soft, thinly laminated to laminated	65.0					
1170.4	Gray SHALE, discontinuous slightly micaceous siltstone seams throughout, few limestone inbeds, pyritic specs observed throughout, reddish brown claystone seams from 67.9' to 68.2', 68.4' to 68.7', 69.3' to 70.1', and 71.3' to 71.6', moderately weathered, moderately broken, moderately soft, thinly laminated to laminated	70.0	RC 6	93 (64)			
1165.3	Light gray LIMESTONE, calcareous, few shale inclusions, slightly weathered, moderately broken, hard, thick bedded						
1164.3		75.0					

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Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

BORING NUMBER SB-18/ MW1103R

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SANDSTONE, very fine to medium grained, micaceous interbedded limestone, slightly weathered, slightly broken to broken, hard, very thin bedded to thin bedded *(continued)*	75.0					
1157.9		Gray SILTSTONE, slightly micaceous, few interbedded sandstone seams, interbedded limestone, slightly weathered, moderately broken, moderately hard, very thin bedded	80.0	RC 7	100 (7)			
			85.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1150.4		Gray SILTSTONE, slightly micaceous, few interbedded shale seams, interbedded limestone, slightly weathered, moderately broken, moderately hard, very thin bedded						
1149.5		Gray SHALE, slightly to moderately weathered, broken, moderately soft, laminated to thinly laminated	90.0	RC 8	100 (30)			
		Reddish-gray discoloration from 92.2' to 92.4'. Pyritic specks observed at 93.7'.						
1143.6		Gray to dark gray LIMESTONE, calcareous, slightly weathered, moderately broken, hard, medium bedded	95.0					
1140.4		Gray SHALE, with calcareous limestone inclusions, slightly weathered, moderately broken, moderately soft, laminated	100.0	RC 9	100 (56)			
		Gray and reddish-gray from 101.6' to 107' with few claystone seams.	105.0					
1130.4		Gray SILTSTONE, moderately to slightly micaceous, fresh, moderately broken, moderately hard, very thin bedded						
1128.2		Gray SANDSTONE, micaceous, very fine to medium grained, interbedded calcareous limestone, fresh, moderately broken, hard, very thin bedded	110.0	RC 10	88 (68)			
			115.0					

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Cincinnati, Ohio 45242

BORING NUMBER SB-18/ MW1103R

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			115.0					
1122.1		Gray SHALE, few interbedded siltstone seams, fresh, moderately broken, moderately soft, thinly laminated to laminated						
			120.0					
1117.1		Reddish-brown and gray CLAYSTONE, few interbedded shale seams, fresh, moderately broken, moderately soft		RC 11	74 (33)			
			125.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1111.6		Gray SILTSTONE, interbedded limestone, fresh, slightly broken, moderately hard, very thin bedded						
1110.4		Gray SILTSTONE, slightly micaceous, interbedded throughout with sandstone seams less than 1/8" thick, limestone inclusions throughout, fresh, moderately broken, moderately hard, very thin bedded						
			130.0	RC 12	100 (83)			
			135.0					
1100.4		Gray SILTSTONE, slightly micaceous, discontinuous sandstone seams less than 1/10" thick, sporadic limestone inclusions throughout, fresh, moderately broken, moderately hard, very thin bedded						
			140.0	RC 13	100 (50)			
1093.9		Gray SANDSTONE, micaceous, very fine to medium grained, interbedded throughout with siltstone seams which decrease in frequency with depth and are less than 1/10" thick, fresh, moderately broken, moderately hard to hard, very thin bedded to thin bedded						
			145.0					
1090.4		Gray SANDSTONE, micaceous, very fine to medium grained, interbedded with siltstone lenses less than 1/16" thick from 147' to 152.3', siltstone seam approximately 1/16" thick at 159.5', discontinuous siltstone lenses from 174.5' to 176.2', fresh, slightly broken, hard, thick bedded						
			150.0	RC 14	100 (90)			
			155.0					

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BORING NUMBER SB-18/ MW1103R

Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
	Gray SANDSTONE, micaceous, very fine to medium grained, interbedded with siltstone lenses less than 1/16" thick from 147' to 152.3', siltstone seam approximately 1/16" thick at 159.5', discontinuous siltstone lenses from 174.5' to 176.2', fresh, slightly broken, hard, thick bedded *(continued)*	155.0					
		160.0	RC 15	100 (100)			
		165.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
		170.0	RC 16	100 (68)			
		175.0					
1061.2	Gray SHALE, 0.5" coal seam at 176.5', hairline coal fractures at 176.3' and 178.4', fresh, broken, moderately hard, thinly laminated to laminated						
1060.4	Gray and dark gray SHALE, few claystone seams, fresh, moderately broken, moderately soft, laminated to thinly laminated	180.0					
1056.1	Gray SANDSTONE, micaceous, very fine to medium grained, interbedded siltstone seams throughout, noted calcareous limestone inclusions throughout, fresh, moderately broken, hard, very thin bedded		RC 17	87 (59)			
1054.1	Gray SILTSTONE, interbedded with sandstone and shale seams less than 1/16" thick, fresh, moderately broken, hard, very thin bedded						
1053.4	Black SHALE, few limestone inclusions, gray shale from 184' to 184.2' and 186.7' to 186.9', fresh, moderately broken, moderately soft, thinly laminated to laminated	185.0					Hole Plug (Bentonite Chips)
1050.4	Dark gray SHALE, calcareous with limestone inclusions, fresh, slightly broken, hard, laminated						
1048.5	Gray SILSTONE, slighlty micaceous, few limestone inclusions, sandstone layer from 191.7' to 192', fresh, moderately broken, moderately hard to hard, very thin bedded	190.0	RC 18	100 (56)			Filter Sand; 2-Inch Slotted Screen
1044.4	Gray SANDSTONE, very fine to medium grained, micaceous, few interbedded siltstone seams throughout, fresh, moderately broken, hard, very thin bedded	195.0					

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Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			195.0					
1041.9		Gray SILTSTONE, slightly micaceous, limestone inclusions, few interbedded sandstone seams throughout, fresh, moderately broken to broken, hard, very thin bedded						Filter Sand
1039.4		Gray SHALE, fresh, moderately broken, moderately soft to moderately hard, thinly laminated to laminated	200.0	RC 19	100 (86)			
1033.1		Gray SILTSTONE, slightly micaceous, few discontinuous sandstone and shale lenses less than 1/10" thick, fresh, moderately broken, hard, very thin bedded	205.0					
1029.8		Gray SHALE, few limestone inclusions, interbedded slightly micaceous siltstone seams less than 1/8" in thickness, slightly micaceous siltstone layer from 210.7' to 211.2', fresh, broken, moderately soft, thinly laminated to laminated Few pyritic specks observed from 212' to 214'.	210.0 215.0	RC 20	95 (56)			
1021.7		Gray and reddish-gray to reddish-brown SHALE, fresh, broken, moderately hard, thinly laminated to laminated						
1019.1		Gray becoming reddish-brown and gray SHALE, few claystone seams, calcareous, limestone inclusions throughout, fresh, moderately broken, hard, laminated	220.0 225.0	RC 21	75 (60)			
1010.4		Gray SILTSTONE, fresh, broken, moderately hard, very thin bedded						
1009.6		Gray SANDSTONE, micaceous, very fine to fine grained, interbedded siltstone layers throughout, few limestone inclusions, fresh, moderately broken, very hard, very thin bedded	230.0					
1006.7		Gray SILTSTONE, slightly micaceous, interbedded throughout with sandstone seams less than about 1/8" thick, fresh, broken, moderately hard, very thin bedded		RC 22	93 (59)			
1004.6			235.0					

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CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			235.0					
1002.1		Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions, interbedded siltstone seams throughout which decrease in frequency with depth, fresh, moderately broken, hard, very thin bedded *(continued)*						
1000.4		Gray SHALE, fresh, broken, moderately hard, thinly laminated to laminated						
		Gray SHALE, few claystone seams, gray and light reddish-gray from 240.8' to 243.2', fresh, broken, moderately broken from 240.8' to 247', moderately hard, thinly laminated to laminated	240.0	RC 23	85 (48)			
			245.0					
989.1		Gray SILTSTONE, slightly micaceous, interbedded sandstone seams generally less than 1/8" thick, fresh, very thin bedded	250.0	RC 24	92 (36)			
983.1		Gray and reddish-brown SHALE, few claystone seams, thinly laminated to laminated, few interbedded siltstone seams from 254.3' to 254.9', fresh, moderately broken to broken, moderately hard	255.0					
979.3		Coal seam at 258'.						
		Gray SILTSTONE, slightly micaceous, fresh, moderately broken, hard, very thin bedded						
977.9		Gray SHALE, calcareous, interbedded slightly micaceous siltstone throughout, few limestone inclusions throughout, very hard shale from 263.6' to 267' with limestone, fresh, moderately broken, moderately hard to hard, thinly laminated to laminated	260.0	RC 25	87 (62)			
			265.0					
970.4		Gray becoming gray and reddish-brown SHALE, many interbedded claystone seams, very calcareous throughout with limestone inclusions, pyritic specks observed at 275.7', predominantly reddish-brown claystone from 280.5' to 282.5', fresh, moderately broken, hard to very hard, thinly laminated to laminated	270.0	RC 26	93 (56)			
			275.0					

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Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

BORING NUMBER SB-18/ MW1103R

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			275.0					
		Gray becoming gray and reddish-brown SHALE, many interbedded claystone seams, very calcareous throughout with limestone inclusions, pyritic specks observed at 275.7', predominantly reddish-brown claystone from 280.5' to 282.5', fresh, moderately broken, hard to very hard, thinly laminated to laminated *(continued)*	280.0	RC 27	99 (74)			
954.9		Gray SILTSTONE, slightly micaceous, few limestone inclusions throughout, fresh, slightly broken, very hard, very thin bedded	285.0					
952.2		Gray SANDSTONE, micaceous, very fine to medium grained, fresh, slightly broken, very hard, thin bedded						
950.4		Gray SILTSTONE, few limestone inclusions, slightly micaceous, interbedded sandstone seams 1/16" thick from 291.4' to 297', fresh, slightly broken, hard to very hard, very thin bedded	290.0 295.0	RC 28	97 (76)			
940.4		Gray SILTSTONE, slightly micaceous, interbedded with shale, pyritic specks observed at 298.2' and 298.5', fresh, broken, hard, very thin bedded						
938.8		Gray SILTSTONE, few limestone inclusions throughout, slightly micaceous, pyritic specks observed at 298.7', fresh, slightly broken, hard to very hard, very thin bedded	300.0					
937.9		Gray SANDSTONE, micaceous, very fine to fine grained, few interbedded siltstone seams less than 1/16" thick, fresh, slightly broken, very hard, thin bedded		RC 29	96 (79)			
936		Gray SILTSTONE, few limestone inclusions throughout, slightly micaceous, fresh, slightly broken, hard to very hard, very thin bedded	305.0					
930.4		Gray SILTSTONE, slightly micaceous, few limestone inclusions, few interbedded sandstone seams less than 1/16" in thickness from 307.6' to 307.8', fresh, broken, hard, very thin bedded						
929.6		Gray SANDSTONE, very fine to medium grained, interbedded siltstone seams throughout less than 1/4" thick, few limestone inclusions, fresh, moderately broken, hard, very thin bedded	310.0					
925.7		Gray SILTSTONE, slightly micaceous, interbedded sandstone and shale seams throughout less than 1/16" thick, fresh, broken, hard, very thin bedded	315.0	RC 30	55 (11)			

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CLIENT American Electric Power **PROJECT NAME** Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416 **PROJECT LOCATION** Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
	Gray SILTSTONE, slightly micaceous, interbedded sandstone and shale seams throughout less than 1/16" thick, fresh, broken, hard, very thin bedded *(continued)*	315.0					
920.4	Gray SANDSTONE, slightly micaceous, few interbedded sandstone seams less than 1/16" thick, fresh, broken, hard, very thin bedded						
919.6	Gray SANDSTONE, micaceous, very fine to medium coarse grained, few limestone inclusions, interbedded siltstone seams less than 1/8" thick, fresh, moderately broken, very hard, thin bedded	320.0					
918.5	Gray SILTSTONE, slightly micaceous, interbedded throughout with shale seams less than 1/8" thick, fresh, moderately broken, hard to very hard, very thin bedded		RC 31	98 (77)			
914.4	Gray SHALE, dark gray shale zone from 325.8' to 326', fresh, moderately broken, hard becoming moderately hard, thinly laminated to laminated	325.0					
910.4	Gray to dark gray SHALE, interbedded siltstone throughout, few limestone inclusions, fresh, moderately broken, hard, laminated	330.0	RC 32	100 (55)			
		335.0					
900.4	Gray SHALE, interbedded siltstone and sandstone seams throughout, interbedded hard siltstone layers with micaceous sandstone inclusions from 337.4' to 338.1' and 339' to 339.2', fresh, broken, moderately hard to hard, laminated	340.0					
897.4	Gray SANDSTONE, interbedded siltstone seams througout less than 1/16" thick, micaceous, very fine to medium grained, interbedded limestone, fresh, moderately broken, hard, very thin bedded		RC 33	100 (50)			
896.2	Gray SHALE, black shale lens 3/4" thick at 344.5', fresh, moderately hard, broken, thinly laminated to laminated						
892.8	Gray and dark gray LIMESTONE, calcareous, fresh, moderately broken, very hard, thick bedded	345.0					
890.4	Gray and dark gray SHALE, calcareous, limestone seam 3/4" thick at 347.8', fresh, broken, moderately hard, laminated						
888.5	Gray LIMESTONE, calcareous, shale inclusions throughout, fresh, moderately broken, very hard, thick bedded	350.0					
885.7	Gray and dark gray SHALE, calcareous, interbedded limestone seams throughout less than 1/8" thick, few limestone inclusions, fresh, moderately broken, moderately hard to hard, thinly laminated to laminated		RC 34	96 (50)			
883.6							
883.1	Gray LIMESTONE, calcareous, shale inclusions throughout,	355.0					

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CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			355.0					
		fresh, moderately broken, very hard, medium bedded						
880.4		Gray and dark gray SHALE, calcareous, interbedded limestone seams throughout less than 1/8" thick, few limestone inclusions, fresh, moderately broken, moderately hard to hard, thinly laminated to laminated *(continued)*						

Bottom of hole at 357.0 feet.

Soil sampling completed on 9/6/11. Boring offset on 9/20/11 for rock coring. Augered to 17.5' to begin rock core sampling.

The following groundwater level readings were taken during drilling:
9/21/2011 7:45 AM at 91.2' bgs (borehole depth = 107' bgs)
9/22/2011 8:25 AM at 223.1' bgs (borehole depth = 227' bgs)
9/23/2011 7:45 AM at 333.1' bgs (borehole depth = 347' bgs)

Geophysical logging and packer testing were performed upon completion.

Well MW1103R installed after completion in an offset boring. The above-noted ground elevation corresponds to the ground elevation at which soil and rock sampling was initiated at SB-18. The ground elevation for MW1103R = 1238.1 ft.

Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

BORING NUMBER SB-18/ MW1103F

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia
DATE STARTED 9/6/11 **COMPLETED** 9/23/11
GROUND ELEVATION 1237.4 ft **HOLE SIZE** 0.5 ft
DRILLING CONTRACTOR Frontz Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD HSA: Auto Hammer & Air Rotary Rock Core (NX)
AT TIME OF DRILLING Refer to notes at bottom of log
LOGGED BY M. McCoy / R. Mahle **CHECKED BY** A. Amicon
AT END OF DRILLING Refer to notes at bottom of log
LOCATION N 487011.2, E 1610102.2
AFTER DRILLING Well installed

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)
		0.0				
1237.4	Brown LEAN CLAY WITH SAND (CL), trace roots, noted iron oxide concretions, moist, medium stiff to stiff (RESIDUAL)		SS 1	93	3-4-5 (9)	2
			SS 2	73	2-2-3 (5)	2
1234.4	Light olive gray and reddish-brown to olive brown LEAN CLAY (CL), few shale fragments, slightly fissile to fissile, moist, medium stiff to very stiff (RESIDUAL)		SS 3	60	3-3-4 (7)	1
		5.0	SS 4	53	5-10-11 (21)	1.5
			SS 5	47	12-10-14 (24)	1.5
1229.9	Reddish-brown CLAYSTONE, completely to highly weathered, very broken, very soft, few limestone seams, blocky, few gray blocky siltstone partings		SS 6	60	11-12-26 (38)	1-2.25
		10.0	SS 7	80	8-11-33 (44)	3-3.5
			SS 8	100	50/5"	1
1225.9	Light gray to brown SHALE, highly weathered, very broken, very soft, laminated, very fissile		SS 9	60	31-22-25 (47)	1
			SS 10	100	14-50/5"	1
1222.6	Light gray SILTSTONE, highly weathered, very broken, very soft, very thin bedded	15.0	SS 11	93	25-34-36 (70)	
1221.9	Reddish-brown to light brown SHALE, highly weathered, very broken, very soft, laminated, fissile		SS 12	100	50/5"	
1219.9	Reddish-brown CLAYSTONE, few interbedded shale seams, highly weathered to moderately weathered, slightly broken, very soft to moderately soft	20.0	RC 1	72 (65)		
1212.6	Gray SHALE, few interbedded slightly micaceous siltstone seams, reddish brown and gray from 27.3' to 28' with claystone seams, moderately weathered, slightly broken, moderately soft, laminated	25.0				
1209.4	Gray SHALE, many interbedded sandstone seams, few discontinuous slightly micaceous siltstone seams throughout, few limestone inclusions, highly to moderately weathered, moderately broken, moderately soft, laminated	30.0	RC 2	80 (43)		
		35.0				

WELL DIAGRAM
- 2.8' Stickup
- Concrete Seal
- 2-Inch Solid PVC Riser Sealed with Bentonite Grout

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Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

BORING NUMBER SB-18/ MW1103F

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SHALE, many interbedded sandstone seams, few discontinuous slightly micaceous siltstone seams throughout, few limestone inclusions, highly to moderately weathered, moderately broken, moderately soft, laminated *(continued)*	35.0					
1199.4		Gray and reddish brown CLAYSTONE, few discontinuous slightly micaceous siltstone seams, few limestone inclusions, moderately weathered, moderately broken, moderately soft	40.0					
1197.7		Gray SILTSTONE, slightly micaceous, few discontinuous shale and sandstone seams, noted pyritic specs at 31.6', increasing in grain size with depth, iron stained fractures from 39.7' to 41.4', moderately weathered, moderately broken, moderately hard, very thin bedded	45.0	RC 3	97 (76)			
1192.1		Gray SANDSTONE, micaceous, very fine to fine grained, few limestone inclusions, few discontinuous siltstone seams, brownish-gray from 46.4' to 47', vertical iron stained fracturing from 46.6' to 47', moderately weathered, moderately broken, moderately hard, very thin bedded to thin bedded						2-Inch Solid PVC Riser Sealed with Bentonite Grout
1190.4		Gray to brownish-gray SANDSTONE, micaceous, very fine to fine grained, few limestone inclusions, few discontinuous siltstone seams, vertical iron stained fracture from 47' to 47.3', moderately weathered, moderately broken, moderately hard, very thin bedded to thin bedded	50.0					
1189.6		Gray SILTSTONE, slightly micaceous, few interbedded sandstone seams throughout, few limestone inclusions, sandstone lens from 49.2' to 50.1', moderately weathered, moderately broken, moderately soft to moderately hard, very thin bedded to thin bedded		RC 4	79 (46)			
1185.4		Gray SHALE, discontinuous and slightly micaceous siltstone seams throughout, reddish-brown from 52.5' to 53.2' with claystone seams and limestone inclusions, pyritic specs observed, highly to moderately weathered, moderately broken, moderately soft, thinly laminated to laminated	55.0					
1180.4		Gray SILTSTONE, slightly micaceous, interbedded sandstone seams throughout, few limestone inclusions, pyritic specs observed, moderately weathered, moderately broken, moderately hard, very thin bedded	60.0					
1178.9		Gray SANDSTONE, micaceous, very fine to medium grained, slightly weathered, moderately broken, moderately hard, very thin bedded		RC 5	93 (29)			
1174.6		Gray SHALE, few limestone inclusions, interbedded slightly micaceous siltstone throughout, pyritic specs observed, moderately to slightly weathered, moderately broken, moderately soft, thinly laminated to laminated	65.0					
1170.4		Gray SHALE, discontinuous slightly micaceous siltstone seams throughout, few limestone inbeds, pyritic specs observed throughout, reddish brown claystone seams from 67.9' to 68.2', 68.4' to 68.7', 69.3' to 70.1', and 71.3' to 71.6', moderately weathered, moderately broken, moderately soft, thinly laminated to laminated	70.0	RC 6	93 (64)			
1165.3		Light gray LIMESTONE, calcareous, few shale inclusions, slightly weathered, moderately broken, hard, thick bedded						
1164.3			75.0					

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4274 Glendale Milford Road
Cincinnati, Ohio 45242

BORING NUMBER SB-18/ MW1103F

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
	Gray SANDSTONE, very fine to medium grained, micaceous interbedded limestone, slightly weathered, slightly broken to broken, hard, very thin bedded to thin bedded *(continued)*	75.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1157.9	Gray SILTSTONE, slightly micaceous, few interbedded sandstone seams, interbedded limestone, slightly weathered, moderately broken, moderately hard, very thin bedded	80.0	RC 7	100 (7)			
1150.4	Gray SILTSTONE, slightly micaceous, few interbedded shale seams, interbedded limestone, slightly weathered, moderately broken, moderately hard, very thin bedded	85.0					
1149.5	Gray SHALE, slightly to moderately weathered, broken, moderately soft, laminated to thinly laminated Reddish-gray discoloration from 92.2' to 92.4'. Pyritic specks observed at 93.7'.	90.0	RC 8	100 (30)			
1143.6	Gray to dark gray LIMESTONE, calcareous, slightly weathered, moderately broken, hard, medium bedded	95.0					
1140.4	Gray SHALE, with calcareous limestone inclusions, slightly weathered, moderately broken, moderately soft, laminated Gray and reddish-gray from 101.6' to 107' with few claystone seams.	100.0 105.0	RC 9	100 (56)			
1130.4	Gray SILTSTONE, moderately to slightly micaceous, fresh, moderately broken, moderately hard, very thin bedded						
1128.2	Gray SANDSTONE, micaceous, very fine to medium grained, interbedded calcareous limestone, fresh, moderately broken, hard, very thin bedded	110.0 115.0	RC 10	88 (68)			

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Civil & Environmental Consultants, Inc.
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ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			115.0					
1122.1		Gray SHALE, few interbedded siltstone seams, fresh, moderately broken, moderately soft, thinly laminated to laminated						
1117.1		Reddish-brown and gray CLAYSTONE, few interbedded shale seams, fresh, moderately broken, moderately soft	120.0	RC 11	74 (33)			
1111.6		Gray SILTSTONE, interbedded limestone, fresh, slightly broken, moderately hard, very thin bedded	125.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1110.4		Gray SILTSTONE, slightly micaceous, interbedded throughout with sandstone seams less than 1/8" thick, limestone inclusions throughout, fresh, moderately broken, moderately hard, very thin bedded	130.0	RC 12	100 (83)			
1100.4		Gray SILTSTONE, slightly micaceous, discontinuous sandstone seams less than 1/10" thick, sporadic limestone inclusions throughout, fresh, moderately broken, moderately hard, very thin bedded	135.0 140.0	RC 13	100 (50)			
1093.9		Gray SANDSTONE, micaceous, very fine to medium grained, interbedded throughout with siltstone seams which decrease in frequency with depth and are less than 1/10" thick, fresh, moderately broken, moderately hard to hard, very thin bedded to thin bedded	145.0					Hole Plug (Bentonite Chips)
1090.4		Gray SANDSTONE, micaceous, very fine to medium grained, interbedded with siltstone lenses less than 1/16" thick from 147' to 152.3', siltstone seam approximately 1/16" thick at 159.5', discontinuous siltstone lenses from 174.5' to 176.2', fresh, slightly broken, hard, thick bedded	150.0 155.0	RC 14	100 (90)			Filter Sand

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CLIENT American Electric Power
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CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
	Gray SANDSTONE, micaceous, very fine to medium grained, interbedded with siltstone lenses less than 1/16" thick from 147' to 152.3', siltstone seam approximately 1/16" thick at 159.5', discontinuous siltstone lenses from 174.5' to 176.2', fresh, slightly broken, hard, thick bedded *(continued)*	155.0					
		160.0	RC 15	100 (100)			
		165.0					2-Inch Slotted Screen
		170.0	RC 16	100 (68)			
		175.0					
1061.2	Gray SHALE, 0.5" coal seam at 176.5', hairline coal fractures at 176.3' and 178.4', fresh, broken, moderately hard, thinly laminated to laminated						
1060.4	Gray and dark gray SHALE, few claystone seams, fresh, moderately broken, moderately soft, laminated to thinly laminated						Filter Sand
		180.0	RC 17	87 (59)			
1056.1	Gray SANDSTONE, micaceous, very fine to medium grained, interbedded siltstone seams throughout, noted calcareous limestone inclusions throughout, fresh, moderately broken, hard, very thin bedded						
1054.1	Gray SILTSTONE, interbedded with sandstone and shale seams less than 1/16" thick, fresh, moderately broken, hard, very thin bedded						
1053.4	Black SHALE, few limestone inclusions, gray shale from 184' to 184.2' and 186.7' to 186.9', fresh, moderately broken, moderately soft, thinly laminated to laminated	185.0					
1050.4	Dark gray SHALE, calcareous with limestone inclusions, fresh, slightly broken, hard, laminated						
1048.5	Gray SILSTONE, slighlty micaceous, few limestone inclusions, sandstone layer from 191.7' to 192', fresh, moderately broken, moderately hard to hard, very thin bedded	190.0	RC 18	100 (56)			
1044.4	Gray SANDSTONE, very fine to medium grained, micaceous, few interbedded siltstone seams throughout, fresh, moderately broken, hard, very thin bedded	195.0					

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Civil & Environmental Consultants, Inc.
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BORING NUMBER SB-18/ MW1103F

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			195.0					
1041.9		Gray SILTSTONE, slightly micaceous, limestone inclusions, few interbedded sandstone seams throughout, fresh, moderately broken to broken, hard, very thin bedded						
1039.4		Gray SHALE, fresh, moderately broken, moderately soft to moderately hard, thinly laminated to laminated	200.0	RC 19	100 (86)			
1033.1		Gray SILTSTONE, slightly micaceous, few discontinuous sandstone and shale lenses less than 1/10" thick, fresh, moderately broken, hard, very thin bedded	205.0					
1029.8		Gray SHALE, few limestone inclusions, interbedded slightly micaceous siltstone seams less than 1/8" in thickness, slightly micaceous siltstone layer from 210.7' to 211.2', fresh, broken, moderately soft, thinly laminated to laminated Few pyritic specks observed from 212' to 214'.	210.0 215.0	RC 20	95 (56)			
1021.7		Gray and reddish-gray to reddish-brown SHALE, fresh, broken, moderately hard, thinly laminated to laminated						
1019.1		Gray becoming reddish-brown and gray SHALE, few claystone seams, calcareous, limestone inclusions throughout, fresh, moderately broken, hard, laminated	220.0 225.0	RC 21	75 (60)			
1010.4		Gray SILTSTONE, fresh, broken, moderately hard, very thin bedded						
1009.6		Gray SANDSTONE, micaceous, very fine to fine grained, interbedded siltstone layers throughout, few limestone inclusions, fresh, moderately broken, very hard, very thin bedded	230.0					
1006.7		Gray SILTSTONE, slightly micaceous, interbedded throughout with sandstone seams less than about 1/8" thick, fresh, broken, moderately hard, very thin bedded		RC 22	93 (59)			
1004.6			235.0					

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CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			235.0					
1002.1		Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions, interbedded siltstone seams throughout which decrease in frequency with depth, fresh, moderately broken, hard, very thin bedded *(continued)*						
1000.4		Gray SHALE, fresh, broken, moderately hard, thinly laminated to laminated						
		Gray SHALE, few claystone seams, gray and light reddish-gray from 240.8' to 243.2', fresh, broken, moderately broken from 240.8' to 247', moderately hard, thinly laminated to laminated	240.0	RC 23	85 (48)			
			245.0					
989.1		Gray SILTSTONE, slightly micaceous, interbedded sandstone seams generally less than 1/8" thick, fresh, very thin bedded	250.0	RC 24	92 (36)			
983.1		Gray and reddish-brown SHALE, few claystone seams, thinly laminated to laminated, few interbedded siltstone seams from 254.3' to 254.9', fresh, moderately broken to broken, moderately hard	255.0					
979.3		Coal seam at 258'.						
		Gray SILTSTONE, slightly micaceous, fresh, moderately broken, hard, very thin bedded						
977.9		Gray SHALE, calcareous, interbedded slightly micaceous siltstone throughout, few limestone inclusions throughout, very hard shale from 263.6' to 267' with limestone, fresh, moderately broken, moderately hard to hard, thinly laminated to laminated	260.0	RC 25	87 (62)			
			265.0					
970.4		Gray becoming gray and reddish-brown SHALE, many interbedded claystone seams, very calcareous throughout with limestone inclusions, pyritic specks observed at 275.7', predominantly reddish-brown claystone from 280.5' to 282.5', fresh, moderately broken, hard to very hard, thinly laminated to laminated	270.0	RC 26	93 (56)			
			275.0					

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PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray becoming gray and reddish-brown SHALE, many interbedded claystone seams, very calcareous throughout with limestone inclusions, pyritic specks observed at 275.7', predominantly reddish-brown claystone from 280.5' to 282.5', fresh, moderately broken, hard to very hard, thinly laminated to laminated *(continued)*	275.0					
			280.0	RC 27	99 (74)			
954.9		Gray SILTSTONE, slightly micaceous, few limestone inclusions throughout, fresh, slightly broken, very hard, very thin bedded	285.0					
952.2		Gray SANDSTONE, micaceous, very fine to medium grained, fresh, slightly broken, very hard, thin bedded						
950.4		Gray SILTSTONE, few limestone inclusions, slightly micaceous, interbedded sandstone seams 1/16" thick from 291.4' to 297', fresh, slightly broken, hard to very hard, very thin bedded	290.0	RC 28	97 (76)			
			295.0					
940.4		Gray SILTSTONE, slightly micaceous, interbedded with shale, pyritic specks observed at 298.2' and 298.5', fresh, broken, hard, very thin bedded						
938.8		Gray SILTSTONE, few limestone inclusions throughout, slightly micaceous, pyritic specks observed at 298.7', fresh, slightly broken, hard to very hard, very thin bedded	300.0					
937.9		Gray SANDSTONE, micaceous, very fine to fine grained, few interbedded siltstone seams less than 1/16" thick, fresh, slightly broken, very hard, thin bedded		RC 29	96 (79)			
936		Gray SILTSTONE, few limestone inclusions throughout, slightly micaceous, fresh, slightly broken, hard to very hard, very thin bedded	305.0					
930.4		Gray SILTSTONE, slightly micaceous, few limestone inclusions, few interbedded sandstone seams less than 1/16" in thickness from 307.6' to 307.8', fresh, broken, hard, very thin bedded						
929.6		Gray SANDSTONE, very fine to medium grained, interbedded siltstone seams throughout less than 1/4" thick, few limestone inclusions, fresh, moderately broken, hard, very thin bedded	310.0					
925.7		Gray SILTSTONE, slightly micaceous, interbedded sandstone and shale seams throughout less than 1/16" thick, fresh, broken, hard, very thin bedded	315.0	RC 30	55 (11)			

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PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
	Gray SILTSTONE, slightly micaceous, interbedded sandstone and shale seams throughout less than 1/16" thick, fresh, broken, hard, very thin bedded *(continued)*	315.0					
920.4	Gray SANDSTONE, slightly micaceous, few interbedded sandstone seams less than 1/16" thick, fresh, broken, hard, very thin bedded						
919.6	Gray SANDSTONE, micaceous, very fine to medium coarse grained, few limestone inclusions, interbedded siltstone seams less than 1/8" thick, fresh, moderately broken, very hard, thin bedded	320.0					
918.5	Gray SILTSTONE, slightly micaceous, interbedded throughout with shale seams less than 1/8" thick, fresh, moderately broken, hard to very hard, very thin bedded		RC 31	98 (77)			
914.4	Gray SHALE, dark gray shale zone from 325.8' to 326', fresh, moderately broken, hard becoming moderately hard, thinly laminated to laminated	325.0					
910.4	Gray to dark gray SHALE, interbedded siltstone throughout, few limestone inclusions, fresh, moderately broken, hard, laminated	330.0	RC 32	100 (55)			
		335.0					
900.4	Gray SHALE, interbedded siltstone and sandstone seams throughout, interbedded hard siltstone layers with micaceous sandstone inclusions from 337.4' to 338.1' and 339' to 339.2', fresh, broken, moderately hard to hard, laminated	340.0					
897.4	Gray SANDSTONE, interbedded siltstone seams througout less than 1/16" thick, micaceous, very fine to medium grained, interbedded limestone, fresh, moderately broken, hard, very thin bedded		RC 33	100 (50)			
896.2	Gray SHALE, black shale lens 3/4" thick at 344.5', fresh, moderately hard, broken, thinly laminated to laminated						
892.8	Gray and dark gray LIMESTONE, calcareous, fresh, moderately broken, very hard, thick bedded	345.0					
890.4	Gray and dark gray SHALE, calcareous, limestone seam 3/4" thick at 347.8', fresh, broken, moderately hard, laminated						
888.5	Gray LIMESTONE, calcareous, shale inclusions throughout, fresh, moderately broken, very hard, thick bedded	350.0	RC 34	96 (50)			
885.7	Gray and dark gray SHALE, calcareous, interbedded limestone seams throughout less than 1/8" thick, few limestone inclusions, fresh, moderately broken, moderately hard to hard, thinly laminated to laminated						
883.6	Gray LIMESTONE, calcareous, shale inclusions throughout,						
883.1		355.0					

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ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		fresh, moderately broken, very hard, medium bedded	355.0					
880.4		Gray and dark gray SHALE, calcareous, interbedded limestone seams throughout less than 1/8" thick, few limestone inclusions, fresh, moderately broken, moderately hard to hard, thinly laminated to laminated *(continued)*						

Bottom of hole at 357.0 feet.

Soil sampling completed on 9/6/11. Boring offset on 9/20/11 for rock coring. Augered to 17.5' to begin rock core sampling.

The following groundwater level readings were taken during drilling:
9/21/2011 7:45 AM at 91.2' bgs (borehole depth = 107' bgs)
9/22/2011 8:25 AM at 223.1' bgs (borehole depth = 227' bgs)
9/23/2011 7:45 AM at 333.1' bgs (borehole depth = 347' bgs)

Geophysical logging and packer testing were performed upon completion.

Well MW1103F installed after completion in an offset boring. The above-noted ground elevation corresponds to the ground elevation at which soil and rock sampling was initiated at SB-18. The ground elevation for MW1103F = 1236.4 ft.

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BORING NUMBER SB-23/ MW1104R

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

DATE STARTED 10/31/11 **COMPLETED** 11/2/11

GROUND ELEVATION 1228.5 ft **HOLE SIZE** 0.5 ft

DRILLING CONTRACTOR Frontz Drilling, Inc.

GROUND WATER LEVELS:

DRILLING METHOD Air Rotary Rock Core

AT TIME OF DRILLING Refer to notes at bottom of log

LOGGED BY R. Mahle **CHECKED BY** M. McCoy

AT END OF DRILLING Refer to notes at bottom of log

LOCATION N 486345.1, E 1609471.2

AFTER DRILLING Well installed

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			0.0					2.0' Stickup
1228.5		No soil sampling performed at boring location. Augered to 19' to begin rock coring.						Concrete Seal
			5.0					
			10.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
			15.0					
1209.5		Grayish-blue SANDSTONE, micaceous, very fine to medium grained, few limestone iclusions throughout, interbedded siltstone seams less than 1/16' thick from 19' to 23.2', moderate olive brown staining from 19.5' to 20.3', 23.3' to 24', 25.5' to 26' and 27.8' to 29' with few iron stains throughout, moderately weathered, moderately broken, hard, very fine bedded	20.0					
			25.0	RC 1	100 (79)			
			30.0					
1196.3		Medium bluish-gray SILTSTONE, slightly micaceous, few limestone inclusions, 1/8" thick iron stained fractures at 38.6' and 39', moderately weathered, slightly broken, moderately hard to hard, very thin bedded	35.0	RC 2	70 (54)			

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ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			35.0					
		Medium bluish-gray SILTSTONE, slightly micaceous, few limestone inclusions, 1/8" thick iron stained fractures at 38.6' and 39', moderately weathered, slightly broken, moderately hard to hard, very thin bedded *(continued)*						
1189.5		Grayish-blue SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions and siltstone seams (less than 1/8" thick) throughout, slightly weathered, moderately broken, hard, very fine bedded	40.0					
1186.1		Medium bluish-gray SHALE, few interbedded slightly micaceous siltstone seams (less than 1/8" thick) from 42.4' to 43.8', grayish-red staining from 44' to 47.3' and 48.2' to 48.5', vertical fracture from 45.8' to 46.3', moderately weathered, moderately broken, moderately soft, thinly laminated to laminated	45.0	RC 3	100 (79)			2-Inch Solid PVC Riser Sealed with Bentonite Grout
		Pyritic specks observed from 47.5' to 47.8'.						
		Grayish-red claystone layer from 48.5' to 49.3'.						
1179.2		Medium bluish-gray to grayish-red purple SILTSTONE, slightly micaceous, few interbedded shale seams (less than 1/8" thick) throughout, moderately weathered, moderately broken, moderately soft, very thin bedded	50.0					
1178.2		Medium bluish-gray SILTSTONE, slightly micaceous, few limestone inclusions throughout, few interbedded sandstone seams (less than 1/8" thick) throughout, slightly weathered, moderately broken, very thin bedded						
1177.1		Grayish-blue SANDSTONE, micaceous, very fine to medium grained, interbedded limestone throughout, slightly weathered, slightly broken, hard, very thin bedded	55.0	RC 4	63 (46)			
		Broken from 59' to 59.3'.						
1169.2		Medium bluish-gray SILTSTONE, interbedded shale and sandstone seams (less than 1/8" thick) throughout, pyritic specks observed throughout, slightly weathered, moderately broken, moderately hard, very thin bedded	60.0					
1166.7		Medium bluish-gray and grayish-red SHALE, few claystone lenses, pyritic specks from 61.8' to 62.1', slightly weathered, moderately broken, moderately hard, thinly laminated	65.0	RC 5	96 (75)			
1161.8		Dark gray SHALE, calcareous interbedded limestone throughout, limestone layers from 66.7' to 67.1' and from 68.6' to 69', slightly weathered, moderately broken, moderately hard to hard, thinly laminated to thin bedded, thin bedded from 69' to 69.4'						
1159.1		Grayish-blue SANDSTONE, micaceous, very fine to medium grained, interbedded siltstone seams from 69.4' to 69.7', few limestone inclusions, slightly weathered, moderately broken, hard, very thin bedded	70.0					
1157.1		Medium bluish-gray SILTSTONE, slightly micaceous, interbedded sandstone seams (less than 1/8" thick) from 74.6' to 79', limestone layer from 76.1' to 76.3', slightly weathered, moderately broken, moderately hard, very thin bedded	75.0	RC 6	98 (55)			

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ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
	Medium bluish-gray SILTSTONE, slightly micaceous, interbedded sandstone seams (less than 1/8" thick) from 74.6' to 79', limestone layer from 76.1' to 76.3', slightly weathered, moderately broken, moderately hard, very thin bedded *(continued)*	75.0					
1149.5	Medium bluish-gray SILTSTONE, slightly micaceous, interbedded shale seams (less than 0.5" thick) throughout, slightly weathered, moderately broken, moderately hard, very thin bedded	80.0 85.0	RC 7	88 (60)			2-Inch Solid PVC Riser Sealed with Bentonite Grout
1141.7	Medium dark gray SHALE, slightly calcareous,limestone layer from 88.8' to 89', slightly weathered, moderately broken, moderately hard to hard, thinly laminated						
1139.5	Olive gray LIMESTONE, calcareous, brownish-gray layer with interbedded calcareous siltstone (slightly micaceous) from 90.3' to 90.8', slightly weathered, moderately broken, very hard, thin bedded	90.0					
1137.3	Dark gray to brownish-gray SILTSTONE, slightly micaceous, calcareous, interbedded limestone, few interbedded shale seams (less than 1/16" thick) from 92.8' to 99', slightly weathered, moderately broken, hard, thin bedded	95.0	RC 8	45 (20)			
1129.5	Brownish-gray SILTSTONE, slightly micaceous, calcareous, interbedded limestone throughout, medium bluish-gray from 100.7' to 103.9', slightly weathered, moderately broken, hard, very thin bedded	100.0					
1124.6	Medium bluish-gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions, few siltstone seams (less than 1/8" thick), fresh, moderately broken, hard, very thin bedded	105.0	RC 9	87 (72)			
	Percentage of siltstone increasing with depth from 109' to 111.4'.	110.0					
1117.1	Medium bluish-gray SILTSTONE, slightly micaceous, few limestone inclusions, few discontinuous sandstone seams (less than 1/16" thick) from 111.4' to 114', few interbedded shale seams from 114' to 114.8', fresh, moderately broken, moderately hard to hard, very thin bedded	115.0	RC 10	90 (65)			

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ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		115.0					
1113.7	Medium bluish-gray SHALE, dark reddish-brown lens from 115.8' to 115.9', few interbedded siltstone lenses (less than 1/8" thick) from 114.8' to 115.8', fresh, moderately broken, moderately hard, thinly laminated to laminated *(continued)*						
1112.2	Dark reddish-brown CLAYSTONE, fresh, moderately broken to broken, moderately hard						
1108.8	Medium bluish-gray SILTSTONE, slightly micaceous, interbedded sandstone seams (less than 1/8" thick) from 119.7' to 126', fresh, moderately broken, hard, very thin bedded	120.0	RC 11	89 (50)			2-Inch Solid PVC Riser Sealed with Bentonite Grout
	Interbedded shale seams (less than 1/10" thick) from 126' to 129'.	125.0					
1099.5	Medium bluish-gray SILTSTONE, slightly micaceous, fresh, slightly broken, moderately hard to hard, very thin bedded	130.0	RC 12	75 (64)			
	Few interbedded shale seams (less than 1/16" thick) from 137.8' to 139'.	135.0					
1089.5	Olive gray becoming grayish-brown, medium bluish-gray and dark reddish-brown SHALE, few interbedded siltstone seams (less than 1/10" thick), few claystone seams, slightly micaceous, fresh, moderately broken, moderately hard, thinly laminated	140.0	RC 13	88 (67)			
	Dark reddish-brown from 144.7' to 147.3' with claystone seams.	145.0					
1079.5	Medium bluish-gray SILTSTONE, slightly micaceous, few interbedded (less than 1/8" thick) sandstone seams, sandstone lens from 149.8' to 150.1', interbedded shale seams (less than 1/16" thick) with grayish-brown staining from 150.3' to 150.8', fresh, moderately broken, hard to very hard, very thin bedded	150.0	RC 14	96 (72)			
1077.7	Medium bluish-gray SANDSTONE, micaceous, very fine to medium grained, fresh, moderately broken, very hard, very thin bedded						
1074.1		155.0					

(Continued Next Page)

Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

BORING NUMBER SB-23/ MW1104R

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
	Medium bluish-gray SILTSTONE, slightly micaceous, interbedded sandstone seams (less than 1" thick) throughout, fresh, moderately broken, hard to very hard, very thin bedded *(continued)*	155.0					
1069.5	Medium bluish-gray SILTSTONE, slightly micaceous, calcareous, few interbedded sandstone seams (less than 0.5" thick) throughout, few interbedded shale seams (less than 1/8" thick) throughout, interbedded limestone throughout, fresh, moderately broken, hard, very thin bedded Broken from 169' to 169.5'.	160.0 165.0	RC 15	95 (69)			2-Inch Solid PVC Riser Sealed with Bentonite Grout
1059	Medium gray SANDSTONE, micaceous, very fine to medium grained, interbedded limestone throughout, fresh, moderately broken, very hard, very thin bedded	170.0	RC 16	98 (68)			
1057.1	Medium gray SILTSTONE, slightly micaceous, calcareous, few interbedded (less than 1/16" thick) shale seams and limestone throughout, fresh, moderately broken, hard, very thin bedded						
1056	Medium bluish-gray SHALE, calcareous, moderate brown from 173.4' to 174.1', interbedded sandstone from 174.1' to 176.5', interbedded limestone throughout, fresh, moderately broken, moderately hard to hard, thinly laminated to laminated	175.0					
1052	Dark gray SILTSTONE, limestone lens from 176.5' to 176.6', limestone inclusions throughout, 1/8" grayish-black shale seams at 177.9' and 178', fresh, moderately broken, very hard, very thin bedded						
1050	Light gray SANDSTONE, micaceous, very fine to medium grained, few siltstone seams (less that 1/16" thick) and broken from 179' to 181.2', fresh, moderately broken, very hard, thin bedded	180.0	RC 17	98 (76)			
1047.3	Grayish-black SHALE, fresh, moderately broken, moderately hard, thinly laminated						Hole Plug (Bentonite Chips)
1044.9	Medium bluish-gray SANDSTONE, micaceous, very fine to fine grained, calcareous limestone inclusions from 175.5' to 178.6', fresh, moderately broken, hard to very hard, very thin bedded to thin bedded	185.0					Filter Sand
1039.5	Medium light gray SANDSTONE, micaceous, very fine to medium grained, medium dark gray less than1/16" thick fine to medium grained seams throughout, few limestone inclusions, fresh, moderately broken, very hard, very thin bedded	190.0 195.0	RC 18	97 (62)			

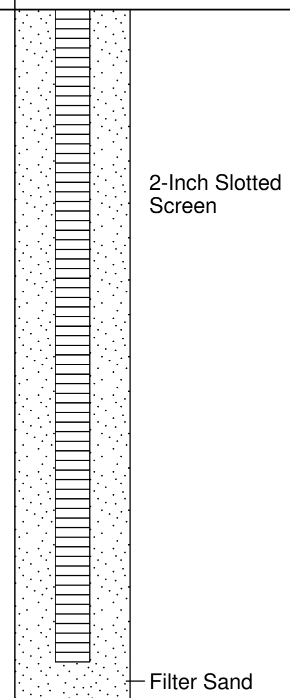
(Continued Next Page)

Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

BORING NUMBER SB-23/ MW1104R

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			195.0					
1032.7		Medium bluish-gray SILTSTONE, slightly micaceous, few interbedded shale seams less than 1/4" thick throughout, few calcareous limestone inclusions, fresh, moderately broken, hard, very thin bedded						
1029.5		Medium bluish-gray SHALE, some brownish-gray staining from about 201.5' to 202.5', few limestone inclusions, interbedded siltstone seams (less than 1/8" thick) from 199' to 201.3', fresh, moderately broken, hard, thinly laminated	200.0					
1025.3		Medium bluish-gray SILTSTONE, slightly micaceous, few limestone inclusions, few interbedded (less than 1/16" thick) very fine to fine grained sandstone seams, fresh, moderately broken, hard, very thin bedded		RC 19	96 (36)			
1023.8		Medium gray SANDSTONE, micaceous, very fine to medium grained, interbedded limestone, interbedded siltstone lenses from 207.4' to 207.9', fresh, moderately broken, very hard, very thin bedded	205.0					
1020.1		Medium bluish-gray SILTSTONE, slightly micaceous, few limestone inclusions, fresh, moderately broken, hard, very thin bedded						
1019.5		Medium bluish-gray SILTSTONE, slightly micaceous, interbedded shale seams (increasing in percentage with depth) throughout, few sandstone seams (less than 1/4" thick) from 210.2' to 210.4', fresh, moderately broken, hard, very thin bedded	210.0					
1015.7		Medium bluish-gray SHALE, few interbedded siltstone seams (less than 1/8" thick) from 212.8' to 214.8', grayish-blue staining from 214.8' to 216.3', fresh, moderately broken, moderately hard to hard, thinly laminated	215.0	RC 20	95 (47)			
1012.1		Medium gray becoming dark reddish-brown SHALE, calcareous, interbedded limestone throughout, becoming dark reddish-brown starting at 217.3' with interbedded claystone, fresh, moderately broken, very hard, laminated						
1009.5		Dark reddish-brown to grayish-red CLAYSTONE, few interbedded shale lenses, calcareous and becoming less calcareous with depth, fresh, moderately broken, very hard	220.0					
			225.0	RC 21	83 (61)			
1002.7		Medium bluish-gray SANDSTONE, micaceous, very fine to fine grained, few limestone inclusions, fresh, moderately broken, very hard, very thin bedded						
999.5		Bottom of hole at 229.0 feet.						



The following groundwater level readings were taken during drilling:
11/1/2011 8:30 AM at 56.7' bgs (borehole depth = 59' bgs)
11/2/2011 9:36 AM at 173.3' bgs (borehole depth = 199' bgs)
Well MW1104R installed after completion in an offset boring.
The above-noted ground elevation corresponds to the ground elevation at which soil and rock sampling was initiated at SB-23.
The ground elevation for MW1104R = 1228.7 ft.

BORING NUMBER SB-23/ MW1104F

Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

DATE STARTED 10/31/11 **COMPLETED** 11/2/11

GROUND ELEVATION 1228.5 ft **HOLE SIZE** 0.5 ft

DRILLING CONTRACTOR Frontz Drilling, Inc.

GROUND WATER LEVELS:

DRILLING METHOD Air Rotary Rock Core

AT TIME OF DRILLING Refer to notes at bottom of log

LOGGED BY R. Mahle **CHECKED BY** M. McCoy

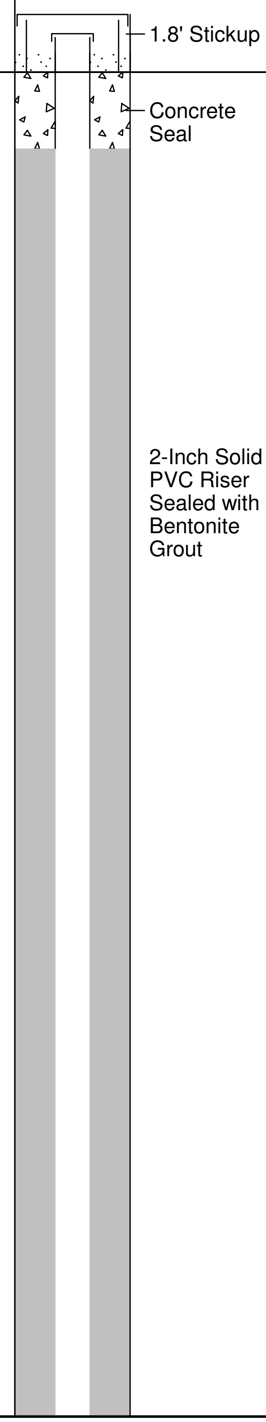
AT END OF DRILLING Refer to notes at bottom of log

LOCATION N 486352.3, E 1609469.3

AFTER DRILLING Well installed

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)
			0.0				
1228.5		No soil sampling performed at boring location. Augered to 19' to begin rock coring.	5.0 10.0 15.0				
1209.5		Grayish-blue SANDSTONE, micaceous, very fine to medium grained, few limestone iclusions throughout, interbedded siltstone seams less than 1/16' thick from 19' to 23.2', moderate olive brown staining from 19.5' to 20.3', 23.3' to 24', 25.5' to 26' and 27.8' to 29' with few iron stains throughout, moderately weathered, moderately broken, hard, very fine bedded	20.0 25.0 30.0	RC 1	100 (79)		
1196.3		Medium bluish-gray SILTSTONE, slightly micaceous, few limestone inclusions, 1/8" thick iron stained fractures at 38.6' and 39', moderately weathered, slightly broken, moderately hard to hard, very thin bedded	35.0	RC 2	70 (54)		

WELL DIAGRAM



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CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Medium bluish-gray SILTSTONE, slightly micaceous, few limestone inclusions, 1/8" thick iron stained fractures at 38.6' and 39', moderately weathered, slightly broken, moderately hard to hard, very thin bedded *(continued)*	35.0					
1189.5		Grayish-blue SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions and siltstone seams (less than 1/8" thick) throughout, slightly weathered, moderately broken, hard, very thin bedded	40.0					
1186.1		Medium bluish-gray SHALE, few interbedded slightly micaceous siltstone seams (less than 1/8" thick) from 42.4' to 43.8', grayish-red staining from 44' to 47.3' and 48.2' to 48.5', vertical fracture from 45.8' to 46.3', moderately weathered, moderately broken, moderately soft, thinly laminated to laminated Pyritic specks observed from 47.5' to 47.8'. Grayish-red claystone layer from 48.5' to 49.3'.	45.0	RC 3	100 (79)			2-Inch Solid PVC Riser Sealed with Bentonite Grout
1179.2		Medium bluish-gray to grayish-red purple SILTSTONE, slightly micaceous, few interbedded shale seams (less than 1/8" thick) throughout, moderately weathered, moderately broken, moderately soft, very thin bedded	50.0					
1178.2		Medium bluish-gray SILTSTONE, slightly micaceous, few limestone inclusions throughout, few interbedded sandstone seams (less than 1/8" thick) throughout, slightly weathered, moderately broken, very thin bedded						
1177.1		Grayish-blue SANDSTONE, micaceous, very fine to medium grained, interbedded limestone throughout, slightly weathered, slightly broken, hard, very thin bedded Broken from 59' to 59.3'.	55.0	RC 4	63 (46)			
1169.2		Medium bluish-gray SILTSTONE, interbedded shale and sandstone seams (less than 1/8" thick) throughout, pyritic specks observed throughout, slightly weathered, moderately broken, moderately hard, very thin bedded	60.0					
1166.7		Medium bluish-gray and grayish-red SHALE, few claystone lenses, pyritic specks from 61.8' to 62.1', slightly weathered, moderately broken, moderately hard, thinly laminated	65.0	RC 5	96 (75)			
1161.8		Dark gray SHALE, calcareous interbedded limestone throughout, limestone layers from 66.7' to 67.1' and from 68.6' to 69', slightly weathered, moderately broken, moderately hard to hard, thinly laminated to thin bedded, thin bedded from 69' to 69.4'						
1159.1		Grayish-blue SANDSTONE, micaceous, very fine to medium grained, interbedded siltstone seams from 69.4' to 69.7', few limestone inclusions, slightly weathered, moderately broken, hard, very thin bedded	70.0					
1157.1		Medium bluish-gray SILTSTONE, slightly micaceous, interbedded sandstone seams (less than 1/8" thick) from 74.6' to 79', limestone layer from 76.1' to 76.3', slightly weathered, moderately broken, moderately hard, very thin bedded	75.0	RC 6	98 (55)			

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Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

BORING NUMBER SB-23/ MW1104F

CLIENT American Electric Power **PROJECT NAME** Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416 **PROJECT LOCATION** Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Medium bluish-gray SILTSTONE, slightly micaceous, interbedded sandstone seams (less than 1/8" thick) from 74.6' to 79', limestone layer from 76.1' to 76.3', slightly weathered, moderately broken, moderately hard, very thin bedded *(continued)*	75.0					
1149.5		Medium bluish-gray SILTSTONE, slightly micaceous, interbedded shale seams (less than 0.5" thick) throughout, slightly weathered, moderately broken, moderately hard, very thin bedded	80.0 85.0	RC 7	88 (60)			2-Inch Solid PVC Riser Sealed with Bentonite Grout
1141.7		Medium dark gray SHALE, slightly calcareous,limestone layer from 88.8' to 89', slightly weathered, moderately broken, moderately hard to hard, thinly laminated						
1139.5		Olive gray LIMESTONE, calcareous, brownish-gray layer with interbedded calcareous siltstone (slightly micaceous) from 90.3' to 90.8', slightly weathered, moderately broken, very hard, thin bedded	90.0					
1137.3		Dark gray to brownish-gray SILTSTONE, slightly micaceous, calcareous, interbedded limestone, few interbedded shale seams (less than 1/16" thick) from 92.8' to 99', slightly weathered, moderately broken, hard, thin bedded	95.0	RC 8	45 (20)			
1129.5		Brownish-gray SILTSTONE, slightly micaceous, calcareous, interbedded limestone throughout, medium bluish-gray from 100.7' to 103.9', slightly weathered, moderately broken, hard, very thin bedded	100.0	RC 9	87 (72)			
1124.6		Medium bluish-gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions, few siltstone seams (less than 1/8" thick), fresh, moderately broken, hard, very thin bedded Percentage of siltstone increasing with depth from 109' to 111.4'.	105.0 110.0					
1117.1		Medium bluish-gray SILTSTONE, slightly micaceous, few limestone inclusions, few discontinuous sandstone seams (less than 1/16" thick) from 111.4' to 114', few interbedded shale seams from 114' to 114.8', fresh, moderately broken, moderately hard to hard, very thin bedded	115.0	RC 10	90 (65)			

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Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

BORING NUMBER SB-23/ MW1104F

CLIENT American Electric Power | **PROJECT NAME** Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416 | **PROJECT LOCATION** Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
1113.7		Medium bluish-gray SHALE, dark reddish-brown lens from 115.8' to 115.9', few interbedded siltstone lenses (less than 1/8" thick) from 114.8' to 115.8', fresh, moderately broken, moderately hard, thinly laminated to laminated *(continued)*	115.0					
1112.2		Dark reddish-brown CLAYSTONE, fresh, moderately broken to broken, moderately hard						
1108.8		Medium bluish-gray SILTSTONE, slightly micaceous, interbedded sandstone seams (less than 1/8" thick) from 119.7' to 126', fresh, moderately broken, hard, very thin bedded	120.0	RC 11	89 (50)			2-Inch Solid PVC Riser Sealed with Bentonite Grout
		Interbedded shale seams (less than 1/10" thick) from 126' to 129'.	125.0					
1099.5		Medium bluish-gray SILTSTONE, slightly micaceous, fresh, slightly broken, moderately hard to hard, very thin bedded	130.0	RC 12	75 (64)			
		Few interbedded shale seams (less than 1/16" thick) from 137.8' to 139'.	135.0					
1089.5		Olive gray becoming grayish-brown, medium bluish-gray and dark reddish-brown SHALE, few interbedded siltstone seams (less than 1/10" thick), few claystone seams, slightly micaceous, fresh, moderately broken, moderately hard, thinly laminated	140.0	RC 13	88 (67)			
		Dark reddish-brown from 144.7' to 147.3' with claystone seams.	145.0					Hole Plug (Bentonite Chips)
1079.5		Medium bluish-gray SILTSTONE, slightly micaceous, few interbedded (less than 1/8" thick) sandstone seams, sandstone lens from 149.8' to 150.1', interbedded shale seams (less than 1/16" thick) with grayish-brown staining from 150.3' to 150.8', fresh, moderately broken, hard to very hard, very thin bedded	150.0	RC 14	96 (72)			Filter Sand
1077.7		Medium bluish-gray SANDSTONE, micaceous, very fine to medium grained, fresh, moderately broken, very hard, very thin bedded						
1074.1			155.0					

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CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			155.0					
		Medium bluish-gray SILTSTONE, slightly micaceous, interbedded sandstone seams (less than 1" thick) throughout, fresh, moderately broken, hard to very hard, very thin bedded *(continued)*						
1069.5		Medium bluish-gray SILTSTONE, slightly micaceous, calcareous, few interbedded sandstone seams (less than 0.5" thick) throughout, few interbedded shale seams (less than 1/8" thick) throughout, interbedded limestone throughout, fresh, moderately broken, hard, very thin bedded	160.0					2-Inch Slotted Screen
			165.0	RC 15	95 (69)			
		Broken from 169' to 169.5'.						
1059		Medium gray SANDSTONE, micaceous, very fine to medium grained, interbedded limestone throughout, fresh, moderately broken, very hard, very thin bedded	170.0					
1057.1		Medium gray SILTSTONE, slightly micaceous, calcareous, few interbedded (less than 1/16" thick) shale seams and limestone throughout, fresh, moderately broken, hard, very thin bedded						Filter Sand
1056		Medium bluish-gray SHALE, calcareous, moderate brown from 173.4' to 174.1', interbedded sandstone from 174.1' to 176.5', interbedded limestone throughout, fresh, moderately broken, moderately hard to hard, thinly laminated to laminated	175.0	RC 16	98 (68)			
1052		Dark gray SILTSTONE, limestone lens from 176.5' to 176.6', limestone inclusions throughout, 1/8" grayish-black shale seams at 177.9' and 178', fresh, moderately broken, very hard, very thin bedded						
1050		Light gray SANDSTONE, micaceous, very fine to medium grained, few siltstone seams (less that 1/16" thick) and broken from 179' to 181.2', fresh, moderately broken, very hard, thin bedded	180.0					
1047.3		Grayish-black SHALE, fresh, moderately broken, moderately hard, thinly laminated						
1044.9		Medium bluish-gray SANDSTONE, micaceous, very fine to fine grained, calcareous limestone inclusions from 175.5' to 178.6', fresh, moderately broken, hard to very hard, very thin bedded to thin bedded	185.0	RC 17	98 (76)			
1039.5		Medium light gray SANDSTONE, micaceous, very fine to medium grained, medium dark gray less than1/16" thick fine to medium grained seams throughout, few limestone inclusions, fresh, moderately broken, very hard, very thin bedded	190.0					
			195.0	RC 18	97 (62)			

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CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			195.0					
1032.7		Medium bluish-gray SILTSTONE, slightly micaceous, few interbedded shale seams less than 1/4" thick throughout, few calcareous limestone inclusions, fresh, moderately broken, hard, very thin bedded						
1029.5		Medium bluish-gray SHALE, some brownish-gray staining from about 201.5' to 202.5', few limestone inclusions, interbedded siltstone seams (less than 1/8" thick) from 199' to 201.3', fresh, moderately broken, hard, thinly laminated	200.0					
1025.3		Medium bluish-gray SILTSTONE, slightly micaceous, few limestone inclusions, few interbedded (less than 1/16" thick) very fine to fine grained sandstone seams, fresh, moderately broken, hard, very thin bedded		RC 19	96 (36)			
1023.8		Medium gray SANDSTONE, micaceous, very fine to medium grained, interbedded limestone, interbedded siltstone lenses from 207.4' to 207.9', fresh, moderately broken, very hard, very thin bedded	205.0					
1020.1		Medium bluish-gray SILTSTONE, slightly micaceous, few limestone inclusions, fresh, moderately broken, hard, very thin bedded						
1019.5		Medium bluish-gray SILTSTONE, slightly micaceous, interbedded shale seams (increasing in percentage with depth) throughout, few sandstone seams (less than 1/4" thick) from 210.2' to 210.4', fresh, moderately broken, hard, very thin bedded	210.0					
1015.7		Medium bluish-gray SHALE, few interbedded siltstone seams (less than 1/8" thick) from 212.8' to 214.8', grayish-blue staining from 214.8' to 216.3', fresh, moderately broken, moderately hard to hard, thinly laminated	215.0	RC 20	95 (47)			
1012.1		Medium gray becoming dark reddish-brown SHALE, calcareous, interbedded limestone throughout, becoming dark reddish-brown starting at 217.3' with interbedded claystone, fresh, moderately broken, very hard, laminated						
1009.5		Dark reddish-brown to grayish-red CLAYSTONE, few interbedded shale lenses, calcareous and becoming less calcareous with depth, fresh, moderately broken, very hard	220.0 225.0	RC 21	83 (61)			
1002.7		Medium bluish-gray SANDSTONE, micaceous, very fine to fine grained, few limestone inclusions, fresh, moderately broken, very hard, very thin bedded						
999.5		Bottom of hole at 229.0 feet. The following groundwater level readings were taken during drilling: 11/1/2011 8:30 AM at 56.7' bgs (borehole depth = 59' bgs) 11/2/2011 9:36 AM at 173.3' bgs (borehole depth = 199' bgs) Well MW1104F installed after completion in an offset boring. The above-noted ground elevation corresponds to the ground elevation at which soil and rock sampling was initiated at SB-23. The ground elevation for MW1104F = 1228.5 ft.						

Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

BORING NUMBER SB-09/ PZ1101H

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia
DATE STARTED 9/13/11 **COMPLETED** 9/19/11
GROUND ELEVATION 1141.3 ft **HOLE SIZE** 0.5 ft
DRILLING CONTRACTOR Frontz Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD HSA: Auto Hammer & Air Rotary Rock Core
AT TIME OF DRILLING Refer to notes at bottom of log
LOGGED BY B. Bashore **CHECKED BY** M. McCoy
AT END OF DRILLING 254.1 ft / Elev 887.2 ft
LOCATION N 485990.9, E 1610339.5
17.75 hours AFTER DRILLING 240.7 ft / Elev 900.6 ft

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		0.0					2.3' Stickup
1141.3	TOPSOIL		SS 1	67	3-3-3 (6)	1.2-1.8	Concrete Seal
1141.2	Brown LEAN CLAY WITH SAND (CL), few shale fragments, trace roots, moist, medium stiff (RESIDUAL)						
1139.8	Reddish-brown to brown FAT CLAY (CH), noted iron oxide concretions, moist, very stiff (RESIDUAL)		SS 2	67	5-7-11 (18)	3.1-4.4	
1138.3	Shelby Tube sample obtained from 1'-3' (Recovery = 20")		SS 3	53	16-27-25 (52)	0.3-0.5	
1136.8	Grayish-brown SANDY LEAN CLAY (CL), few shale fragments, hard, moist (RESIDUAL)	5.0	SS 4	47	13-31-40 (71)	0.1 0.9	
	Grayish-brown to reddish-brown and brown SHALE, completely becoming highly weathered, very broken, very soft, laminated		SS 5	86	42-50/1"	1.5	
			SS 6	93	17-50/3"	1.9 0.2	
		10.0	SS 7	60	33-31-36 (67)	0.1 4.5+	1-Inch Solid PVC Riser Sealed with Bentonite Grout
			SS 8	80	50/3"	1.2	
			SS 9	0	50/1"		
1127.8	Gray to dark gray SANDSTONE, few calcite inclusions, trace shale laminations, fine to medium grained, micaceous, few iron stained fractures, moderately weathered, slightly broken, hard to very hard, thick bedded	15.0	RC 1	95 (94)			
1121	Dark gray SHALE, rough to smooth texture, vertical fractures with iron staining from 20.3' to 22', moderately weathered, very broken, moderately hard, laminated	20.0					
1119.3	Maroon CLAYSTONE, rough to smooth texture, highly weathered, very broken, soft to moderately hard Assuming highly weathered maroon claystone from 22.6' - 29.8' (No Recovery)	25.0	RC 2	28 (5)			
1111.5	Dark gray SHALE, some limestone inclusions, some calcite inclusions, smooth to rough texture, moderately weathered, broken, soft, thinly laminated to laminated	30.0					
1106.9		35.0	RC	96			

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CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Dark gray SILTSTONE, some calcite inclusions, few limestone inclusions, rough to smooth texture, micaceous, moderately weathered, moderately broken, moderately hard to hard, very thin bedded *(continued)*	35.0	3	(88)			
1101.5		Dark gray SILTSTONE, some sandstone seams and shale laminations, trace calcite inclusions, rough to smooth texture, micaceous, slightly weathered, broken, moderately hard to hard, very thin bedded	40.0					
1097.2		Dark gray SANDSTONE, some siltstone seams, fine to medium grained, micaceous, slightly weathered, moderately broken, hard, medium bedded	45.0	RC 4	99 (93)			1-Inch Solid PVC Riser Sealed with Bentonite Grout
1095.4		Dark gray SILTSTONE, some sandstone seams, few calcite inclusions, rough to smooth texture, micaceous, slightly weathered, broken, moderately hard to hard, very thin bedded						
1092.8		Gray SANDSTONE, some siltstone seams, very fine to medium grained, micaceous, slightly weathered, moderately to slightly broken, hard to very hard, very thin bedded	50.0					
			55.0	RC 5	100 (100)			
1081.5		Gray SANDSTONE, trace calcite inclusions, fine to medium grained, micaceous, slightly weathered, moderately broken, hard, very thin bedded to medium bedded	60.0					
			65.0	RC 6	96 (93)			
			70.0					
1070.4		note: sandstone interbedded w/ shale and intensely fractured from 70.9' - 71.6'						
1069.7		Gray SANDSTONE, few shale laminations, fine to medium grained, micaceous, slightly weathered, slightly broken, hard, thin bedded to thick bedded	75.0	RC	93			

(Continued Next Page)

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			75.0	7	(74)			
1065		Dark gray SHALE, smooth to rough texture, slightly weathered, broken, soft to moderately hard, thinly laminated to laminated						
1061.5		Dark gray SHALE, some calcite inclusions, few limestone inclusions, smooth to rough texture, slightly weathered, broken, moderately hard to soft, thinly laminated to laminated	80.0	RC 8	97 (72)			1-Inch Solid PVC Riser Sealed with Bentonite Grout
1056.8		Dark gray to black SHALE, few claystone seams, some plant fossils, some calcite inclusions, rough texture, fresh, moderately broken, soft to moderately hard, thinly laminated to laminated	85.0					
1054.3		Gray SANDSTONE, few shale inclusions, very fine to medium grained, micaceous, fresh, moderately broken, hard, very thin bedded						
1051.5		Dark gray to black SHALE, few calcite inclusions, smooth texture, fresh, broken, soft to hard, thinly laminated to laminated Completely black from 90.9' - 91.4', shale becomes interbedded with limestone at 91.4'.	90.0	RC 9	77 (58)			
1047.3		Dark gray to gray SANDSTONE, some shale laminations, some limestone inclusions, fine to medium grained, micaceous, fresh, slightly weathered, hard, thick bedded	95.0					
1041.5		Gray SANDSTONE, few coal inclusions, fine to medium grained, micaceous, fresh, slightly broken, hard, medium bedded to thick bedded	100.0	RC 10	100 (99)			
			105.0					
1031.5		Gray SANDSTONE, fine to medium grained, micaceous, fresh, slightly weathered, hard, medium bedded to thick bedded	110.0					
			115.0	RC	99			

(Continued Next Page)

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SANDSTONE, fine to medium grained, micaceous, fresh, slightly weathered, hard, medium bedded to thick bedded *(continued)*	115.0	11	(99)			
			120.0					
			125.0	RC 12	87 (71)			1-Inch Solid PVC Riser Sealed with Bentonite Grout
1015.4		Dark gray to red-brown CLAYSTONE, waxy texture, fresh, broken, moderately hard to soft						
			130.0					
		Highly weathered vertical fracture at 132.8'.						
1007.8		Dark gray SHALE, interbedded siltstone seams throughout, some calcite inclusions, smooth to rough texture, fresh, moderately broken, soft to moderately hard, laminated	135.0	RC 13	95 (81)			
1003.8		Gray SANDSTONE, trace shale laminations, fine to medium grained, micaceous, fresh, moderately broken, hard, thin bedded to medium bedded						
			140.0					
996.7		Dark gray SHALE, smooth texture, fresh, broken, moderately hard to soft, thinly laminated to laminated	145.0	RC 14	86 (85)			
991.5		Dark gray to maroon SHALE, few claystone seams, some plant fossils, trace calcite inclusions, smooth to waxy texture, fresh, broken, soft to moderately hard, thinly laminated to laminated	150.0					
			155.0	RC	75			

(Continued Next Page)

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			155.0	15	(41)			
985.6		Dark gray to maroon SHALE, few claystone seams, some plant fossils, trace calcite inclusions, smooth to waxy texture, fresh, broken, soft to moderately hard, thinly laminated to laminated *(continued)* note: siltstone layer from 155.7' - 156.7'						
981.5		Dark gray to brown SHALE, some plant fossils, platy w/ horizontal bedding, smooth to rough texture, fresh, broken, soft to moderately hard, thinly laminated to laminated	160.0					
			165.0	RC 16	87 (73)			1-Inch Solid PVC Riser Sealed with Bentonite Grout
975		Dark gray to brown SHALE, some plant fossils, smooth to rough texture, fresh, broken, moderately hard, thinly laminated to laminated						
971.5		Dark gray SHALE, some plant fossils, platy, smooth texture, fresh, broken, moderately hard to soft, thinly laminated to laminated	170.0					
968.1		Dark gray to maroon SILTSTONE, few claystone seams throughout, trace calcite inclusions, slightly micaceous, rough texture, fresh, broken, soft, very thin bedded	175.0	RC 17	90 (79)			
961.5		Dark gray to maroon SHALE, siltstone and claystone seams throughout, some plant fossils, smooth to rough texture, fresh, broken, moderately hard to soft, laminated	180.0					
			185.0	RC 18	78 (65)			
951.5		Dark gray to maroon CLAYSTONE, few shale and siltstone seams, trace plant fossils, platy, smooth to rough texture, fresh, broken, moderately hard to soft	190.0					
948.1		Dark gray SILTSTONE, few sandstone seams, trace calcite inclusions, gritty texture, micaceous, fresh, slightly broken, hard, thick bedded	195.0	RC	95			

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Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

BORING NUMBER SB-09/ PZ1101H

CLIENT American Electric Power

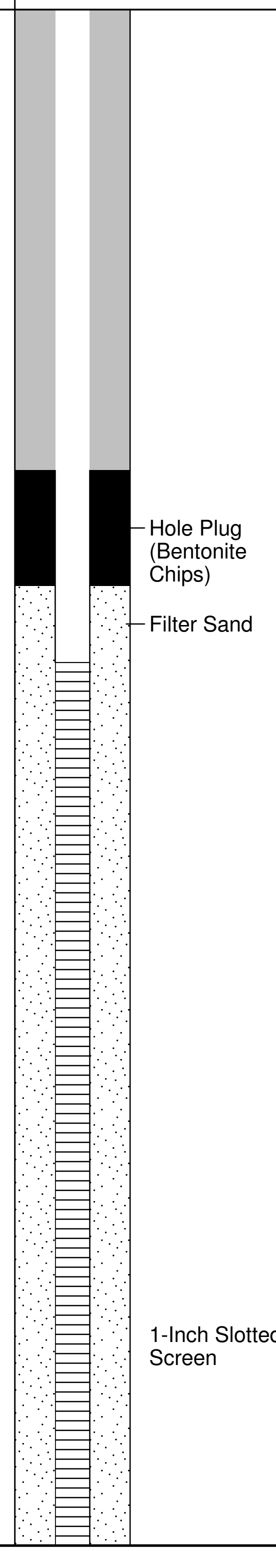
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)
		Dark gray SILTSTONE, few sandstone seams, trace calcite inclusions, gritty texture, micaceous, fresh, slightly broken, hard, thick bedded *(continued)*	195.0	19	(91)		
943		Dark gray SHALE, some limestone inclusions, trace plant fossils, trace sandstone and siltstone seams, rough to smooth texture, fresh, broken, moderately hard to hard, laminated	200.0				
			205.0	RC 20	98 (95)		
935.3		Dark gray SANDSTONE, interbedded shale laminations increasing in percentage with depth, few siltstone seams, trace calcite inclusions, micaceous, very fine to medium grained, fresh, broken, moderately hard to hard, very thin bedded	210.0				
929.9		Gray SANDSTONE, some shale laminations, fine to medium grained, micaceous, fresh, moderately broken, hard, thin bedded to medium bedded note: sandstone interbedded w/ shale from 213.5' - 214.8'	215.0	RC 21	98 (97)		
			220.0				
918.5		Dark gray SHALE, some limestone inclusions, trace calcite inclusions, smooth to rough texture, fresh, broken, moderately hard to soft, thinly laminated to laminated	225.0	RC 22	94 (89)		
911.5		Dark gray to maroon SHALE, few claystone seams, trace calcite inclusions, platy, smooth texture, fresh, broken, moderately hard to soft, thinly laminated to laminated	230.0				
			235.0	RC	86		

WELL DIAGRAM



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CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)
		235.0	23	(68)		
905.5	Dark gray SANDSTONE, interbedded shale laminations and siltstone seams, trace limestone inclusions, micaceous, fresh, broken, moderately hard to hard, very thin bedded					
901.5	Gray SANDSTONE, some shale laminations, fine to medium grained, micaceous, fresh, broken, hard, very thin bedded to thin bedded	240.0				
896.5	Dark gray SHALE, some interbedded sandstone, platy, smooth to gritty texture, fresh, very broken, moderately hard, thinly laminated to laminated	245.0	RC 24	94 (82)		
894.1	Gray SANDSTONE, few shale inclusions, fine to medium grained, micaceous, fresh, moderately broken, hard, very thin bedded					
893.5	Dark gray SHALE, some plant fossils, platy, smooth texture, fresh, broken, moderately hard, thinly laminated	250.0				
887.3	Black COAL, fresh, broken, laminated	255.0	RC 25	57 (35)		
886.8	Dark gray SHALE, some plant fossils, platy, smooth texture, fresh, broken, moderately hard, thinly laminated to laminated					
885.4	Brown to dark gray LIMESTONE, few coal inclusions, high reaction to HCl, fresh, slightly broken, very hard, thick bedded					
881.5	Bottom of hole at 259.8 feet.					

WELL DIAGRAM: Filter Sand; Hole Plug (Bentonite Chips)

The following groundwater level readings were taken during drilling:
9/13/2011 6:00 PM at 129.4' bgs (borehole depth = 129.8' bgs)
9/14/2011 8:00 AM at 109.3' bgs (borehole depth = 129.8' bgs)
9/15/2011 8:15 AM at 114.2' bgs (borehole depth = 149.8' bgs)
9/16/2011 8:00 AM at 211.7' bgs (borehole depth = 230' bgs)
9/19/2011 11:00 AM at 131.3' bgs (borehole depth = 230' bgs)
9/19/2011 2:40 PM at 254.1' bgs (borehole depth = 259.8' bgs)

The following groundwater level readings were taken after drilling:
9/20/2011 8:30 AM at 240.7' bgs (borehole depth = 259.8' bgs)

Piezometer PZ1101H installed upon completion.

Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

BORING NUMBER B-1501/ MW1501R

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia
DATE STARTED 6/4/15 **COMPLETED** 7/29/15
GROUND ELEVATION 1158.80 ft **HOLE SIZE** 8.00"
DRILLINGCONTRACTOR AEP
TOP OF PVC ELEVATION 1161.78 ft
DRILLING METHOD 4.25" I.D. HSA: Auto Hammer & Rotary Rock Core
GROUND WATER LEVELS:
LOGGED BY D. Follett **CHECKED BY** RAS
AT END OF DRILLING ---
LOCATION N 484663.0, E 1609913.5

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	Elevation	WELL DIAGRAM
0	SS 1	67	2-2-2 (4)		Brown LEAN CLAY (CL), trace roots, trace organics, trace moist, medium stiff, highly plastic, cohesive (RESIDUAL)		
1.5	SS 2	53	2-2-7 (9)		Light Brown LEAN CLAY WITH SILT (CL), trace sand, dry, very stiff, low plasticity, massive (RESIDUAL)	1157.3	
3.0	SS 3	60	4-7-8 (15)		Burgundy LEAN CLAY (CL), dry, very stiff, massive (RESIDUAL)	1155.8	
4.5	SS 4	60	4-8-17 (25)		Brown LEAN CLAY WITH SILT (CL), trace fine sand, trace organics, very stiff, dry, massive (RESIDUAL)	1154.3	Bentonite Grout
5	SS 5	67	2-2-10 (12)		Some mottling		
7.5	SS 6	100	50		Tan SILT (ML), medium stiff, massive, non cohesive, non plastic (RESIDUAL)	1151.3	
	SS 7	100	50		SILTSTONE gravel in spoon		
10.5	SS 8	100	50/4"		Light green SILTSTONE, slightly micaceous, some calcereous limestone inclusions, moderately decomposed, moderately friable, moderate strength	1148.3	
	RC 1	125 (0)			At 15.1' healed iron stained sub vertical fracture, from 16.6 to 17.0' vertical fracture		
15	RC 2	99 (39)					4-Inch Solid PVC Riser
20					Interbedded SHALE from 19.5' to 19.6'		
21.7					Blue gray SHALE, strong, hard, laminated, slightly decomposed, moderately friable, non calcereous, moderate to highly fractured	1137.1	
					Iron stained vertical fractures from 22.2' to 22.7' and 23.1' to 23.2'		
25	RC 3	101 (52)			Iron stained vertical fracture 24.0' to 24.1'		
26.4					Tan CLAYSTONE, weak, highly decomposed, moderately friable	1132.4	
26.6					Gray LIMESTONE, strong, hard, microcrystaline, calcereous, massive, slightly decomposed, slightly friable, slightly to moderately fractured	1132.2	
30.2					Gray CLAYSTONE, weak, calcereous, massive, moderately decomposed, slightly disintegrated, moderately to intensely fractured.	1128.6	Bentonite Grout
					Iron stained vertical fracture 33.5' to 34.0'		
					Iron stained sub vertical fracture at 35.0'		
35.0						1123.8	

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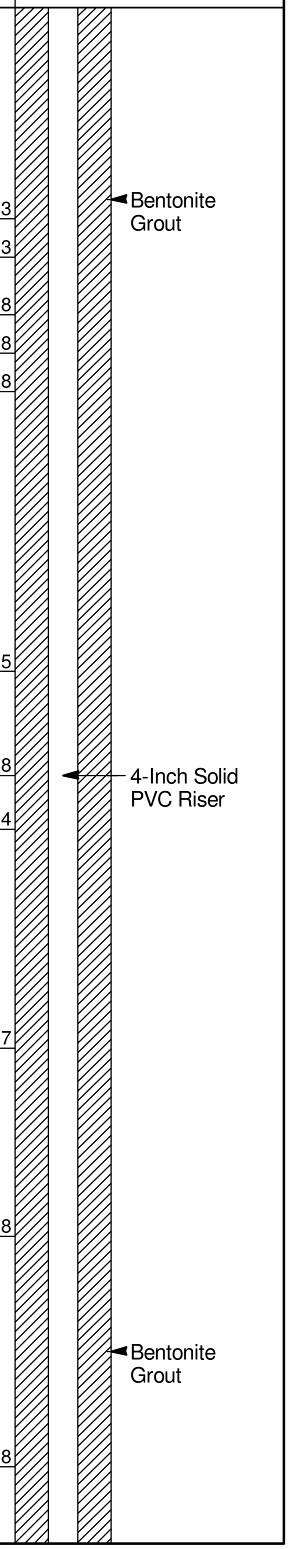
Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

BORING NUMBER B-1501/ MW1501R

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION
35	RC 4	102 (57)			Gray CLAYSTONE, weak, calcereous, massive, moderately decomposed, slightly friable, moderately to highly fractured. At 35.0' color change to gray burgundy, moderate to strong, massive, slightly decomposed, slightly friable Iron stained sub vertical fractures at 37.6', 39.0', 39.2' and 39.8'
40.5					1118.3 Burgundy CLAYSTONE, moderate to strong, massive, moderately decomposed, moderately friable, very highly fractured Iron stained sub vertical fractures at 40.7', 41.0' and 41.4'
41.5					1117.3 Gray CLAYSTONE, strong, massive, few calcereous limestone nodules, moderately decomposed, moderately friable Iron stained vertical fractured 42.7 to 43.3'
43.0					1115.8 Gray LIMESTONE, hard, microcrystaline, calcereous, moderately decomposed, slightly friable, some stylolites Iron stained sub vertical fractured at 44.3'
44.0	RC 5	102 (81)			1114.8 Brown SILTSTONE, strong, micaceous, some limestone inclusions, slightly decomposed, slightly friable, highly fractured Iron stained vertical fracture from 44.7' to 45.2'
45.0					1113.8 Gray SHALE, strong, hard, slightly decomposed, slightly friable, few gray calcereous nodules Iron stained vertical fracture at 49.0'
52.3					1106.5 Burgundy CLAYSTONE, strong, fresh, massive, slightly friable, moderately fractured
55.0	RC 6	99 (84)			1103.8 Gray CLAYSTONE, moderate strength, few limestone clasts, slightly decomposed, slightly friable At 56.4' sharp contact
56.4					1102.4 Brown SANDSTONE, strong, micaceous, trace mangenese, very thinly bedded, cross bedded, moderately decomposed, moderately friable, few limestone inclusions, moderately fractured Iron stained vertical fracture from 57.1' to 57.5' and 60.5' to 60.7'
62.1					1096.7 Gray & Burgundy CLAYSTONE, weak, micaceous, massive, slightly decomposed, moderately friable, moderately fractured, sharp contact Sub vertical fracture 63.5' to 64.0'
67.0	RC 7	100 (78)			1091.8 Blue gray SHALE, moderate to strong, laminated, slightly decomposed, slightly friable, some limestone nodules, some CLAYSTONE interbeds, slightly fractured
73.0					1085.8 Gray & Burgundy CLAYSTONE, weak to moderate strength, fresh, slightly friable, moderately fractured
75					

WELL DIAGRAM



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Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

BORING NUMBER B-1501/ MW1501R

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)
RC 8	95 (76)	
RC 9	45 (28)	
RC 10	199 (171)	
RC 11	94 (76)	
RC 12	102 (101)	

DEPTH (ft)	MATERIAL DESCRIPTION	Elevation
75	Gray & Burgundy CLAYSTONE, weak to moderate strength, fresh, slightly friable, moderately fractured *(continued)*	
82.2	Dark gray LIMESTONE, strong, hard, medium bedded, slightly decomposed, slightly friable	1076.6
82.4	Gray & Burgundy CLAYSTONE, weak to moderate strength, fresh, slightly friable, moderately fractured	1076.4
85.2	Light green SANDSTONE, strong, fine grained, some calcereous clasts, fresh, trace mica, trace manganese, slightly friable, slightly to moderately fractured Lost part of core run # 9, picked up core on core run # 10	1073.6
92.0	Dark green SILTSTONE, fresh, massive, competent, slightly to moderately fractured	1066.8
92.6	Light green SANDSTONE, strong, fresh, very fine grained, micaceous, thinly bedded, few cross beds, competent, well cemented, slightly to moderately fractured Fresh sub vertical fracture from 97.3' to 97.7'	1066.2
101.0	Gray CLAYSTONE, strong, massive, slightly decomposed, slightly friable, moderately fractured Color change to dark gray at 101.9', moderately friable	1057.8
102.2	Light green SILTSTONE, strong, fresh, massive, slightly decomposed, slightly friable, moderately fractured	1056.6
104.0	Light green gray SANDSTONE, strong, micaceous, very fine grained, fresh, competent, well cemented, calcereous, slightly to moderately fractured Sharp contact at 108.1'	1054.8
108.1	Green CLAYSTONE, strong, massive, interbedded with very fine grained SANDSTONE, slightly to moderately fractured	1050.7
113.5	Dark gray to black SHALE, strong, massive, slightly decomposed, slightly friable, moderately fractured	1045.3
114.4		1044.4
114.8		1044.0

WELL DIAGRAM

Depth (approx.)	Label
80	Bentonite Grout
95	4-Inch Solid PVC Riser
110	Bentonite Grout

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BORING NUMBER B-1501/ MW1501R

Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

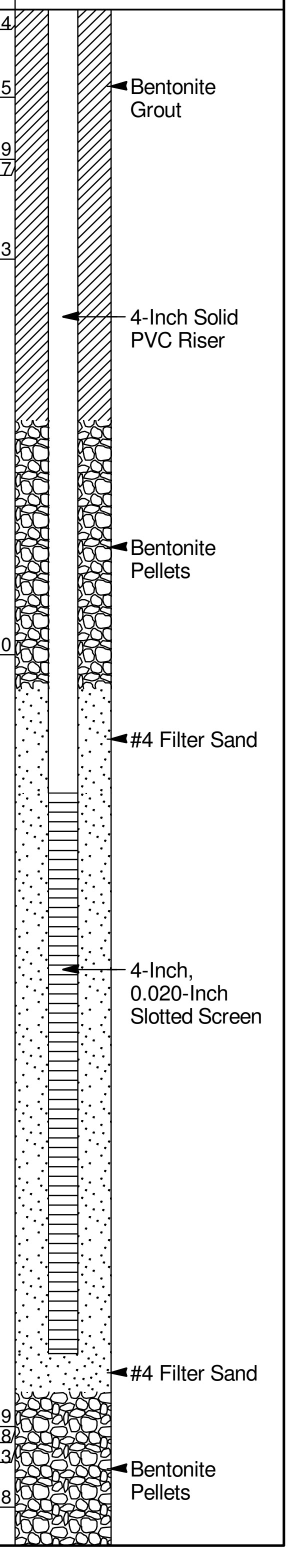
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)
115	RC 13	102 (64)	
120	RC 14	100 (98)	
125			
130	RC 15	100 (100)	
135			
140	RC 16	99 (92)	
145			
150	RC 17	99 (84)	
155			

MATERIAL DESCRIPTION

Depth (ft)	Description	Elevation
115.4	Burgundy CLAYSTONE, strong, massive, moderately decomposed, moderately friable, moderately fractured	1043.4
117.3	Dark Gray to Black CLAYSTONE, strong, massive, carbonaceous, moderately decomposed, moderately friable Grades to light green CLAYSTONE *(continued)*	1041.5
118.9	Light green SANDSTONE, strong, fresh, fine grained, thinly bedded, competent, well cemented	1039.9
119.1	Black SHALE, strong, laminated, carbonaceous, pyrite stringers, slightly decomposed, moderately friable, slightly fractured	1039.7
121.5	Black COAL, weak, massive, blocky	1037.3
	Gray LIMESTONE, strong, microcrystaline, calcereous, unfractured Sub vertical fracture 120.4' to 120.8'	
	Light gray SILTSTONE, strong, thick bedded, limestone nodules throughout, slightly decomposed, slightly friable At 123.4' interbedded with fine grained cross bedded SANDSTONE	
131.8	Gray SANDSTONE, strong, hard, fine grained, well sorted, micaceous, some thin to medium bedded cross beds, well cemented, dark gray mica seams <1/16" , slightly fractured to unfractured Horizontial fractures along medium grained mica at 135.2', 135.55', and 143.5' Sub horizontial fracture at 138.8' and 145.5'	1027.0
151.9		1006.9
152.0	Light green gray CLAYSTONE, weak, massive, slightly decomposed, slightly friable	1006.8
152.5	Dark gray SHALE, moderate strength, carbonaceous, laminated, few red CLAYSTONE stringers, slightly decomposed, slightly friable, moderately fractured	1006.3
154.0		1004.8

WELL DIAGRAM



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CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM
155	RC 18	96 (58)			Gray to dark gray LIMESTONE, strong, hard, microcrystaline, slightly decomposed, slightly friable, moderately fractured Sub vertical fracture at 152.8' Sub horizontial fracture at 153.6' and 153.8'		
159.0					Dark gray to burgundy CLAYSTONE, strong, massive, calcereous, slightly decomposed, slightly friable, moderately fractured Sub horizontial fractures / slickenslides at 155.0', 155.7', 156.5', 157.5' and 157.8' Very highly fractured from 158.0' to 158.7' *(continued)*	999.8	Bentonite Pellets
160	RC 19	101 (101)			Light green SANDSTONE, strong, fine grained, thin to thickly bedded, fresh, competent, slight to unfractured, some dark thinly bedded mica beds <1/16" Vertical fracture 168.9' to 169.0'		
165							
169.0						989.8	
169.6	RC 20	77 (52)			Green gray SHALE, weak, laminated, slightly decomposed, slightly friable, highly fractured	989.2	
170					Gray to Burgundy CLAYSTONE, moderate strength, massive, moderately decomposed, moderately friable, moderately fractured Sub horizontial fractures / slickenslides at 171.1', 171.8' and 172.4'		
173.1					Light green gray SILTSTONE, strong, massive, fresh, competent, slightly decomposed, interbedded with few CLAYSTONE beds, moderately fractured Lost part of core run # 20, retrieved on core run # 21	985.7	Bentonite Pellets
175							
179.7					Light green gray SANDSTONE, strong, fine grained, thinly bedded, calcereous, fresh, competent, slightly fractured	979.1	
180	RC 21	104 (104)					
181.4					Burgundy to gray SHALE, moderate strength, laminated, slightly decomposed, slightly friable, highly fractured Very highly fractured at 183.0' Vertical healed fracture at 183.4'	977.4	
183.7					Light green gray SANDSTONE, strong, fine grained, thinly bedded, calcereous, fresh, competent, slightly fractured	975.1	
184.0					Bottom of hole at 184.0 feet	974.8	

Monitoring well installed on 8/05/2015

Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

BORING NUMBER MW1501F

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

DATE STARTED 7/30/15 **COMPLETED** 7/30/15

GROUND ELEVATION 1158.84 ft **HOLE SIZE** 8.00"

DRILLINGCONTRACTOR AEP

TOP OF PVC ELEVATION 1161.83 ft

DRILLING METHOD 4.25" I.D. HSA: Auto Hammer & Rotary Rock Core

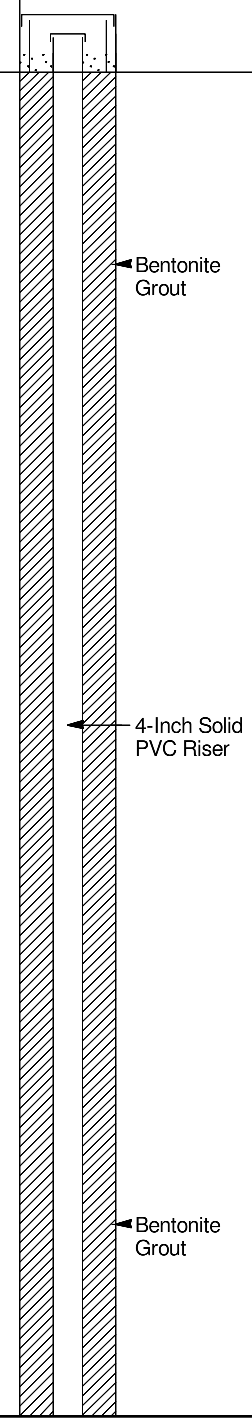
GROUND WATER LEVELS:

LOGGED BY D. Follett **CHECKED BY** RAS

AT END OF DRILLING ---

LOCATION N 484662.0, E 1609917.5

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0			Blind drilled from 0' to 107'. See B-1501 boring log for description.	
5				
10				
15				
20				
25				
30				
35				



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Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

BORING NUMBER MW1501F

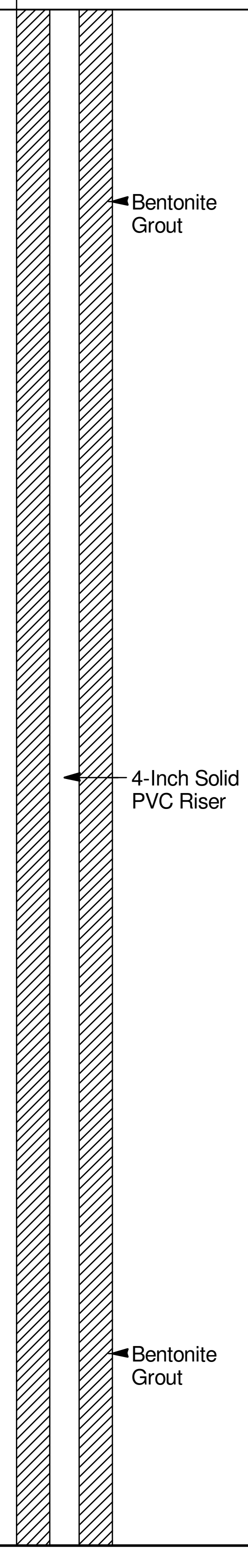
CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35			Blind drilled from 0' to 107'. See B-1501 boring log for description. *(continued)*	
40				
45				
50				
55				
60				
65				
70				
75				



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Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

BORING NUMBER MW1501F

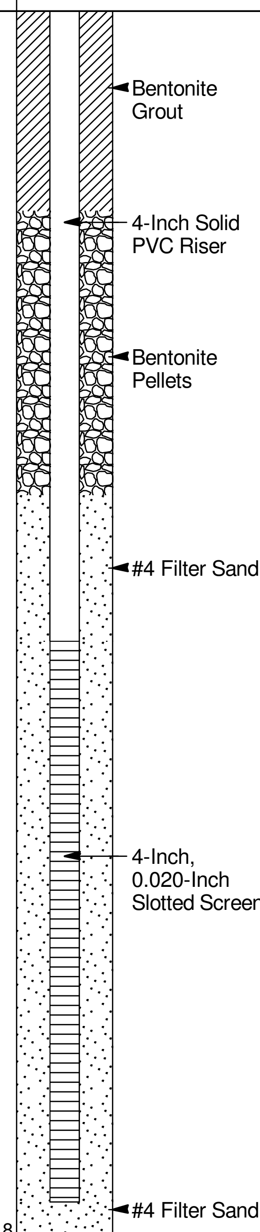
CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
75			Blind drilled from 0' to 107'. See B-1501 boring log for description. *(continued)*	
80				
85				
90				
95				
100				
105				
			107.0 — 1051.8	
			Bottom of hole at 107.0 feet	
			Monitoring well installed on 8/06/2015	



Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

BORING NUMBER MW1502R

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

DATE STARTED 6/3/15 **COMPLETED** 7/31/15

GROUND ELEVATION 1045.23 ft **HOLE SIZE** 8.00"

DRILLINGCONTRACTOR AEP

TOP OF PVC ELEVATION 1047.41 ft

DRILLING METHOD 4.25" I.D. HSA: Auto Hammer & Rotary Rock Core

GROUND WATER LEVELS:

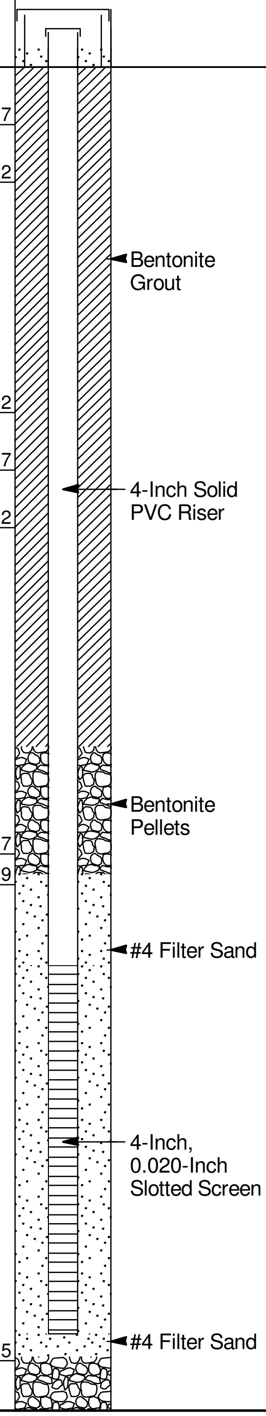
LOGGED BY D. Follett **CHECKED BY** RAS

AT END OF DRILLING ---

LOCATION N 484648.8, E 1610218.1

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MATERIAL DESCRIPTION	Depth / Elevation
0	SS 1	53	12-7-5 (12)	Gray GRAVEL (FILL), moist, some silt, some sand	1.5 / 1043.7
	SS 2	40	6-3-3 (6)	Brown LEAN CLAY (CL), stiff, moist, medium plasticity, cohesive, massive, trace gravel, trace organics, trace mica	3.0 / 1042.2
	SS 3	53	4-6-5 (11)	Brown LEAN CLAY WITH GRAVEL (CL), medium stiff, moist, massive, low plasticity, non cohesive, sub angular gravel	
5	SS 4	67	5-4-3 (7)		
	SS 5	53	5-5-7 (12)	Some gray SILTSTONE	
	SS 6	40	4-4-4 (8)		9.0 / 1036.2
10	SS 7	60	3-2-5 (7)	Brown LEAN CLAY (CL), stiff, moist, some wood, trace mica, trace sand, trace roots	10.5 / 1034.7
	SS 8	67	4-15-26 (41)	Light brown SILT (ML), hard, dry, non plastic, non cohesive, some iron stained gravel	12.0 / 1033.2
	SS 9	100	50/4"	Brown SILTSTONE, very weak, dry, trace mica	
15					
	SS 10	100	26-50/3"		
20					20.5 / 1024.7
	SS 11	100	50/1"	Gray SANDSTONE, hard, dry, fine grained, micaceous	21.3 / 1023.9
	RC 1	98 (57)		Gray SANDSTONE, hard, fine to medium grained, very thin to thick bedded, micaceous, well cemented calcite, moderately fractured Iron stained vertical fracture 21.4' to 22.1' Fine bedded SILTSTONE interbeds 23.1' to 23.2', color change to tan Horizontial fractures at 23.1', 23.2', 23.7', 23.8' and 23.9'	
25				At 25.1' color change to gray At 27.3' color change to light brown, slightly friable	
30	RC 2	101 (57)		Iron stained sub vertical fractures at 29.5' and 30.7' Highly to moderately fractured from 27.5' to 31.2', moderately decomposed Very highly fractured from 31.2' to 32.0'	33.7 / 1011.5
35					

WELL DIAGRAM



(Continued Next Page)

BORING NUMBER MW1502R

Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35–38.0	RC 3	98 (56)			Gray SILTSTONE, hard, slightly calcereous along fractures, slightly micaceous, moderate to highly fractured Moderately friable and weak from 33.7' to 34.3', few limestone inclusions Slightly decomposed 34.3' to 38.0' *(continued)*	Bentonite Pellets
38.0–39.1 (1007.2)					Dark gray SHALE, hard, carbonaceous, laminated, few limestone nodules, fresh	
39.1–44.0 (1006.1)					Gray SILTSTONE, hard, slightly calcereous along fractures, slightly micaceous, slightly decomposed, moderate to highly fractured	
44.0–46.0 (1001.2)	RC 4	101 (68)			Burgundy CLAYSTONE, weak to moderate strength, calcereous, massive, gray mud stringers throughout, moderately decomposed, intensely fractured Subvertical fracture at 44.5' CLAYSTONE BRECCIA 45.8' to 45.9', calcereous	
46.0–56.4 (999.2)					Gray SANDSTONE, strong, hard, micaceous, very fine grained to medium grained, fresh to slightly decomposed, slightly friable, very thinly bedded, cross bedded, calcereous, slightly to moderately fractured Subvertical fractures at 48.0', 49.1' and 49.9' Very highly fractured 51.1' to 51.6', weak, iron stained, calcereous Subvertical iron stained calcereous fractures at 53.9', 54.25' and 54.9'	
56.4–58.9 (988.8)	RC 5	77 (39)			Gray to burgundy CLAYSTONE, weak to moderate strength, massive, moderate to highly decomposed, moderately friable	Natural Backfill
58.9–64.3 (986.3)					Gray SILTSTONE, hard, slightly micaceous, fresh, very thinly bedded, slightly friable, moderately fractured	
64.3 (980.9)					Bottom of hole at 64.3 feet	

Monitoring well installed on 8/06/2015

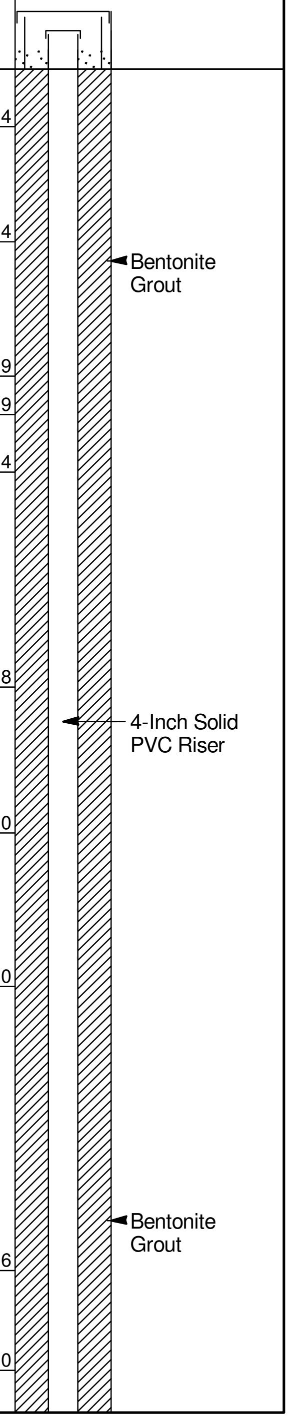
Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

BORING NUMBER B-1503/ MW1503R

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia
DATE STARTED 6/11/15 **COMPLETED** 7/20/15
GROUND ELEVATION 1108.86 ft **HOLE SIZE** 8.00"
DRILLINGCONTRACTOR AEP
TOP OF PVC ELEVATION 1111.96 ft
DRILLING METHOD 4.25" I.D. HSA: Auto Hammer & Rotary Rock Core
GROUND WATER LEVELS:
LOGGED BY D. Follett **CHECKED BY** RAS
AT END OF DRILLING ---
LOCATION N 484596.7, E 1610487.6

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	Depth	MATERIAL DESCRIPTION	Elev.
0	SS 1	67	3-2-3 (5)	1.5	Yellow brown LEAN CLAY (CL), stiff, highly plastic, few mica, trace sand, trace sandstone gravel, trace mottled (FILL)	1107.4
	SS 2	80	3-4-7 (11)		Yellow brown LEAN CLAY with SILT (CL), stiff, dry, trace gravel, trace mica	
	SS 3	80	5-5-8 (13)	4.5	Some mottling at 3.0'	1104.4
5	SS 4	80	4-5-8 (13)		Yellow brown LEAN CLAY with GRAVEL (CL), very stiff, moderately plastic, subangular sandstone gravel, some silt, trace sand	
	SS 5	67	5-6-6 (12)	8.0	Some siltstone gravel at 6.0'	1100.9
	SS 6	73	3-6-9 (15)	9.0	Burgundy LEAN CLAY with SILT (CL), very stiff, dry, low plasticity, mottled, some gray clay, trace sand, massive	1099.9
10	SS 7	100	50/5"	10.5	Tan SANDSTONE, weak, dry, trace mica, highly weathered	1098.4
	SS 8	100	50/5"		Gray SANDSTONE, strong, micaceous, very fine grained, thin to thickly bedded, moderately decomposed, moderately friable, highly fractured	
	RC 1	8 (61)			Vertical fractures 11.0' to 11.5' and 12.4' to 12.8', iron stained calcite filled fractures	
15					Sub horizontial iron stained fractures 13.2'. 13.6' and 13.7'	
				16.1	Lost water return on core run #1	1092.8
	RC 2	73 (38)			Brown CLAYSTONE, weak to strong, slight to moderately decomposed, moderately friable, highly to very highly fractured	
				19.9	Very intensely iron stained fractured 16.1' - 16.9'	1089.0
20					Light green SILTSTONE, strong, massive, slight to moderately decomposed, slightly friable, trace mica, moderately fractured	
					Sub horizontial iron stained slickenslide at 17.1'	
				23.9	Iron stained vertical fractured 19.1' to 20.5'	1085.0
25	RC 3	94 (42)			Green brown CLAYSTONE, moderate strength to strong, massive, moderately decomposed, moderately friable	
					Very highly fractured 23.9' to 28.4 ', iron stained and calcereous	
					Vertical fracture 26.8' to 27.0' and 27.7' to 28.6', iron stained and calcereous	
30				31.3	Subvertical fracture 29.2' to 29.4', iron stained	1077.6
				33.9	Dark brown SILTSTONE, weak to moderate strength, massive, moderate to highly decomposed, moderately friable, very highly fractured, iron stained, mangenese stained	1075.0
35					Sub horizontial slickenslide at 31.8'	

WELL DIAGRAM



(Continued Next Page)

Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

BORING NUMBER B-1503/ MW1503R

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35	RC 4	90 (31)			Water return at end of core run # 3 Burgundy and gray CLAYSTONE, very weak, massive, highly decomposed, slightly friable, trace mica, trace sand, moderately to highly fractured Very highly fractured 34.9' to 35.9', highly weathered *(continued)*	Bentonite Grout
42.6					Light green SILTSTONE with SHALE interbeds, strong, thin to medium bedded, slightly decomposed, slightly friable, trace mica, calcereous, moderately fractured (1066.3)	
44.8	RC 5	100 (100)			Light green SANDSTONE, very strong, fresh, competent, very fine grained, thin to thickly bedded, trace biotite, trace mica, well cemented, trace calcereous nodules, slightly fractured to unfractured (1064.1) Horizontial fractured at 47.5', iron stained Sub horizontial fracture at 49.0', iron stained Very thinly bedded cross beds 50.7' to 54.0'	
54.7	RC 6	99 (70)			Gray SHALE, strong, laminated, slightly decomposed, slightly friable, moderately fractured (1054.2)	4-Inch Solid PVC Riser
55.5					Dark gray CLAYSTONE, weak, massive, highly decomposed, moderately friable, unfractured (1053.4)	
55.7					Light green SANDSTONE, very strong, fresh, competent, very fine to fine grained, thin to thickly bedded, trace biotite, trace mica, well cemented, trace calcereous nodules, slightly fractured to unfractured (1053.2)	
58.5					Dark gray SHALE, strong, laminated, slightly decomposed, slightly friable, moderately fractured Moderate to highly fractured 54.7' to 55.5' (1050.4)	
60.5					Light green SANDSTONE, very strong, fresh, competent, very fine to fine grained, thin to thickly bedded, trace biotite, trace mica, well cemented, trace calcereous nodules, slightly to unfractured (1048.4)	
64.7	RC 7	98 (96)			Dark gray SHALE, strong, laminated, slightly decomposed, slightly friable, moderately fractured (1044.2)	
67.0					Gray to burgundy CLAYSTONE, strong, laminated, slightly decomposed, slightly friable, moderately fractured Sub horizontial slickenslide 67.0' and 67.9' From 68.4' to 69.5', trace red CLAYSTONE stringers, massive (1041.9)	Bentonite Grout
69.5					Light green SANDSTONE, very strong, fresh, competent, very fine to fine grained, thin to thickly bedded, trace biotite, trace mica, well cemented, trace calcereous nodules, slightly fractured to unfractured (1039.4)	
70.9					Black SHALE with thinly bedded coal stringers, strong, some pyrite nodules and stringers, thinly bedded, moderately decomposed, moderately friable, moderately fractured (1038.0)	
73.9					(1035.0)	
75						

(Continued Next Page)

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	MATERIAL DESCRIPTION	ELEVATION	WELL DIAGRAM
75.6	RC 8	101 (97)		Sub horizontial slickenslide at 73.5'	1033.3	Bentonite Grout
77.3				Gray LIMESTONE, strong, hard, microcrystaline, massive, fresh, competent, calcereous, some black angular clasts, unfractured	1031.6	
				Sharp contact at 75.6' *(continued)*		
				Light green gray SILTSTONE, moderate to strong, massive, slight to moderately decomposed, slightly friable, slightly fractured		
80.5				Light green gray SANDSTONE interbeds, strong, fine grained, thin to moderately bedded, micaceous, calcereous inclusions, slightly decomposed, slightly friable	1028.4	Bentonite Pellets
84.2				Light green gray SHALE, moderate strength, laminated, fresh, slightly friable, moderately fractured	1024.7	
84.8	RC 9	100 (100)		Light gray SANDSTONE, strong, thinly bedded, calcereous, slightly decomposed, slightly friable, slightly fractured	1024.1	
89.0				Light green gray SANDSTONE, strong, medium to thickly bedded, micaceous, fresh, slightly decomposed, slightly friable, slight to moderately fractured Gradational contact at 89.0'	1019.9	#4 Filter Sand
100.1	RC 10	100 (92)		Gray SANDSTONE, strong, hard, very fine to fine grained, well sorted, thinly bedded, well cemented calcereous cement, trace pyrite, slightly decomposed, slightly friable, slightly fractured to unfractured At 94.0' grain size change to fine to medium grained, few dark gray angular clasts From 94.75' to 95.65', some brecciated calcereous siltstone & mudstone interbeds, moderately decomposed Sub vertical fractures at 94.8' and 95.5' Sub vertical iron stained fracture 96.4' to 96.6'	1008.8	4-Inch, 0.020-Inch Slotted Screen; #4 Filter Sand
105.6				Gray to dark gray SHALE, strong, laminated, few silt, some calcereous nodules, slightly decomposed, slightly friable At 102.6' black SHALE stringer, 1/2" thick	1003.3	
107.0	RC 11	100 (89)		Gray to burgundy CLAYSTONE, strong, massive to laminated, slightly decomposed, slightly friable, moderately fractured	1001.9	
107.2				Gray LIMESTONE, strong, hard, microcrystaline, fresh, competent, calcereous, unfractured	1001.7	Bentonite Pellets
111.0				Dark gray CLAYSTONE, strong, some coarse grained limestone clasts, calcereous, slightly decomposed, slightly friable, slight to moderately fractured At 107.4', 45 degree slickenslide	997.9	
113.9				Burgundy CLAYSTONE, strong, non calcereous, massive, fresh to slightly decomposed, slightly friable, moderately fractured At 112.0' and 112.4' 45 degree slickenslides	995.0	
115.0				Gray green SILTSTONE, strong, thickly bedded, trace mica, fresh to slightly	993.9	

(Continued Next Page)

Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

BORING NUMBER B-1503/ MW1503R

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
115					decomposed, slightly friable, unfractured	
	RC 12	99 (93)			Light green gray SANDSTONE, strong, hard, very fine to fine grained, micaceous well cemented, thinly bedded, moderate to unfractured At 118.8' some limestone clasts, hard, calcereous	
120						
123.1					Gray green SILTSTONE, strong, hard, massive, fresh, competent, slightly fractured (elev. 985.8)	Bentonite Pellets
125						
126.2	RC 13	76 (52)			Gray and burgundy CLAYSTONE, weak to moderate strength, massive, slight to moderately decomposed, slight to moderately friable, non calcereous, moderately fractured (elev. 982.7) Sub horizontial slickenslide at 127.8'	
130						
133.9					(elev. 975.0)	

Bottom of hole at 133.9 feet

6/16/15 8:20 AM at 27.45' bgs (borehole depth = 73.9' bgs)

Monitoring well installed on 8/15/2015

BORING NUMBER MW1503F

Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia
DATE STARTED 7/23/15 **COMPLETED** 7/23/15
GROUND ELEVATION 1108.80 ft **HOLE SIZE** 8.00"
DRILLINGCONTRACTOR AEP
TOP OF PVC ELEVATION 1111.93 ft
DRILLING METHOD 4.25" I.D. HSA: Auto Hammer & Rotary Rock Core
GROUND WATER LEVELS:
LOGGED BY D. Follett **CHECKED BY** RAS
AT END OF DRILLING ---
LOCATION N 484591.4, E 1610488.5

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0			Blind drilled from 0' to 64'. See B-1503 boring log for description.	
5				Bentonite Grout
10				
15				4-Inch Solid PVC Riser
20				
25				
30				Bentonite Grout
35				

(Continued Next Page)

Civil & Environmental Consultants, Inc.
250 Old Wilson Bridge Road, Suite 250
Worthington, OH 43085

BORING NUMBER MW1503F

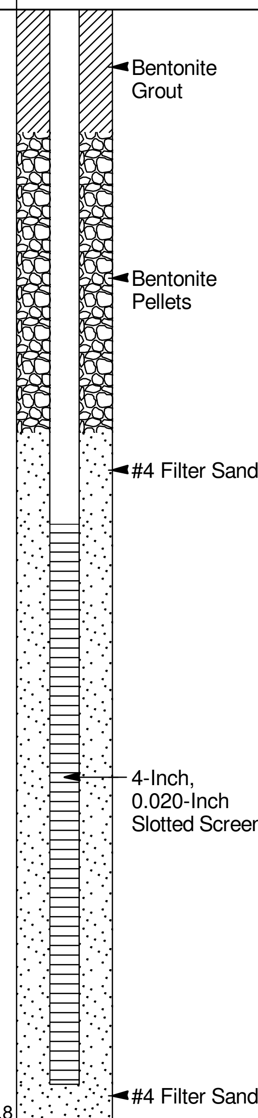
CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

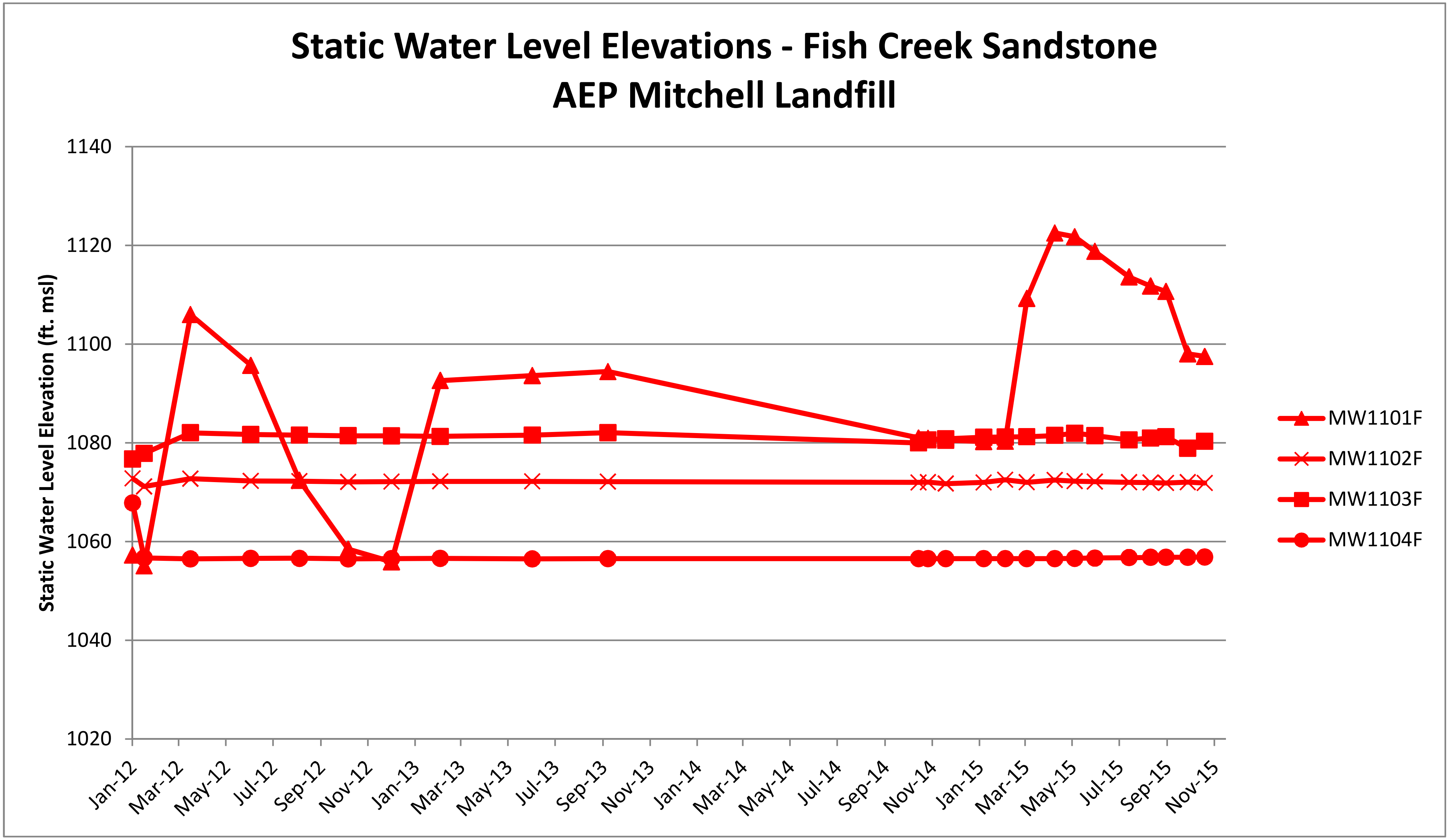
CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
35			Blind drilled from 0' to 64'. See B-1503 boring log for description. *(continued)*	
40				
45				
50				
55				
60				
			64.0 ... 1044.8	
			Bottom of hole at 64.0 feet	
			Monitoring well installed on 8/15/2015	



APPENDIX B


Static Water Level Elevations - Fish Creek Sandstone
AEP Mitchell Landfill
Static Water Level Elevation (ft. msl)
1140
1120
1100
1080
1060
1040
1020
Jan-12
Mar-12
May-12
Jul-12
Sep-12
Nov-12
Jan-13
Mar-13
May-13
Jul-13
Sep-13
Nov-13
Jan-14
Mar-14
May-14
Jul-14
Sep-14
Nov-14
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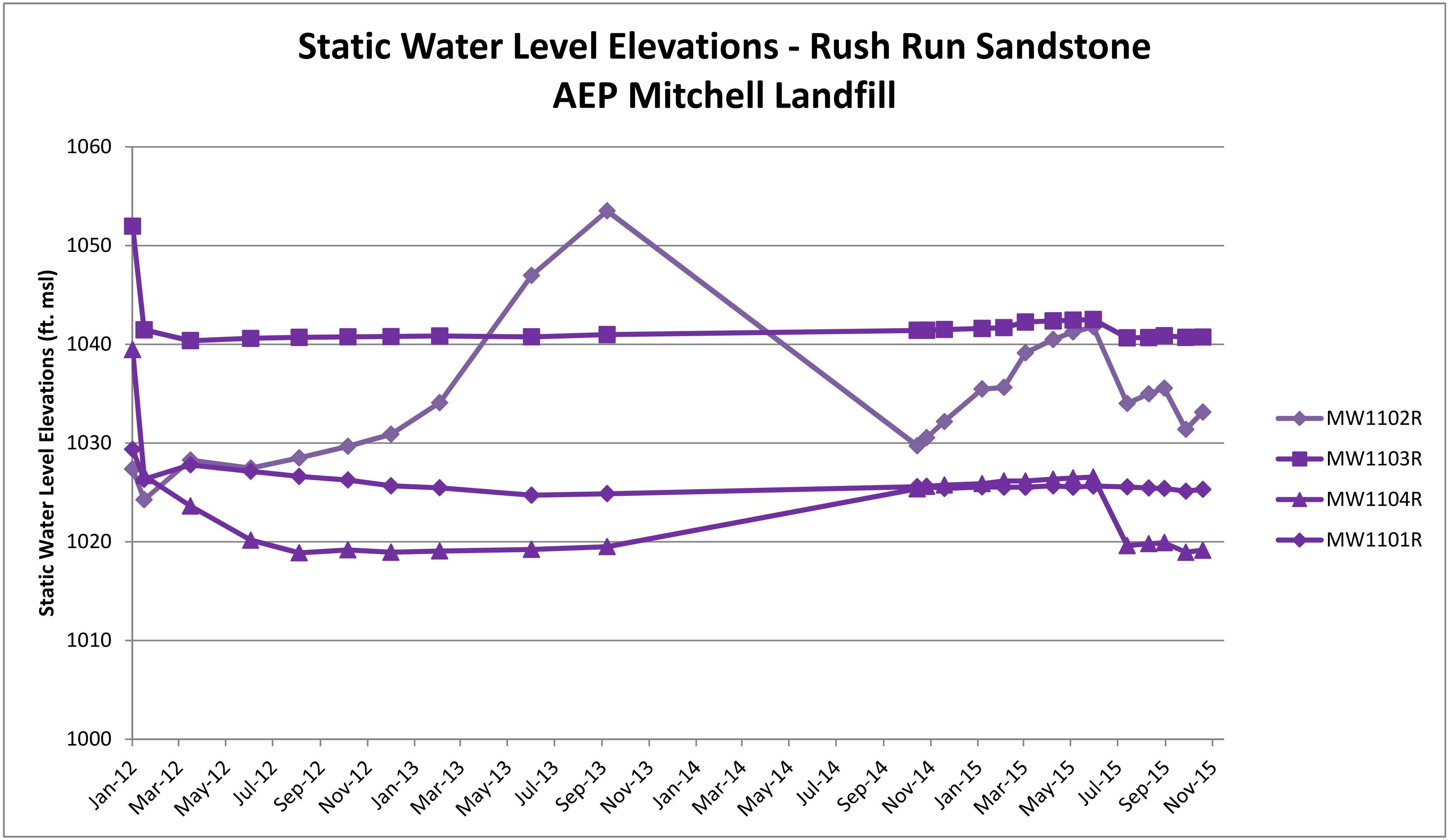
Jul-15
Sep-15
Nov-15
MW1101F
MW1102F
MW1103F
MW1104F



Static Water Level Elevations - Rush Run Sandstone
AEP Mitchell Landfill
Static Water Level Elevations (ft. msl)
1060
1050
1040
1030
1020
1010
1000
Jan-12
Mar-12
May-12
Jul-12
Sep-12
Nov-12
Jan-13
Mar-13
May-13
Jul-13
Sep-13
Nov-13
Jan-14
Mar-14
May-14
Jul-14
Sep-14
Nov-14
Jan-15
Mar-15
May-15
Jul-15
Sep-15
Nov-15
MW1102R
MW1103R
MW1104R
MW1101R

Appendix E

Annual Groundwater Monitoring Reports – January 2020

for

Mitchell Plant's

Bottom Ash Pond

and

Landfill

Annual Groundwater Monitoring Report

Kentucky Power Company

Mitchell Plant

Bottom Ash Pond

Moundsville, WV

January 2020

Prepared by:
American Electric Power Service Corporation
1 Riverside Plaza
Columbus, Ohio 43215

KENTUCKY POWER

An AEP Company

BOUNDLESS ENERGY

Table of Contents

I. Overview

This *Annual Groundwater Monitoring Report* (Report) has been prepared to report the status of activities for the preceding year for the Bottom Ash Pond at Kentucky Power Company's, a wholly owned subsidiary of American Electric Power Company (AEP), Mitchell Power Plant. The USEPA's CCR rules require that the Annual Groundwater Monitoring Report be posted to the operating record for the preceding year no later than January 31st.

In general, the following activities were completed in 2019:

- In accordance with 40 CFR 257.95(d)(1), groundwater samples were collected and analyzed for all Appendix III constituents and those Appendix IV constituents that were detected during the previous sampling in accordance with 40 CFR 257.95(b) in August 2018. This occurred in April/May, 2019. In accordance with 40 CFR 257.95(b), groundwater samples were collected and analyzed for all Appendix IV constituents. This occurred in June 2019. All sampling was performed in accordance with 40 CFR 257.95 *et seq.*, and AEP's *Groundwater Sampling and Analysis Plan (2016)*;
- Groundwater data underwent various validation tests, including tests for completeness, valid values, transcription errors, and consistent units;
- Statistical analysis of the assessment monitoring samples collected in August 2018 and April/May 2019 was completed in January and July 2019, respectively.
- Because no statistically significant levels (SSLs) above the groundwater protection standard were detected, assessment monitoring continued.
- No alternative source demonstrations (ASDs) relative to the Appendix IV SSLs above the groundwater protection standard were pursued.
- As required by 40 CFR 257.95(d)(1), groundwater samples were collected and analyzed for all Appendix III constituents and those Appendix IV constituents that were detected during the June 2019 sampling in accordance with 40 CFR 257.95(b). This occurred in October 2019.

The major components of this annual report, to the extent applicable at this time, are presented in sections that follow:

- A map, aerial photograph or a drawing showing the CCR management unit(s), all groundwater monitoring wells and monitoring well identification numbers;
- All of the monitoring data collected, including the rate and direction of groundwater flow, plus a summary showing the number of samples collected per monitoring well, the dates the samples were collected, and whether the sample was collected as part of detection monitoring or assessment monitoring programs (Attached as **Appendix 1**);

- Statistical comparison of monitoring data to determine if there have been statistically significant levels above the groundwater protection standards (Attached as **Appendix 2**, where applicable);
- A discussion of whether any alternate source demonstration were performed, and the conclusions (Attached as **Appendix 3**, where applicable);
- A summary of any transition between monitoring programs, for example the date and circumstances for transitioning from detection monitoring to assessment monitoring (Notices attached as **Appendix 4**, where applicable);
- Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a statement as to why that happened (Attached as **Appendix 5**, where applicable); and
- Other information required to be included in the annual report such as an alternate monitoring frequency, or assessment of corrective measures, if applicable.

In addition, this report summarizes key actions completed, and where applicable, describes any problems encountered and actions taken to resolve those problems. The report includes a projection of key activities for the upcoming year.

II. Groundwater Monitoring Well Locations and Identification Numbers

A figure that depicts the PE-certified groundwater monitoring network, the monitoring well locations, and their corresponding identification is provided in Appendix 1.

III. Monitoring Wells Installed or Decommissioned

There were no monitoring wells installed or decommissioned in 2019. The network design, as summarized in the *Groundwater Monitoring Network Design Report* (2016) and as posted at the CCR web site for Mitchell Plant, did not change. That design report, viewable on the AEP CCR web site, discusses the facility location, the hydrogeological setting, the hydrostratigraphic units, the uppermost aquifer, downgradient monitoring well locations and the upgradient monitoring well locations.

IV. Groundwater Quality Data and Static Water Elevation Data, With Flow Rate and Direction and Discussion

Appendix 1 contains tables showing the groundwater quality data collected during the establishment of background quality, detection monitoring, and assessment monitoring. Static water elevation data from each monitoring event also are shown in Appendix 1, along with the groundwater velocities, groundwater flow direction, and potentiometric maps developed after each sampling event.

V. Groundwater Quality Data Statistical Analysis

Statistical analysis of the assessment monitoring samples taken in August 2018 and in April/May 2019 was completed in January 2019 and July 2019, respectively. No SSLs above the groundwater protection standards were identified during either analysis. The results of these statistical analyses are documented in the corresponding statistical analysis summary reports, which are provided in Appendix 2.

As required by 40 CFR 257.95(d)(1), groundwater samples were collected and analyzed for all Appendix III constituents and those Appendix IV constituents that were detected during the June 2019 sampling in accordance with 40 CFR 257.95(b). This occurred in October 2019. Based on the results, Appendix IV groundwater protection standards are being calculated and will be statistically compared to Appendix IV concentrations in downgradient wells. Statistical analysis and the setting of Appendix IV groundwater protection standards and will be completed in February 2020.

VI. Alternative Source Demonstrations

ASDs relative to Appendix IV SSLs above the groundwater protection standard were not necessary because no SSLs above the groundwater protection standards were identified in 2019. A statement to this effect is provided in Appendix 3.

VII. Discussion About Transition Between Monitoring Requirements or Alternate Monitoring Frequency

No transition between monitoring requirements occurred in 2019; the CCR unit remained in assessment monitoring over the entire year. A statement to this effect is provided in Appendix 4.

The bottom ash pond will remain in assessment monitoring unless all Appendix III and IV parameters are below background values for two consecutive monitoring events, at which point, the CCR Unit would return to detection monitoring. If one or more Appendix IV parameters exceed the respective groundwater protection standard due to a release from the bottom ash pond, and are not demonstrated to be caused by a source other than the CCR unit or resulting from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality by means of an ASD, an assessment of corrective measures will be undertaken as required by 40 CFR 257.96.

Regarding defining an alternate monitoring frequency, the groundwater velocity and monitoring well production is high enough at this facility that no modification of the semiannual detection monitoring effort is necessary.

VIII. Other Information Required

The bottom ash pond has progressed from detection monitoring to its current status in assessment monitoring. All required information has been included in this annual groundwater monitoring report.

IX. Description of Any Problems Encountered in 2019 and Actions Taken

No significant problems were encountered. The low flow sampling effort went smoothly and the schedule was met to support this annual groundwater report preparation.

X. A Projection of Key Activities for the Upcoming Year

Key activities for 2020 include:

- Assessment monitoring on a semiannual schedule;
- Evaluation of the assessment monitoring results from a statistical analysis viewpoint, looking for any statistically significant increases over an established groundwater protection standard, or whether the concentrations have returned below background concentrations;
- Responding to any new data received in light of what the CCR rule requires;
- Preparation of the next annual groundwater report.

APPENDIX 1 - Groundwater Data Tables and Figures

Tables follow showing the groundwater monitoring data collected, the rate of groundwater flow each time groundwater was sampled, the number of samples collected per monitoring well, dates that the samples were collected, and whether each sample was collected as part of a detection monitoring or an assessment monitoring program. Figures follow showing the PE-certified groundwater monitoring network with the corresponding well identifications along with static water elevation data and groundwater flow directions each time groundwater was sampled in the form of annotated satellite images.

Table 1 - Groundwater Data Summary: MW-1504
Mitchell - BAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
6/13/2016	Background	0.054	220	99.1	0.23	6.9	990	375
8/1/2016	Background	0.070	220	103	0.25	7.0	970	403
9/26/2016	Background	0.098	225	103	0.24	7.1	946	389
11/8/2016	Background	0.053	219	92.8	0.19	7.1	930	369
2/7/2017	Background	0.162	218	81.7	0.20	7.1	904	291
4/4/2017	Background	0.105	237	89.8	0.21	7.3	924	362
5/16/2017	Background	0.113	225	93.5	0.22	7.2	995	371
7/19/2017	Background	0.129	230	96.3	0.15	7.2	999	405
10/9/2017	Detection	0.114	212	93.4	0.24	7.2	982	392
4/11/2018	Assessment	0.063	204	83.6	0.19	7.0	842	291
8/22/2018	Assessment	0.096	230	91.9	0.20	7.3	936	372
5/1/2019	Assessment	0.05 J	220	81.8	0.17	8.0	926	317
6/11/2019	Assessment	0.04 J	183	78.5	0.17	7.6	829	261

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1504
Mitchell - BAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
6/13/2016	Background	0.03 J	0.73	46.2	0.01 J	0.04	0.4	0.523	0.0838	0.23	0.379	0.002	<0.002 U	0.59	0.1	0.02 J
8/1/2016	Background	0.02 J	0.52	42.7	0.009 J	0.04	0.5	0.549	0.248	0.25	0.222	<0.0002 U	0.002 J	0.74	0.07 J	0.02 J
9/26/2016	Background	<0.05 U	0.38	36.7	<0.02 U	0.03 J	0.3	0.362	0.656	0.24	0.104	0.007	<0.002 U	2.31	0.2 J	0.1 J
11/8/2016	Background	0.02 J	0.36	38.4	<0.005 U	0.03	0.469	0.249	1.748	0.19	0.041	0.004	<0.002 U	0.66	<0.03 U	0.089
2/7/2017	Background	0.02 J	0.39	33.8	<0.005 U	0.03	0.53	0.239	0.563	0.20	0.022	0.008	<0.002 U	0.94	<0.03 U	0.09
4/4/2017	Background	0.02 J	0.35	40.5	<0.005 U	0.04	0.283	0.277	0.327	0.21	0.021	0.009	<0.002 U	0.81	0.06 J	0.11
5/16/2017	Background	0.02 J	0.46	37.3	<0.004 U	0.04	0.25	0.319	0.3882	0.22	0.01 J	0.011	<0.002 U	0.55	0.05 J	0.02 J
7/19/2017	Background	0.03 J	0.41	34.9	<0.004 U	0.04	0.175	0.382	0.401	0.15	0.087	0.012	<0.002 U	1.25	<0.03 U	0.03 J
4/11/2018	Assessment	0.02 J	0.36	36.9	0.005 J	0.03	0.562	0.114	0.349	0.19	0.052	0.004	<0.004 U	0.41	0.04 J	0.03 J
8/22/2018	Assessment	0.05 J	0.28	37.9	<0.004 U	0.03	0.331	0.093	1.048	0.20	0.037	0.006	<0.002 U	0.33	0.04 J	0.03 J
5/1/2019	Assessment	<0.02 U	0.22	36.4	<0.02 U	0.03 J	0.305	0.071	0.675	0.17	0.02 J	<0.009 U	<0.002 U	<0.4 U	<0.03 U	<0.1 U
6/11/2019	Assessment	<0.02 U	0.24	33.5	<0.02 U	<0.01 U	0.05 J	0.04 J	0.261	0.17	<0.02 U	<0.009 U	<0.002 U	<0.4 U	0.7	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-1505
Mitchell - BAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
6/14/2016	Background	10.8	288	365	<0.05 U	7.1	1530	337
8/1/2016	Background	10.6	294	358	<0.05 U	7.1	1580	337
9/26/2016	Background	10.3	289	345	<0.05 U	7.2	1420	317
11/8/2016	Background	9.12	261	316	<0.05 U	7.2	1470	307
2/7/2017	Background	10.0	296	318	<0.05 U	7.2	1340	317
4/4/2017	Background	8.80	293	303	<0.05 U	7.3	1350	324
5/16/2017	Background	10.1	278	298	<0.05 U	7.2	1550	316
7/19/2017	Background	9.13	267	293	<0.05 U	7.3	1390	318
10/10/2017	Detection	8.70	255	287	<0.05 U	7.2	1270	327
12/27/2017	Detection	8.02	259	288	- -	7.3	1220	- -
4/11/2018	Assessment	8.00	282	289	<0.05 U	7.0	1220	401
8/22/2018	Assessment	8.00	274	284	0.02 J	7.3	1520	383
5/1/2019	Assessment	7.31	287	285	<0.01 U	7.8	1580	408
6/11/2019	Assessment	7.79	279	261	0.03 J	7.7	1450	404

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1505
Mitchell - BAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
6/14/2016	Background	0.06	1.40	57.7	0.049	0.03	33.2	0.966	0.466	<0.05 U	1.02	0.006	0.002 J	2.94	0.2	0.074
8/1/2016	Background	0.11	3.73	81.0	0.150	0.05	10.4	2.69	1.2271	<0.05 U	3.69	0.011	0.013	0.95	0.9	0.093
9/26/2016	Background	<0.05 U	0.79	47.2	<0.02 U	0.03 J	0.9	0.404	0.912	<0.05 U	0.546	0.008	<0.002 U	7.35	0.4 J	0.464
11/8/2016	Background	0.07	2.14	63.3	0.091	0.03	7.07	1.77	1.26	<0.05 U	2.06	0.007	0.006	0.90	0.5	0.093
2/7/2017	Background	0.04 J	1.16	51.7	0.035	0.03	9.06	0.772	1.236	<0.05 U	0.697	0.010	0.002 J	1.21	0.5	0.102
4/4/2017	Background	0.03 J	0.41	47.2	<0.005 U	0.02	11.0	0.509	0.4842	<0.05 U	0.091	0.007	<0.002 U	1.54	0.3	0.057
5/16/2017	Background	0.04 J	0.73	45.5	0.01 J	0.02	4.93	0.594	0.604	<0.05 U	0.224	0.017	<0.002 U	0.85	0.4	0.067
7/19/2017	Background	0.04 J	0.78	45.9	0.02 J	0.03 J	2.38	0.628	1.222	<0.05 U	0.434	0.012	<0.002 U	1.69	0.9	0.08 J
4/11/2018	Assessment	0.03 J	0.44	46.0	0.006 J	0.03	1.16	0.151	0.582	<0.05 U	0.116	0.005	<0.002 U	0.67	0.7	0.065
8/22/2018	Assessment	0.05 J	0.38	48.0	0.007 J	0.03	1.40	0.257	0.576	0.02 J	0.150	0.008	<0.002 U	1.35	0.4	0.070
5/1/2019	Assessment	0.03 J	0.29	48.7	<0.02 U	0.03 J	0.665	0.199	0.2396	<0.01 U	0.07 J	<0.009 U	<0.002 U	0.6 J	0.9	<0.1 U
6/11/2019	Assessment	0.03 J	0.28	49.3	<0.02 U	0.03 J	0.849	0.155	0.526	0.03 J	0.04 J	0.01 J	<0.002 U	0.7 J	0.4	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-1506
Mitchell - BAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
6/14/2016	Background	8.04	275	422	0.07 J	7.1	1640	315
8/2/2016	Background	9.72	299	418	0.07 J	7.0	1600	325
9/27/2016	Background	6.77	304	428	<0.05 U	7.2	1610	323
11/9/2016	Background	5.50	281	392	<0.05 U	7.4	1510	285
2/8/2017	Background	5.70	289	395	<0.05 U	7.3	1350	292
4/5/2017	Background	5.59	282	389	<0.05 U	7.4	1430	301
5/17/2017	Background	7.11	278	393	<0.05 U	7.3	1520	307
7/19/2017	Background	6.26	277	379	<0.05 U	7.3	1480	297
10/10/2017	Detection	8.03	257	357	<0.05 U	7.3	1390	326
12/27/2017	Detection	6.14	264	383	- -	7.3	1280	- -
4/11/2018	Assessment	5.73	275	382	<0.05 U	7.1	1300	347
8/22/2018	Assessment	5.91	270	369	0.05 J	7.4	1590	349
5/1/2019	Assessment	5.24	280	331	0.03 J	7.9	1360	347
6/11/2019	Assessment	5.27	265	315	0.05 J	7.8	1370	335

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1506
Mitchell - BAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
6/14/2016	Background	0.07	1.65	73.0	0.053	0.04	1.1	1.31	0.488	0.07 J	1.25	0.006	0.004 J	0.74	0.2	0.070
8/2/2016	Background	0.05 J	1.01	70.4	0.026	0.04	0.8	0.799	0.670	0.07 J	0.601	0.015	0.003 J	0.68	0.09 J	0.060
9/27/2016	Background	0.05 J	1.14	62.0	0.030	0.03	1.0	0.739	1.263	<0.05 U	0.744	0.015	0.002 J	0.55	0.2	0.064
11/9/2016	Background	0.03 J	0.64	57.4	0.01 J	0.02 J	0.959	0.251	2.196	<0.05 U	0.272	0.008	<0.002 U	0.45	0.07 J	0.05 J
2/8/2017	Background	0.03 J	0.62	52.9	0.008 J	0.02 J	4.28	0.305	0.4008	<0.05 U	0.217	0.013	<0.002 U	1.07	<0.03 U	0.066
4/5/2017	Background	0.04 J	0.81	60.1	0.021	0.02	3.87	0.891	0.438	<0.05 U	0.574	0.011	0.002 J	0.49	0.08 J	0.04 J
5/17/2017	Background	0.05 J	1.26	60.9	0.027	0.03	2.83	0.768	0.226	<0.05 U	0.726	0.016	0.002 J	1.22	0.1	0.05 J
7/19/2017	Background	0.18	0.80	54.9	0.02 J	0.02 J	3.15	0.932	0.889	<0.05 U	0.457	0.016	<0.002 U	1.14	<0.06 U	0.06 J
4/11/2018	Assessment	0.03 J	0.73	55.4	0.021	0.02 J	2.01	0.476	0.592	<0.05 U	0.477	0.009	0.002 J	1.23	0.1	0.05 J
8/22/2018	Assessment	0.06	0.46	54.6	0.01 J	0.02	2.47	0.581	1.723	0.05 J	0.319	0.010	<0.002 U	0.50	0.09 J	0.050
5/1/2019	Assessment	0.03 J	0.34	53.5	<0.02 U	0.02 J	0.752	0.256	0.1879	0.03 J	0.135	0.02 J	<0.002 U	2 J	0.07 J	<0.1 U
6/11/2019	Assessment	0.03 J	0.42	49.8	<0.02 U	0.01 J	1.11	0.290	1.009	0.05 J	0.234	<0.009 U	<0.002 U	0.4 J	0.04 J	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-1507
Mitchell - BAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
6/14/2016	Background	13.2	333	529	0.06 J	7.0	1070	339
8/2/2016	Background	12.2	323	497	0.07 J	7.0	1890	332
9/27/2016	Background	14.1	355	517	0.06 J	7.1	1840	345
11/9/2016	Background	12.1	325	480	0.06 J	7.1	1840	314
2/8/2017	Background	11.1	312	401	0.06 J	7.1	1480	276
4/5/2017	Background	10.6	324	445	0.05 J	7.2	1630	306
5/17/2017	Background	12.1	308	437	0.05 J	7.2	1680	310
7/19/2017	Background	11.1	298	447	<0.05 U	7.2	1740	308
10/10/2017	Detection	10.7	289	430	0.06 J	7.2	1660	316
12/27/2017	Detection	10.4	284	450	- -	7.2	1380	- -
4/11/2018	Assessment	10.4	296	400	0.06 J	6.9	1390	347
8/21/2018	Assessment	9.29	272	331	0.07	7.2	1430	323
5/1/2019	Assessment	8.36	271	296	0.07	8.0	1270	346
6/11/2019	Assessment	8.41	257	279	0.07	7.8	1340	349

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1507
Mitchell - BAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
6/14/2016	Background	0.05 J	2.19	84.5	0.142	0.07	3.6	3.18	0.521	0.06 J	4.07	0.011	0.025	0.25	0.7	0.051
8/2/2016	Background	0.12	4.54	104	0.168	0.07	10.4	4.10	2.09	0.07 J	4.48	0.019	0.016	2.14	0.5	0.078
9/27/2016	Background	0.10	3.58	92.0	0.134	0.06	14.0	3.06	2.029	0.06 J	2.96	0.020	0.010	1.80	0.5	0.08 J
11/9/2016	Background	0.11	4.15	102	0.202	0.07	12.6	4.50	1.784	0.06 J	3.97	0.016	0.010	12.8	0.5	0.09 J
2/8/2017	Background	0.08	2.16	73.6	0.089	0.04	6.16	1.77	16.587	0.06 J	1.86	0.013	0.007	2.31	0.3	0.081
4/5/2017	Background	0.06	1.51	71.3	0.053	0.04	19.4	1.26	0.600	0.05 J	1.17	0.011	0.006	5.29	0.2	0.053
5/17/2017	Background	0.11	1.30	63.6	0.031	0.04	12.6	0.990	0.767	0.05 J	0.799	0.024	0.003 J	4.54	0.2	0.04 J
7/19/2017	Background	0.06 J	1.29	62.0	0.044	0.04	12.1	2.37	1.215	<0.05 U	0.999	0.018	0.004 J	4.37	0.1 J	0.06 J
4/11/2018	Assessment	0.07	1.67	71.2	0.062	0.04	21.3	1.45	0.701	0.06 J	1.56	0.012	0.006	2.73	0.3	0.059
8/21/2018	Assessment	0.08	0.47	62.1	0.01 J	0.03	2.00	0.426	1.419	0.07	0.308	0.010	0.002 J	0.87	0.08 J	0.05 J
5/1/2019	Assessment	0.03 J	0.43	53.9	<0.02 U	0.03 J	2.35	0.331	0.496	0.07	0.239	<0.009 U	<0.002 U	1 J	0.07 J	<0.1 U
6/11/2019	Assessment	0.03 J	0.24	52.2	<0.02 U	0.03 J	0.315	0.160	1.454	0.07	<0.02 U	0.01 J	0.003 J	0.4 J	0.04 J	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-1508
Mitchell - BAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
6/14/2016	Background	0.509	204	211	0.1 J	6.9	1060	291
8/1/2016	Background	0.690	218	237	0.1 J	7.0	1100	302
9/26/2016	Background	1.03	215	238	0.1 J	7.0	1110	304
11/8/2016	Background	1.36	234	227	0.08 J	7.2	1140	304
2/8/2017	Background	1.04	236	220	0.08 J	7.1	1070	301
4/5/2017	Background	0.780	228	215	0.08 J	7.2	1070	311
5/16/2017	Background	0.846	218	208	0.07 J	7.1	1130	296
7/18/2017	Background	1.00	224	214	0.06 J	7.1	1110	305
10/9/2017	Detection	0.881	207	212	0.08 J	7.1	1200	322
4/11/2018	Assessment	0.806	229	200	0.08	6.9	1050	302
8/21/2018	Assessment	0.952	219	204	0.08	7.2	1080	313
5/1/2019	Assessment	0.622	221	178	0.08	8.2	978	287
6/12/2019	Assessment	0.679	209	163	0.08	7.1	988	285

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1508
Mitchell - BAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
6/14/2016	Background	0.04 J	1.05	48.7	0.038	0.09	0.8	3.21	0.763	0.1 J	1.61	0.009	0.003 J	0.93	0.5	0.04 J
8/1/2016	Background	0.04 J	1.07	51.7	0.037	0.07	1.2	2.22	0.0803	0.1 J	1.34	<0.0002 U	0.008	0.74	0.7	0.03 J
9/26/2016	Background	0.06 J	1.65	50.2	0.06 J	0.07 J	2.3	2.34	0.596	0.1 J	1.69	0.007	0.003 J	1.17	0.8	<0.05 U
11/8/2016	Background	0.05 J	1.32	53.9	0.058	0.05	1.70	2.17	2.782	0.08 J	2.06	0.003	0.002 J	0.63	0.7	0.03 J
2/8/2017	Background	0.04 J	0.97	46.1	0.042	0.04	1.34	1.40	12.465	0.08 J	1.32	0.009	0.003 J	0.53	0.7	0.04 J
4/5/2017	Background	0.04 J	1.09	49.9	0.049	0.04	1.74	1.66	0.394	0.08 J	1.71	0.008	0.004 J	0.35	0.9	0.03 J
5/16/2017	Background	0.04 J	1.21	47.0	0.041	0.03	1.32	1.12	0.931	0.07 J	1.13	0.014	<0.002 U	0.46	0.9	0.04 J
7/18/2017	Background	0.04 J	1.11	45.1	0.040	0.04	1.33	1.27	0.597	0.06 J	1.20	0.012	<0.002 U	0.68	0.6	0.04 J
4/11/2018	Assessment	0.04 J	1.04	46.4	0.040	0.04	1.40	1.03	0.236	0.08	1.11	0.008	<0.004 U	0.45	0.7	0.05 J
8/21/2018	Assessment	0.06	0.44	40.1	0.01 J	0.04	0.691	0.678	0.3152	0.08	0.384	0.007	<0.002 U	0.25	0.4	0.03 J
5/1/2019	Assessment	0.03 J	0.60	37.4	0.02 J	0.03 J	0.735	0.637	0.636	0.08	0.540	<0.009 U	<0.002 U	<0.4 U	0.3	<0.1 U
6/12/2019	Assessment	<0.02 U	0.41	35.2	<0.02 U	0.03 J	0.59	0.419	0.295	0.08	0.336	<0.009 U	<0.002 U	<0.4 U	0.2	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-1509
Mitchell - BAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
6/14/2016	Background	12.4	280	435	0.16	7.0	1730	380
8/9/2016	Background	11.6	292	401	0.16	7.1	1670	388
9/27/2016	Background	10.6	292	371	0.1 J	7.1	1540	418
11/8/2016	Background	8.29	258	333	0.1 J	7.1	1410	400
2/7/2017	Background	7.65	280	360	0.15	7.1	1450	416
4/5/2017	Background	6.22	290	358	0.1 J	7.2	1560	416
5/17/2017	Background	7.36	284	354	0.1 J	7.2	1520	420
7/19/2017	Background	6.54	279	346	0.1 J	7.2	1560	418
10/10/2017	Detection	6.70	277	345	0.1 J	7.2	1490	432
12/27/2017	Detection	6.31	271	315	- -	7.1	1360	- -
4/11/2018	Assessment	6.81	272	324	0.15	6.9	1390	488
8/21/2018	Assessment	6.97	279	323	0.14	7.2	1540	465
5/1/2019	Assessment	8.73	287	328	0.13	8.5	1480	429
6/11/2019	Assessment	8.37	273	311	0.13	7.8	1410	432

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1509
Mitchell - BAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
6/14/2016	Background	0.03 J	0.55	64.4	0.008 J	0.03	2.5	0.514	0.816	0.16	0.102	0.0009 J	<0.002 U	1.43	0.1	0.03 J
8/9/2016	Background	0.03 J	0.62	64.4	0.01 J	0.02	0.5	0.484	0.45569	0.16	0.251	0.015	<0.002 U	1.00	0.1	0.03 J
9/27/2016	Background	0.03 J	0.39	61.0	<0.005 U	0.02	4.6	0.424	2.664	0.1 J	0.024	0.018	<0.002 U	1.07	0.2	0.04 J
11/8/2016	Background	0.03 J	0.40	62.0	<0.005 U	0.02	0.627	0.253	0.413	0.1 J	0.006 J	0.012	<0.002 U	0.59	0.1	0.05 J
2/7/2017	Background	0.03 J	0.50	56.7	<0.005 U	0.02	0.650	0.130	1.399	0.15	0.056	0.011	<0.002 U	0.66	0.09 J	0.04 J
4/5/2017	Background	0.02 J	0.33	63.5	<0.005 U	0.02 J	1.15	0.189	0.304	0.1 J	0.01 J	0.012	<0.002 U	0.48	0.2	0.03 J
5/17/2017	Background	0.02 J	0.56	61.5	<0.004 U	0.01 J	1.05	0.255	1.673	0.1 J	0.02 J	0.022	0.002 J	0.56	0.2	0.03 J
7/19/2017	Background	0.03 J	0.65	58.5	0.01 J	0.01 J	0.857	0.344	1.134	0.1 J	0.22	0.017	<0.002 U	0.80	0.2 J	0.04 J
4/11/2018	Assessment	0.03 J	0.42	52.8	0.005 J	0.01 J	0.657	0.215	0.792	0.15	0.062	0.009	0.002 J	0.34	0.2	0.057
8/21/2018	Assessment	0.09	0.33	53.8	<0.004 U	0.008 J	0.777	0.132	0.736	0.14	0.035	0.012	<0.002 U	0.32	0.3	0.03 J
5/1/2019	Assessment	0.03 J	0.33	47.2	<0.02 U	0.01 J	2.28	0.324	0.4075	0.13	0.114	<0.009 U	<0.002 U	<0.4 U	0.2 J	<0.1 U
6/11/2019	Assessment	0.03 J	0.28	48.6	<0.02 U	0.02 J	1.47	0.097	0.559	0.13	0.05 J	0.02 J	<0.002 U	<0.4 U	0.2	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-1510
Mitchell - BAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
6/14/2016	Background	9.36	283	334	0.06 J	7.0	1520	358
8/2/2016	Background	9.18	294	333	0.06 J	7.0	1410	356
9/27/2016	Background	10.1	296	338	0.05 J	7.1	1410	367
11/9/2016	Background	9.22	280	325	<0.05 U	7.1	1420	332
2/8/2017	Background	10.4	281	314	0.06 J	7.2	1270	325
4/5/2017	Background	9.23	261	303	0.06 J	7.3	1330	313
5/17/2017	Background	10.8	249	306	0.05 J	7.2	1340	307
7/18/2017	Background	9.86	255	311	<0.05 U	7.2	1410	309
10/9/2017	Detection	8.70	249	327	0.05 J	7.2	1520	356
12/27/2017	Detection	8.83	261	339	- -	7.2	1300	- -
4/12/2018	Assessment	10.4	292	322	<0.05 U	7.0	1290	398
8/21/2018	Assessment	9.13	268	334	0.09	7.3	1550	428
5/1/2019	Assessment	8.83	287	325	0.10	8.1	1460	467
6/12/2019	Assessment	8.50	266	293	0.10	6.9	1430	469

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1510
Mitchell - BAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
6/14/2016	Background	0.03 J	0.72	50.8	0.02 J	0.01 J	0.6	0.257	0.331	0.06 J	0.282	0.003	<0.002 U	0.65	0.2	0.057
8/2/2016	Background	0.03 J	0.62	49.0	0.02 J	0.009 J	0.7	0.256	1.383	0.06 J	0.269	0.016	<0.002 U	0.92	0.2	0.02 J
9/27/2016	Background	0.03 J	0.70	48.7	0.02 J	0.009 J	0.8	0.329	0.865	0.05 J	0.333	0.014	<0.002 U	0.45	0.2	0.04 J
11/9/2016	Background	0.02 J	0.58	44.6	0.02 J	0.01 J	0.655	0.230	0.88	<0.05 U	0.261	0.009	<0.002 U	0.33	0.1	0.03 J
2/8/2017	Background	0.02 J	0.47	39.5	<0.005 U	0.005 J	0.521	0.073	6.828	0.06 J	0.066	0.013	<0.002 U	0.42	0.08 J	0.02 J
4/5/2017	Background	0.02 J	0.36	41.4	<0.005 U	0.006 J	2.34	0.175	1.12829	0.06 J	0.094	0.011	<0.002 U	0.27	0.07 J	<0.01 U
5/17/2017	Background	0.02 J	0.53	40.2	<0.004 U	0.005 J	1.40	0.138	0.176	0.05 J	0.049	0.015	<0.002 U	0.28	0.1	0.01 J
7/18/2017	Background	0.02 J	0.51	41.0	0.007 J	0.008 J	6.41	0.234	0.97	<0.05 U	0.125	0.014	<0.002 U	0.85	0.1	0.01 J
4/12/2018	Assessment	0.03 J	0.42	43.3	0.01 J	0.005 J	27.4	0.217	0.094	<0.05 U	0.119	0.006	0.002 J	3.30	0.1	0.02 J
8/21/2018	Assessment	0.03 J	0.37	42.6	0.008 J	0.006 J	5.64	0.383	1.237	0.09	0.133	0.011	<0.002 U	0.43	0.1	0.01 J
5/1/2019	Assessment	0.02 J	0.29	41.7	<0.02 U	<0.01 U	1.75	0.172	0.5725	0.1	0.105	0.01 J	<0.002 U	<0.4 U	0.2 J	<0.1 U
6/12/2019	Assessment	0.02 J	0.27	41.3	<0.02 U	<0.01 U	0.697	0.105	0.4098	0.1	0.07 J	0.02 J	<0.002 U	<0.4 U	0.2 J	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1: Residence Time Calculation Summary
Mitchell Bottom Ash Ponds

			2019-04		2019-06	
CCR Management Unit	Monitoring Well	Well Diameter (inches)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
Bottom Ash Pond	MW-1504 [1]	2.0	33.2	1.8	16.4	3.7
	MW-1505 [2]	2.0	23.1	2.6	39.1	1.6
	MW-1506 [2]	2.0	15.6	3.9	38.8	1.6
	MW-1507 [2]	2.0	11.9	5.1	17.2	3.5
	MW-1508 [3]	2.0	45.5	1.3	20.0	3.0
	MW-1509 [2]	2.0	39.5	1.5	14.1	4.3
	MW-1510 [1]	2.0	15.0	4.1	11.4	5.3

Notes:
[1] - Sidegradient Well
[2] - Downgradient Well
[3] - Upgradient Well

Monitoring Well Network
- Compliance Sampling Location
- Upgradient Sampling Location

Bottom Ash Pond

Notes
- Monitoring well coordinates provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.

250 125 0 250 Feet

Site Layout
Bottom Ash Pond

Mitchell Power Generation Plant - Bottom Ash Pond
Marshall County, West Virginia

Geosyntec consultants

Figure **1**

Columbus, Ohio | 2018/01/26

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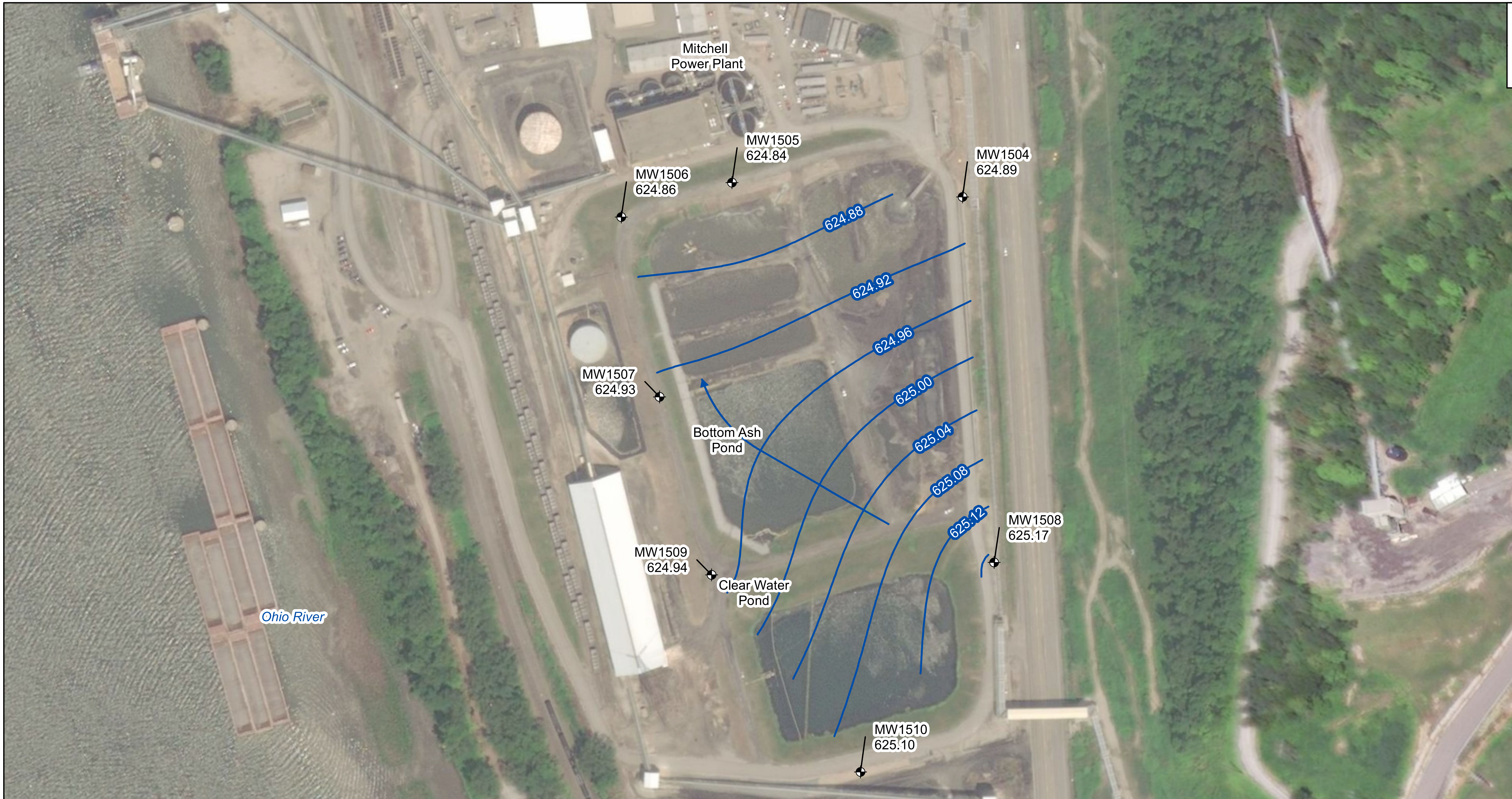

Legend

- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour

Notes

- Monitoring well coordinates and water level data (collected on April 30, 2019) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.
- Groundwater and river elevation units are feet above mean sea level (NAVD 88).

250 125 0 250 Feet

Potentiometric Surface Map - Uppermost Aquifer April 2019

Mitchell Power Generation Plant - Bottom Ash Pond
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio | 2019/12/13

Figure **2**

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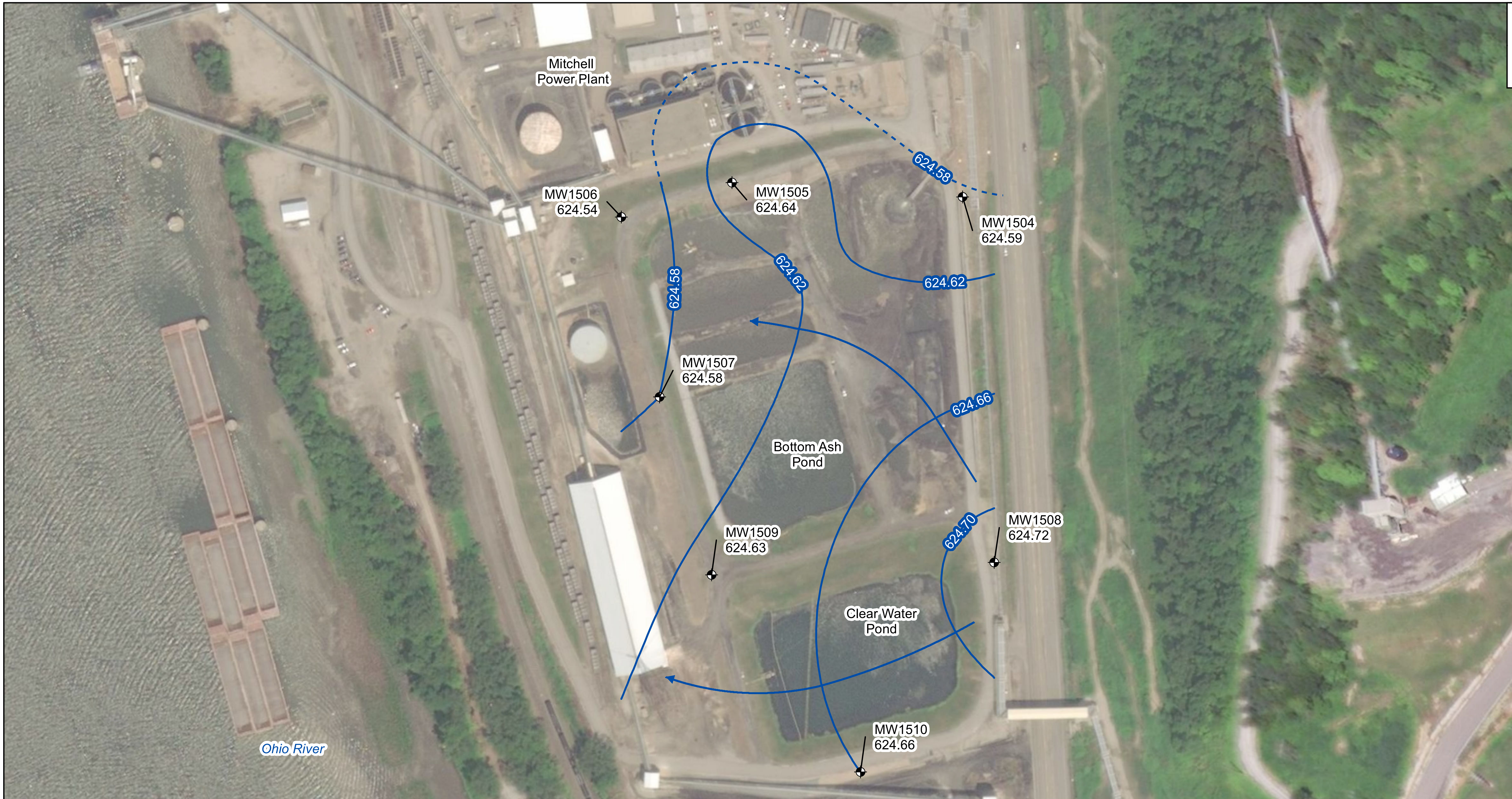

Legend

- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)

Notes

- Monitoring well coordinates and water level data (collected on June 11, 2019) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.
- Groundwater and river elevation units are feet above mean sea level (NAVD 88).

Potentiometric Surface Map - Uppermost Aquifer June 2019

Mitchell Power Generation Plant - Bottom Ash Pond
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio | 2019/12/11

Figure 3

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APPENDIX 2 - Statistical Analyses

The January and July 2019 statistical analysis summaries concluding that no SSLs were identified at the CCR unit follow.

STATISTICAL ANALYSIS SUMMARY
BOTTOM ASH POND
Mitchell Plant
Moundsville, West Virginia

Submitted to

American Electric Power

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants

engineers | scientists | innovators

941 Chatham Lane
Suite 103
Columbus, Ohio 43221

January 8, 2019

CHA8473

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
BAP	Bottom Ash Pond
CCR	Coal Combustion Residuals
CCV	Continuing Calibration Verification
CFR	Code of Federal Regulations
GWPS	Groundwater Protection Standard
LCL	Lower Confidence Limit
LFB	Laboratory Fortified Blanks
LRB	Laboratory Reagent Blanks
MCL	Maximum Contaminant Level
NELAP	National Environmental Laboratory Accreditation Program
QA	Quality Assurance
QC	Quality Control
RSL	Regional Screening Level
SSI	Statistically Significant Increase
SSL	Statistically Significant Level
TDS	Total Dissolved Solids
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency
UTL	Upper Tolerance Limit

SECTION 1

EXECUTIVE SUMMARY

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257.90-257.98, "CCR rule"), groundwater monitoring has been conducted at the Bottom Ash Pond (BAP), an existing CCR unit at the Mitchell Power Plant located in Moundsville, West Virginia.

Based on detection monitoring conducted in 2017, statistically significant increases (SSIs) over background were concluded for boron, calcium, chloride, and total dissolved solids (TDS) at the BAP. An alternate source was not identified at the time, so two assessment monitoring events were conducted at the BAP in 2018, in accordance with 40 CFR 257.95.

Groundwater data underwent several validation tests, including those for completeness, sample tracking accuracy, transcription errors, and consistent use of measurement units. No data quality issues were identified which would impact the usability of the data.

The monitoring data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. Groundwater protection standards (GWPSs) were established for the Appendix IV parameters. Confidence intervals were calculated for Appendix IV parameters at the compliance wells to assess whether Appendix IV parameters were present at a statistically significant level (SSL) above the GWPS. No SSLs were identified, but Appendix III concentrations for boron, calcium, chloride, sulfate, and TDS remained above background. Thus, either the unit will remain in assessment monitoring or an alternative source demonstration will be conducted to evaluate if the unit can return to detection monitoring. Certification of the selected statistical methods by a qualified professional engineer is documented in Attachment A.

SECTION 2

BOTTOM ASH POND EVALUATION

2.1 Data Validation & QA/QC

During the assessment monitoring program, two sets of samples were collected for analysis from each upgradient and downgradient well to meet the requirements of 40 CFR 257.95(b) and 257.95(d)(1). Samples from both sampling events were analyzed for the Appendix III and Appendix IV parameters. A summary of data collected during assessment monitoring may be found in Table 1.

Chemical analysis was completed by an analytical laboratory certified by the National Environmental Laboratory Accreditation Program (NELAP). Quality assurance and quality control (QA/QC) samples completed by the analytical laboratory included the use of laboratory reagent blanks (LRBs), continuing calibration verification (CCV) samples, and laboratory fortified blanks (LFBs).

The analytical data were imported into a Microsoft Access database, where checks were completed to assess the accuracy of sample location identification and analyte identification. Where necessary, unit conversions were applied to standardize reported units across all sampling events. Exported data files were created for use with the Sanitas™ v.9.5 statistics software. The export file was checked against the analytical data for transcription errors and completeness. No QA/QC issues were noted which would impact data usability.

2.2 Statistical Analysis

Statistical analyses for the BAP were conducted in accordance with the January 2017 *Statistical Analysis Plan* (AEP, 2017), except where noted below. Time series plots and results for all completed statistical tests are provided in Attachment B.

The data obtained to meet the requirements of 40 CFR 257.95(b) and 257.95(d)(1) were screened for potential outliers. No outliers were identified. Outliers identified from the background and detection monitoring events conducted through January 2018 were summarized in a previous report (Geosyntec, 2018).

2.2.1 Establishment of GWPSs

A GWPS was established for each Appendix IV parameter in accordance with 40 CFR 257.95(h) and the *Statistical Analysis Plan* (AEP, 2017). The established GWPS was determined to be the greater value of the background concentration and the maximum contaminant level (MCL) or regional screening level (RSL) for each Appendix IV parameter. To determine background concentrations, an upper tolerance limit (UTL) was calculated using pooled data from the background wells collected during the background monitoring and assessment monitoring events.

Generally, tolerance limits were calculated parametrically with 95% coverage and 95% confidence. Non-parametric tolerance limits were calculated for cadmium, fluoride, mercury, selenium, and thallium due to apparent non-normal distributions. Tolerance limits and the final GWPSs are summarized in Table 2.

2.2.2 Evaluation of Potential Appendix IV SSLs

A confidence interval was constructed for each Appendix IV parameter at each compliance well. Confidence limits were generally calculated parametrically ($\alpha = 0.01$); however, non-parametric confidence limits were calculated in some cases (e.g., when the data did not appear to be normally distributed or when the non-detect frequency was too high). An SSL was concluded if the lower confidence limit (LCL) exceeded the GWPS (i.e., if the entire confidence interval exceeded the GWPS). Calculated confidence limits are shown in Attachment B.

No SSLs were identified at the Mitchell BAP.

2.2.3 Evaluation of Potential Appendix III SSIs

The CCR rule allows CCR units to move from assessment monitoring to detection monitoring if all Appendix III and Appendix IV parameters were at or below background levels for two consecutive sampling events [40 CFR 257.95(e)]. Since no Appendix IV SSLs were identified, Appendix III results were analyzed to assess whether concentrations of Appendix III parameters at the compliance wells exceeded background concentrations.

Prediction limits were calculated for the Appendix III parameters to represent background values. As described in the January 2018 *Statistical Analysis Summary* report (Geosyntec, 2018), intrawell tests were used to evaluate potential SSIs for fluoride and sulfate, whereas interwell tests were used to evaluate potential SSIs for boron, calcium, chloride, pH, and TDS.

Prediction limits for the interwell tests were recalculated using data collected during the 2018 assessment monitoring events. Twelve data points (i.e., two samples from six background wells) were added to the background dataset for each interwell test. New data were tested for outliers prior to being added to the background dataset. The updated prediction limits were calculated for a one-of-two retesting procedure, as during detection monitoring. The values of the updated prediction limits were similar to the values of the prediction limits calculated during detection monitoring. The revised prediction limits were used to evaluate potential SSIs for boron, calcium, chloride, pH, and TDS.

For the intrawell tests, limited data made it possible to add only two data points (i.e., two samples from each compliance well) to each background dataset. Because two sample results are insufficient to compare against the existing background dataset, the prediction limits were not updated for the intrawell tests at this time. The prediction limits calculated during detection monitoring were used to evaluate potential SSIs for fluoride and sulfate.

Data collected during the second assessment monitoring event from each compliance well were compared to the prediction limits to evaluate SSIs. The results from this event and the prediction limits are summarized in Table 3. The following exceedances of the upper prediction limits (UPLs) were noted:

- Boron concentrations exceeded the interwell UPL of 1.36 mg/L at MW-1505 (8.00 mg/L for both events), MW-1506 (5.73 mg/L and 5.91 mg/L), MW-1507 (10.4 mg/L and 9.29 mg/L), MW-1509 (6.81 mg/L and 6.97 mg/L), and MW-1510 (10.3 mg/L and 9.13 mg/L).

- Calcium concentrations exceeded the interwell UPL of 241 mg/L at MW-1505 (282 mg/L and 274 mg/L), MW-1506 (275 mg/L and 270 mg/L), MW-1507 (296 mg/L and 272 mg/L), MW-1509 (272 mg/L and 279 mg/L), and MW-1510 (292 mg/L and 268 mg/L).

- Chloride concentrations exceeded the interwell UPL of 238 mg/L at MW-1505 (289 mg/L and 284 mg/L), MW-1506 (382 mg/L and 369 mg/L), MW-1507 (400 mg/L and 331 mg/L), MW-1509 (324 mg/L and 323 mg/L), and MW-1510 (322 mg/L and 334 mg/L).

- Sulfate concentrations exceeded the intrawell UPL of 351 mg/L at MW-1505 (401 mg/L and 383 mg/L), the intrawell UPL of 345 mg/L at MW-1506 (347 mg/L and 349 mg/L), the intrawell UPL of 450 mg/L at MW-1509 (488 mg/L and 465 mg/L), and the intrawell UPL of 399 mg/L at MW-1510 (428 mg/L).

- TDS concentrations exceeded the interwell UPL of 1193 mg/L at MW-1505 (1220 mg/L and 1520 mg/L), MW-1506 (1300 mg/L and 1590 mg/L), MW-1507 (1390 mg/L and 1430 mg/L), MW-1509 (1390 mg/L and 1540 mg/L), and MW-1510 (1290 mg/L and 1550 mg/L).

Based on these results, concentrations of Appendix III parameters exceeded background levels at compliance wells at the Mitchell BAP during assessment monitoring. As a result, the Mitchell BAP CCR unit will remain in assessment monitoring.

2.3 Conclusions

Two assessment monitoring events were conducted in 2018 in accordance with the CCR Rule. The laboratory and field data were reviewed prior to statistical analysis, with no QA/QC issues identified that impacted data usability. A review of outliers identified no potential outliers in the 2018 data. GWPSs were established for the Appendix IV parameters. A confidence interval was constructed at each compliance well for each Appendix IV parameter; SSLs were concluded if the entire confidence interval exceeded the GWPS. No SSLs were identified.

The Appendix III results were evaluated to assess whether concentrations of Appendix III parameters exceeded background levels. Interwell tests were used to evaluate potential SSIs for boron, calcium, chloride, pH and TDS, and intrawell tests were used to evaluate potential SSIs for fluoride and sulfate. The prediction limits for the interwell tests were updated with additional data collected from the background wells. Prediction limits were recalculated using a one-of-two retesting procedure. The prediction limits calculated during detection monitoring were used for the intrawell tests. Boron, calcium, chloride, sulfate, and TDS results exceeded background levels.

Based on this evaluation, the Mitchell BAP CCR unit will remain in assessment monitoring.

SECTION 3

REFERENCES

American Electric Power (AEP). 2017. Statistical Analysis Plan – Mitchell Plant. January 2017.

Geosyntec Consultants (Geosyntec). 2018. Statistical Analysis Summary – Bottom Ash Pond, Mitchell Plant, Moundsville, West Virginia. January 15, 2018.

TABLES

Table 1 – Groundwater Data Summary
Mitchell – Bottom Ash Pond

Parameter	Unit	MW-1504		MW-1505		MW-1506		MW-1507		MW-1508		MW-1509		MW-1510	
		4/11/2018	8/22/2018	4/11/2018	8/22/2018	4/11/2018	8/22/2018	4/11/2018	8/21/2018	4/11/2018	8/21/2018	4/11/2018	8/21/2018	4/12/2018	8/21/2018
Antimony	µg/L	0.0200 J	0.0500 J	0.0300 J	0.0500 J	0.0300 J	0.0600	0.0700	0.0800	0.0400 J	0.0600	0.0300 J	0.0900	0.0300 J	0.0300 J
Arsenic	µg/L	0.360	0.280	0.440	0.380	0.730	0.460	1.67	0.470	1.04	0.440	0.420	0.330	0.420	0.370
Barium	µg/L	36.9	37.9	46.0	48.0	55.4	54.6	71.2	62.1	46.4	40.1	52.8	53.8	43.3	42.6
Beryllium	µg/L	0.00500 J	0.02 U	0.00600 J	0.00700 J	0.0210	0.0100 J	0.0620	0.0100 J	0.0400	0.0100 J	0.00500 J	0.02 U	0.0100 J	0.00800 J
Boron	mg/L	0.0630	0.0960	8.00	8.00	5.73	5.91	10.4	9.29	0.806	0.952	6.81	6.97	10.4	9.13
Cadmium	µg/L	0.0300	0.0300	0.0300	0.0300	0.0200 J	0.0200	0.0400	0.0300	0.0400	0.0400	0.0100 J	0.00800 J	0.00500 J	0.00600 J
Calcium	mg/L	204	230	282	274	275	270	296	272	229	219	272	279	292	268
Chloride	mg/L	83.6	91.9	289	284	382	369	400	331	200	204	324	323	322	334
Chromium	µg/L	0.562	0.331	1.16	1.40	2.01	2.47	21.3	2.00	1.40	0.691	0.657	0.777	27.4	5.64
Cobalt	µg/L	0.114	0.0930	0.151	0.257	0.476	0.581	1.45	0.426	1.03	0.678	0.215	0.132	0.217	0.383
Combined Radium	pCi/L	0.349	1.05	0.582	0.576	0.592	1.72	0.701	1.42	0.236	0.315	0.792	0.736	0.0940	1.24
Fluoride	mg/L	0.190	0.200	0.20 U	0.0200 J	0.02 U	0.0500 J	0.0600 J	0.0700	0.0800	0.0800	0.150	0.140	0.20 U	0.0900
Lead	µg/L	0.0520	0.0370	0.116	0.150	0.477	0.319	1.56	0.308	1.11	0.384	0.0620	0.0350	0.119	0.133
Lithium	mg/L	0.00400	0.00600	0.00500	0.00800	0.00900	0.0100	0.0120	0.0100	0.00800	0.00700	0.00900	0.0120	0.00600	0.0110
Mercury	µg/L	0.01 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.00600	0.00200 J	0.01 U	0.005 U	0.00200 J	0.005 U	0.00200 J	0.005 U
Molybdenum	µg/L	0.410	0.330	0.670	1.35	1.23	0.500	2.73	0.870	0.450	0.250	0.340	0.320	3.30	0.430
Selenium	µg/L	0.0400 J	0.0400 J	0.700	0.400	0.100	0.0900 J	0.300	0.0800 J	0.700	0.400	0.200	0.300	0.100	0.100
Total Dissolved Solids	mg/L	842	936	1220	1520	1300	1590	1390	1430	1050	1080	1390	1540	1290	1550
Sulfate	mg/L	291	372	401	383	347	349	347	323	302	313	488	465	398	428
Thallium	µg/L	0.0300 J	0.0300 J	0.0650	0.0700	0.0500 J	0.0500	0.0590	0.0500 J	0.0500 J	0.0300 J	0.0570	0.0300 J	0.0200 J	0.0100 J
pH	SU	6.98	7.34	7.02	7.33	7.08	7.40	6.93	7.23	6.90	7.17	6.92	7.24	6.95	7.30

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Parameter was not present in concentrations above method detection limit and is reported as the reporting limit
J: Estimated value. Parameter was detected in concentrations below the reporting limit

Table 2: Groundwater Protection Standards
Mitchell Plant - Bottom Ash Pond

Constituent Name	MCL	RSL	Background Limit
Antimony, Total (mg/L)	0.006		0.000091
Arsenic, Total (mg/L)	0.01		0.0018
Barium, Total (mg/L)	2		0.06
Beryllium, Total (mg/L)	0.004		0.000077
Cadmium, Total (mg/L)	0.005		0.00009
Chromium, Total (mg/L)	0.1		0.0024
Cobalt, Total (mg/L)	n/a	0.006	0.0032
Combined Radium, Total (pCi/L)	5		2.41
Fluoride, Total (mg/L)	4		0.25
Lead, Total (mg/L)	n/a	0.015	0.0046
Lithium, Total (mg/L)	n/a	0.04	0.016
Mercury, Total (mg/L)	0.002		0.000008
Molybdenum, Total (mg/L)	n/a	0.1	0.002
Selenium, Total (mg/L)	0.05		0.0009
Thallium, Total (mg/L)	0.002		0.00011

Notes:
Grey cell indicates calculated UTL is higher than MCL.
MCL = Maximum Contaminant Level
RSL = Regional Screening Level
Calculated UTL (Upper Tolerance Limit) represents site-specific background values.
The higher of the calculated UTL or MCL/RSL is used as the GWPS.

Table 3: Appendix III Data Evaluation
Mitchell Plant - Bottom Ash Pond

Parameter	Units	Description	MW-1505		MW-1506		MW-1507		MW-1509		MW-1510	
			4/11/2018	8/22/2018	4/11/2018	8/22/2018	4/11/2018	8/21/2018	4/11/2018	8/21/2018	4/12/2018	8/21/2018
Boron	mg/L	Interwell Background Value (UPL)	1.36									
		Assessment Monitoring Result	**8.00**	**8.00**	**5.73**	**5.91**	**10.4**	**9.29**	**6.81**	**6.97**	**10.3**	**9.13**
Calcium	mg/L	Interwell Background Value (UPL)	241									
		Assessment Monitoring Result	**282**	**274**	**275**	**270**	**296**	**272**	**272**	**279**	**292**	**268**
Chloride	mg/L	Interwell Background Value (UPL)	238									
		Assessment Monitoring Result	**289**	**284**	**382**	**369**	**400**	**331**	**324**	**323**	**322**	**334**
Fluoride	mg/L	Intrawell Background Value (UPL)	0.200		0.200		0.200		0.160		0.200	
		Assessment Monitoring Result	0.050	0.020	0.050	0.050	0.060	0.070	0.150	0.140	0.050	0.090
pH	SU	Interwell Background Value (UPL)	7.35									
		Interwell Background Value (LPL)	6.84									
		Assessment Monitoring Result	7.02	7.33	7.08	**7.40**	6.93	7.23	6.92	7.24	6.95	7.30
Sulfate	mg/L	Intrawell Background Value (UPL)	351		345		377		450		399	
		Assessment Monitoring Result	**401**	**383**	**347**	**349**	347	323	**488**	**465**	398	**428**
Total Dissolved Solids	mg/L	Interwell Background Value (UPL)	1193									
		Assessment Monitoring Result	**1220**	**1520**	**1300**	**1590**	**1390**	**1430**	**1390**	**1540**	**1290**	**1550**

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit
Bold values exceed the background value.
Background values are shaded gray.
Based on a 1-of-2 resampling, a statistically significant increase (SSI)
is only identified when both samples in the detection monitoring

ATTACHMENT A

Certification by Qualified Professional Engineer

Certification by Qualified Professional Engineer

I certify that the selected and above described statistical method is appropriate for evaluating the groundwater monitoring data for the Mitchell Bottom Ash Pond CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER
Printed Name of Licensed Professional Engineer

David Anthony Miller
Signature

DAVID ANTHONY MILLER
REGISTERED
22663
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER

22663	WEST VIRGINIA	01.08.19
License Number	Licensing State	Date

ATTACHMENT B

Statistical Analysis Output

GROUNDWATER STATS CONSULTING

November 12, 2018

Geosyntec Consultants
Attn: Ms. Allison Kreinberg
150 E. Wilson Bridge Rd., #232
Worthington, OH 43085

Dear Ms. Kreinberg,

Groundwater Stats Consulting, formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the evaluation of groundwater data for American Electric Power Company's Mitchell Bottom Ash Pond. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities (CCR Rule, 2015) as well as with the USEPA Unified Guidance (2009).

Sampling at each of the wells below began at Mitchell Bottom Ash Pond for the CCR program in 2016. The monitoring well network, as provided by Geosyntec Consultants, consists of the following: upgradient wells MW-1504 and MW-1508; and downgradient wells MW-1505, MW-1506, MW-1507, MW-1509 and MW-1510.

Data were sent electronically, and the statistical analysis was conducted according to the Statistical Analysis Plan and screening evaluation prepared by GSC and approved by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to GSC.

The CCR program consists of the following constituents:

- **Appendix III** (Detection Monitoring) **-** boron, calcium, chloride, fluoride, pH, sulfate, and TDS; and
- **Appendix IV** (Assessment Monitoring) **–** antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, combined radium 226 + 228, fluoride, lead, lithium, mercury, molybdenum, selenium, and thallium.

Time series plots for Appendix III and IV parameters are provided for all wells and constituents; and are used to evaluate concentrations over the entire record. Values in background which have previously been flagged as outliers may be seen in a lighter font and disconnected symbol on the graphs. Additionally, a summary of flagged values follows this letter.

Evaluation of Appendix III Parameters

Interwell prediction limits combined with a 1-of-2 resample plan were constructed for boron, calcium, chloride, pH, and TDS; and intrawell prediction limits combined with a 1-of-2 resample plan were constructed for fluoride and sulfate. The statistical method for applicable for each parameter was determined based on the results of the screening analysis performed in December 2017.

In the event of an initial exceedance of compliance well data, the 1-of-2 resample plan allows for collection of one additional sample to determine whether the initial exceedance is confirmed. When the resample confirms the initial exceedance, a statistically significant increase (SSI) is identified and further research would be required to identify the cause of the exceedance (i.e. impact from the site, natural variation, or an off-site source). If the resample falls within the statistical limit, the initial exceedance is considered a false positive result and, therefore, no further action is necessary. SSIs were noted for several of the Appendix III parameters and the results of those findings may be found in the Prediction Limit Summary tables following this letter.

When a statistically significant increase is identified, the data are further evaluated using the Sen's Slope/Mann Kendall trend test to determine whether data are statistically increasing, decreasing or stable. Several statistically significant decreasing trends were noted, but no statistically significant increasing trends were found except for sulfate in downgradient well MW_1509. The Trend Test Summary Table follows this letter.

<u>Appendix IV – Assessment Monitoring Program</u>

Evaluation of Appendix IV Parameters

Parametric tolerance limits were used to calculate background limits from pooled upgradient well data for Appendix IV parameters with a target of 95% confidence and 95% coverage to determine the Alternate Contaminant Level (ACL). The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. These limits were compared to the Maximum Contaminant Levels

(MCLs) and Regional Screening Levels (RSLs) in the Groundwater Protection Standards (GWPS) table following this letter to determine the highest limit for use as the GWPS in the Confidence Interval comparisons.

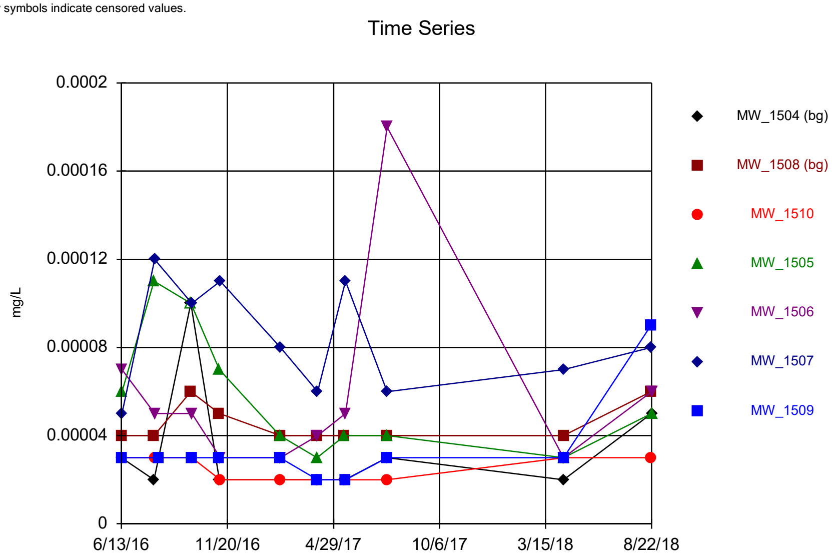
Confidence intervals were then constructed on downgradient wells for each of the Appendix IV parameters using the highest limit of either the MCL, RSL, or ACL as discussed above. Only when the entire confidence interval is above a GWPS is the well/constituent pair considered to exceed its respective standard. No exceedances were noted at any of the downgradient wells. A summary of the confidence interval results follows this letter.

Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for the Mitchell Bottom Ash Pond. If you have any questions or comments, please feel free to contact me.

For Groundwater Stats Consulting,

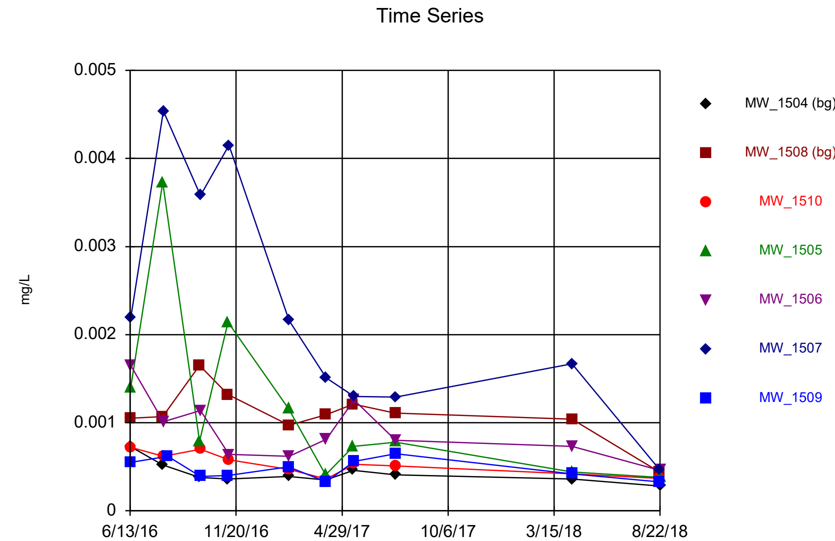
Kristina L. Rayner
Groundwater Statistician

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



Constituent: Antimony, total   Analysis Run 11/11/2018 2:37 PM   View: Time Series - All Wells
Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Arsenic, Total   Analysis Run 11/11/2018 2:37 PM   View: Time Series - All Wells
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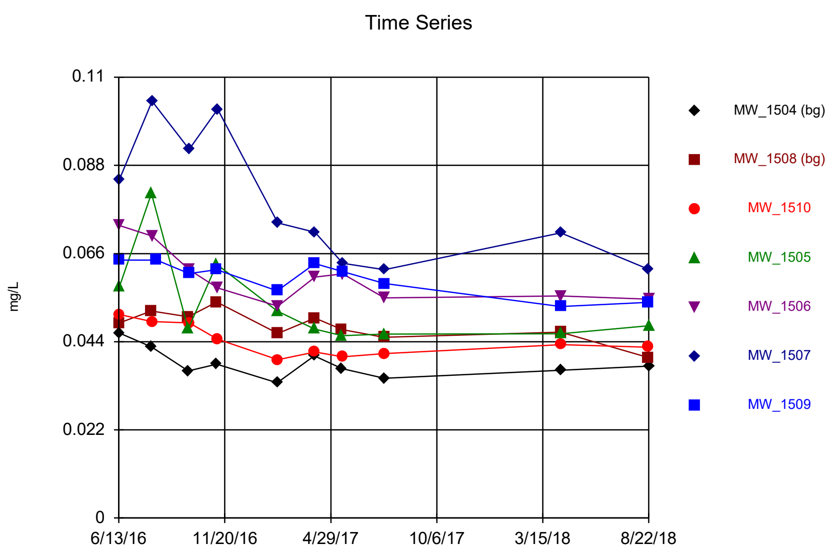

Constituent: Barium, Total   Analysis Run 11/11/2018 2:37 PM   View: Time Series - All Wells
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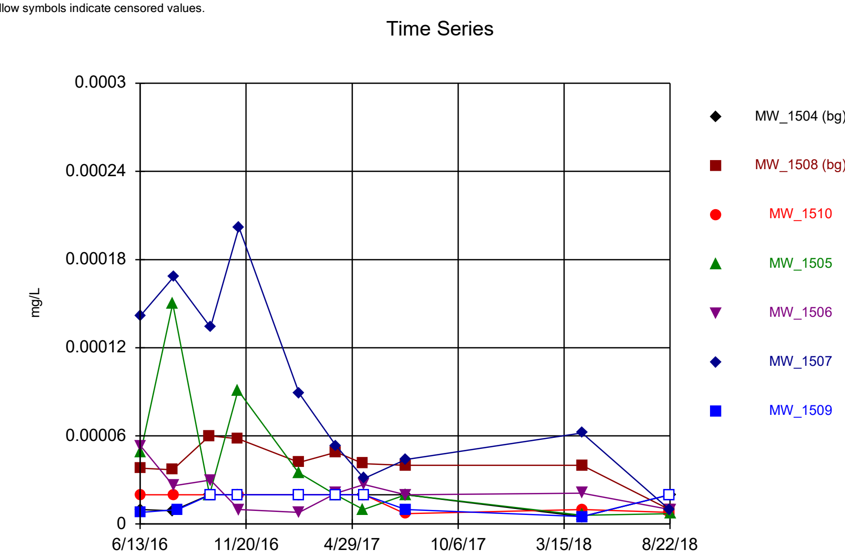
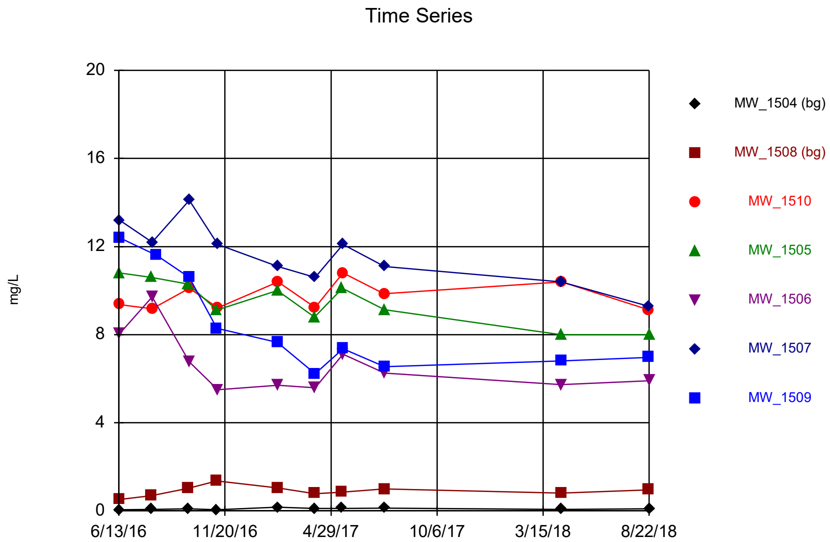


Constituent: Beryllium, total   Analysis Run 11/11/2018 2:37 PM   View: Time Series - All Wells
Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Boron, total Analysis Run 11/11/2018 2:37 PM View: Time Series - All Wells
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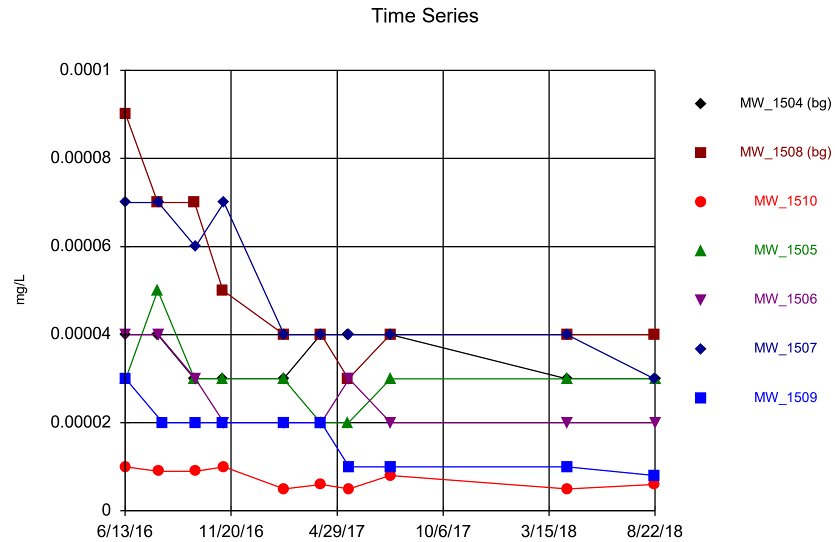

Constituent: Cadmium, total Analysis Run 11/11/2018 2:37 PM View: Time Series - All Wells
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

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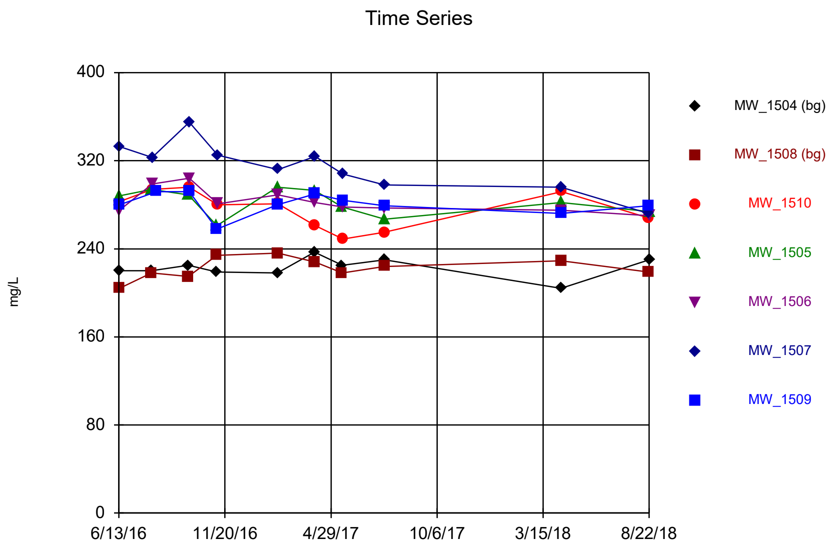

Constituent: Calcium, total Analysis Run 11/11/2018 2:37 PM View: Time Series - All Wells
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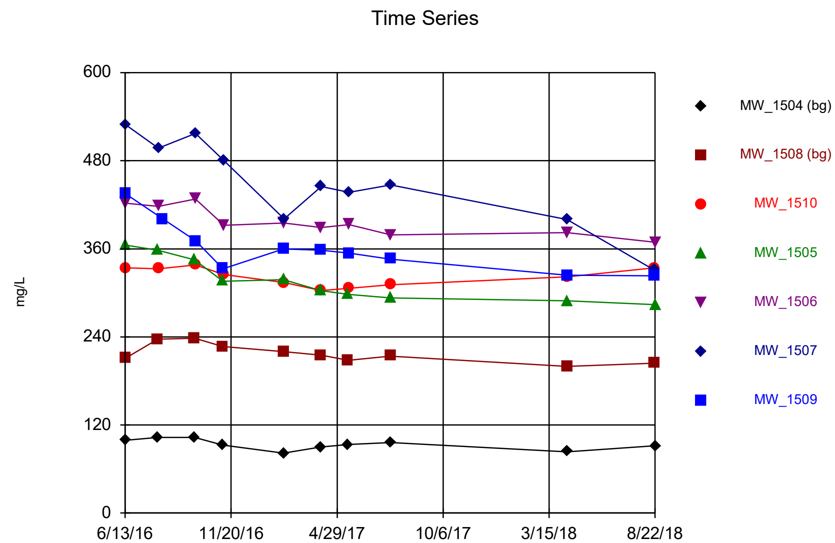
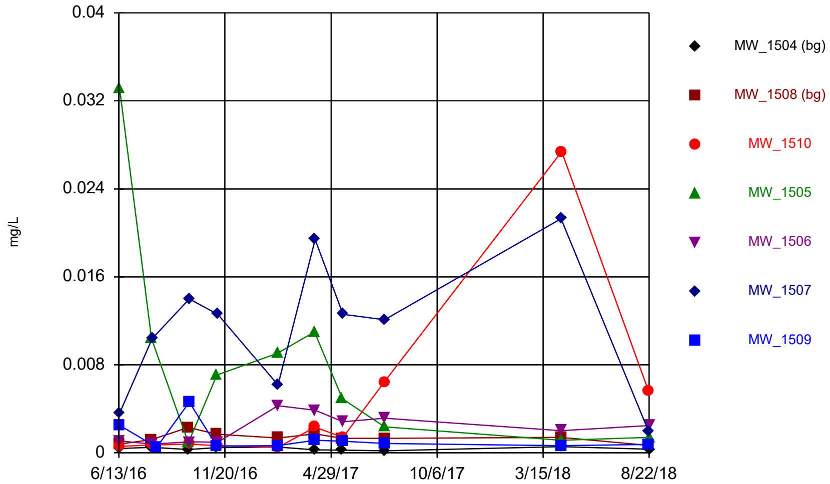


Constituent: Chloride, total Analysis Run 11/11/2018 2:37 PM View: Time Series - All Wells
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Time Series



Constituent: Chromium, total   Analysis Run 11/11/2018 2:37 PM   View: Time Series - All Wells
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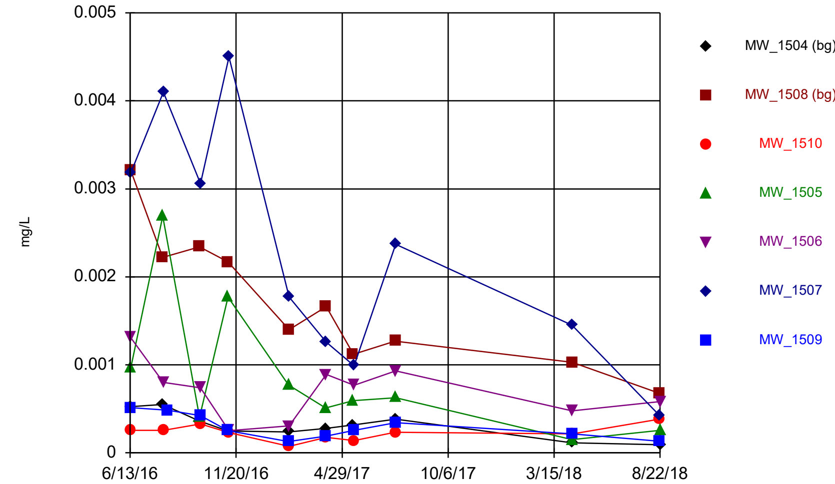
Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Time Series



Constituent: Cobalt, total   Analysis Run 11/11/2018 2:37 PM   View: Time Series - All Wells
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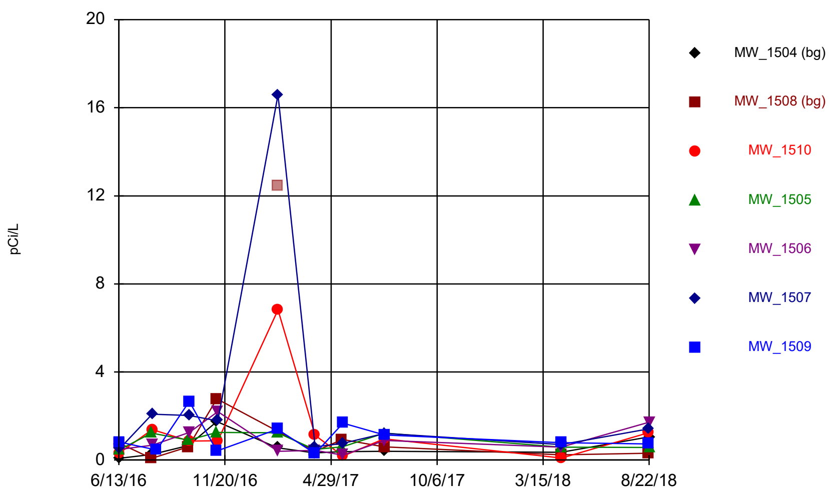
Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Time Series



Constituent: Combined Radium 226 + 228   Analysis Run 11/11/2018 2:37 PM   View: Time Series - All Well
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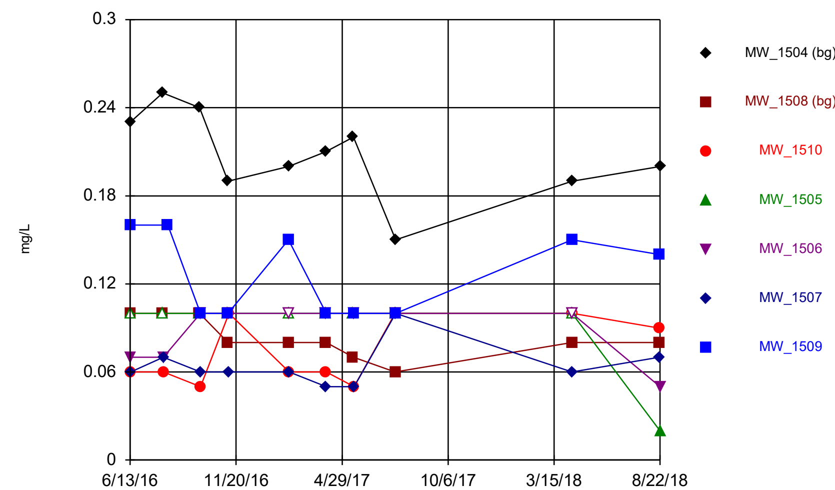
Hollow symbols indicate censored values.

Time Series



Constituent: Fluoride, total   Analysis Run 11/11/2018 2:37 PM   View: Time Series - All Wells
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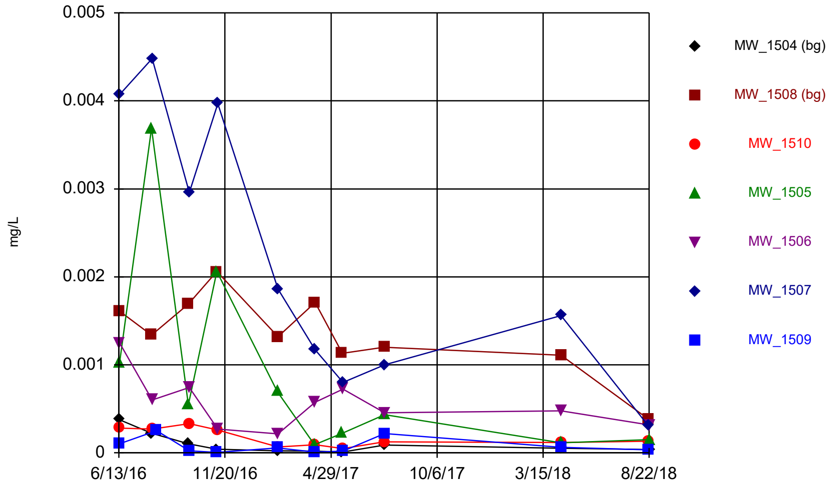
Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Time Series



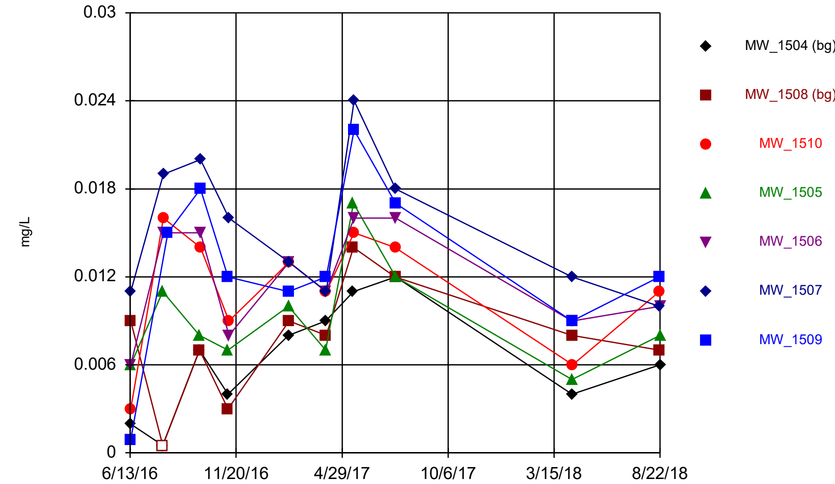
Constituent: Lead, total Analysis Run 11/11/2018 2:37 PM View: Time Series - All Wells

Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Hollow symbols indicate censored values.

Time Series



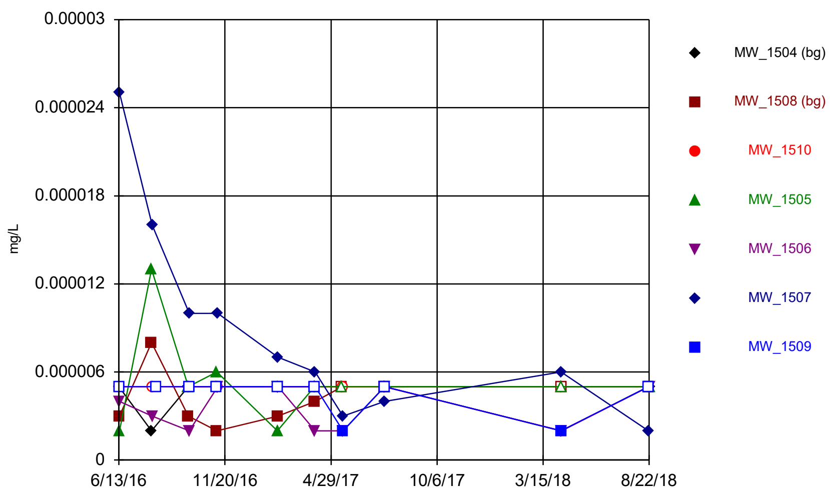
Constituent: Lithium, total Analysis Run 11/11/2018 2:37 PM View: Time Series - All Wells

Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Hollow symbols indicate censored values.

Time Series

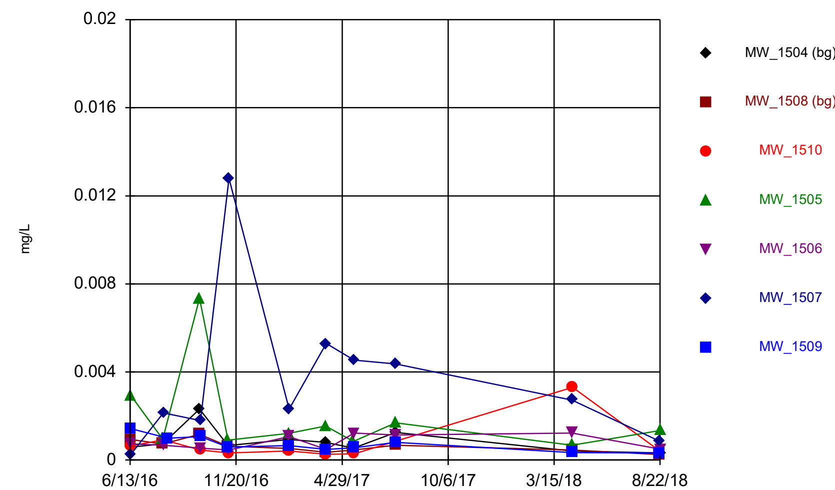


Constituent: Mercury, total Analysis Run 11/11/2018 2:37 PM View: Time Series - All Wells

Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

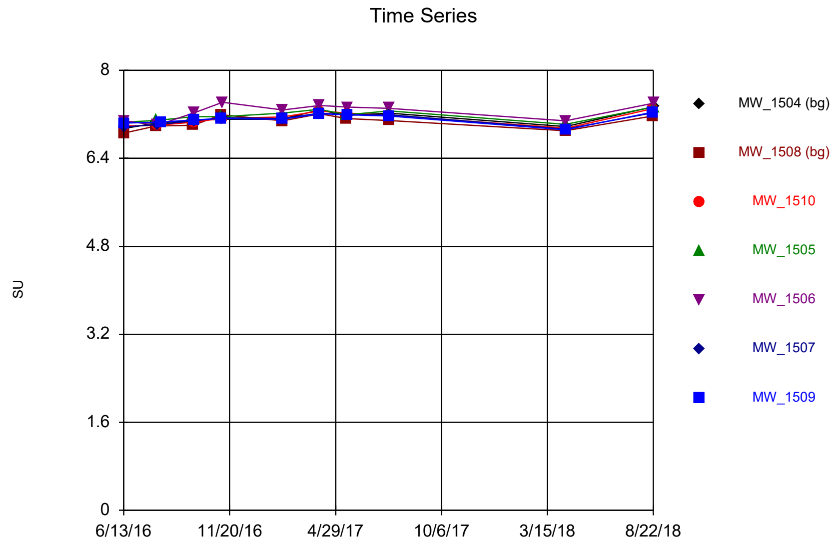
Time Series



Constituent: Molybdenum, total Analysis Run 11/11/2018 2:37 PM View: Time Series - All Wells

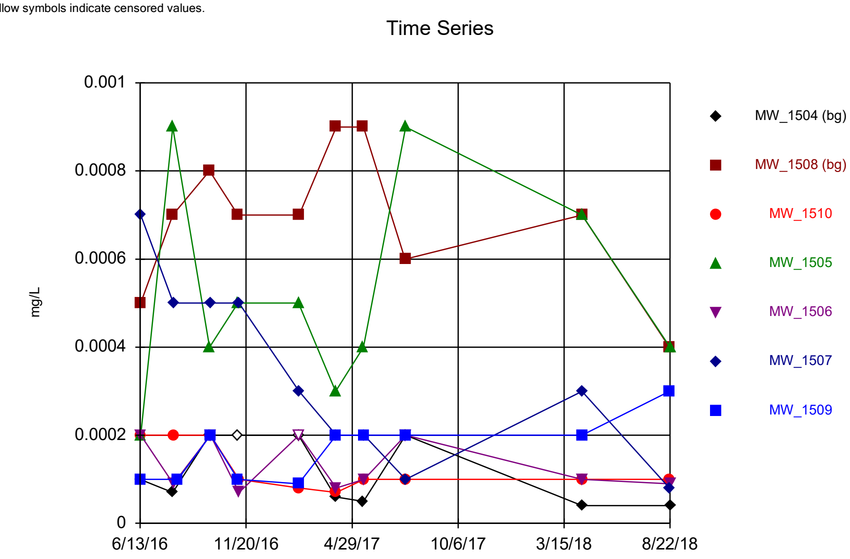
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



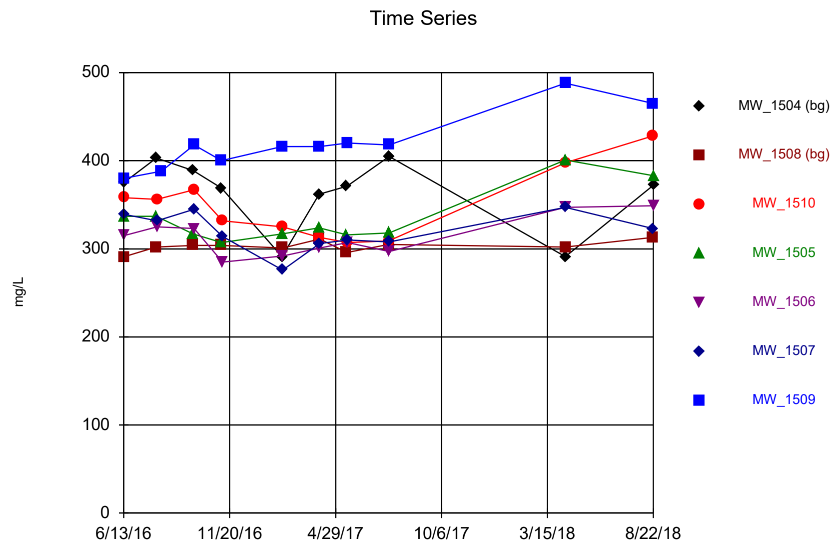
Constituent: pH, field Analysis Run 11/11/2018 2:37 PM View: Time Series - All Wells
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



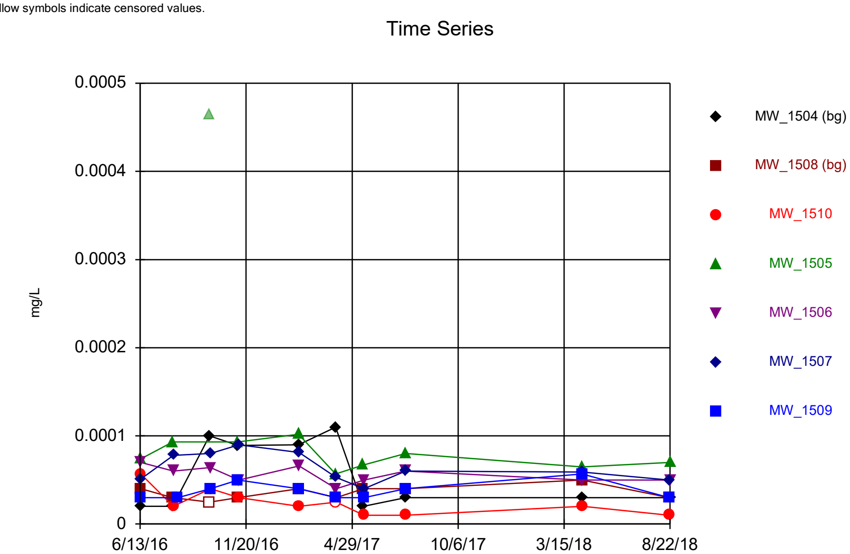
Constituent: Selenium, Total Analysis Run 11/11/2018 2:37 PM View: Time Series - All Wells
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



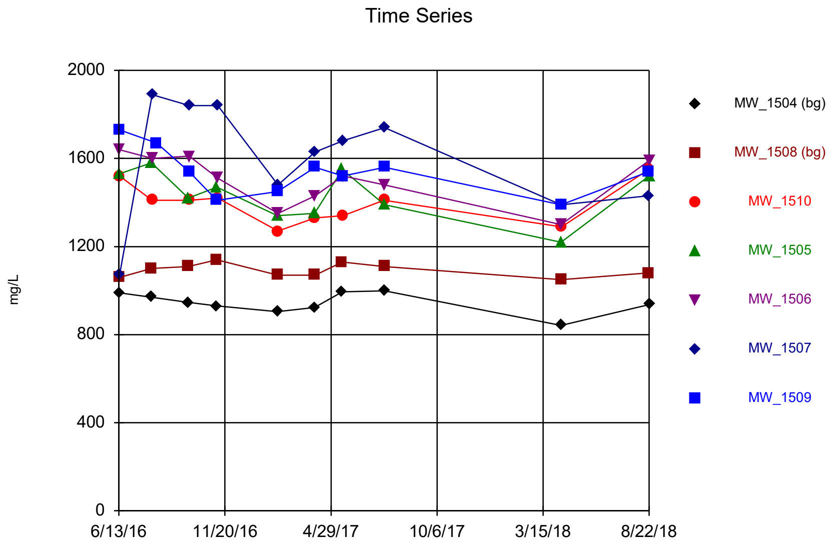
Constituent: Sulfate, total Analysis Run 11/11/2018 2:37 PM View: Time Series - All Wells
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



Constituent: Thallium, Total Analysis Run 11/11/2018 2:37 PM View: Time Series - All Wells
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Total Dissolved Solids [TDS] Analysis Run 11/11/2018 2:37 PM View: Time Series - All Wells

Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Interwell Prediction Limit Summary Table - Significant Results

Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP   Printed 11/11/2018, 2:12 PM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	**MW_1510**	**1.36**	**n/a**	**8/21/2018**	**9.13**	**Yes**	**20**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.004024**	NP (normality) 1 of 2
Boron, total (mg/L)	**MW_1505**	**1.36**	**n/a**	**8/22/2018**	**8**	**Yes**	**20**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.004024**	NP (normality) 1 of 2
Boron, total (mg/L)	**MW_1506**	**1.36**	**n/a**	**8/22/2018**	**5.91**	**Yes**	**20**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.004024**	NP (normality) 1 of 2
Boron, total (mg/L)	**MW_1507**	**1.36**	**n/a**	**8/21/2018**	**9.29**	**Yes**	**20**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.004024**	NP (normality) 1 of 2
Boron, total (mg/L)	**MW_1509**	**1.36**	**n/a**	**8/21/2018**	**6.97**	**Yes**	**20**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.004024**	NP (normality) 1 of 2
Calcium, total (mg/L)	**MW_1510**	**241.2**	**n/a**	**8/21/2018**	**268**	**Yes**	**20**	**222.7**	**9.069**	**0**	**None**	**No**	**0.001504**	Param 1 of 2
Calcium, total (mg/L)	**MW_1505**	**241.2**	**n/a**	**8/22/2018**	**274**	**Yes**	**20**	**222.7**	**9.069**	**0**	**None**	**No**	**0.001504**	Param 1 of 2
Calcium, total (mg/L)	**MW_1506**	**241.2**	**n/a**	**8/22/2018**	**270**	**Yes**	**20**	**222.7**	**9.069**	**0**	**None**	**No**	**0.001504**	Param 1 of 2
Calcium, total (mg/L)	**MW_1507**	**241.2**	**n/a**	**8/21/2018**	**272**	**Yes**	**20**	**222.7**	**9.069**	**0**	**None**	**No**	**0.001504**	Param 1 of 2
Calcium, total (mg/L)	**MW_1509**	**241.2**	**n/a**	**8/21/2018**	**279**	**Yes**	**20**	**222.7**	**9.069**	**0**	**None**	**No**	**0.001504**	Param 1 of 2
Chloride, total (mg/L)	**MW_1510**	**238**	**n/a**	**8/21/2018**	**334**	**Yes**	**20**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.004024**	NP (normality) 1 of 2
Chloride, total (mg/L)	**MW_1505**	**238**	**n/a**	**8/22/2018**	**284**	**Yes**	**20**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.004024**	NP (normality) 1 of 2
Chloride, total (mg/L)	**MW_1506**	**238**	**n/a**	**8/22/2018**	**369**	**Yes**	**20**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.004024**	NP (normality) 1 of 2
Chloride, total (mg/L)	**MW_1507**	**238**	**n/a**	**8/21/2018**	**331**	**Yes**	**20**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.004024**	NP (normality) 1 of 2
Chloride, total (mg/L)	**MW_1509**	**238**	**n/a**	**8/21/2018**	**323**	**Yes**	**20**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.004024**	NP (normality) 1 of 2
pH, field (SU)	**MW_1506**	**7.352**	**6.838**	**8/22/2018**	**7.4**	**Yes**	**20**	**7.095**	**0.1256**	**0**	**None**	**No**	**0.000752**	Param 1 of 2
Total Dissolved Solids [TDS] (mg/L)	**MW_1509**	**1193**	**n/a**	**8/21/2018**	**1540**	**Yes**	**20**	**1018**	**85.7**	**0**	**None**	**No**	**0.001504**	Param 1 of 2
Total Dissolved Solids [TDS] (mg/L)	**MW_1510**	**1193**	**n/a**	**8/21/2018**	**1550**	**Yes**	**20**	**1018**	**85.7**	**0**	**None**	**No**	**0.001504**	Param 1 of 2
Total Dissolved Solids [TDS] (mg/L)	**MW_1505**	**1193**	**n/a**	**8/22/2018**	**1520**	**Yes**	**20**	**1018**	**85.7**	**0**	**None**	**No**	**0.001504**	Param 1 of 2
Total Dissolved Solids [TDS] (mg/L)	**MW_1506**	**1193**	**n/a**	**8/22/2018**	**1590**	**Yes**	**20**	**1018**	**85.7**	**0**	**None**	**No**	**0.001504**	Param 1 of 2
Total Dissolved Solids [TDS] (mg/L)	**MW_1507**	**1193**	**n/a**	**8/21/2018**	**1430**	**Yes**	**20**	**1018**	**85.7**	**0**	**None**	**No**	**0.001504**	Param 1 of 2

Interwell Prediction Limit Summary Table - All Results

Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP   Printed 11/11/2018, 2:12 PM

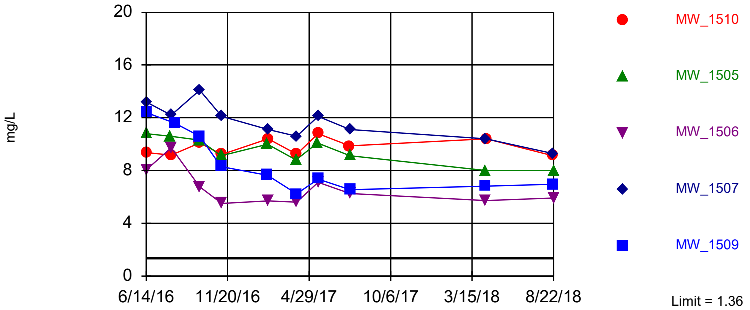
Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	MW_1505	1.36	n/a	8/22/2018	8	Yes	20	n/a	n/a	0	n/a	n/a	0.004024	NP (normality) 1 of 2
Boron, total (mg/L)	MW_1506	1.36	n/a	8/22/2018	5.91	Yes	20	n/a	n/a	0	n/a	n/a	0.004024	NP (normality) 1 of 2
Boron, total (mg/L)	MW_1507	1.36	n/a	8/21/2018	9.29	Yes	20	n/a	n/a	0	n/a	n/a	0.004024	NP (normality) 1 of 2
Boron, total (mg/L)	MW_1509	1.36	n/a	8/21/2018	6.97	Yes	20	n/a	n/a	0	n/a	n/a	0.004024	NP (normality) 1 of 2
Boron, total (mg/L)	MW_1510	1.36	n/a	8/21/2018	9.13	Yes	20	n/a	n/a	0	n/a	n/a	0.004024	NP (normality) 1 of 2
Calcium, total (mg/L)	MW_1505	241.2	n/a	8/22/2018	274	Yes	20	222.7	9.069	0	None	No	0.001504	Param 1 of 2
Calcium, total (mg/L)	MW_1506	241.2	n/a	8/22/2018	270	Yes	20	222.7	9.069	0	None	No	0.001504	Param 1 of 2
Calcium, total (mg/L)	MW_1507	241.2	n/a	8/21/2018	272	Yes	20	222.7	9.069	0	None	No	0.001504	Param 1 of 2
Calcium, total (mg/L)	MW_1509	241.2	n/a	8/21/2018	279	Yes	20	222.7	9.069	0	None	No	0.001504	Param 1 of 2
Calcium, total (mg/L)	MW_1510	241.2	n/a	8/21/2018	268	Yes	20	222.7	9.069	0	None	No	0.001504	Param 1 of 2
Chloride, total (mg/L)	MW_1505	238	n/a	8/22/2018	284	Yes	20	n/a	n/a	0	n/a	n/a	0.004024	NP (normality) 1 of 2
Chloride, total (mg/L)	MW_1506	238	n/a	8/22/2018	369	Yes	20	n/a	n/a	0	n/a	n/a	0.004024	NP (normality) 1 of 2
Chloride, total (mg/L)	MW_1507	238	n/a	8/21/2018	331	Yes	20	n/a	n/a	0	n/a	n/a	0.004024	NP (normality) 1 of 2
Chloride, total (mg/L)	MW_1509	238	n/a	8/21/2018	323	Yes	20	n/a	n/a	0	n/a	n/a	0.004024	NP (normality) 1 of 2
Chloride, total (mg/L)	MW_1510	238	n/a	8/21/2018	334	Yes	20	n/a	n/a	0	n/a	n/a	0.004024	NP (normality) 1 of 2
pH, field (SU)	MW_1505	7.352	6.838	8/22/2018	7.33	No	20	7.095	0.1256	0	None	No	0.000752	Param 1 of 2
pH, field (SU)	MW_1506	7.352	6.838	8/22/2018	7.4	Yes	20	7.095	0.1256	0	None	No	0.000752	Param 1 of 2
pH, field (SU)	MW_1507	7.352	6.838	8/21/2018	7.23	No	20	7.095	0.1256	0	None	No	0.000752	Param 1 of 2
pH, field (SU)	MW_1509	7.352	6.838	8/21/2018	7.24	No	20	7.095	0.1256	0	None	No	0.000752	Param 1 of 2
pH, field (SU)	MW_1510	7.352	6.838	8/21/2018	7.3	No	20	7.095	0.1256	0	None	No	0.000752	Param 1 of 2
Total Dissolved Solids [TDS] (mg/L)	MW_1505	1193	n/a	8/22/2018	1520	Yes	20	1018	85.7	0	None	No	0.001504	Param 1 of 2
Total Dissolved Solids [TDS] (mg/L)	MW_1506	1193	n/a	8/22/2018	1590	Yes	20	1018	85.7	0	None	No	0.001504	Param 1 of 2
Total Dissolved Solids [TDS] (mg/L)	MW_1507	1193	n/a	8/21/2018	1430	Yes	20	1018	85.7	0	None	No	0.001504	Param 1 of 2
Total Dissolved Solids [TDS] (mg/L)	MW_1509	1193	n/a	8/21/2018	1540	Yes	20	1018	85.7	0	None	No	0.001504	Param 1 of 2
Total Dissolved Solids [TDS] (mg/L)	MW_1510	1193	n/a	8/21/2018	1550	Yes	20	1018	85.7	0	None	No	0.001504	Param 1 of 2

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit: MW_1510, MW_1505, MW_1506, MW_1507, MW_1509

Prediction Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 20 background values. Annual per-constituent alpha = 0.03952. Individual comparison alpha = 0.004024 (1 of 2). Comparing 5 points to limit.

Constituent: Boron, total Analysis Run 11/11/2018 2:10 PM View: PLs - Interwell

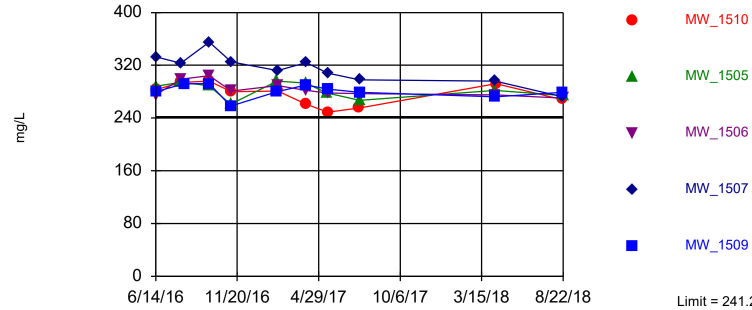
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit: MW_1510, MW_1505, MW_1506, MW_1507, MW_1509

Prediction Limit

Interwell Parametric



Background Data Summary: Mean=222.7, Std. Dev.=9.069, n=20. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9422, critical = 0.868. Kappa = 2.048 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.001504. Comparing 5 points to limit.

Constituent: Calcium, total Analysis Run 11/11/2018 2:10 PM View: PLs - Interwell

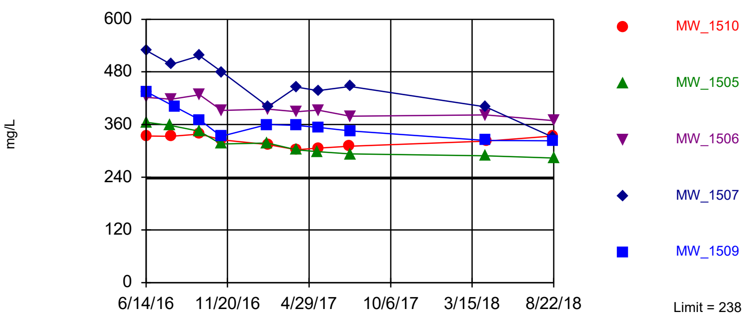
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit: MW_1510, MW_1505, MW_1506, MW_1507, MW_1509

Prediction Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 20 background values. Annual per-constituent alpha = 0.03952. Individual comparison alpha = 0.004024 (1 of 2). Comparing 5 points to limit.

Constituent: Chloride, total Analysis Run 11/11/2018 2:10 PM View: PLs - Interwell

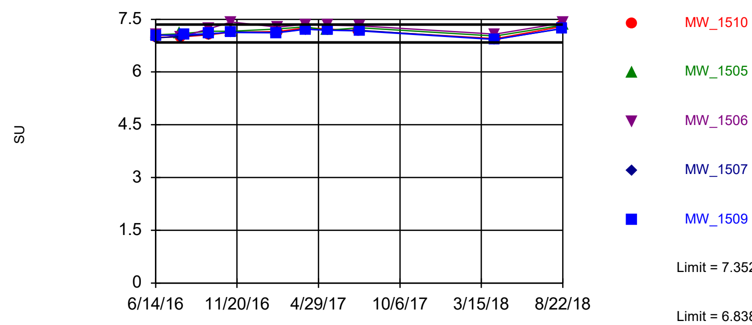
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limits: MW_1506

Prediction Limit

Interwell Parametric



Background Data Summary: Mean=7.095, Std. Dev.=0.1256, n=20. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9864, critical = 0.868. Kappa = 2.048 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.000752. Comparing 5 points to limit.

Constituent: pH, field Analysis Run 11/11/2018 2:10 PM View: PLs - Interwell

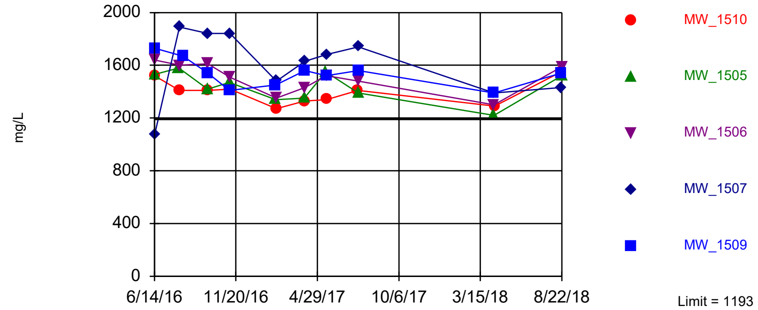
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit: MW_1510, MW_1505, MW_1506, MW_1507, MW_1509

Prediction Limit

Interwell Parametric



Background Data Summary: Mean=1018, Std. Dev.=85.7, n=20. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9477, critical = 0.868. Kappa = 2.048 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.001504. Comparing 5 points to limit.

Constituent: Total Dissolved Solids [TDS] Analysis Run 11/11/2018 2:10 PM View: PLs - Interwell

Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Intrawell Prediction Limit Summary - Significant Results

Mitchell BAP Client: Geosyntec Data: Mitchell BAP Printed 1/8/2019, 9:26 AM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Sulfate, total (mg/L)	**MW_1510**	**399.1**	**n/a**	**8/21/2018**	**428**	**Yes**	**8**	**333.4**	**23.98**	**0**	**None**	**No**	**0.001504**	Param 1 of 2
Sulfate, total (mg/L)	**MW_1505**	**350.5**	**n/a**	**8/22/2018**	**383**	**Yes**	**8**	**321.6**	**10.56**	**0**	**None**	**No**	**0.001504**	Param 1 of 2
Sulfate, total (mg/L)	**MW_1506**	**345.4**	**n/a**	**8/22/2018**	**349**	**Yes**	**8**	**305.6**	**14.51**	**0**	**None**	**No**	**0.001504**	Param 1 of 2
Sulfate, total (mg/L)	**MW_1509**	**449.9**	**n/a**	**8/21/2018**	**465**	**Yes**	**8**	**407**	**15.64**	**0**	**None**	**No**	**0.001504**	Param 1 of 2

Intrawell Prediction Limit Summary - All Results

Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP   Printed 1/8/2019, 9:26 AM

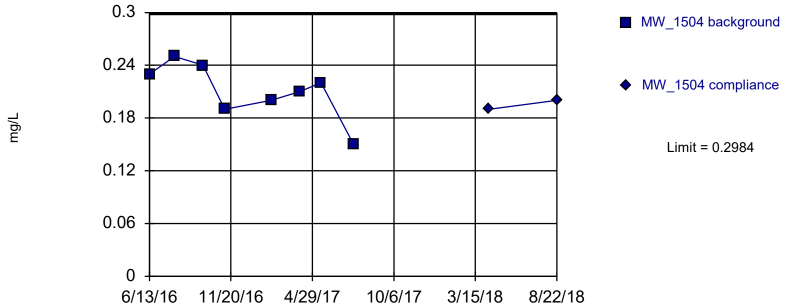
Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Fluoride, total (mg/L)	MW_1504	0.2984	n/a	8/22/2018	0.2	No	8	0.2113	0.03182	0	None	No	0.001504	Param 1 of 2
Fluoride, total (mg/L)	MW_1508	0.125	n/a	8/21/2018	0.08	No	8	0.08375	0.01506	0	None	No	0.001504	Param 1 of 2
Fluoride, total (mg/L)	MW_1510	0.2	n/a	8/21/2018	0.09	No	8	n/a	n/a	25	n/a	n/a	0.02144	NP (normality) 1 of 2
Fluoride, total (mg/L)	MW_1505	0.2	n/a	8/22/2018	0.02	No	8	n/a	n/a	100	n/a	n/a	0.02144	NP (NDs) 1 of 2
Fluoride, total (mg/L)	MW_1506	0.2	n/a	8/22/2018	0.05	No	8	n/a	n/a	75	n/a	n/a	0.02144	NP (NDs) 1 of 2
Fluoride, total (mg/L)	MW_1507	0.2	n/a	8/21/2018	0.07	No	8	n/a	n/a	12.5	n/a	n/a	0.02144	NP (normality) 1 of 2
Fluoride, total (mg/L)	MW_1509	0.16	n/a	8/21/2018	0.14	No	8	n/a	n/a	0	n/a	n/a	0.02144	NP (normality) 1 of 2
Sulfate, total (mg/L)	MW_1504	468.9	n/a	8/22/2018	372	No	8	370.6	35.86	0	None	No	0.001504	Param 1 of 2
Sulfate, total (mg/L)	MW_1508	318.3	n/a	8/21/2018	313	No	8	301.8	6.042	0	None	No	0.001504	Param 1 of 2
Sulfate, total (mg/L)	**MW_1510**	**399.1**	**n/a**	**8/21/2018**	**428**	**Yes**	**8**	**333.4**	**23.98**	**0**	**None**	**No**	**0.001504**	Param 1 of 2
Sulfate, total (mg/L)	**MW_1505**	**350.5**	**n/a**	**8/22/2018**	**383**	**Yes**	**8**	**321.6**	**10.56**	**0**	**None**	**No**	**0.001504**	Param 1 of 2
Sulfate, total (mg/L)	**MW_1506**	**345.4**	**n/a**	**8/22/2018**	**349**	**Yes**	**8**	**305.6**	**14.51**	**0**	**None**	**No**	**0.001504**	Param 1 of 2
Sulfate, total (mg/L)	MW_1507	376.9	n/a	8/21/2018	323	No	8	316.3	22.13	0	None	No	0.001504	Param 1 of 2
Sulfate, total (mg/L)	**MW_1509**	**449.9**	**n/a**	**8/21/2018**	**465**	**Yes**	**8**	**407**	**15.64**	**0**	**None**	**No**	**0.001504**	Param 1 of 2

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=0.2113, Std. Dev.=0.03182, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9517, critical = 0.749. Kappa = 2.74 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504.

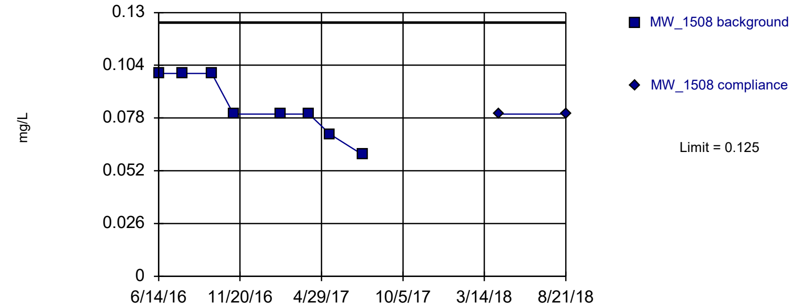
Constituent: Fluoride, total Analysis Run 1/7/2019 7:40 PM View: PLs - Intrawell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=0.08375, Std. Dev.=0.01506, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8711, critical = 0.749. Kappa = 2.74 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504.

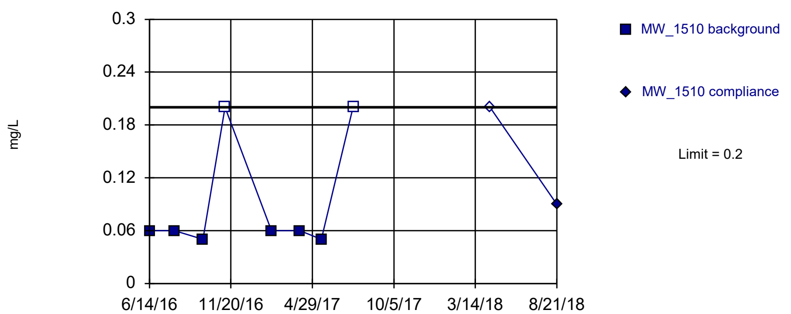
Constituent: Fluoride, total Analysis Run 1/7/2019 7:40 PM View: PLs - Intrawell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Intrawell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 8 background values. 25% NDs. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2).

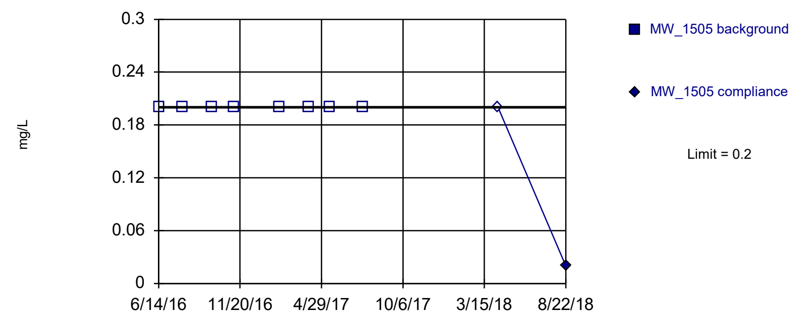
Constituent: Fluoride, total Analysis Run 1/7/2019 7:40 PM View: PLs - Intrawell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Intrawell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. All background values (n = 8) were censored; limit is most recent reporting limit. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2).

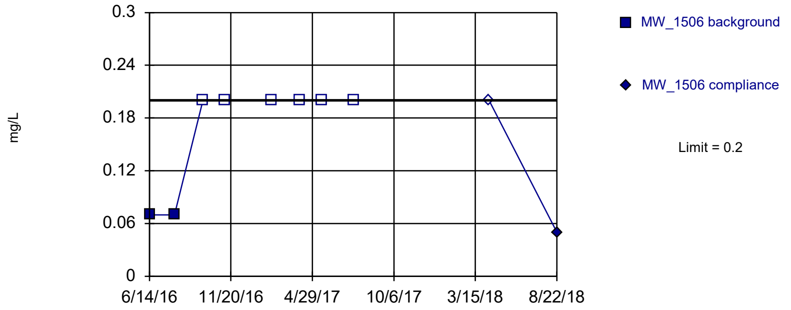
Constituent: Fluoride, total Analysis Run 1/7/2019 7:40 PM View: PLs - Intrawell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Intrawell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 8 background values. 75% NDs. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2).

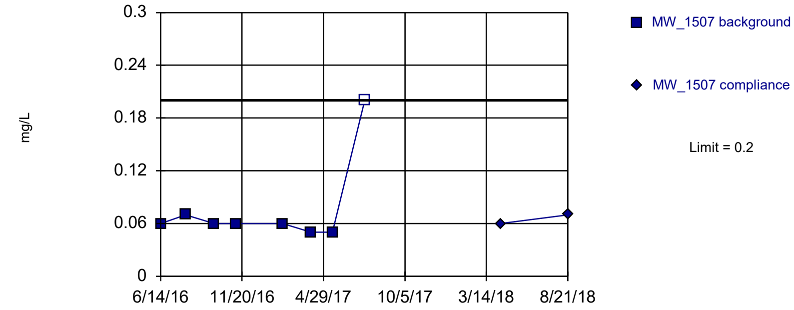
Constituent: Fluoride, total Analysis Run 1/7/2019 7:40 PM View: PLs - Intrawell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Intrawell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 8 background values. 12.5% NDs. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2).

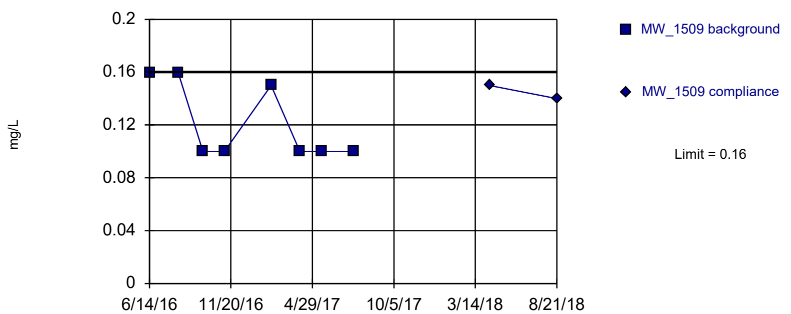
Constituent: Fluoride, total Analysis Run 1/7/2019 7:40 PM View: PLs - Intrawell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 8 background values. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2).

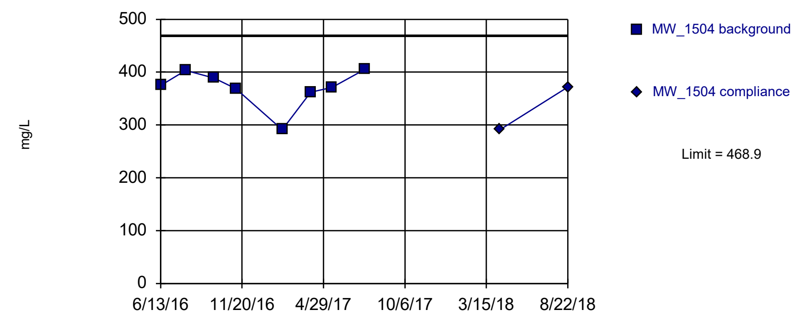
Constituent: Fluoride, total Analysis Run 1/7/2019 7:40 PM View: PLs - Intrawell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=370.6, Std. Dev.=35.86, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8152, critical = 0.749. Kappa = 2.74 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504.

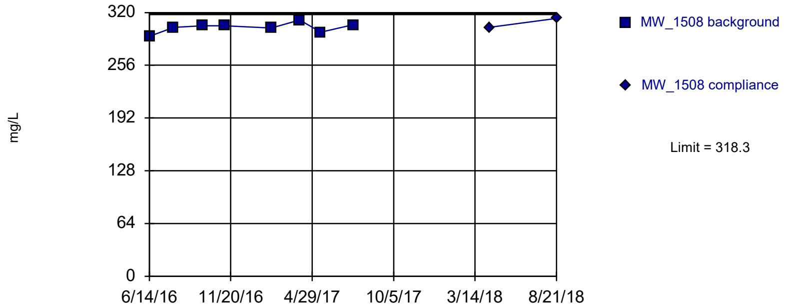
Constituent: Sulfate, total Analysis Run 1/7/2019 7:40 PM View: PLs - Intrawell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=301.8, Std. Dev.=6.042, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9509, critical = 0.749. Kappa = 2.74 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504.

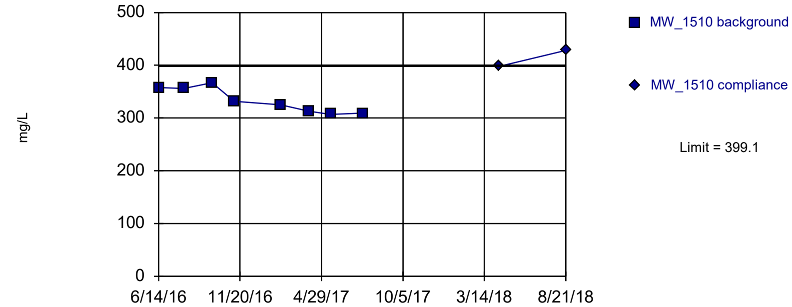
Constituent: Sulfate, total Analysis Run 1/7/2019 7:40 PM View: PLs - Intrawell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=333.4, Std. Dev.=23.98, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8854, critical = 0.749. Kappa = 2.74 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504.

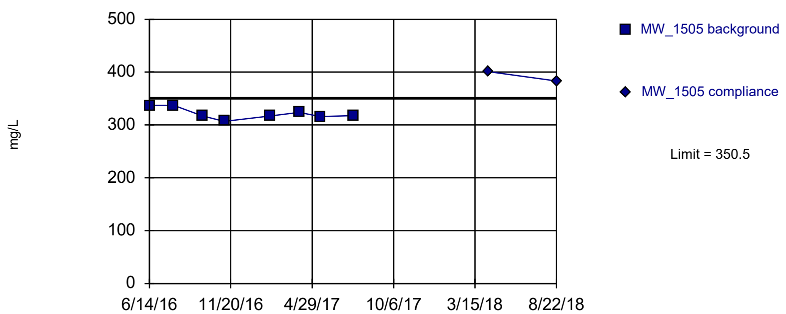
Constituent: Sulfate, total Analysis Run 1/7/2019 7:40 PM View: PLs - Intrawell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=321.6, Std. Dev.=10.56, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8719, critical = 0.749. Kappa = 2.74 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504.

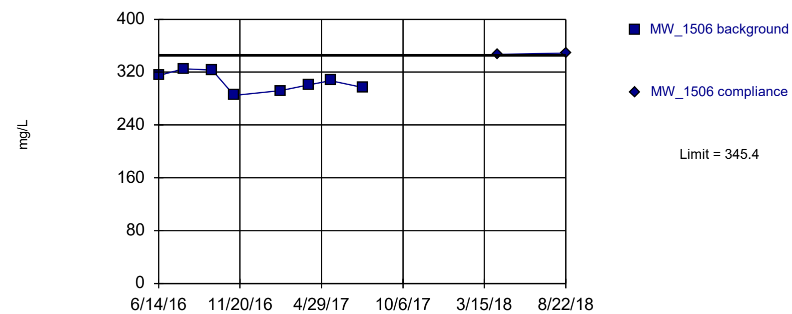
Constituent: Sulfate, total Analysis Run 1/7/2019 7:40 PM View: PLs - Intrawell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=305.6, Std. Dev.=14.51, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9536, critical = 0.749. Kappa = 2.74 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504.

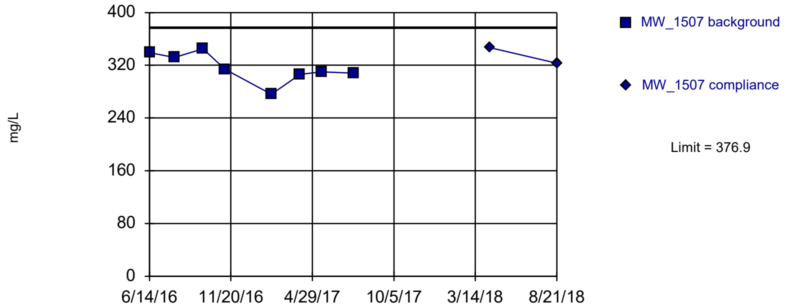
Constituent: Sulfate, total Analysis Run 1/7/2019 7:40 PM View: PLs - Intrawell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=316.3, Std. Dev.=22.13, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9344, critical = 0.749. Kappa = 2.74 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504.

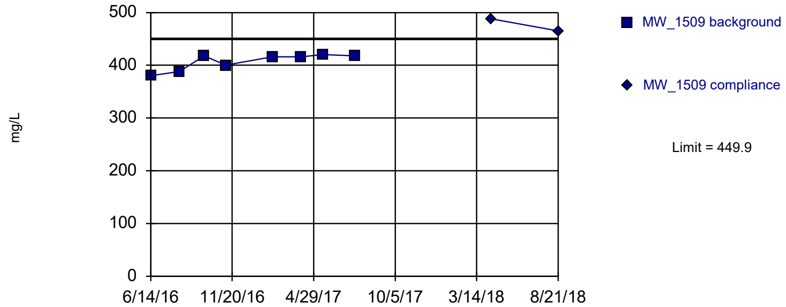
Constituent: Sulfate, total Analysis Run 1/7/2019 7:40 PM View: PLs - Intrawell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=407, Std. Dev.=15.64, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7926, critical = 0.749. Kappa = 2.74 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504.

Constituent: Sulfate, total Analysis Run 1/7/2019 7:40 PM View: PLs - Intrawell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Trend Test Summary Table - Significant Results

Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP   Printed 11/11/2018, 2:30 PM

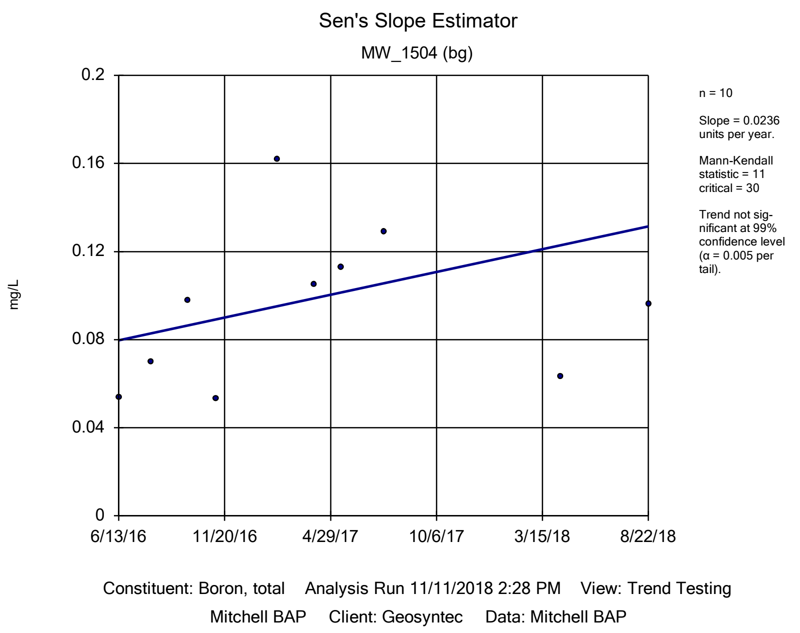
Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Boron, total (mg/L)	**MW_1505**	**-1.301**	**-32**	**-30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Boron, total (mg/L)	**MW_1507**	**-1.66**	**-33**	**-30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Boron, total (mg/L)	**MW_1509**	**-2.866**	**-31**	**-30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Calcium, total (mg/L)	**MW_1507**	**-27.55**	**-35**	**-30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Chloride, total (mg/L)	**MW_1505**	**-41.65**	**-43**	**-30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Chloride, total (mg/L)	**MW_1506**	**-29.8**	**-33**	**-30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Chloride, total (mg/L)	**MW_1507**	**-77.15**	**-33**	**-30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Chloride, total (mg/L)	**MW_1509**	**-33.28**	**-37**	**-30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Sulfate, total (mg/L)	**MW_1509**	**38.88**	**33**	**30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**

Trend Test Summary Table - All Results

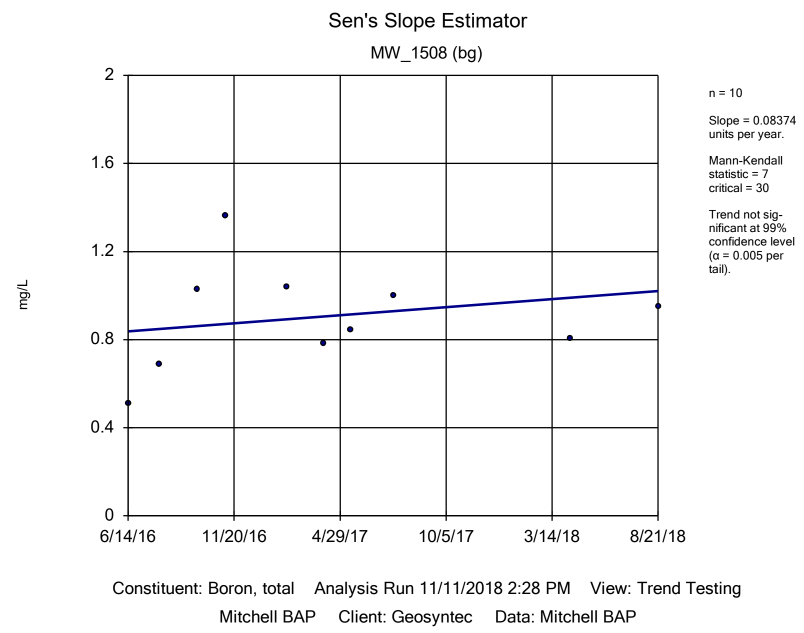
Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP   Printed 11/11/2018, 2:30 PM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Boron, total (mg/L)	MW_1504 (bg)	0.0236	11	30	No	10	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	MW_1508 (bg)	0.08374	7	30	No	10	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	MW_1510	0.1475	6	30	No	10	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	**MW_1505**	**-1.301**	**-32**	**-30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Boron, total (mg/L)	MW_1506	-0.7273	-11	-30	No	10	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	**MW_1507**	**-1.66**	**-33**	**-30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Boron, total (mg/L)	**MW_1509**	**-2.866**	**-31**	**-30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Calcium, total (mg/L)	MW_1504 (bg)	3.942	6	30	No	10	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	MW_1508 (bg)	6.239	12	30	No	10	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	MW_1510	-14.75	-17	-30	No	10	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	MW_1505	-7.878	-13	-30	No	10	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	MW_1506	-8.69	-24	-30	No	10	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	**MW_1507**	**-27.55**	**-35**	**-30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Calcium, total (mg/L)	MW_1509	-3.959	-16	-30	No	10	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	MW_1504 (bg)	-6.065	-16	-30	No	10	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	MW_1508 (bg)	-17.1	-27	-30	No	10	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	MW_1510	-7.449	-12	-30	No	10	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	**MW_1505**	**-41.65**	**-43**	**-30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Chloride, total (mg/L)	**MW_1506**	**-29.8**	**-33**	**-30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Chloride, total (mg/L)	**MW_1507**	**-77.15**	**-33**	**-30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Chloride, total (mg/L)	**MW_1509**	**-33.28**	**-37**	**-30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
pH, field (SU)	MW_1504 (bg)	0.1587	26	30	No	10	0	n/a	n/a	0.01	NP
pH, field (SU)	MW_1508 (bg)	0.0876	15	30	No	10	0	n/a	n/a	0.01	NP
pH, field (SU)	MW_1506	0.08941	14	30	No	10	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	MW_1504 (bg)	-14.8	-8	-30	No	10	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	MW_1508 (bg)	5.353	17	30	No	10	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	MW_1510	-28.08	-5	-30	No	10	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	MW_1505	11.41	7	30	No	10	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	MW_1506	13.67	9	30	No	10	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	**MW_1509**	**38.88**	**33**	**30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Total Dissolved Solids [TDS] (m...	MW_1504 (bg)	-42.26	-9	-30	No	10	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (m...	MW_1508 (bg)	0	-1	-30	No	10	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (m...	MW_1510	-39.25	-6	-30	No	10	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (m...	MW_1505	-115.4	-13	-30	No	10	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (m...	MW_1506	-130	-19	-30	No	10	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (m...	MW_1507	-156	-12	-30	No	10	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (m...	MW_1509	-86.9	-15	-30	No	10	0	n/a	n/a	0.01	NP

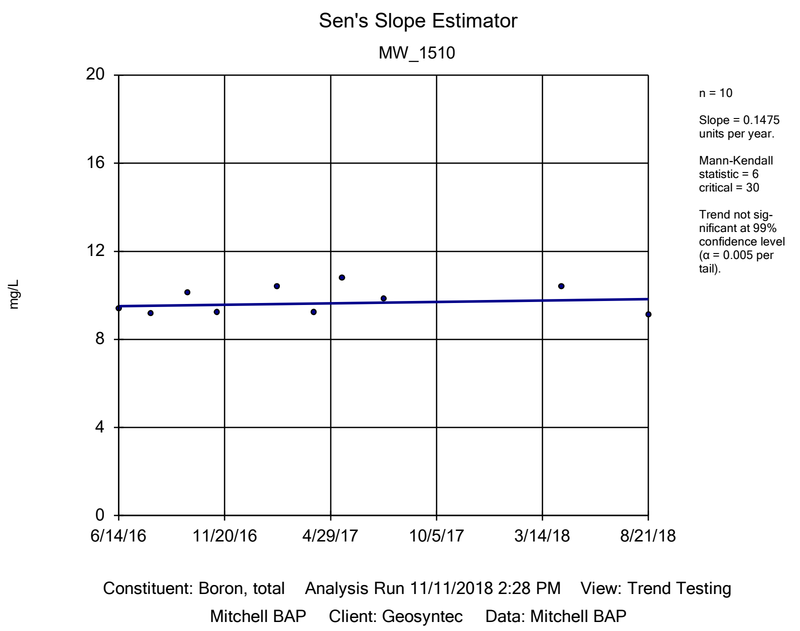
Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



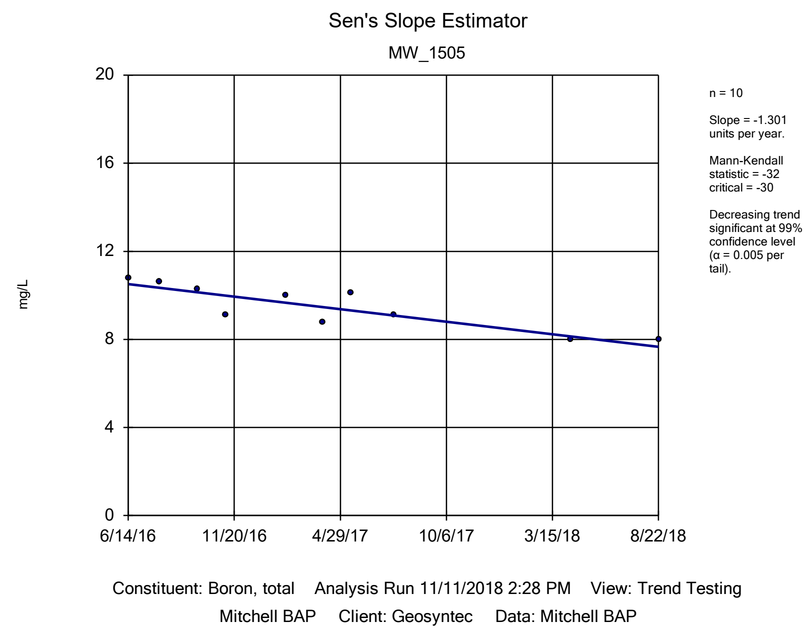
Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



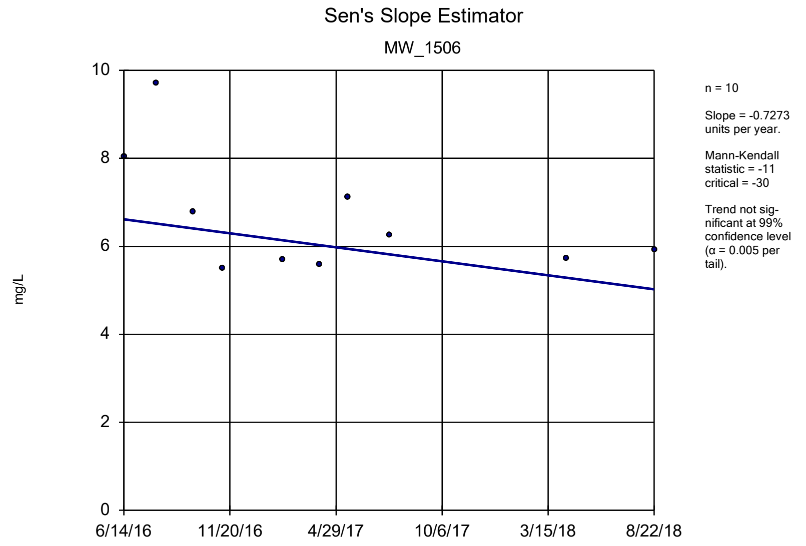
Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

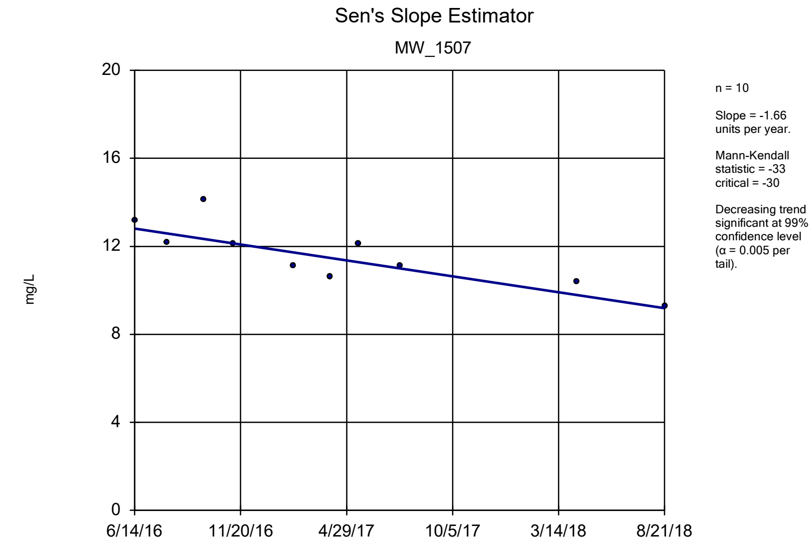


Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



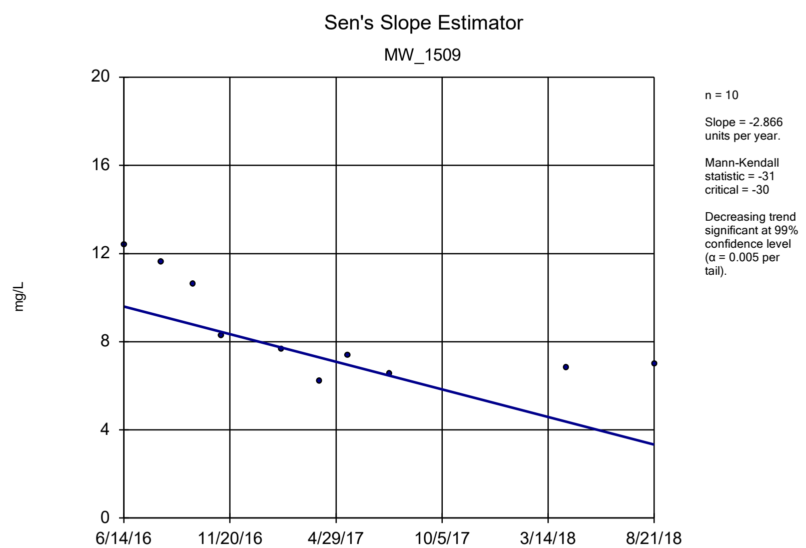
Constituent: Boron, total Analysis Run 11/11/2018 2:28 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



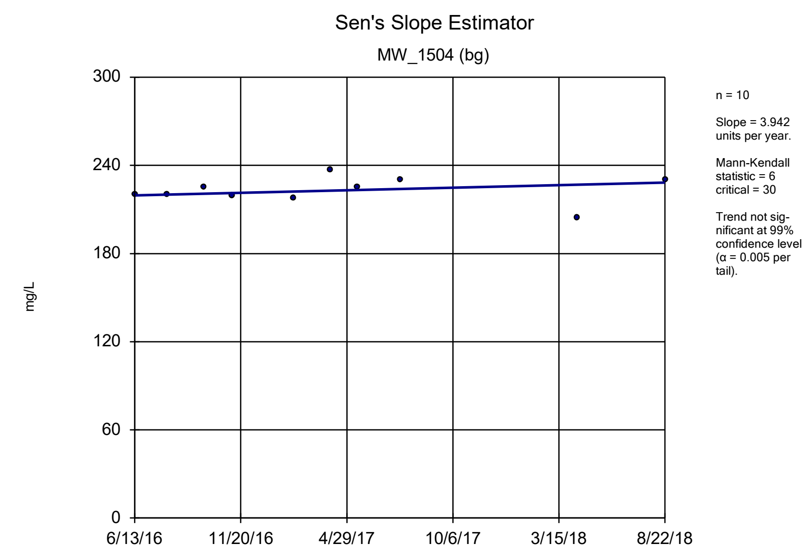
Constituent: Boron, total Analysis Run 11/11/2018 2:28 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

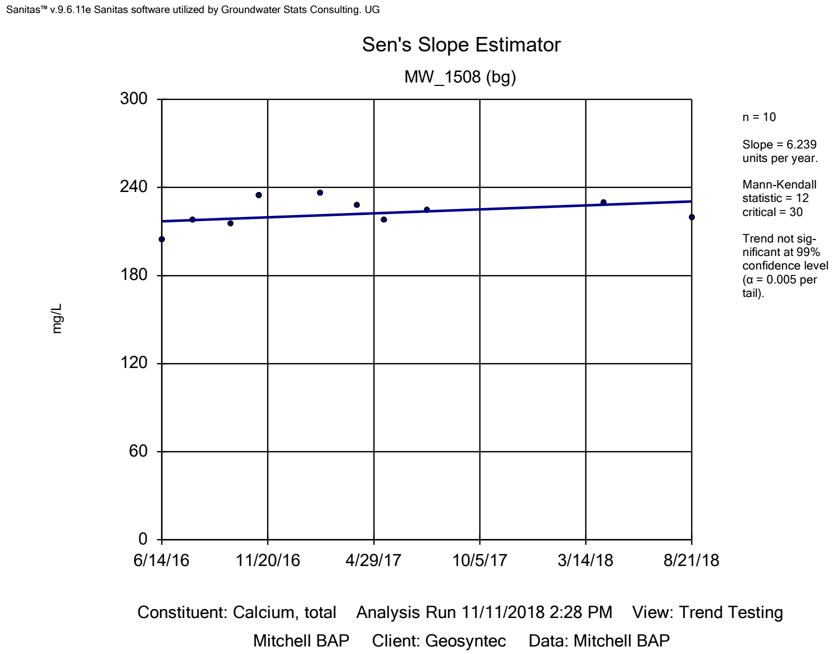


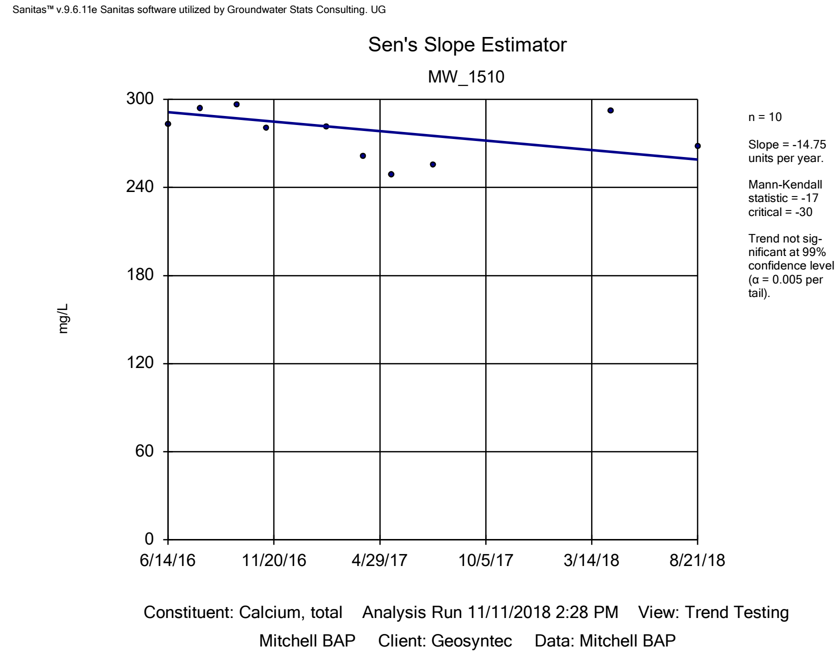
Constituent: Boron, total Analysis Run 11/11/2018 2:28 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

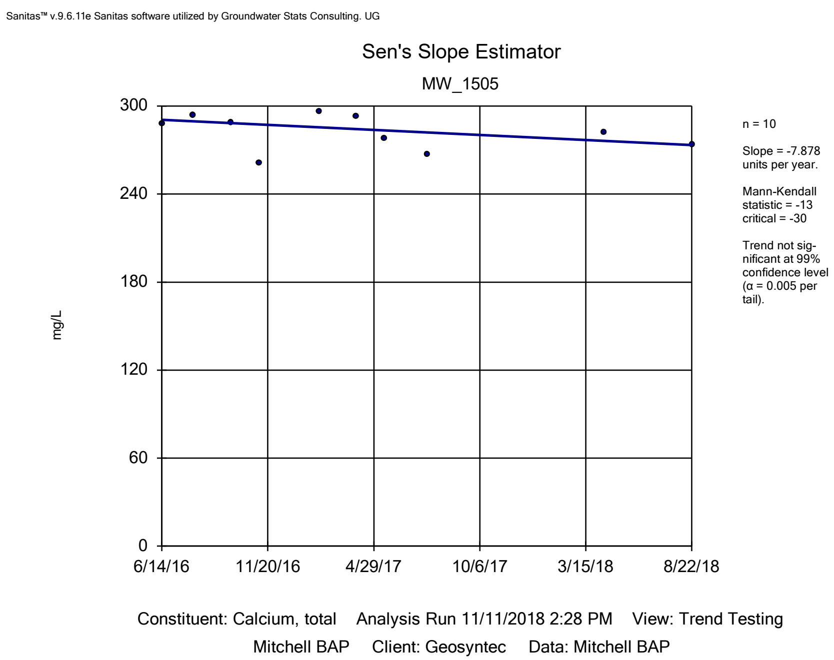
Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

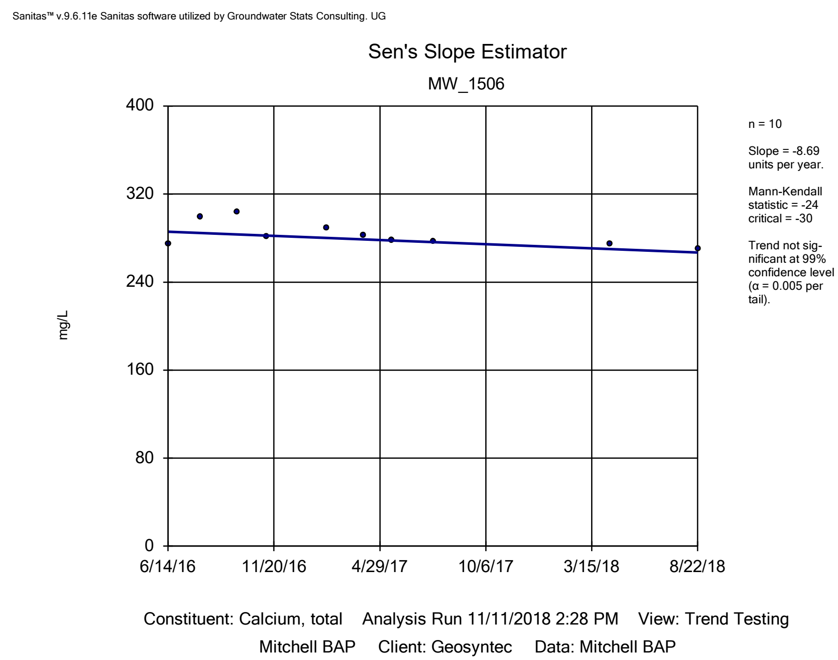


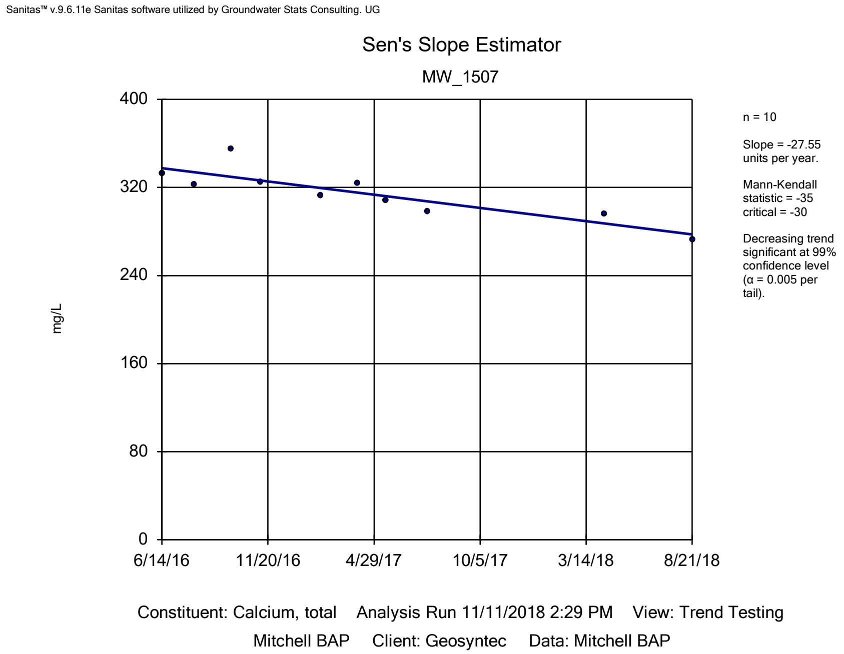
Constituent: Calcium, total Analysis Run 11/11/2018 2:28 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

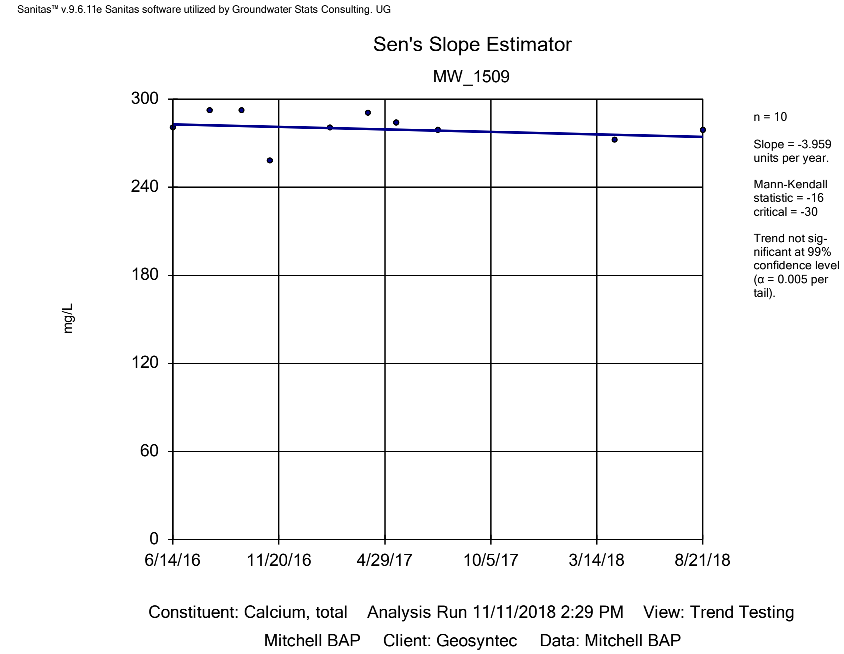

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Sen's Slope Estimator
MW_1508 (bg)
300
240
180
120
60
0
mg/L
6/14/16
11/20/16
4/29/17
10/5/17
3/14/18
8/21/18
n = 10
Slope = 6.239 units per year.
Mann-Kendall statistic = 12 critical = 30
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Calcium, total Analysis Run 11/11/2018 2:28 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

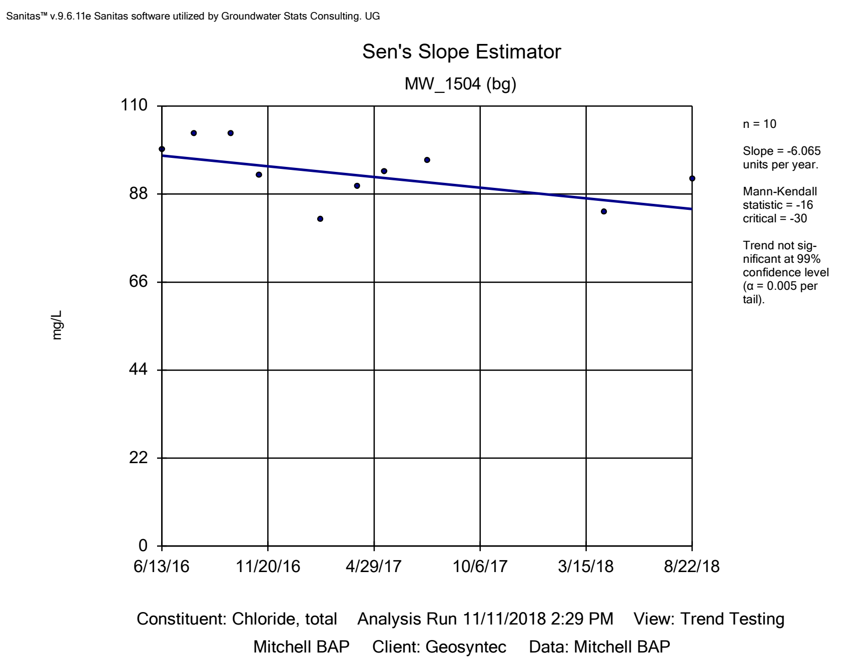

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Sen's Slope Estimator
MW_1510
300
240
180
120
60
0
mg/L
6/14/16
11/20/16
4/29/17
10/5/17
3/14/18
8/21/18
n = 10
Slope = -14.75 units per year.
Mann-Kendall statistic = -17 critical = -30
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Calcium, total Analysis Run 11/11/2018 2:28 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

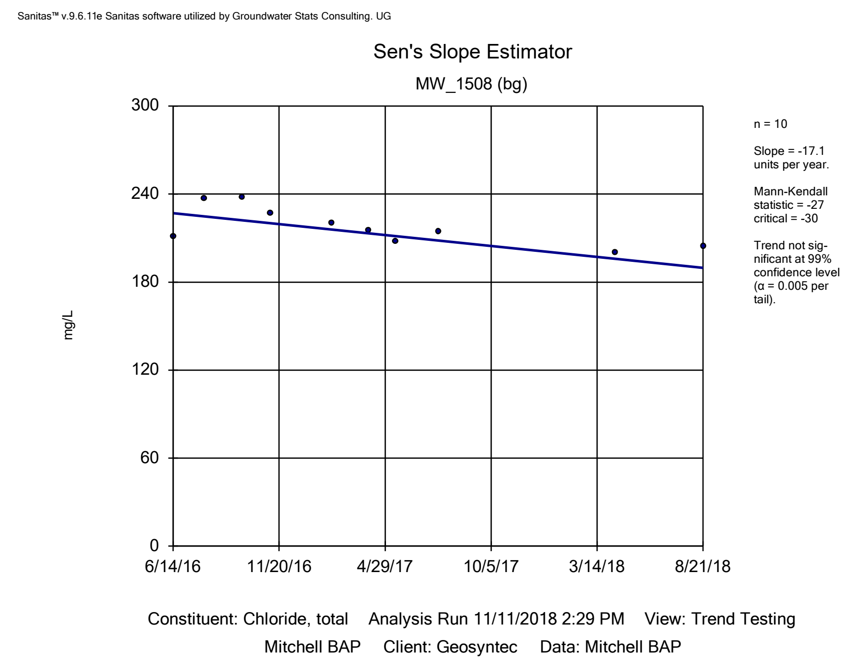

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Sen's Slope Estimator
MW_1505
300
240
180
120
60
0
mg/L
6/14/16
11/20/16
4/29/17
10/6/17
3/15/18
8/22/18
n = 10
Slope = -7.878 units per year.
Mann-Kendall statistic = -13 critical = -30
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Calcium, total Analysis Run 11/11/2018 2:28 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP


Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Sen's Slope Estimator
MW_1506
400
320
240
160
80
0
mg/L
6/14/16
11/20/16
4/29/17
10/6/17
3/15/18
8/22/18
n = 10
Slope = -8.69 units per year.
Mann-Kendall statistic = -24 critical = -30
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Calcium, total Analysis Run 11/11/2018 2:28 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP


Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Sen's Slope Estimator
MW_1507
n = 10
Slope = -27.55 units per year.
Mann-Kendall statistic = -35 critical = -30
Decreasing trend significant at 99% confidence level (α = 0.005 per tail).
mg/L
400
320
240
160
80
0
6/14/16
11/20/16
4/29/17
10/5/17
3/14/18
8/21/18
Constituent: Calcium, total Analysis Run 11/11/2018 2:29 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP


Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Sen's Slope Estimator
MW_1509
n = 10
Slope = -3.959 units per year.
Mann-Kendall statistic = -16 critical = -30
Trend not significant at 99% confidence level (α = 0.005 per tail).
mg/L
300
240
180
120
60
0
6/14/16
11/20/16
4/29/17
10/5/17
3/14/18
8/21/18
Constituent: Calcium, total Analysis Run 11/11/2018 2:29 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

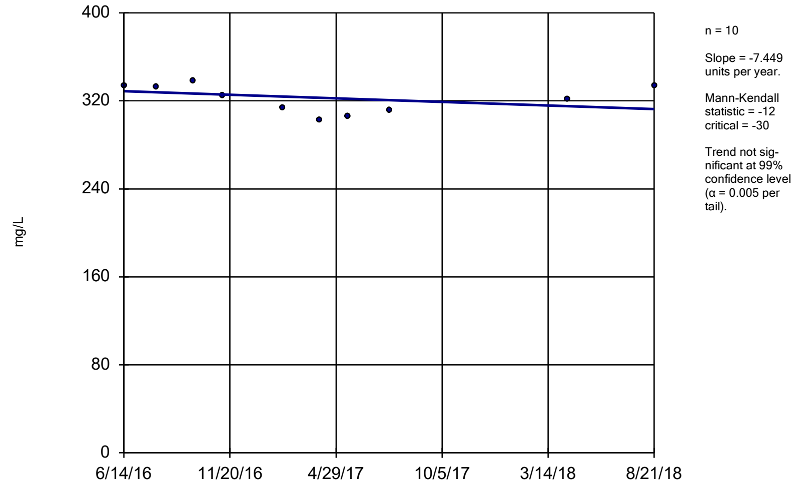

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Sen's Slope Estimator
MW_1504 (bg)
n = 10
Slope = -6.065 units per year.
Mann-Kendall statistic = -16 critical = -30
Trend not significant at 99% confidence level (α = 0.005 per tail).
mg/L
110
88
66
44
22
0
6/13/16
11/20/16
4/29/17
10/6/17
3/15/18
8/22/18
Constituent: Chloride, total Analysis Run 11/11/2018 2:29 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP


Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Sen's Slope Estimator
MW_1508 (bg)
n = 10
Slope = -17.1 units per year.
Mann-Kendall statistic = -27 critical = -30
Trend not significant at 99% confidence level (α = 0.005 per tail).
mg/L
300
240
180
120
60
0
6/14/16
11/20/16
4/29/17
10/5/17
3/14/18
8/21/18
Constituent: Chloride, total Analysis Run 11/11/2018 2:29 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

MW_1510

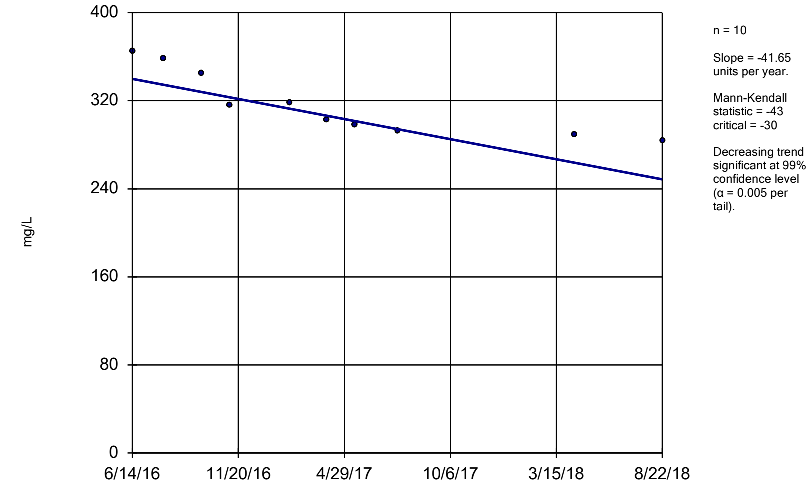


Constituent: Chloride, total Analysis Run 11/11/2018 2:29 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

MW_1505

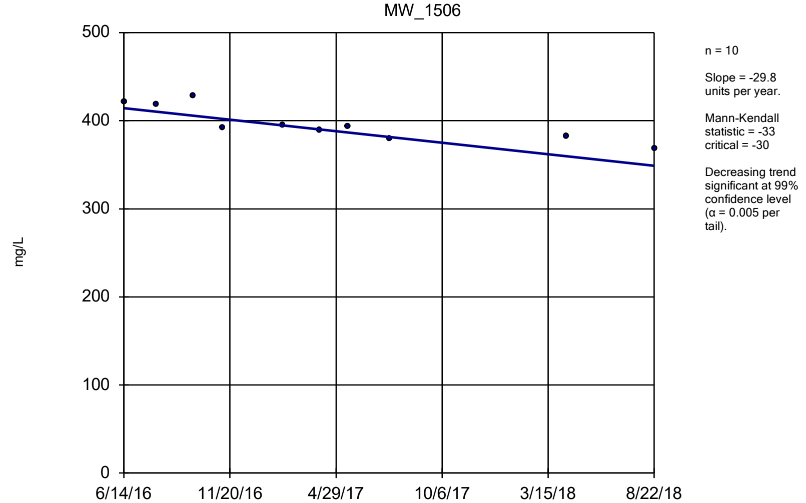


Constituent: Chloride, total Analysis Run 11/11/2018 2:29 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

MW_1506

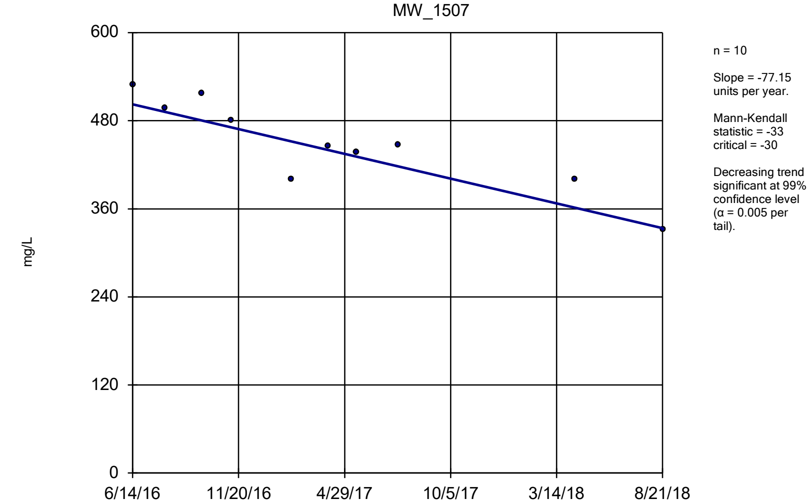


Constituent: Chloride, total Analysis Run 11/11/2018 2:29 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

MW_1507

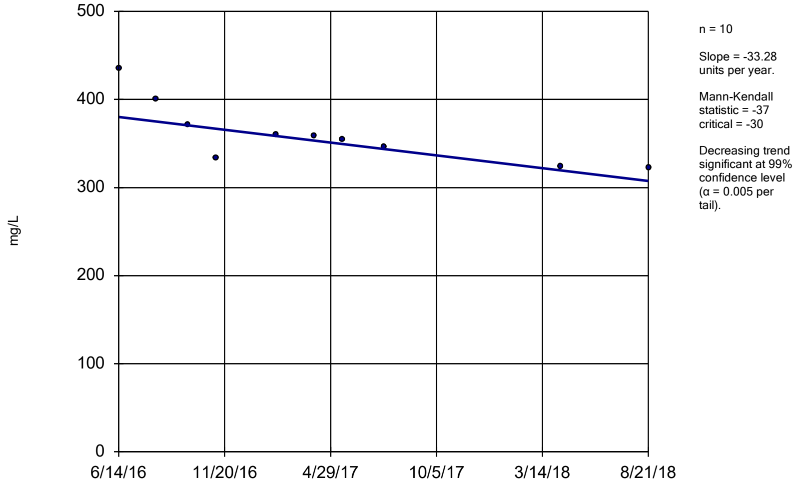


Constituent: Chloride, total Analysis Run 11/11/2018 2:29 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

MW_1509

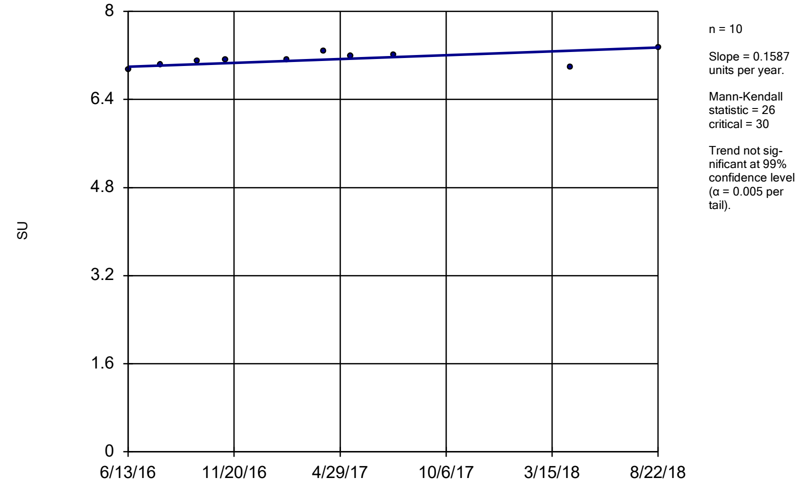


Constituent: Chloride, total Analysis Run 11/11/2018 2:29 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

MW_1504 (bg)

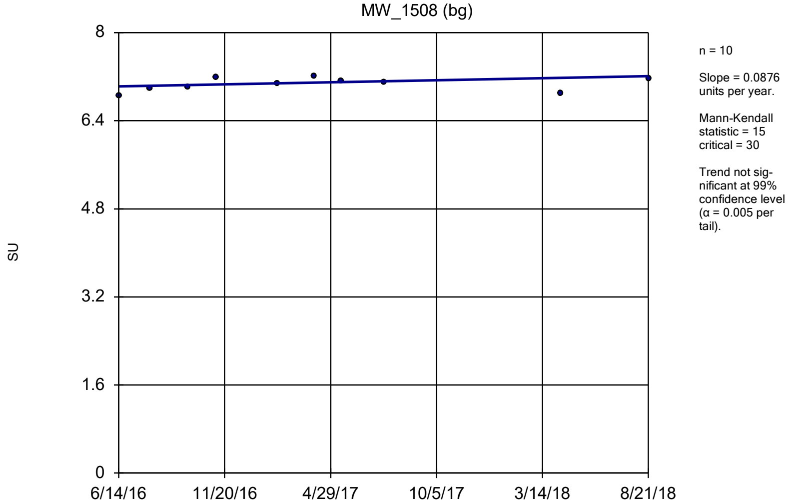


Constituent: pH, field Analysis Run 11/11/2018 2:29 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

MW_1508 (bg)

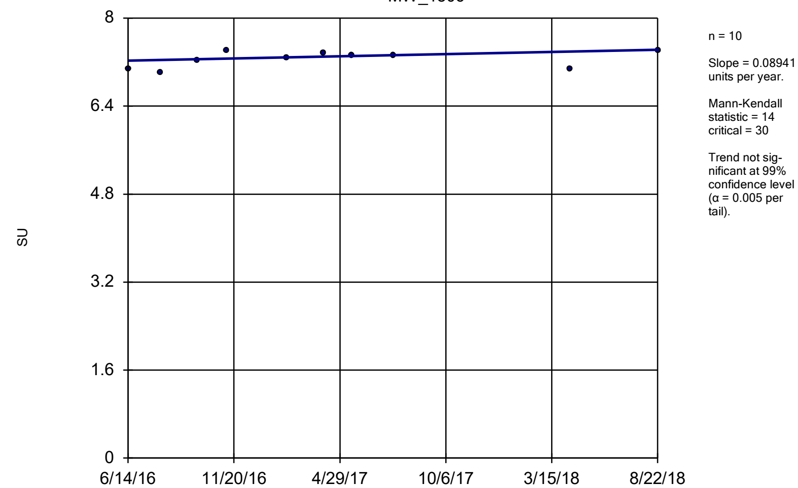


Constituent: pH, field Analysis Run 11/11/2018 2:29 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

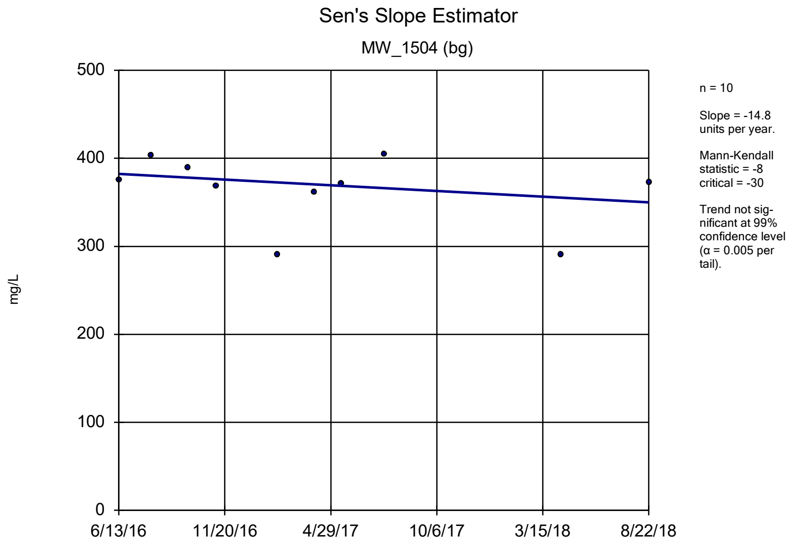
Sen's Slope Estimator

MW_1506



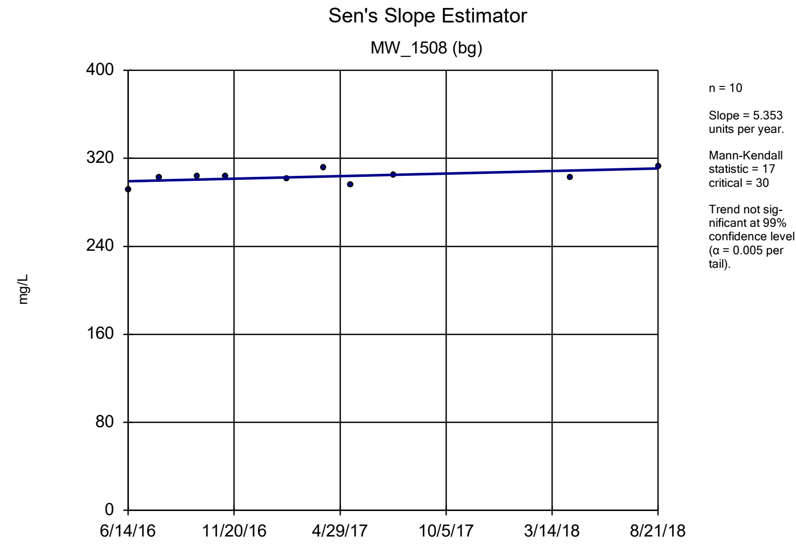
Constituent: pH, field Analysis Run 11/11/2018 2:29 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



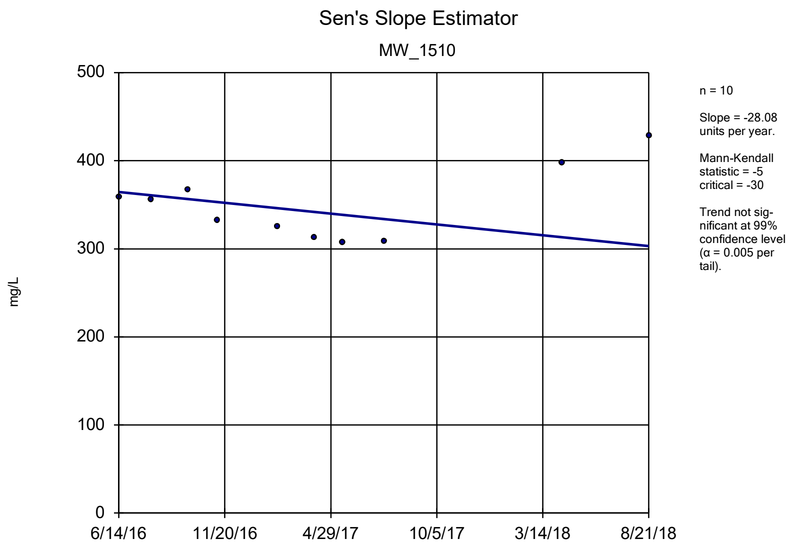
Constituent: Sulfate, total Analysis Run 11/11/2018 2:29 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



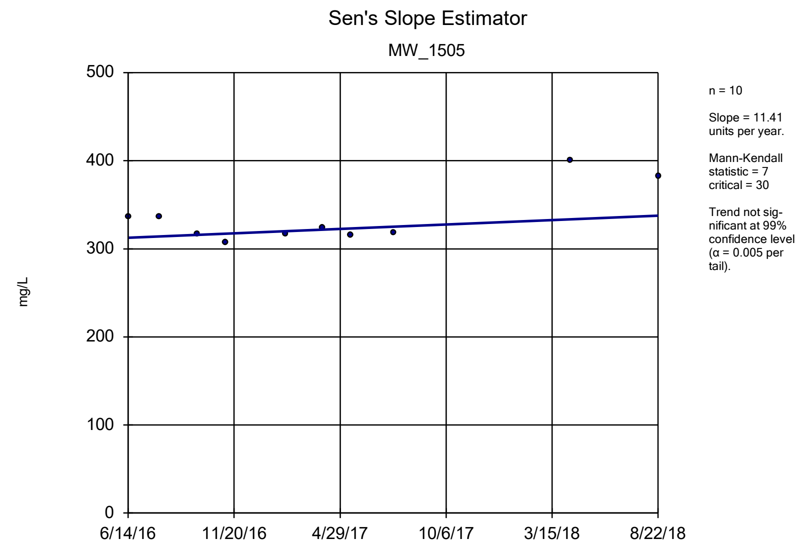
Constituent: Sulfate, total Analysis Run 11/11/2018 2:29 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



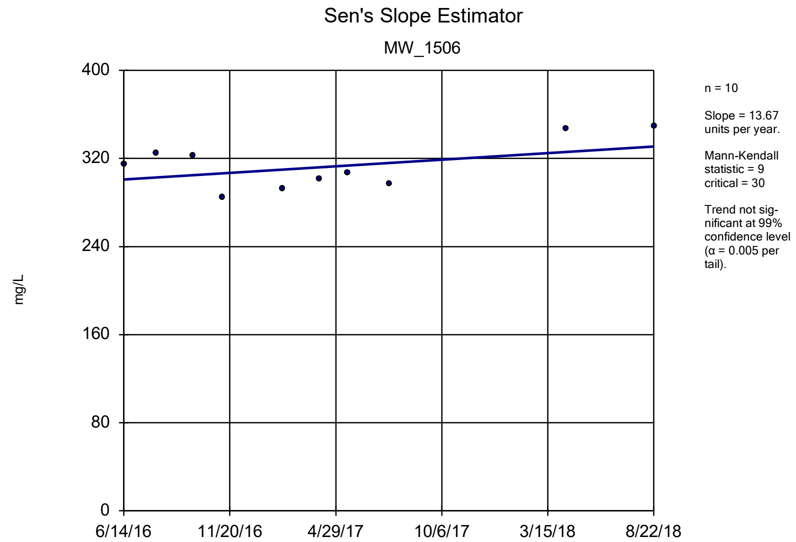
Constituent: Sulfate, total Analysis Run 11/11/2018 2:29 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



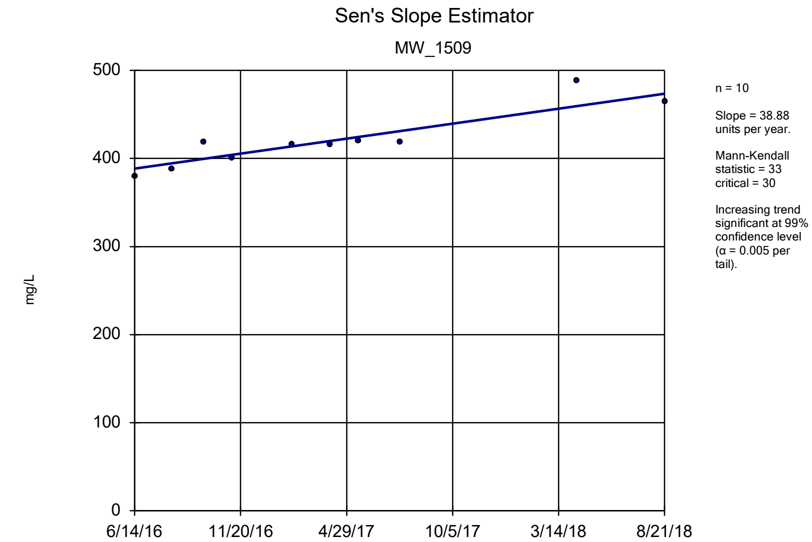
Constituent: Sulfate, total Analysis Run 11/11/2018 2:29 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



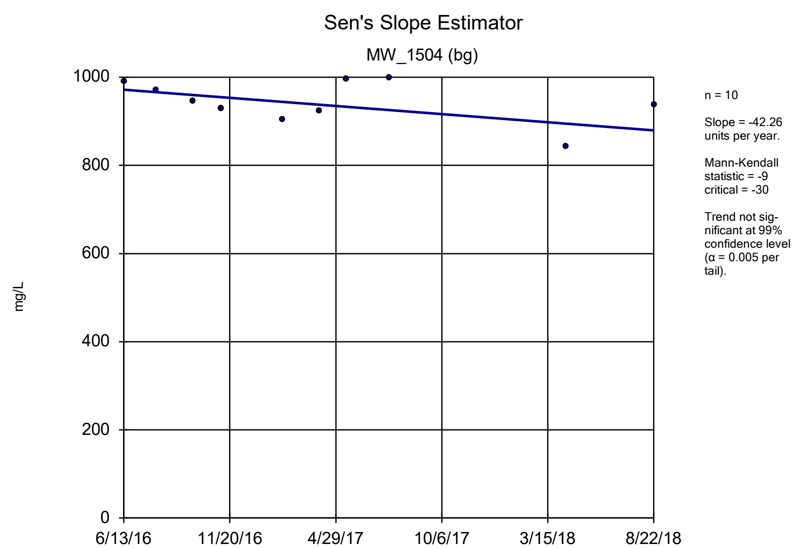
Constituent: Sulfate, total Analysis Run 11/11/2018 2:29 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



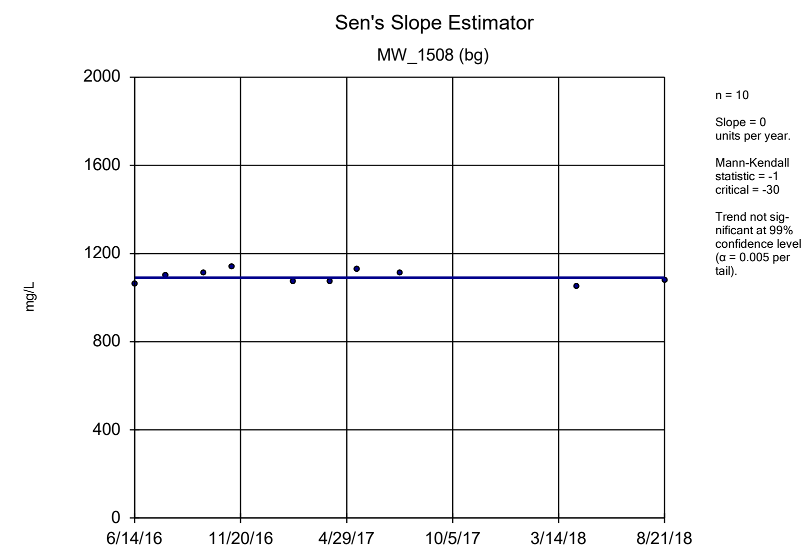
Constituent: Sulfate, total Analysis Run 11/11/2018 2:29 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



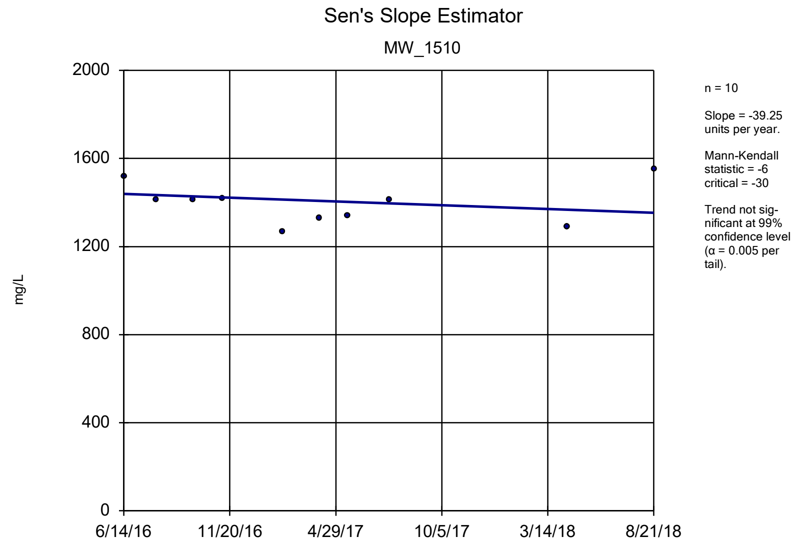
Constituent: Total Dissolved Solids [TDS] Analysis Run 11/11/2018 2:29 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



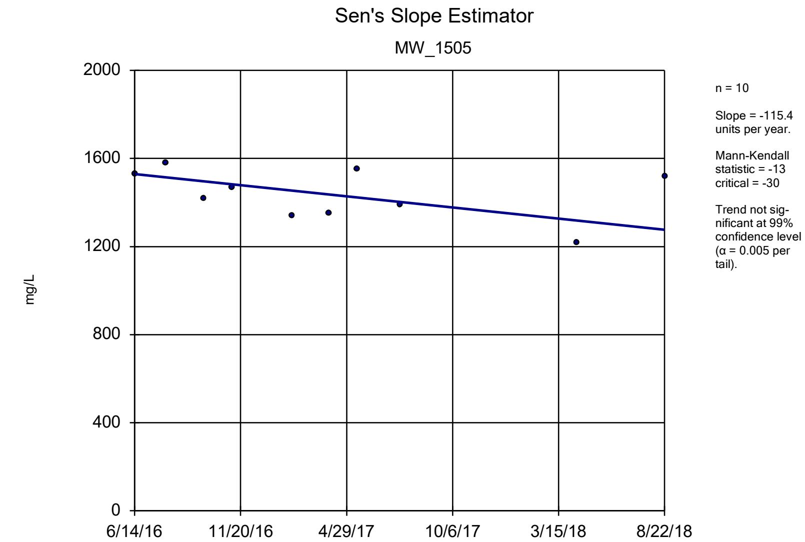
Constituent: Total Dissolved Solids [TDS] Analysis Run 11/11/2018 2:29 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



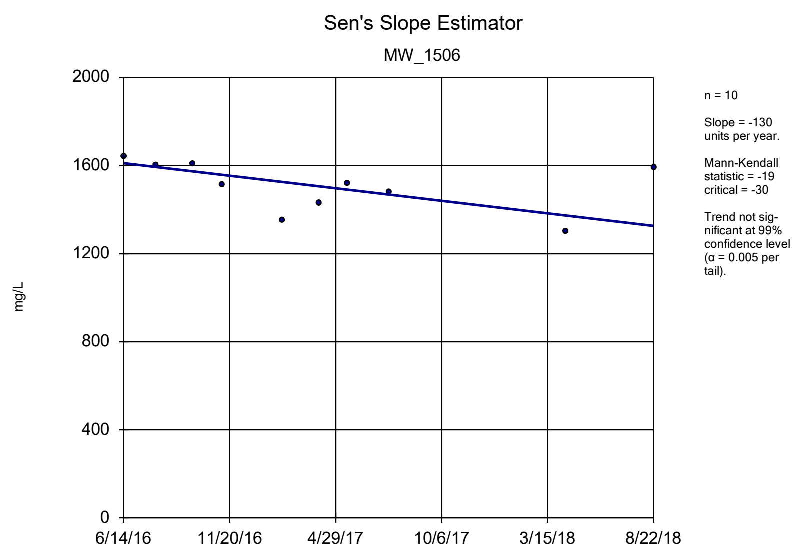
Constituent: Total Dissolved Solids [TDS] Analysis Run 11/11/2018 2:29 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



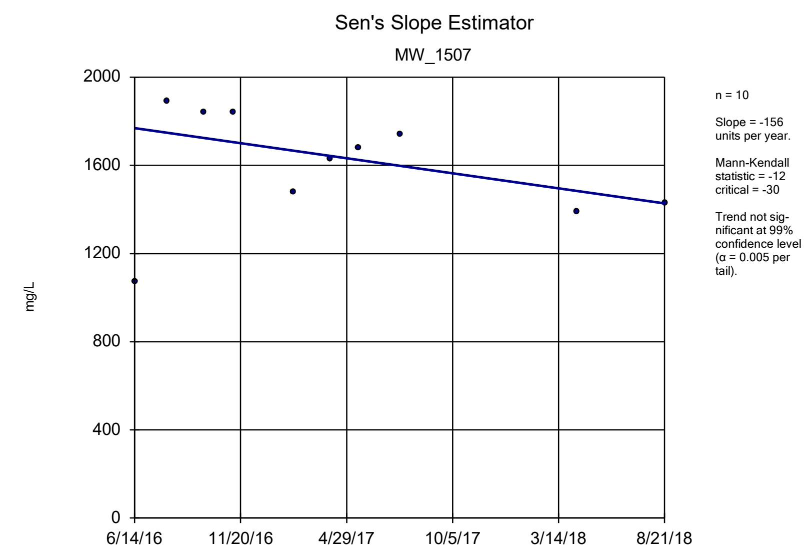
Constituent: Total Dissolved Solids [TDS] Analysis Run 11/11/2018 2:29 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

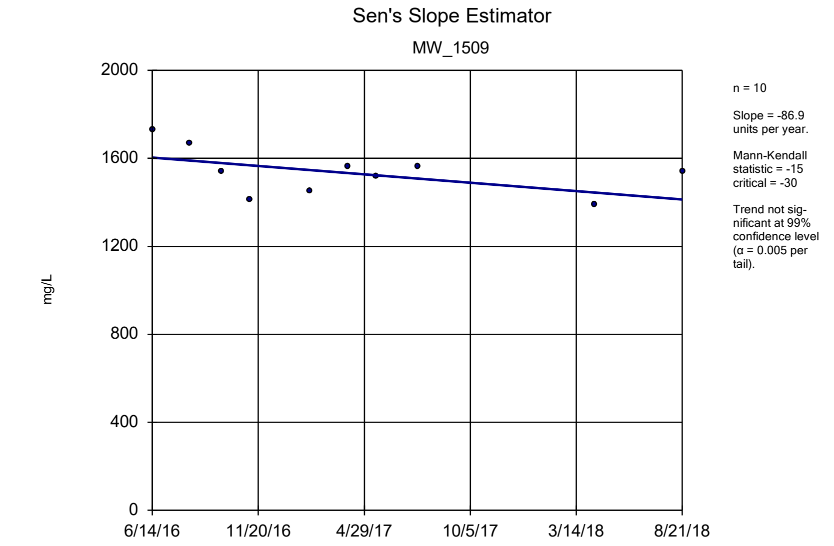


Constituent: Total Dissolved Solids [TDS] Analysis Run 11/11/2018 2:29 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Total Dissolved Solids [TDS] Analysis Run 11/11/2018 2:29 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP



Constituent: Total Dissolved Solids [TDS] Analysis Run 11/11/2018 2:29 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Upper Tolerance Limits

Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP   Printed 11/11/2018, 2:18 PM

Constituent	Well	Upper Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Antimony, total (mg/L)	n/a	0.00009103	20	0.006085	0.001443	5	None	sqrt(x)	0.05	Inter
Arsenic, Total (mg/L)	n/a	0.001745	20	0.0007595	0.0004114	0	None	No	0.05	Inter
Barium, Total (mg/L)	n/a	0.05775	20	0.04322	0.006065	0	None	No	0.05	Inter
Beryllium, total (mg/L)	n/a	0.00007696	20	0.00002304	0.00002251	35	Cohen`s	No	0.05	Inter
Cadmium, total (mg/L)	n/a	0.00009	20	n/a	n/a	0	n/a	n/a	0.3585	NP Inter(normality)
Chromium, total (mg/L)	n/a	0.002346	20	0.0008811	0.0006116	0	None	No	0.05	Inter
Cobalt, total (mg/L)	n/a	0.003159	20	0.00101	0.0008968	0	None	No	0.05	Inter
Combined Radium 226 + 228 (pCi/L)	n/a	2.412	19	0.7433	0.3343	0	None	sqrt(x)	0.05	Inter
Fluoride, total (mg/L)	n/a	0.25	20	n/a	n/a	0	n/a	n/a	0.3585	NP Inter(normality)
Lead, total (mg/L)	n/a	0.004584	20	0.07481	0.0381	0	None	x^(1/3)	0.05	Inter
Lithium, total (mg/L)	n/a	0.01616	20	0.00705	0.003801	10	None	No	0.05	Inter
Mercury, total (mg/L)	n/a	0.000008	20	n/a	n/a	65	n/a	n/a	0.3585	NP Inter(normality)
Molybdenum, total (mg/L)	n/a	0.001907	20	0.02624	0.007275	0	None	sqrt(x)	0.05	Inter
Selenium, Total (mg/L)	n/a	0.0009	20	n/a	n/a	15	n/a	n/a	0.3585	NP Inter(normality)
Thallium, Total (mg/L)	n/a	0.00011	20	n/a	n/a	5	n/a	n/a	0.3585	NP Inter(normality)

Confidence Interval - All Results (No Significant Results)

Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP   Printed 11/11/2018, 2:34 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	%NDs	Transform	Alpha	Method
Antimony, total (mg/L)	MW_1505	0.00008225	0.00003175	0.006	No	10	10	No	0.01	Param.
Antimony, total (mg/L)	MW_1506	0.00007	0.00003	0.006	No	10	0	No	0.011	NP (normality)
Antimony, total (mg/L)	MW_1507	0.0001059	0.00006206	0.006	No	10	0	No	0.01	Param.
Antimony, total (mg/L)	MW_1509	0.00003	0.00002	0.006	No	10	0	No	0.011	NP (normality)
Arsenic, Total (mg/L)	MW_1505	0.001934	0.0004216	0.01	No	10	0	sqrt(x)	0.01	Param.
Arsenic, Total (mg/L)	MW_1506	0.001231	0.0005935	0.01	No	10	0	No	0.01	Param.
Arsenic, Total (mg/L)	MW_1507	0.003494	0.001078	0.01	No	10	0	No	0.01	Param.
Arsenic, Total (mg/L)	MW_1509	0.0005793	0.0003707	0.01	No	10	0	No	0.01	Param.
Barium, Total (mg/L)	MW_1505	0.0633	0.0455	2	No	10	0	No	0.011	NP (normality)
Barium, Total (mg/L)	MW_1506	0.06622	0.0541	2	No	10	0	No	0.01	Param.
Barium, Total (mg/L)	MW_1507	0.09293	0.06433	2	No	10	0	No	0.01	Param.
Barium, Total (mg/L)	MW_1509	0.06364	0.05608	2	No	10	0	No	0.01	Param.
Beryllium, total (mg/L)	MW_1505	0.000091	0.000006	0.004	No	10	20	No	0.011	NP (Cohens/xfrm)
Beryllium, total (mg/L)	MW_1506	0.00003432	0.00001088	0.004	No	10	0	No	0.01	Param.
Beryllium, total (mg/L)	MW_1507	0.0001509	0.00003606	0.004	No	10	0	No	0.01	Param.
Beryllium, total (mg/L)	MW_1509	0.00001	0.000005	0.004	No	10	60	No	0.011	NP (normality)
Cadmium, total (mg/L)	MW_1505	0.00003	0.00002	0.005	No	10	0	No	0.011	NP (normality)
Cadmium, total (mg/L)	MW_1506	0.00004	0.00002	0.005	No	10	0	No	0.011	NP (normality)
Cadmium, total (mg/L)	MW_1507	0.00007	0.00003	0.005	No	10	0	No	0.011	NP (normality)
Cadmium, total (mg/L)	MW_1509	0.00002294	0.00001051	0.005	No	10	0	sqrt(x)	0.01	Param.
Chromium, total (mg/L)	MW_1505	0.01444	0.001413	0.1	No	10	0	sqrt(x)	0.01	Param.
Chromium, total (mg/L)	MW_1506	0.003385	0.001108	0.1	No	10	0	No	0.01	Param.
Chromium, total (mg/L)	MW_1507	0.01698	0.005854	0.1	No	10	0	No	0.01	Param.
Chromium, total (mg/L)	MW_1509	0.001897	0.00055	0.1	No	10	0	ln(x)	0.01	Param.
Cobalt, total (mg/L)	MW_1505	0.00144	0.0002788	0.006	No	10	0	sqrt(x)	0.01	Param.
Cobalt, total (mg/L)	MW_1506	0.0009874	0.000423	0.006	No	10	0	No	0.01	Param.
Cobalt, total (mg/L)	MW_1507	0.003528	0.001093	0.006	No	10	0	No	0.01	Param.
Cobalt, total (mg/L)	MW_1509	0.0004193	0.0001687	0.006	No	10	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	MW_1505	1.236	0.466	5	No	10	0	No	0.011	NP (normality)
Combined Radium 226 + 228 (pCi/L)	MW_1506	1.462	0.3149	5	No	10	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	MW_1507	2.09	0.521	5	No	10	0	No	0.011	NP (normality)
Combined Radium 226 + 228 (pCi/L)	MW_1509	1.68	0.3969	5	No	10	0	No	0.01	Param.
Fluoride, total (mg/L)	MW_1505	0.1	0.02	4	No	10	90	No	0.011	NP (NDs)
Fluoride, total (mg/L)	MW_1506	0.1	0.05	4	No	10	70	No	0.011	NP (normality)
Fluoride, total (mg/L)	MW_1507	0.07	0.05	4	No	10	10	No	0.011	NP (normality)
Fluoride, total (mg/L)	MW_1509	0.16	0.1	4	No	10	0	No	0.011	NP (normality)
Lead, total (mg/L)	MW_1505	0.001631	0.0001178	0.015	No	10	0	sqrt(x)	0.01	Param.
Lead, total (mg/L)	MW_1506	0.0008323	0.0002951	0.015	No	10	0	No	0.01	Param.
Lead, total (mg/L)	MW_1507	0.00358	0.0008556	0.015	No	10	0	No	0.01	Param.
Lead, total (mg/L)	MW_1509	0.00014	0.00001278	0.015	No	10	0	sqrt(x)	0.01	Param.
Lithium, total (mg/L)	MW_1505	0.01226	0.00594	0.04	No	10	0	No	0.01	Param.
Lithium, total (mg/L)	MW_1506	0.01512	0.008684	0.04	No	10	0	No	0.01	Param.
Lithium, total (mg/L)	MW_1507	0.01961	0.01119	0.04	No	10	0	No	0.01	Param.
Lithium, total (mg/L)	MW_1509	0.018	0.007779	0.04	No	10	0	No	0.01	Param.
Mercury, total (mg/L)	MW_1505	0.000006	0.000002	0.002	No	10	60	No	0.011	NP (normality)
Mercury, total (mg/L)	MW_1506	0.000003	0.000002	0.002	No	10	40	No	0.011	NP (normality)
Mercury, total (mg/L)	MW_1507	0.00001513	0.000002669	0.002	No	10	0	No	0.01	Param.
Mercury, total (mg/L)	MW_1509	0.0000025	0.000002	0.002	No	10	80	No	0.011	NP (NDs)
Molybdenum, total (mg/L)	MW_1505	0.002746	0.0007789	0.1	No	10	0	ln(x)	0.01	Param.
Molybdenum, total (mg/L)	MW_1506	0.001095	0.0005189	0.1	No	10	0	No	0.01	Param.
Molybdenum, total (mg/L)	MW_1507	0.00628	0.0009915	0.1	No	10	0	sqrt(x)	0.01	Param.
Molybdenum, total (mg/L)	MW_1509	0.00104	0.0004104	0.1	No	10	0	No	0.01	Param.
Selenium, Total (mg/L)	MW_1505	0.0007336	0.0003064	0.05	No	10	0	No	0.01	Param.
Selenium, Total (mg/L)	MW_1506	0.0002	0.00007	0.05	No	10	20	No	0.011	NP (normality)
Selenium, Total (mg/L)	MW_1507	0.0005199	0.0001561	0.05	No	10	0	No	0.01	Param.

Confidence Interval - All Results (No Significant Results)

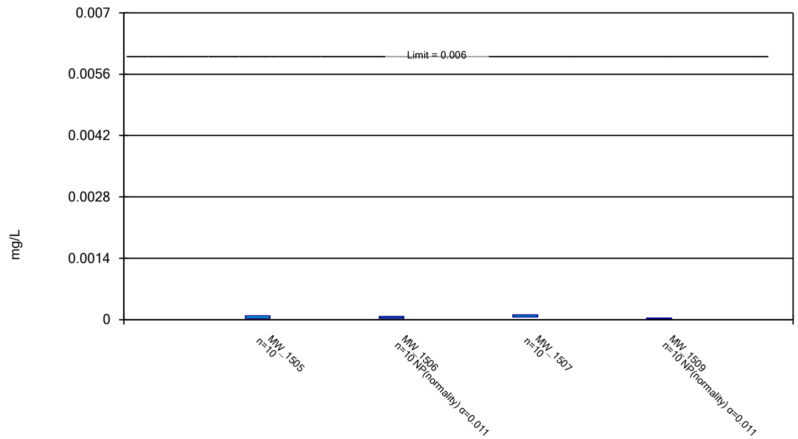
Mitchell BAP Client: Geosyntec Data: Mitchell BAP Printed 11/11/2018, 2:34 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	%NDs	Transform	Alpha	Method
Selenium, Total (mg/L)	MW_1509	0.0002	0.00009	0.05	No	10	0	No	0.011	NP (normality)
Thallium, Total (mg/L)	MW_1505	0.00009253	0.00006324	0.002	No	9	0	No	0.01	Param.
Thallium, Total (mg/L)	MW_1506	0.00006437	0.00004763	0.002	No	10	0	No	0.01	Param.
Thallium, Total (mg/L)	MW_1507	0.00007913	0.00004927	0.002	No	10	0	No	0.01	Param.
Thallium, Total (mg/L)	MW_1509	0.00005	0.00003	0.002	No	10	0	No	0.011	NP (normality)

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

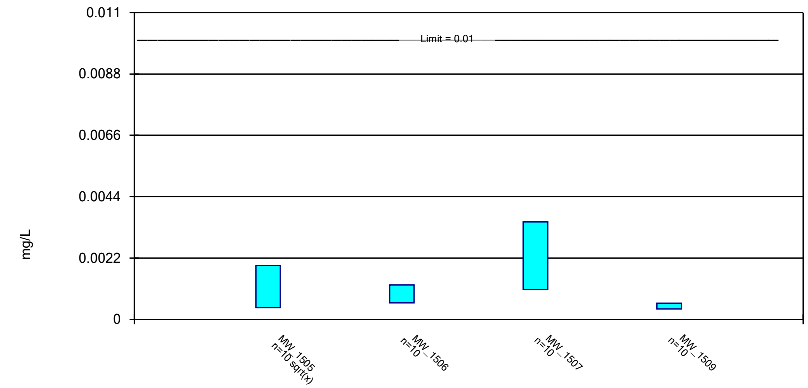


Constituent: Antimony, total Analysis Run 11/11/2018 2:32 PM View: Confidence Intervals - Appendix IV
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

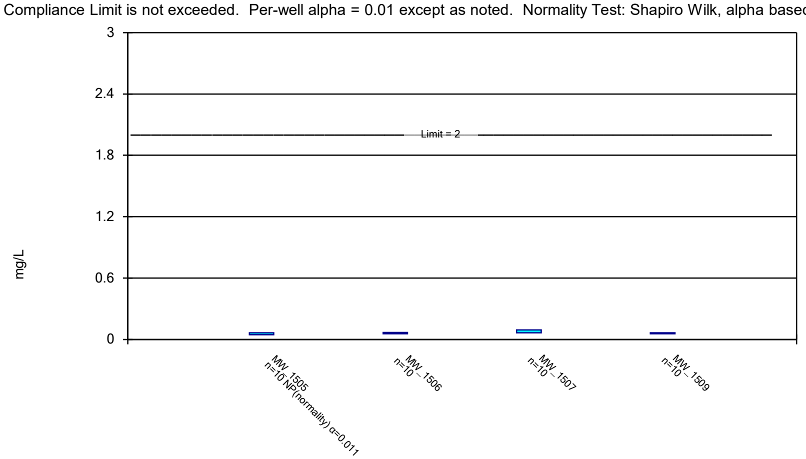


Constituent: Arsenic, Total Analysis Run 11/11/2018 2:32 PM View: Confidence Intervals - Appendix IV
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

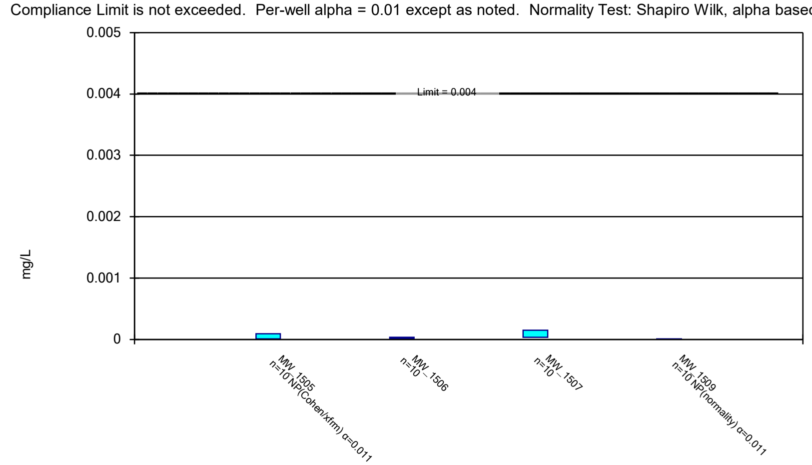


Constituent: Barium, Total Analysis Run 11/11/2018 2:32 PM View: Confidence Intervals - Appendix IV
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

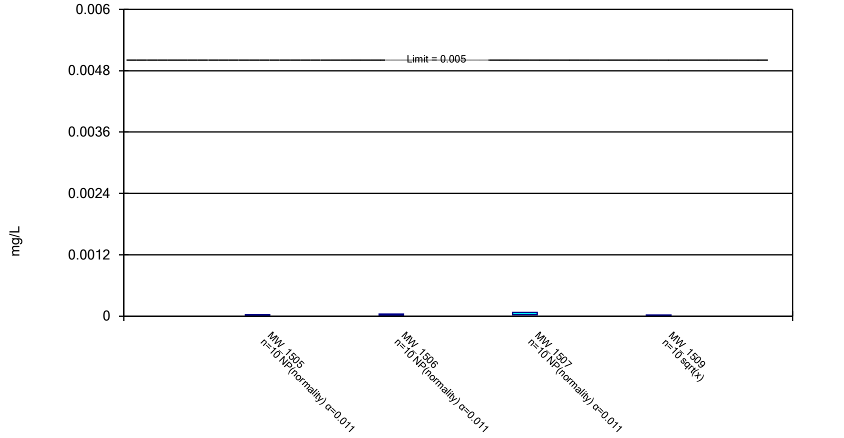


Constituent: Beryllium, total Analysis Run 11/11/2018 2:32 PM View: Confidence Intervals - Appendix IV
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

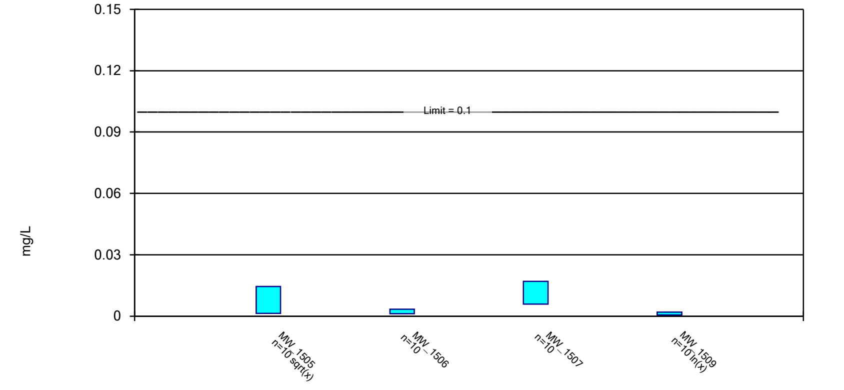


Constituent: Cadmium, total Analysis Run 11/11/2018 2:32 PM View: Confidence Intervals - Appendix IV
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

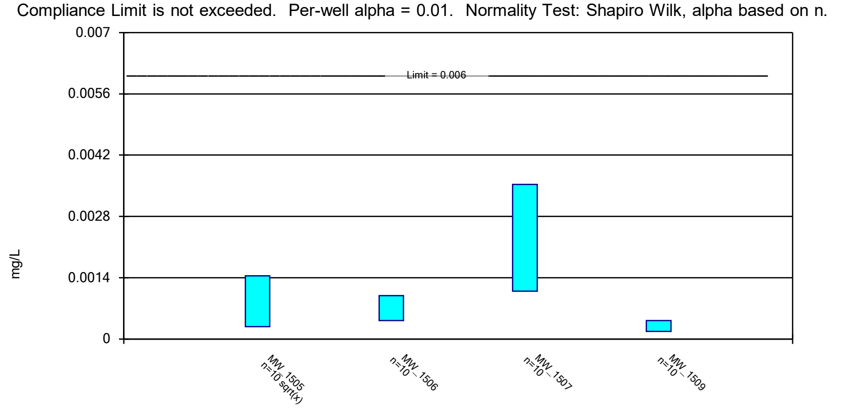


Constituent: Chromium, total Analysis Run 11/11/2018 2:32 PM View: Confidence Intervals - Appendix IV
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

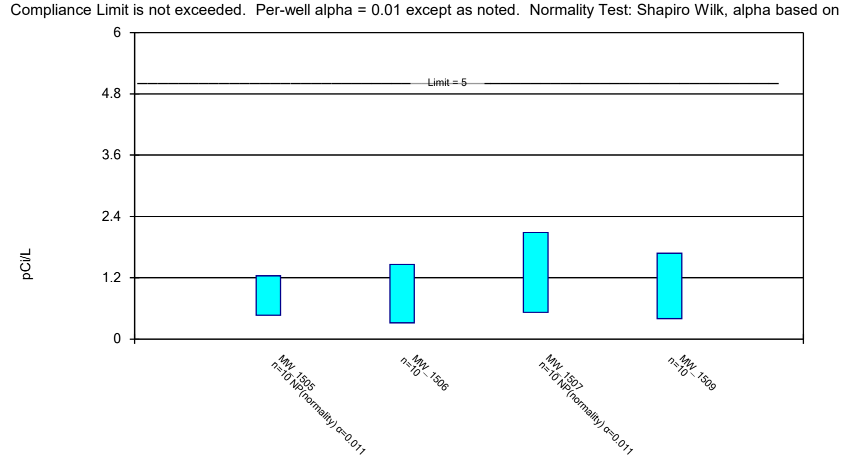


Constituent: Cobalt, total Analysis Run 11/11/2018 2:32 PM View: Confidence Intervals - Appendix IV
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

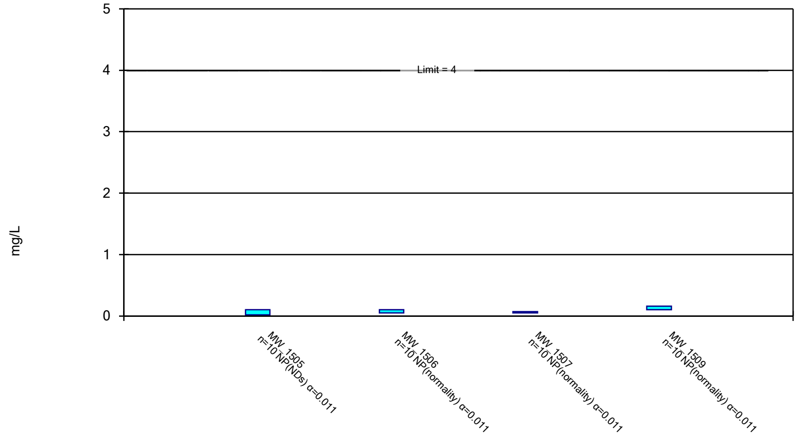


Constituent: Combined Radium 226 + 228 Analysis Run 11/11/2018 2:32 PM View: Confidence Intervals -
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.

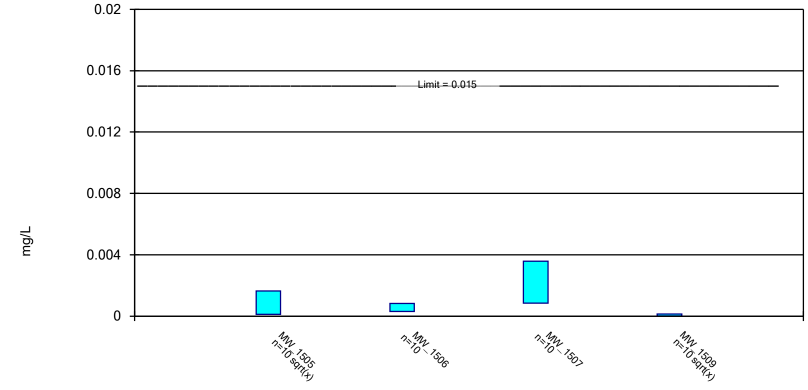


Constituent: Fluoride, total   Analysis Run 11/11/2018 2:32 PM   View: Confidence Intervals - Appendix IV
Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

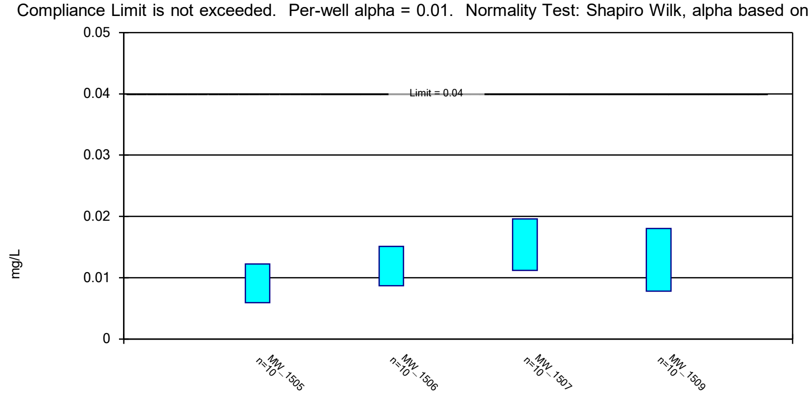


Constituent: Lead, total   Analysis Run 11/11/2018 2:32 PM   View: Confidence Intervals - Appendix IV
Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

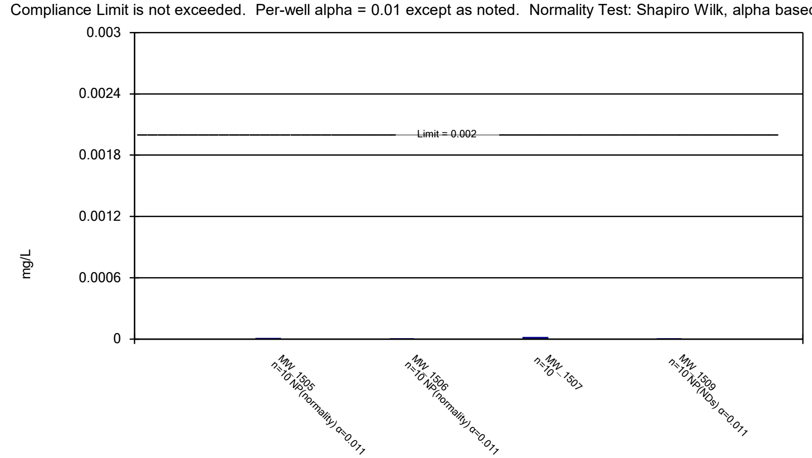


Constituent: Lithium, total   Analysis Run 11/11/2018 2:32 PM   View: Confidence Intervals - Appendix IV
Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

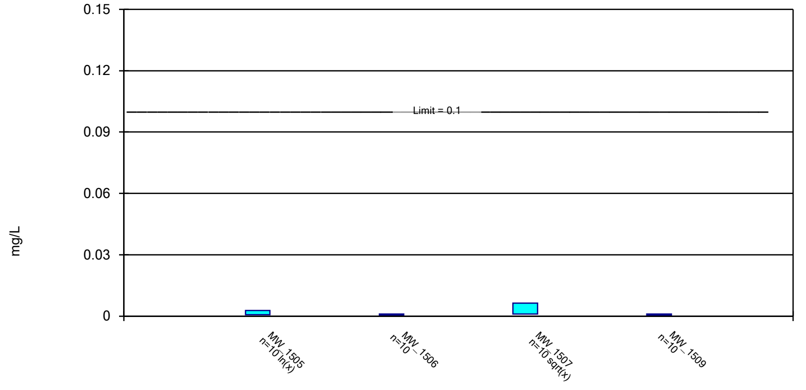


Constituent: Mercury, total   Analysis Run 11/11/2018 2:33 PM   View: Confidence Intervals - Appendix IV
Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

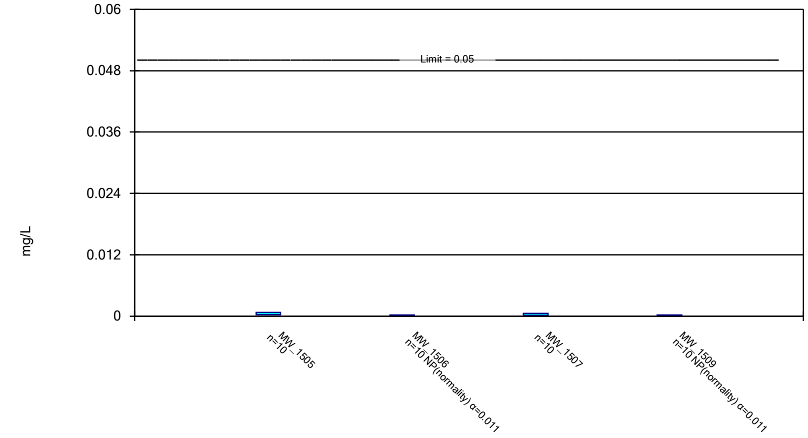


Constituent: Molybdenum, total   Analysis Run 11/11/2018 2:33 PM   View: Confidence Intervals - Appendix I
Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

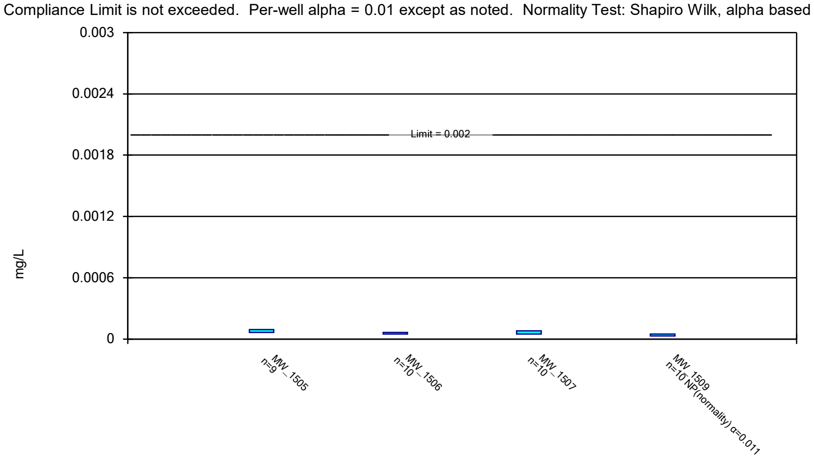


Constituent: Selenium, Total   Analysis Run 11/11/2018 2:33 PM   View: Confidence Intervals - Appendix IV
Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Thallium, Total   Analysis Run 11/11/2018 2:33 PM   View: Confidence Intervals - Appendix IV
Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP

STATISTICAL ANALYSIS SUMMARY
BOTTOM ASH POND
Mitchell Plant
Moundsville, West Virginia

Submitted to

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

engineers | scientists | innovators

941 Chatham Lane
Suite 103
Columbus, Ohio 43221

July 10, 2019

CHA8473

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LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ASD	Alternative Source Demonstration
BAP	Bottom Ash Pond
CCR	Coal Combustion Residuals
CCV	Continuing Calibration Verification
CFR	Code of Federal Regulations
GWPS	Groundwater Protection Standard
LCL	Lower Confidence Limit
LFB	Laboratory Fortified Blanks
LRB	Laboratory Reagent Blanks
MCL	Maximum Contaminant Level
NELAP	National Environmental Laboratory Accreditation Program
QA	Quality Assurance
QC	Quality Control
RSL	Regional Screening Level
SSI	Statistically Significant Increase
SSL	Statistically Significant Level
TDS	Total Dissolved Solids
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency
UTL	Upper Tolerance Limit

SECTION 1

EXECUTIVE SUMMARY

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257.90-257.98, "CCR rule"), groundwater monitoring has been conducted at the Bottom Ash Pond (BAP), an existing CCR unit at the Mitchell Power Plant located in Moundsville, West Virginia.

Based on detection monitoring conducted in 2017 and 2018, statistically significant increases (SSIs) over background were concluded for boron, calcium, chloride, and total dissolved solids (TDS and sulfate at the BAP. An alternative source was not identified at the time, so two assessment monitoring events were conducted at the BAP in 2018, in accordance with 40 CFR 257.95. No SSLs were identified and so the unit remained in assessment monitoring. A semi-annual assessment monitoring event was also completed in May 2019, with the results of the May 2019 event documented in this report.

Groundwater data underwent several validation tests, including those for completeness, sample tracking accuracy, transcription errors, and consistent use of measurement units. No data quality issues were identified which would impact the usability of the data.

The monitoring data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. Groundwater protection standards (GWPSs) were re-established for the Appendix IV parameters. Confidence intervals were calculated for Appendix IV parameters at the compliance wells to assess whether Appendix IV parameters were present at a statistically significant level (SSL) above the GWPS. No SSLs were identified, but Appendix III concentrations for boron, calcium, chloride, pH, sulfate, and TDS remained above background. Thus, either the unit will remain in assessment monitoring or an alternative source demonstration (ASD) will be conducted to evaluate if the unit can return to detection monitoring. Certification of the selected statistical methods by a qualified professional engineer is documented in Attachment A.

SECTION 2

BOTTOM ASH POND EVALUATION

2.1 Data Validation & QA/QC

During the assessment monitoring program, one set of samples was collected for analysis from each upgradient and downgradient well to meet the requirements of 40 CFR 257.95(d)(1). Samples from the May 2019 semi-annual sampling event were analyzed for the Appendix III and Appendix IV parameters. A summary of data collected during this assessment monitoring event may be found in Table 1.

Chemical analysis was completed by an analytical laboratory certified by the National Environmental Laboratory Accreditation Program (NELAP). Quality assurance and quality control (QA/QC) samples completed by the analytical laboratory included the use of laboratory reagent blanks (LRBs), continuing calibration verification (CCV) samples, and laboratory fortified blanks (LFBs).

The analytical data were imported into a Microsoft Access database, where checks were completed to assess the accuracy of sample location identification and analyte identification. Where necessary, unit conversions were applied to standardize reported units across all sampling events. Exported data files were created for use with the Sanitas™ v.9.6.14 statistics software. The export file was checked against the analytical data for transcription errors and completeness. No QA/QC issues were noted which would impact data usability.

2.2 Statistical Analysis

Statistical analyses for the BAP were conducted in accordance with the January 2017 *Statistical Analysis Plan* (AEP, 2017), except where noted below. Time series plots and results for all completed statistical tests are provided in Attachment B.

The data obtained to meet the requirements of 40 CFR 257.95(d)(1) were screened for potential outliers. No outliers were identified.

2.2.1 Establishment of GWPSs

A GWPS was established for each Appendix IV parameter in accordance with 40 CFR 257.95(h) and the *Statistical Analysis Plan* (AEP, 2017). The established GWPS was determined to be the greater value of the background concentration and the maximum contaminant level (MCL) or risk-based level specified in 40 CFR 257.95(h)(2) for each Appendix IV parameter. To determine background concentrations, an upper tolerance limit (UTL) was calculated using pooled data from the background wells collected during the background monitoring and assessment monitoring events. Generally, tolerance limits were calculated parametrically with 95% coverage and 95% confidence. Non-parametric tolerance limits were calculated for beryllium, cadmium, fluoride, mercury, and thallium due to apparent non-normal distributions. Tolerance limits and the final GWPSs are summarized in Table 2.

2.2.2 Evaluation of Potential Appendix IV SSLs

A confidence interval was constructed for each Appendix IV parameter at each compliance well. Confidence limits were generally calculated parametrically ($\alpha = 0.01$); however, non-parametric confidence limits were calculated in some cases (e.g., when the data did not appear to be normally distributed or when the non-detect frequency was too high). An SSL was concluded if the lower confidence limit (LCL) exceeded the GWPS (i.e., if the entire confidence interval exceeded the GWPS). Calculated confidence limits are shown in Attachment B.

No SSLs were identified at the Mitchell BAP.

2.2.3 Evaluation of Potential Appendix III SSIs

The CCR rule allows CCR units to move from assessment monitoring to detection monitoring if all Appendix III and Appendix IV parameters were at or below background levels for two consecutive sampling events [40 CFR 257.95(e)]. Since no Appendix IV SSLs were identified, Appendix III results were analyzed to assess whether concentrations of Appendix III parameters at the compliance wells exceeded background concentrations.

Prediction limits were calculated for the Appendix III parameters to represent background values. As described in the January 2018 *Statistical Analysis Summary* report (Geosyntec, 2018), intrawell tests were used to evaluate potential SSIs for fluoride and sulfate, whereas interwell tests were used to evaluate potential SSIs for boron, calcium, chloride, pH, and TDS.

Prediction limits for the interwell tests were recalculated using data collected during the May 2019 assessment monitoring event. Six data points (i.e., one sample from six background wells) were added to the background dataset for each interwell test. New data were tested for outliers prior to being added to the background dataset. The updated prediction limits were calculated for a one-of-two retesting procedure, as during detection monitoring. The values of the updated prediction limits were similar to the values of the prediction limits calculated during detection monitoring. The revised interwell prediction limits were used to evaluate potential SSIs for boron, calcium, chloride, pH, and TDS.

For the intrawell tests, limited data made it possible to add only one data point (i.e., one sample from each compliance well) to each background dataset. Because one sample result is insufficient to compare against the existing background dataset, the prediction limits were not updated for the intrawell tests at this time. The intrawell prediction limits calculated during detection monitoring were used to evaluate potential SSIs for fluoride and sulfate.

Data collected during the August 2018 and May 2019 assessment monitoring events from each compliance well were compared to the prediction limits to evaluate results above background values. The results from this event and the prediction limits are summarized in Table 3. The following exceedances of the upper prediction limits (UPLs) were noted:

- Boron concentrations exceeded the interwell UPL of 1.36 mg/L at MW-1505 (8.00 mg/L and 7.31 mg/L), MW-1506 (5.91 mg/L and 5.24 mg/L), MW-1507 (9.29 mg/L and 8.36 mg/L), MW-1509 (6.97 mg/L and 8.36 mg/L), and MW-1510 (9.13 mg/L and 8.83 mg/L).

- Calcium concentrations exceeded the interwell UPL of 240 mg/L at MW-1505 (274 mg/L and 287 mg/L), MW-1505 (270 mg/L and 280 mg/L), MW-1507 (272 mg/L and 271 mg/L), MW-1509 (279 mg/L and 287 mg/L), and MW-1510 (268 mg/L and 287 mg/L).

- Chloride concentrations exceeded the interwell UPL of 238 mg/L at MW-1505 (284 mg/L and 285 mg/L), MW-1506 (369 mg/L and 331 mg/L), MW 1507 (331 mg/L and 296 mg/L), MW-1509 (323 mg/L and 328 mg/L), and MW-1510 (334 mg/L and 325 mg/L).

- The pH result exceeded the interwell UPL of 8.2 SU at MW-1509 (8.5 SU).

- Sulfate concentrations exceeded the intrawell UPL of 351 mg/L at MW-1505 (383 mg/L and 408 mg/L), the intrawell UPL of 345 mg/L at MW-1506 (349 mg/L and 347 mg/L), the intrawell UPL of 450 mg/L at MW-1509 (465 mg/L), and the intrawell UPL of 399 mg/L at MW-1510 (428 mg/L and 467 mg/L).

- TDS concentrations exceeded the interwell UPL of 1182 mg/L at MW-1505 (1520 mg/L and 1580 mg/L), MW-1506 (1590 mg/L and 1360 mg/L), MW-1507 (1430 mg/L and 1270 mg/L), MW-1509 (1540 mg/L and 1480 mg/L), and MW-1510 (1550 mg/L and 1460 mg/L).

Based on these results, concentrations of Appendix III parameters exceeded background levels at compliance wells at the Mitchell BAP during assessment monitoring. As a result, the Mitchell BAP CCR unit will remain in assessment monitoring.

2.3 Conclusions

A semi-annual assessment monitoring event was conducted in accordance with the CCR Rule. The laboratory and field data were reviewed prior to statistical analysis, with no QA/QC issues identified that impacted data usability. A review of outliers identified no potential outliers in the May 2019 data. GWPSs were re-established for the Appendix IV parameters. A confidence interval was constructed at each compliance well for each Appendix IV parameter; SSLs were concluded if the entire confidence interval exceeded the GWPS. No SSLs were identified.

The Appendix III results were evaluated to assess whether concentrations of Appendix III parameters exceeded background levels. Interwell tests were used to evaluate potential SSIs for boron, calcium, chloride, pH, and TDS, and intrawell tests were used to evaluate potential SSIs for fluoride and sulfate. The prediction limits for the interwell tests were updated with additional data collected from the background wells. Prediction limits were recalculated using a one-of-two retesting procedure. The prediction limits calculated during detection monitoring were used for the intrawell tests. Boron, calcium, chloride, pH, sulfate, and TDS results exceeded background levels.

Based on this evaluation, either the Mitchell BAP CCR unit will remain in assessment monitoring or an ASD will be conducted to evaluate if the unit can return to detection monitoring.

SECTION 3

REFERENCES

American Electric Power (AEP). 2017. Statistical Analysis Plan – Mitchell Plant. January 2017.

Geosyntec Consultants (Geosyntec). 2018. Statistical Analysis Summary – Bottom Ash Pond, Mitchell Plant, Moundsville, West Virginia. January 15, 2018.

TABLES

Table 1 - Groundwater Data Summary
Mitchell Plant - Bottom Ash Pond

Parameter	Unit	MW-1504	MW-1505	MW-1506	MW-1507	MW-1508	MW-1509	MW-1510
		5/1/2019	5/1/2019	5/1/2019	5/1/2019	5/1/2019	5/1/2019	5/1/2019
Antimony	µg/L	0.100 U	0.0300 J	0.0300 J	0.0300 J	0.0300 J	0.0300 J	0.0200 J
Arsenic	µg/L	0.220	0.290	0.340	0.430	0.600	0.330	0.290
Barium	µg/L	36.4	48.7	53.5	53.9	37.4	47.2	41.7
Beryllium	µg/L	0.100 U	0.100 U	0.100 U	0.100 U	0.0200 J	0.100 U	0.100 U
Boron	mg/L	0.0500 J	7.31	5.24	8.36	0.622	8.73	8.83
Cadmium	µg/L	0.0300 J	0.0300 J	0.0200 J	0.0300 J	0.0300 J	0.0100 J	0.0500 U
Calcium	mg/L	220	287	280	271	221	287	287
Chloride	mg/L	81.8	285	331	296	178	328	325
Chromium	µg/L	0.305	0.665	0.752	2.35	0.735	2.28	1.75
Cobalt	µg/L	0.0710	0.199	0.256	0.331	0.637	0.324	0.172
Combined Radium	pCi/L	0.675	0.240	0.188	0.496	0.636	0.408	0.573
Fluoride	mg/L	0.170	0.0600 U	0.0300 J	0.0700	0.0800	0.130	0.100
Lead	µg/L	0.0200 J	0.0700 J	0.135	0.239	0.540	0.114	0.105
Lithium	mg/L	0.0300 U	0.0300 U	0.0200 J	0.0300 U	0.0300 U	0.0300 U	0.0100 J
Mercury	mg/L	0.00500 U	0.00500 U	0.00500 U	0.00500 U	0.00500 U	0.00500 U	0.00500 U
Molybdenum	µg/L	2.00 U	0.600 J	2.00 J	1.00 J	2.00 U	2.00 U	2.00 U
Selenium	µg/L	0.200 U	0.900	0.0700 J	0.0700 J	0.300	0.200 J	0.200 J
Total Dissolved Solids	mg/L	926	1580	1360	1270	978	1480	1460
Sulfate	mg/L	317	408	347	346	287	429	467
Thallium	µg/L	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U
pH	SU	8.01	7.80	7.87	8.04	8.18	8.45	8.11

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Non-detect value. For statistical analysis, parameters which were not detected were replaced with the reporting limit.
J: Estimated value. Parameter was detected in concentrations below the reporting limit.
-: Not sampled

Table 2: Groundwater Protection Standards
Mitchell Plant - Bottom Ash Pond

Constituent Name	MCL	CCR Rule-Specified	Background Limit
Antimony, Total (mg/L)	0.006		0.000068
Arsenic, Total (mg/L)	0.01		0.0017
Barium, Total (mg/L)	2		0.057
Beryllium, Total (mg/L)	0.004		0.0001
Cadmium, Total (mg/L)	0.005		0.00009
Chromium, Total (mg/L)	0.1		0.0023
Cobalt, Total (mg/L)	n/a	0.006	0.0037
Combined Radium, Total (pCi/L)	5		2.26
Fluoride, Total (mg/L)	4		0.25
Lead, Total (mg/L)	n/a	0.015	0.0042
Lithium, Total (mg/L)	n/a	0.04	0.019
Mercury, Total (mg/L)	0.002		0.000008
Molybdenum, Total (mg/L)	n/a	0.1	0.0019
Selenium, Total (mg/L)	0.05		0.0011
Thallium, Total (mg/L)	0.002		0.00025

Notes:
Grey cell indicates calculated UTL is higher than MCL.
MCL = Maximum Contaminant Level
RSL = Regional Screening Level
Calculated UTL (Upper Tolerance Limit) represents site-specific background values.
The higher of the calculated UTL or MCL/Rule-Specified Level is used as the GWPS.

Table 3: Appendix III Data Summary
Mitchell Plant - Bottom Ash Pond

Parameter	Units	Description	MW-1505		MW-1506		MW-1507		MW-1509		MW-1510	
			8/22/2018	5/1/2019	8/22/2018	5/1/2019	8/21/2018	5/1/2019	8/21/2018	5/1/2019	8/21/2018	5/1/2019
Boron	mg/L	Interwell Background Value (UPL)	1.36									
		Detection Monitoring Result	**8.00**	**7.31**	**5.91**	**5.24**	**9.29**	**8.36**	**6.97**	**8.73**	**9.13**	**8.83**
Calcium	mg/L	Interwell Background Value (UPL)	240									
		Detection Monitoring Result	**274**	**287**	**270**	**280**	**272**	**271**	**279**	**287**	**268**	**287**
Chloride	mg/L	Interwell Background Value (UPL)	238									
		Detection Monitoring Result	**284**	**285**	**369**	**331**	**331**	**296**	**323**	**328**	**334**	**325**
Fluoride	mg/L	Intrawell Background Value (UPL)	0.20		0.20		0.11		0.16		0.20	
		Detection Monitoring Result	0.02	0.01	0.05	0.03	0.07	0.07	0.14	0.13	0.09	0.1
pH	SU	Interwell Background Value (UPL)	8.2									
		Interwell Background Value (LPL)	6.9									
		Detection Monitoring Result	7.3	7.8	7.4	7.9	7.2	8.0	7.2	**8.5**	7.3	8.1
Sulfate	mg/L	Intrawell Background Value (UPL)	351		345		377		450		399	
		Detection Monitoring Result	**383**	**408**	**349**	**347**	323	346	**465**	429	**428**	**467**
Total Dissolved Solids	mg/L	Interwell Background Value (UPL)	1182									
		Detection Monitoring Result	**1520**	**1580**	**1590**	**1360**	**1430**	**1270**	**1540**	**1480**	**1550**	**1460**

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit
Bold values exceed the background value.
Background values are shaded gray.

ATTACHMENT A

Certification by Qualified Professional Engineer

Certification by Qualified Professional Engineer

I certify that the selected and above described statistical method is appropriate for evaluating the groundwater monitoring data for the Mitchell Bottom Ash Pond CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER
Printed Name of Licensed Professional Engineer

David Anthony Miller
Signature

DAVID ANTHONY MILLER REGISTERED 22663 STATE OF WEST VIRGINIA PROFESSIONAL ENGINEER

22663	WEST VIRGINIA	07.10.19
License Number	Licensing State	Date

ATTACHMENT B

Statistical Analysis Output

GROUNDWATER STATS CONSULTING

July 10, 2019

Geosyntec Consultants
Attn: Ms. Allison Kreinberg
941 Chatham Lane, #103
Columbus, OH 43221

RE: Mitchell Bottom Ash Pond (BAP) Assessment Event – Spring 2019

Dear Ms. Kreinberg,

Groundwater Stats Consulting, formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the evaluation of groundwater data for the Spring 2019 sample event for American Electric Power Company's Mitchell Bottom Ash Pond. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities (CCR Rule, 2015) as well as with the USEPA Unified Guidance (2009).

Sampling at each of the wells below began at Mitchell Bottom Ash Pond for the CCR program in 2016. The monitoring well network, as provided by Geosyntec Consultants, consists of the following: upgradient wells MW-1504 and MW-1508; and downgradient wells MW-1505, MW-1506, MW-1507, MW-1509 and MW-1510.

Data were sent electronically, and the statistical analysis was conducted according to the Statistical Analysis Plan and screening evaluation prepared by GSC and approved by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to GSC.

The CCR program consists of the following constituents:

- **Appendix III** (Detection Monitoring) **-** boron, calcium, chloride, fluoride, pH, sulfate, and TDS; and

- **Appendix IV** (Assessment Monitoring) **–** antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, combined radium 226 + 228, fluoride, lead, lithium, mercury, molybdenum, selenium, and thallium.

Time series plots for Appendix III and IV parameters are provided for all wells and constituents; and are used to evaluate concentrations over the entire record (Figure A). Values in background which have previously been flagged as outliers may be seen in a lighter font and disconnected symbol on the graphs. Additionally, a summary of flagged values follows this letter (Figure B).

Evaluation of Appendix III Parameters

Interwell prediction limits combined with a 1-of-2 resample plan were constructed for boron, calcium, chloride, pH, and TDS; and intrawell prediction limits combined with a 1-of-2 resample plan were constructed for fluoride and sulfate (Figures C & D, respectively). The statistical method selected for each parameter was determined based on the results of the evaluation performed in December 2017; and all proposed background data were screened for outliers and trends at that time. The findings of those reports were submitted with that analysis.

Interwell prediction limits utilize all upgradient well data for construction of statistical limits. During each sample event, upgradient well data are screened for any newly suspected outliers or obvious trending patterns using time series plots. All values flagged as outliers may be seen on the Outlier Summary report following this letter. No obvious trending patterns were observed in the upgradient wells.

Intrawell prediction limits utilize the background data set that was originally screened in 2017. As recommended in the EPA Unified Guidance (2009), the background data set will be tested for the purpose of updating statistical limits using the Mann-Whitney two-sample test when an additional four to eight measurements are available.

In the event of an initial exceedance of compliance well data, the 1-of-2 resample plan allows for collection of one additional sample to determine whether the initial exceedance is confirmed. When the resample confirms the initial exceedance, a statistically significant increase (SSI) is identified, and further research would be required to identify the cause of the exceedance (i.e. impact from the site, natural variation, or an off-site source). If the resample falls within the statistical limit, the initial exceedance is considered a false positive result; therefore, no further action is necessary. Prediction limit exceedances were noted for boron, calcium, chloride, pH, sulfate and TDS in at least one downgradient well. The results of those findings may be found in the Prediction Limit Summary tables following this letter.

When a statistically significant increase is identified, the data are further evaluated using the Sen's Slope/Mann Kendall trend test to determine whether data are statistically increasing, decreasing or stable (Figure E). Several statistically significant decreasing trends were noted, but no statistically significant increasing trends were found in any of the downgradient wells. A statistically significant increasing trend was noted for pH in upgradient well MW_1504. When trends are identified in upgradient wells, it typically represents naturally changing groundwater quality unrelated to the site. The Trend Test Summary Table follows this letter.

Evaluation of Appendix IV Parameters

Tolerance limits were used to calculate background limits from all available pooled upgradient well data for Appendix IV parameters with a target of 95% confidence and 95% coverage to determine the Alternate Contaminant Level (ACL) for each constituent (Figure F). Background data are screened for outliers and extreme trending patterns that would lead to artificially elevated statistical limits. Any flagged values may be seen on the Outlier Summary following this letter.

For parametric limits the target is 95% confidence and 95% coverage. The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. These limits were compared to the Maximum Contaminant Levels (MCLs) and CCR-Rule specified levels in the Groundwater Protection Standards (GWPS) table following this letter to determine the highest limit for use as the GWPS in the Confidence Interval comparisons (Figure G).

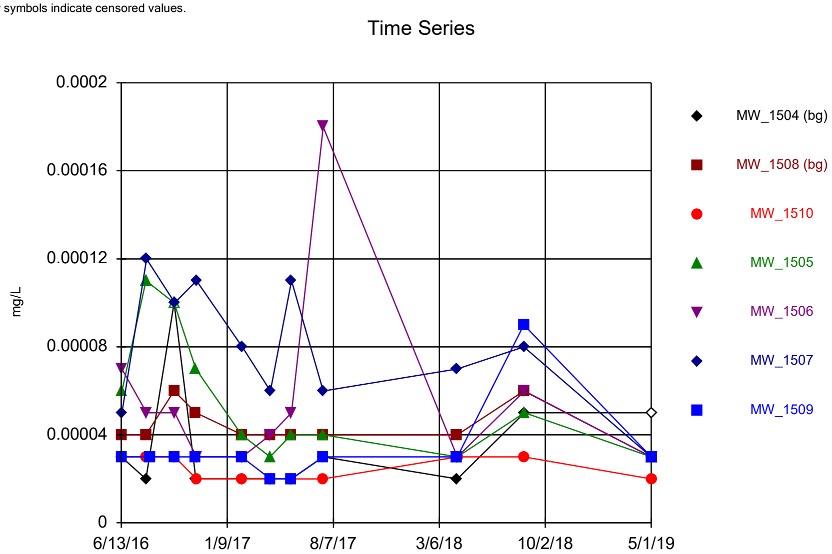
Confidence intervals were then constructed on downgradient wells for each of the Appendix IV parameters using the highest limit of the MCL, CCR-Rule specified levels, or ACL as discussed above (Figure H). Only when the entire confidence interval is above a GWPS is the well/constituent pair considered to exceed its respective standard. No exceedances were noted at any of the downgradient wells. A summary of the confidence interval results follows this letter.

Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for the Mitchell Bottom Ash Pond. If you have any questions or comments, please feel free to contact me.

For Groundwater Stats Consulting,

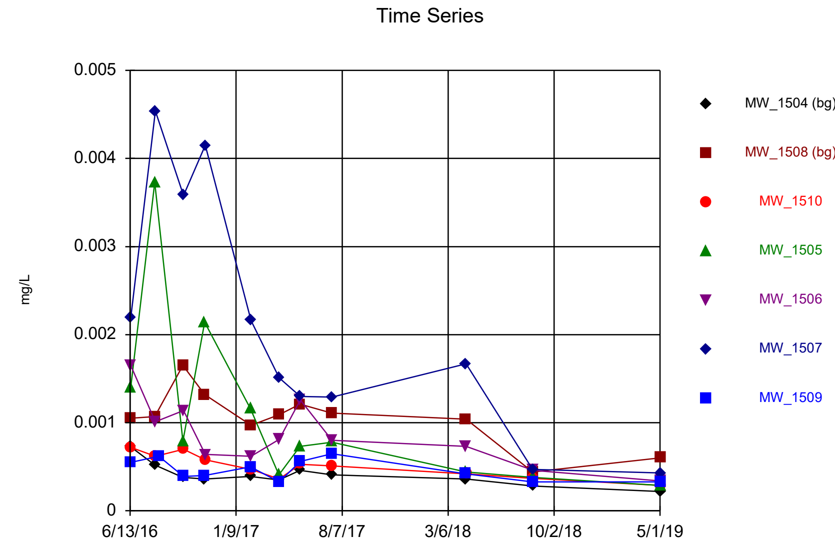
Kristina L. Rayner
Groundwater Statistician

Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



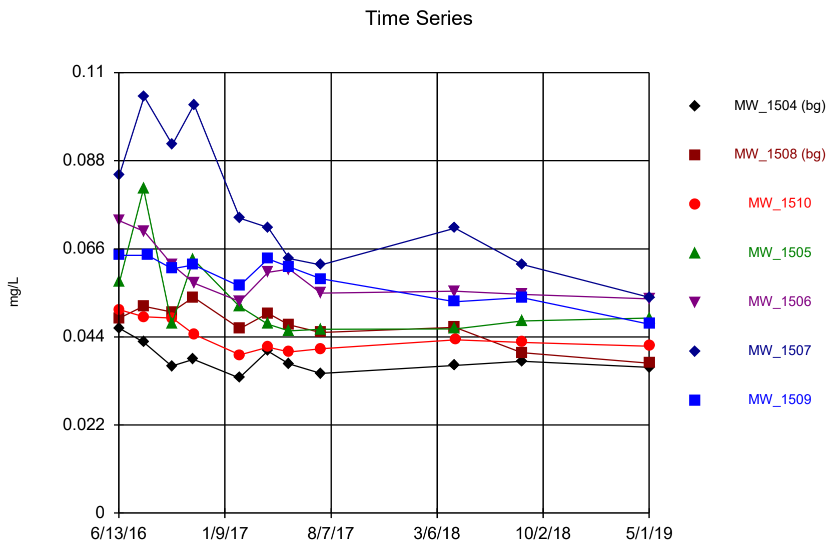
Constituent: Antimony, total   Analysis Run 7/10/2019 10:41 AM   View: Time Series - All Wells
Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP

Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG



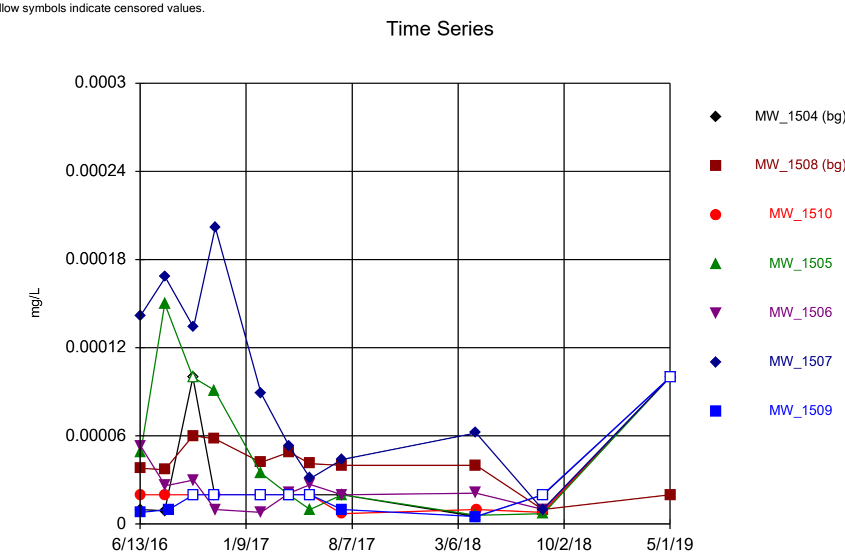
Constituent: Arsenic, Total   Analysis Run 7/10/2019 10:41 AM   View: Time Series - All Wells
Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP

Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG



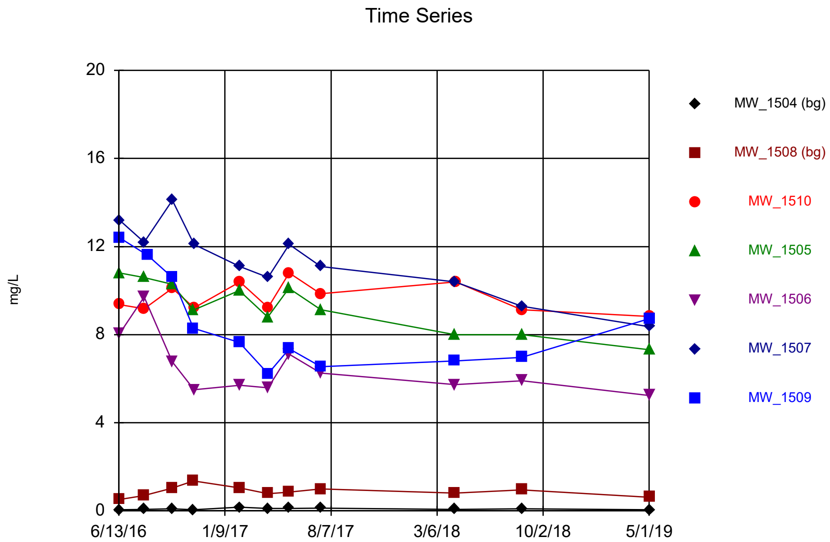
Constituent: Barium, Total   Analysis Run 7/10/2019 10:41 AM   View: Time Series - All Wells
Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP

Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



Constituent: Beryllium, total   Analysis Run 7/10/2019 10:41 AM   View: Time Series - All Wells
Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP

Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Boron, total Analysis Run 7/10/2019 10:41 AM View: Time Series - All Wells
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

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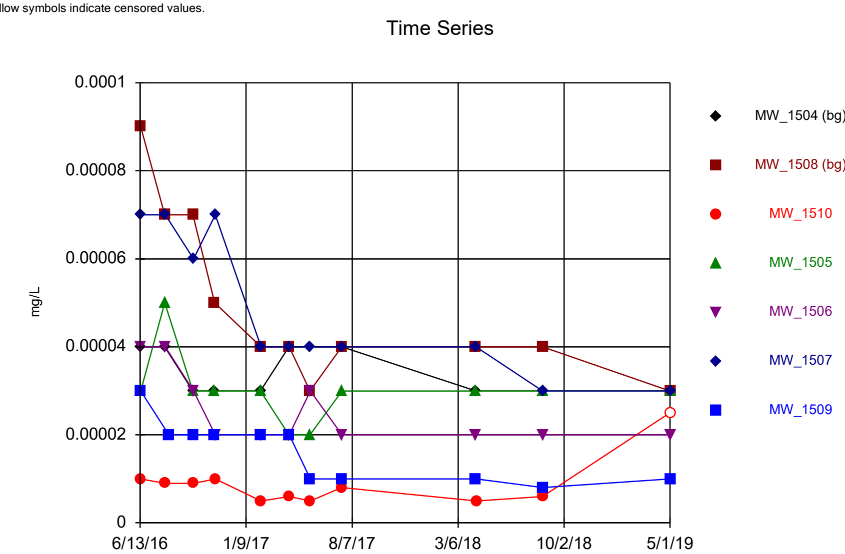
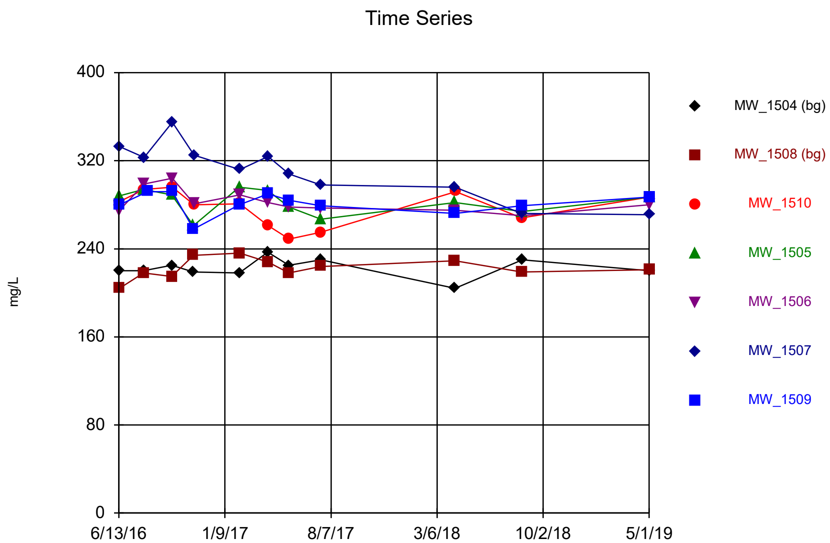
Hollow symbols indicate censored values.



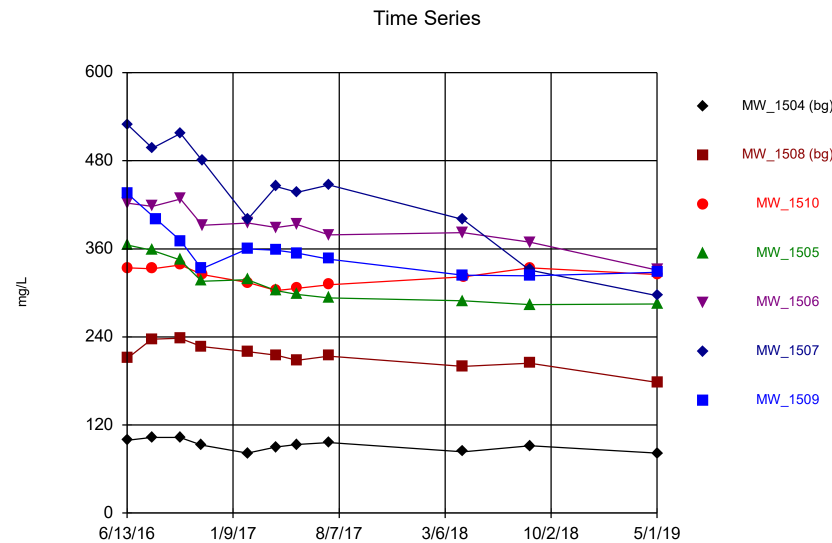
Constituent: Cadmium, total Analysis Run 7/10/2019 10:41 AM View: Time Series - All Wells
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG



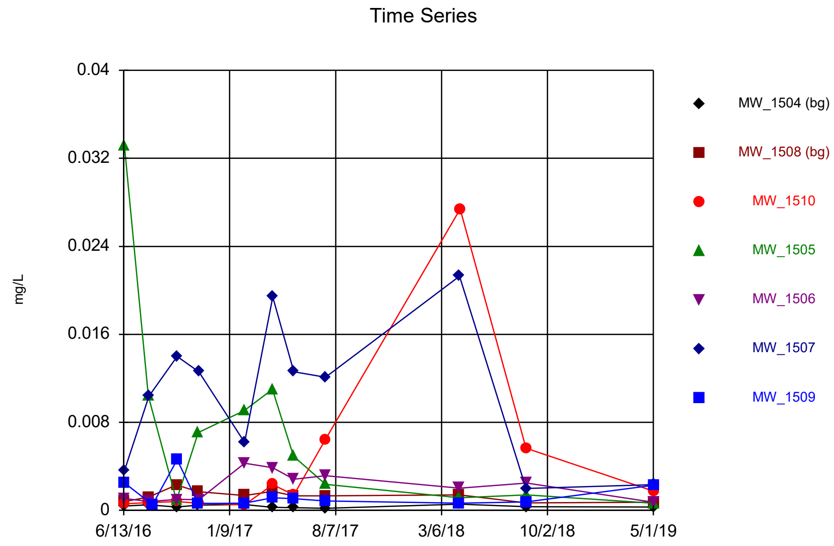
Constituent: Calcium, total Analysis Run 7/10/2019 10:41 AM View: Time Series - All Wells
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG



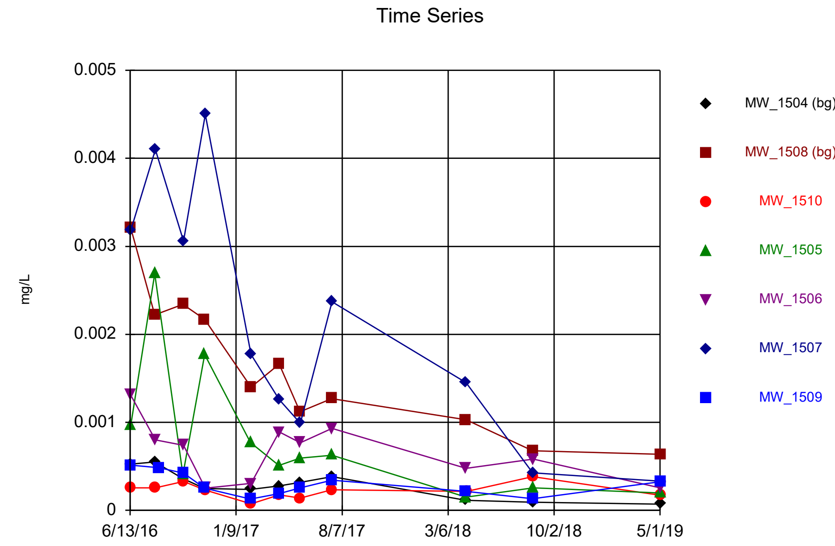
Constituent: Chloride, total Analysis Run 7/10/2019 10:42 AM View: Time Series - All Wells
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG



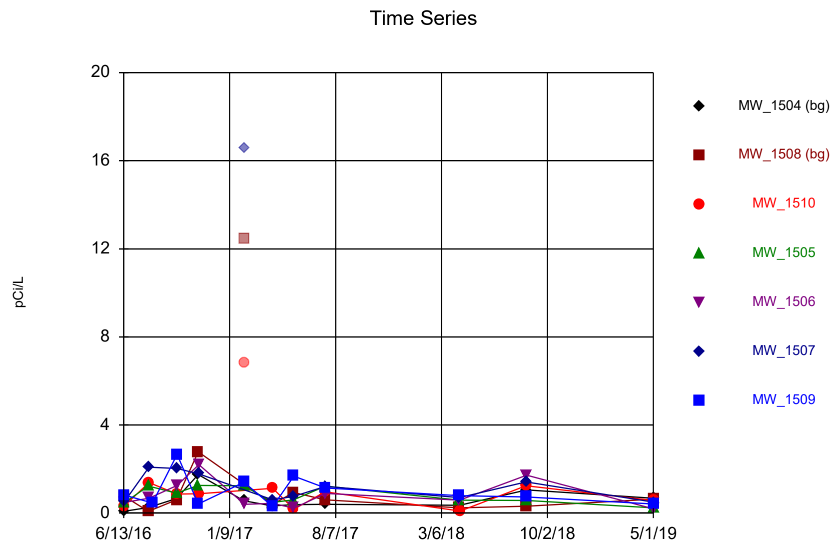
Constituent: Chromium, total Analysis Run 7/10/2019 10:42 AM View: Time Series - All Wells
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG



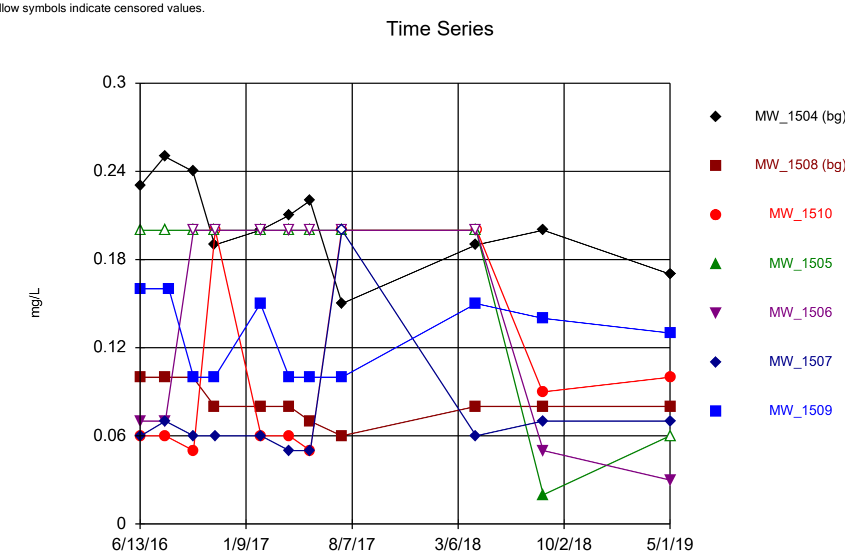
Constituent: Cobalt, total Analysis Run 7/10/2019 10:42 AM View: Time Series - All Wells
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG



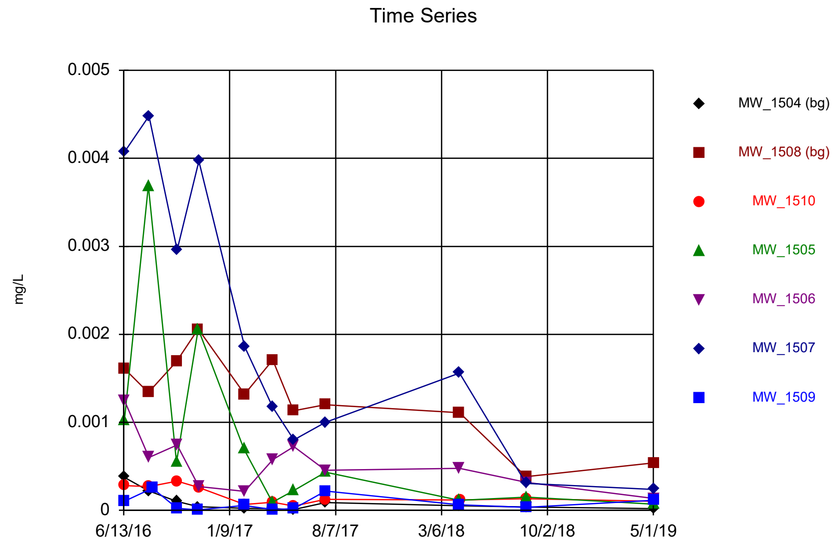
Constituent: Combined Radium 226 + 228 Analysis Run 7/10/2019 10:42 AM View: Time Series - All Well
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



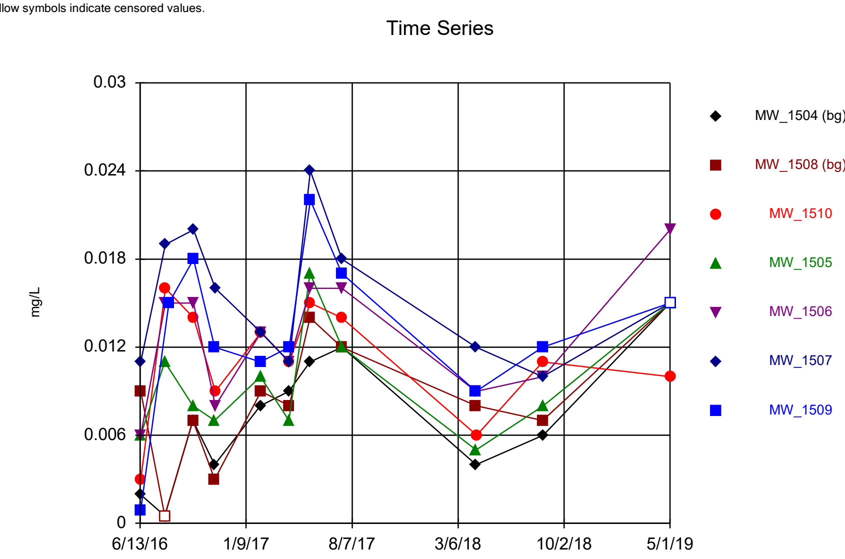
Constituent: Fluoride, total Analysis Run 7/10/2019 10:42 AM View: Time Series - All Wells
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG



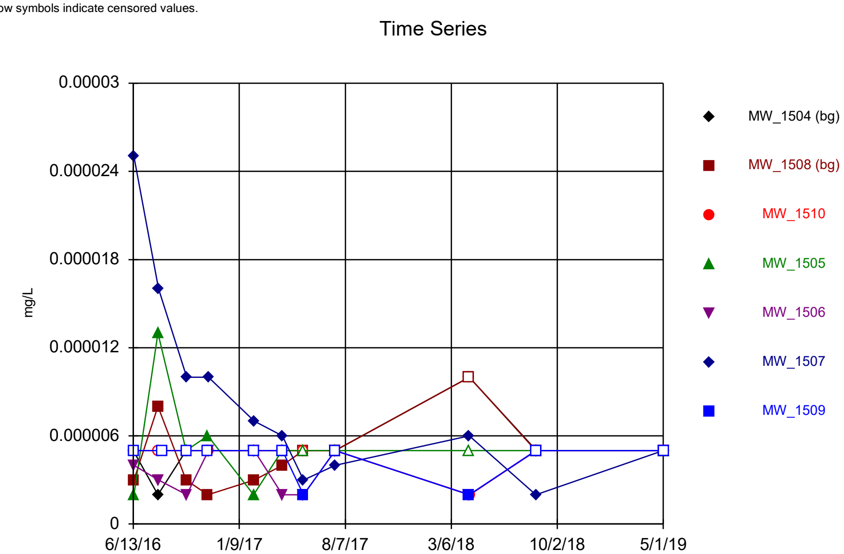
Constituent: Lead, total Analysis Run 7/10/2019 10:42 AM View: Time Series - All Wells
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



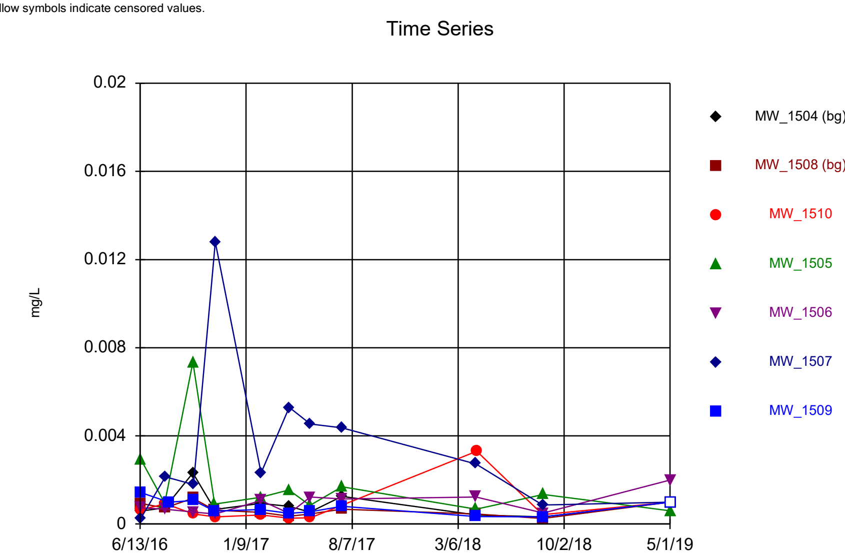
Constituent: Lithium, total Analysis Run 7/10/2019 10:42 AM View: Time Series - All Wells
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

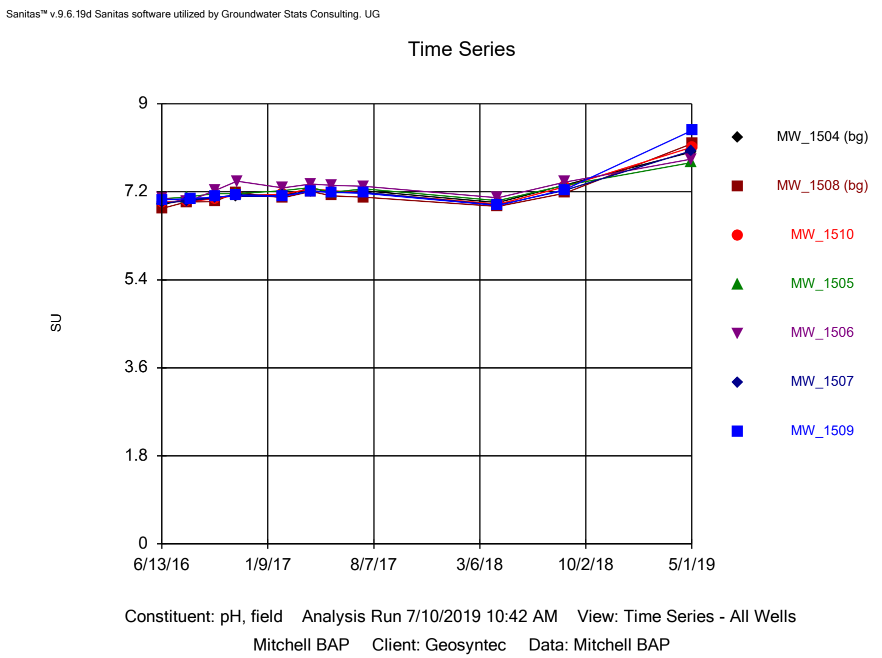


Constituent: Mercury, total Analysis Run 7/10/2019 10:42 AM View: Time Series - All Wells
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

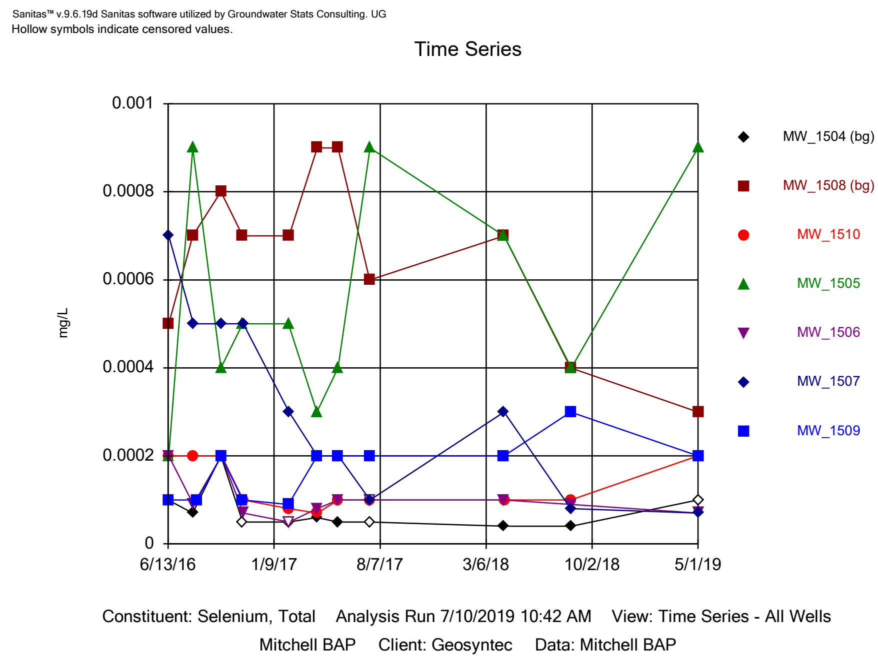
Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



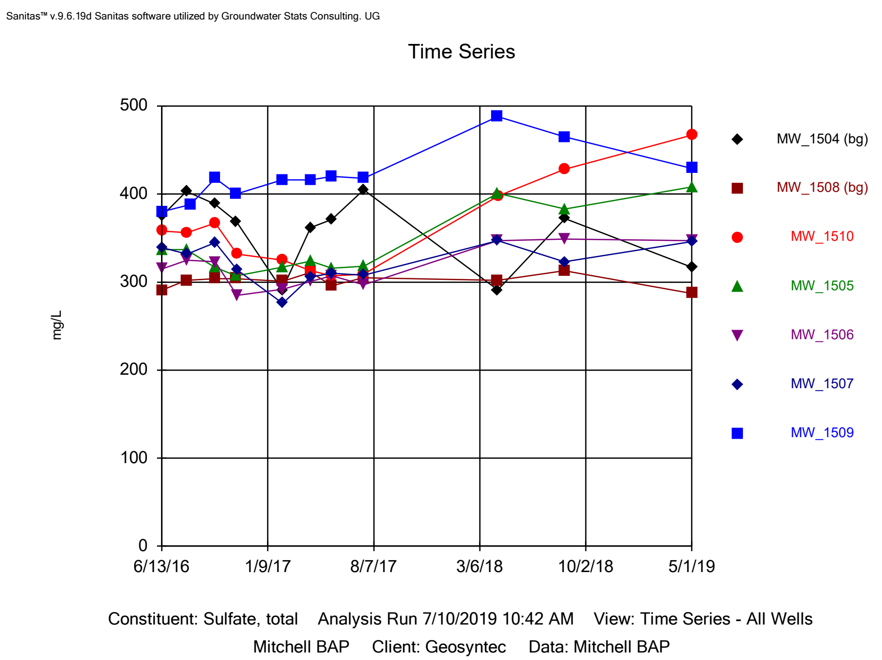
Constituent: Molybdenum, total Analysis Run 7/10/2019 10:42 AM View: Time Series - All Wells
Mitchell BAP Client: Geosyntec Data: Mitchell BAP



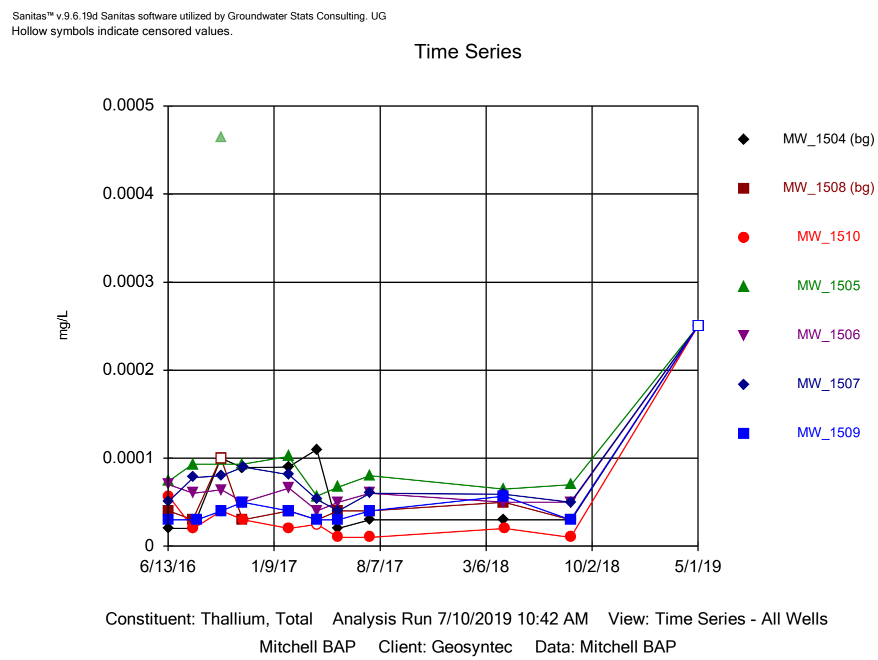
Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG
Time Series
SU
9
7.2
5.4
3.6
1.8
0
6/13/16
1/9/17
8/7/17
3/6/18
10/2/18
5/1/19
MW_1504 (bg)
MW_1508 (bg)
MW_1510
MW_1505
MW_1506
MW_1507
MW_1509
Constituent: pH, field Analysis Run 7/10/2019 10:42 AM View: Time Series - All Wells
Mitchell BAP Client: Geosyntec Data: Mitchell BAP



Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
mg/L
0.001
0.0008
0.0006
0.0004
0.0002
0
6/13/16
1/9/17
8/7/17
3/6/18
10/2/18
5/1/19
MW_1504 (bg)
MW_1508 (bg)
MW_1510
MW_1505
MW_1506
MW_1507
MW_1509
Constituent: Selenium, Total Analysis Run 7/10/2019 10:42 AM View: Time Series - All Wells
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

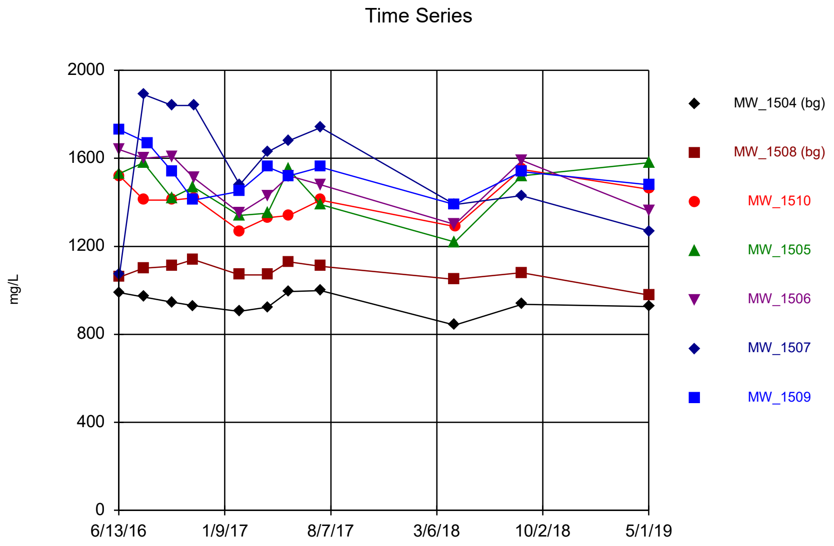


Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG
Time Series
mg/L
500
400
300
200
100
0
6/13/16
1/9/17
8/7/17
3/6/18
10/2/18
5/1/19
MW_1504 (bg)
MW_1508 (bg)
MW_1510
MW_1505
MW_1506
MW_1507
MW_1509
Constituent: Sulfate, total Analysis Run 7/10/2019 10:42 AM View: Time Series - All Wells
Mitchell BAP Client: Geosyntec Data: Mitchell BAP



Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
mg/L
0.0005
0.0004
0.0003
0.0002
0.0001
0
6/13/16
1/9/17
8/7/17
3/6/18
10/2/18
5/1/19
MW_1504 (bg)
MW_1508 (bg)
MW_1510
MW_1505
MW_1506
MW_1507
MW_1509
Constituent: Thallium, Total Analysis Run 7/10/2019 10:42 AM View: Time Series - All Wells
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Total Dissolved Solids [TDS] Analysis Run 7/10/2019 10:42 AM View: Time Series - All Wells

Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Outlier Summary

Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP   Printed 7/10/2019, 10:43 AM

	MW_1508 Combined Radium 226 + 228 (pCi/L)	MW_1510 Combined Radium 226 + 228 (pCi/L)	MW_1507 Combined Radium 226 + 228 (pCi/L)	MW_1505 Thallium, Total (mg/L)
9/26/2016				0.000464 (o)
2/8/2017	12.465 (o)	6.828 (o)	16.587 (o)	

Interwell Prediction Limit Summary - Significant Results

Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP   Printed 7/8/2019, 2:00 PM

Constituent	Well	Upper Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	**MW_1510**	**1.36**	**5/1/2019**	**8.83**	**Yes**	**22**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.003495**	**NP Inter (normality) 1 of 2**
Boron, total (mg/L)	**MW_1505**	**1.36**	**5/1/2019**	**7.31**	**Yes**	**22**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.003495**	**NP Inter (normality) 1 of 2**
Boron, total (mg/L)	**MW_1506**	**1.36**	**5/1/2019**	**5.24**	**Yes**	**22**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.003495**	**NP Inter (normality) 1 of 2**
Boron, total (mg/L)	**MW_1507**	**1.36**	**5/1/2019**	**8.36**	**Yes**	**22**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.003495**	**NP Inter (normality) 1 of 2**
Boron, total (mg/L)	**MW_1509**	**1.36**	**5/1/2019**	**8.73**	**Yes**	**22**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.003495**	**NP Inter (normality) 1 of 2**
Calcium, total (mg/L)	**MW_1510**	**239.9**	**5/1/2019**	**287**	**Yes**	**22**	**222.5**	**8.651**	**0**	**None**	**No**	**0.001504**	**Param Inter 1 of 2**
Calcium, total (mg/L)	**MW_1505**	**239.9**	**5/1/2019**	**287**	**Yes**	**22**	**222.5**	**8.651**	**0**	**None**	**No**	**0.001504**	**Param Inter 1 of 2**
Calcium, total (mg/L)	**MW_1506**	**239.9**	**5/1/2019**	**280**	**Yes**	**22**	**222.5**	**8.651**	**0**	**None**	**No**	**0.001504**	**Param Inter 1 of 2**
Calcium, total (mg/L)	**MW_1507**	**239.9**	**5/1/2019**	**271**	**Yes**	**22**	**222.5**	**8.651**	**0**	**None**	**No**	**0.001504**	**Param Inter 1 of 2**
Calcium, total (mg/L)	**MW_1509**	**239.9**	**5/1/2019**	**287**	**Yes**	**22**	**222.5**	**8.651**	**0**	**None**	**No**	**0.001504**	**Param Inter 1 of 2**
Chloride, total (mg/L)	**MW_1510**	**238**	**5/1/2019**	**325**	**Yes**	**22**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.003495**	**NP Inter (normality) 1 of 2**
Chloride, total (mg/L)	**MW_1505**	**238**	**5/1/2019**	**285**	**Yes**	**22**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.003495**	**NP Inter (normality) 1 of 2**
Chloride, total (mg/L)	**MW_1506**	**238**	**5/1/2019**	**331**	**Yes**	**22**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.003495**	**NP Inter (normality) 1 of 2**
Chloride, total (mg/L)	**MW_1507**	**238**	**5/1/2019**	**296**	**Yes**	**22**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.003495**	**NP Inter (normality) 1 of 2**
Chloride, total (mg/L)	**MW_1509**	**238**	**5/1/2019**	**328**	**Yes**	**22**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.003495**	**NP Inter (normality) 1 of 2**
pH, field (SU)	**MW_1509**	**8.18**	**5/1/2019**	**8.45**	**Yes**	**22**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.006991**	**NP Inter (normality) 1 of 2**
Total Dissolved Solids [TDS] (mg/L)	**MW_1510**	**1182**	**5/1/2019**	**1460**	**Yes**	**22**	**1012**	**84.17**	**0**	**None**	**No**	**0.001504**	**Param Inter 1 of 2**
Total Dissolved Solids [TDS] (mg/L)	**MW_1505**	**1182**	**5/1/2019**	**1580**	**Yes**	**22**	**1012**	**84.17**	**0**	**None**	**No**	**0.001504**	**Param Inter 1 of 2**
Total Dissolved Solids [TDS] (mg/L)	**MW_1506**	**1182**	**5/1/2019**	**1360**	**Yes**	**22**	**1012**	**84.17**	**0**	**None**	**No**	**0.001504**	**Param Inter 1 of 2**
Total Dissolved Solids [TDS] (mg/L)	**MW_1507**	**1182**	**5/1/2019**	**1270**	**Yes**	**22**	**1012**	**84.17**	**0**	**None**	**No**	**0.001504**	**Param Inter 1 of 2**
Total Dissolved Solids [TDS] (mg/L)	**MW_1509**	**1182**	**5/1/2019**	**1480**	**Yes**	**22**	**1012**	**84.17**	**0**	**None**	**No**	**0.001504**	**Param Inter 1 of 2**

Interwell Prediction Limit Summary - All Results

Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP   Printed 7/8/2019, 2:00 PM

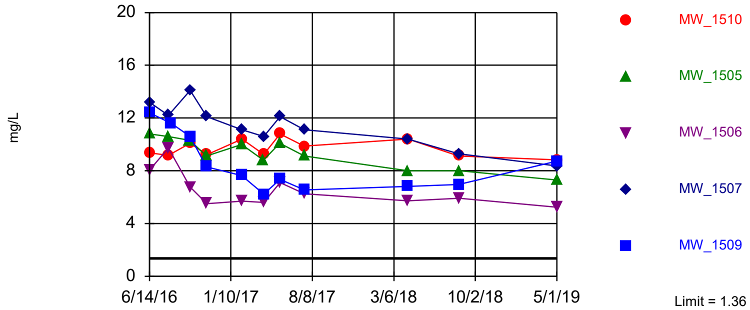
Constituent	Well	Upper Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	**MW_1510**	**1.36**	**5/1/2019**	**8.83**	**Yes**	**22**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.003495**	**NP Inter (normality) 1 of 2**
Boron, total (mg/L)	**MW_1505**	**1.36**	**5/1/2019**	**7.31**	**Yes**	**22**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.003495**	**NP Inter (normality) 1 of 2**
Boron, total (mg/L)	**MW_1506**	**1.36**	**5/1/2019**	**5.24**	**Yes**	**22**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.003495**	**NP Inter (normality) 1 of 2**
Boron, total (mg/L)	**MW_1507**	**1.36**	**5/1/2019**	**8.36**	**Yes**	**22**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.003495**	**NP Inter (normality) 1 of 2**
Boron, total (mg/L)	**MW_1509**	**1.36**	**5/1/2019**	**8.73**	**Yes**	**22**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.003495**	**NP Inter (normality) 1 of 2**
Calcium, total (mg/L)	**MW_1510**	**239.9**	**5/1/2019**	**287**	**Yes**	**22**	**222.5**	**8.651**	**0**	**None**	**No**	**0.001504**	**Param Inter 1 of 2**
Calcium, total (mg/L)	**MW_1505**	**239.9**	**5/1/2019**	**287**	**Yes**	**22**	**222.5**	**8.651**	**0**	**None**	**No**	**0.001504**	**Param Inter 1 of 2**
Calcium, total (mg/L)	**MW_1506**	**239.9**	**5/1/2019**	**280**	**Yes**	**22**	**222.5**	**8.651**	**0**	**None**	**No**	**0.001504**	**Param Inter 1 of 2**
Calcium, total (mg/L)	**MW_1507**	**239.9**	**5/1/2019**	**271**	**Yes**	**22**	**222.5**	**8.651**	**0**	**None**	**No**	**0.001504**	**Param Inter 1 of 2**
Calcium, total (mg/L)	**MW_1509**	**239.9**	**5/1/2019**	**287**	**Yes**	**22**	**222.5**	**8.651**	**0**	**None**	**No**	**0.001504**	**Param Inter 1 of 2**
Chloride, total (mg/L)	**MW_1510**	**238**	**5/1/2019**	**325**	**Yes**	**22**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.003495**	**NP Inter (normality) 1 of 2**
Chloride, total (mg/L)	**MW_1505**	**238**	**5/1/2019**	**285**	**Yes**	**22**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.003495**	**NP Inter (normality) 1 of 2**
Chloride, total (mg/L)	**MW_1506**	**238**	**5/1/2019**	**331**	**Yes**	**22**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.003495**	**NP Inter (normality) 1 of 2**
Chloride, total (mg/L)	**MW_1507**	**238**	**5/1/2019**	**296**	**Yes**	**22**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.003495**	**NP Inter (normality) 1 of 2**
Chloride, total (mg/L)	**MW_1509**	**238**	**5/1/2019**	**328**	**Yes**	**22**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.003495**	**NP Inter (normality) 1 of 2**
pH, field (SU)	MW_1510	8.18	5/1/2019	8.11	No	22	n/a	n/a	0	n/a	n/a	0.006991	NP Inter (normality) 1 of 2
pH, field (SU)	MW_1505	8.18	4/30/2019	7.8	No	22	n/a	n/a	0	n/a	n/a	0.006991	NP Inter (normality) 1 of 2
pH, field (SU)	MW_1506	8.18	4/30/2019	7.87	No	22	n/a	n/a	0	n/a	n/a	0.006991	NP Inter (normality) 1 of 2
pH, field (SU)	MW_1507	8.18	4/30/2019	8.04	No	22	n/a	n/a	0	n/a	n/a	0.006991	NP Inter (normality) 1 of 2
pH, field (SU)	**MW_1509**	**8.18**	**5/1/2019**	**8.45**	**Yes**	**22**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.006991**	**NP Inter (normality) 1 of 2**
Total Dissolved Solids [TDS] (mg/L)	**MW_1510**	**1182**	**5/1/2019**	**1460**	**Yes**	**22**	**1012**	**84.17**	**0**	**None**	**No**	**0.001504**	**Param Inter 1 of 2**
Total Dissolved Solids [TDS] (mg/L)	**MW_1505**	**1182**	**5/1/2019**	**1580**	**Yes**	**22**	**1012**	**84.17**	**0**	**None**	**No**	**0.001504**	**Param Inter 1 of 2**
Total Dissolved Solids [TDS] (mg/L)	**MW_1506**	**1182**	**5/1/2019**	**1360**	**Yes**	**22**	**1012**	**84.17**	**0**	**None**	**No**	**0.001504**	**Param Inter 1 of 2**
Total Dissolved Solids [TDS] (mg/L)	**MW_1507**	**1182**	**5/1/2019**	**1270**	**Yes**	**22**	**1012**	**84.17**	**0**	**None**	**No**	**0.001504**	**Param Inter 1 of 2**
Total Dissolved Solids [TDS] (mg/L)	**MW_1509**	**1182**	**5/1/2019**	**1480**	**Yes**	**22**	**1012**	**84.17**	**0**	**None**	**No**	**0.001504**	**Param Inter 1 of 2**

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit: MW_1510, MW_1505, MW 1506. MW 1507. MW 1509

Prediction Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 22 background values. Annual per-constituent alpha = 0.03441. Individual comparison alpha = 0.003495 (1 of 2). Comparing 5 points to limit.

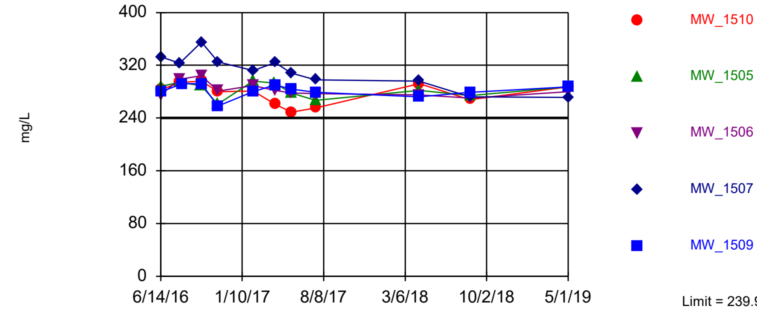
Constituent: Boron, total Analysis Run 7/8/2019 1:58 PM View: PLs - Interwell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit: MW_1510, MW_1505, MW 1506. MW 1507. MW 1509

Prediction Limit

Interwell Parametric



Background Data Summary: Mean=222.5, Std. Dev.=8.651, n=22. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9394, critical = 0.878. Kappa = 2.022 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.001504. Comparing 5 points to limit.

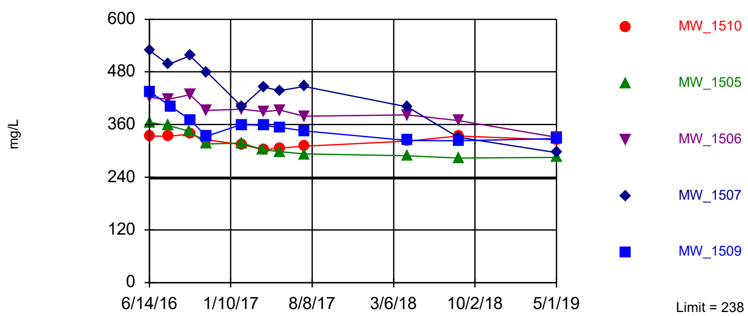
Constituent: Calcium, total Analysis Run 7/8/2019 1:58 PM View: PLs - Interwell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit: MW_1510, MW_1505, MW 1506, MW 1507, MW 1509

Prediction Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 22 background values. Annual per-constituent alpha = 0.03441. Individual comparison alpha = 0.003495 (1 of 2). Comparing 5 points to limit.

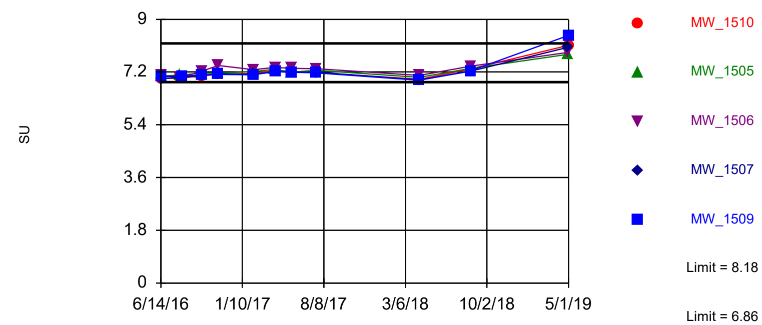
Constituent: Chloride, total Analysis Run 7/8/2019 1:58 PM View: PLs - Interwell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limits: MW_1509

Prediction Limit

Interwell Non-parametric



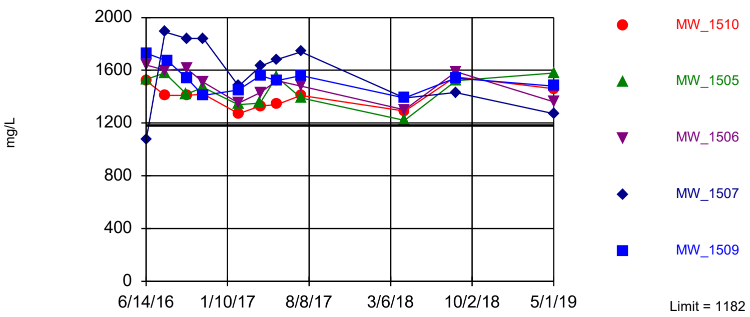
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limits are highest and lowest of 22 background values. Annual per-constituent alpha = 0.06882. Individual comparison alpha = 0.006991 (1 of 2). Comparing 5 points to limit.

Constituent: pH, field Analysis Run 7/8/2019 1:58 PM View: PLs - Interwell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Exceeds Limit: MW_1510, MW_1505, MW_1506, MW_1507, MW_1509

Prediction Limit

Interwell Parametric



Background Data Summary: Mean=1012, Std. Dev.=84.17, n=22. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9516, critical = 0.878. Kappa = 2.022 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.001504. Comparing 5 points to limit.

Constituent: Total Dissolved Solids [TDS] Analysis Run 7/8/2019 1:58 PM View: PLs - Interwell

Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Intrawell Prediction Limit Summary - Significant Results

Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP   Printed 7/8/2019, 2:10 PM

Constituent	Well	Upper Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Sulfate, total (mg/L)	**MW_1510**	**399.1**	**5/1/2019**	**467**	**Yes**	**8**	**333.4**	**23.98**	**0**	**None**	**No**	**0.001504**	Param 1 of 2
Sulfate, total (mg/L)	**MW_1505**	**350.5**	**5/1/2019**	**408**	**Yes**	**8**	**321.6**	**10.56**	**0**	**None**	**No**	**0.001504**	Param 1 of 2
Sulfate, total (mg/L)	**MW_1506**	**345.4**	**5/1/2019**	**347**	**Yes**	**8**	**305.6**	**14.51**	**0**	**None**	**No**	**0.001504**	Param 1 of 2

Intrawell Prediction Limit Summary - All Results

Mitchell BAP Client: Geosyntec Data: Mitchell BAP Printed 7/8/2019, 2:10 PM

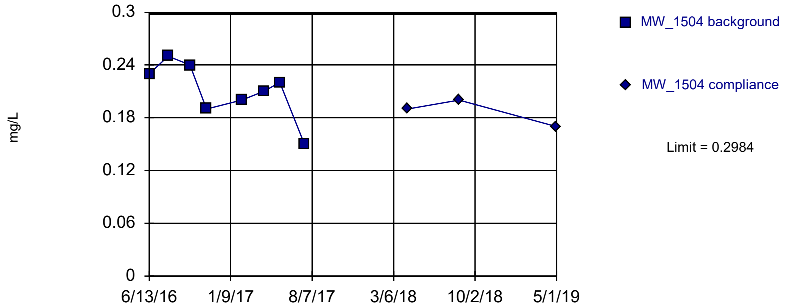
Constituent	Well	Upper Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Fluoride, total (mg/L)	MW_1504	0.2984	5/1/2019	0.17	No	8	0.2113	0.03182	0	None	No	0.001504	Param 1 of 2
Fluoride, total (mg/L)	MW_1508	0.125	5/1/2019	0.08	No	8	0.08375	0.01506	0	None	No	0.001504	Param 1 of 2
Fluoride, total (mg/L)	MW_1510	0.2	5/1/2019	0.1	No	8	n/a	n/a	25	n/a	n/a	0.02144	NP (normality) 1 of 2
Fluoride, total (mg/L)	MW_1505	0.2	5/1/2019	0.06ND	No	8	n/a	n/a	100	n/a	n/a	0.02144	NP (NDs) 1 of 2
Fluoride, total (mg/L)	MW_1506	0.2	5/1/2019	0.03	No	8	n/a	n/a	75	n/a	n/a	0.02144	NP (NDs) 1 of 2
Fluoride, total (mg/L)	MW_1507	0.2	5/1/2019	0.07	No	8	n/a	n/a	12.5	n/a	n/a	0.02144	NP (normality) 1 of 2
Fluoride, total (mg/L)	MW_1509	0.16	5/1/2019	0.13	No	8	n/a	n/a	0	n/a	n/a	0.02144	NP (normality) 1 of 2
Sulfate, total (mg/L)	MW_1504	468.9	5/1/2019	317	No	8	370.6	35.86	0	None	No	0.001504	Param 1 of 2
Sulfate, total (mg/L)	MW_1508	318.3	5/1/2019	287	No	8	301.8	6.042	0	None	No	0.001504	Param 1 of 2
Sulfate, total (mg/L)	**MW_1510**	**399.1**	**5/1/2019**	**467**	**Yes**	**8**	**333.4**	**23.98**	**0**	**None**	**No**	**0.001504**	Param 1 of 2
Sulfate, total (mg/L)	**MW_1505**	**350.5**	**5/1/2019**	**408**	**Yes**	**8**	**321.6**	**10.56**	**0**	**None**	**No**	**0.001504**	Param 1 of 2
Sulfate, total (mg/L)	**MW_1506**	**345.4**	**5/1/2019**	**347**	**Yes**	**8**	**305.6**	**14.51**	**0**	**None**	**No**	**0.001504**	Param 1 of 2
Sulfate, total (mg/L)	MW_1507	376.9	5/1/2019	346	No	8	316.3	22.13	0	None	No	0.001504	Param 1 of 2
Sulfate, total (mg/L)	MW_1509	449.9	5/1/2019	429	No	8	407	15.64	0	None	No	0.001504	Param 1 of 2

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=0.2113, Std. Dev.=0.03182, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9517, critical = 0.749. Kappa = 2.74 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504.

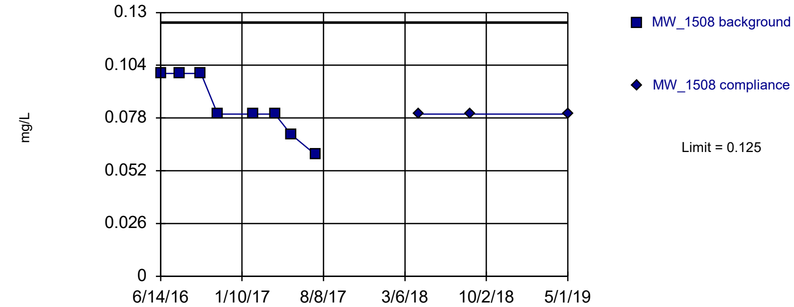
Constituent: Fluoride, total Analysis Run 7/8/2019 2:08 PM View: PLs - Intrawell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=0.08375, Std. Dev.=0.01506, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8711, critical = 0.749. Kappa = 2.74 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504.

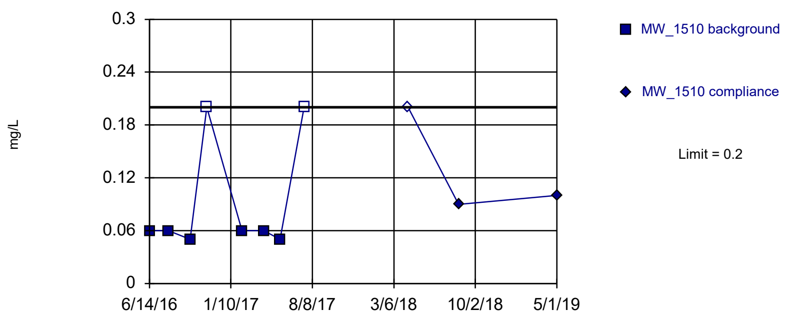
Constituent: Fluoride, total Analysis Run 7/8/2019 2:08 PM View: PLs - Intrawell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Intrawell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 8 background values. 25% NDs. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2).

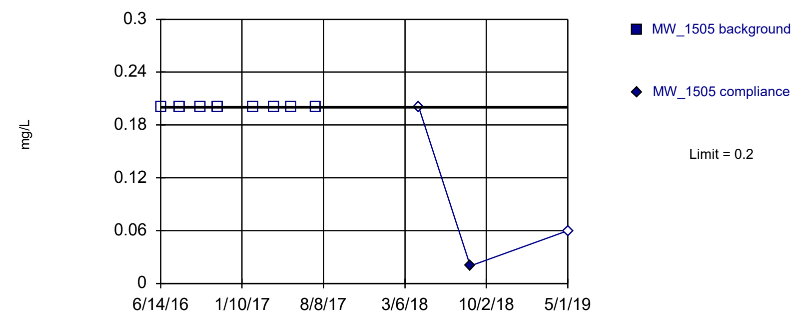
Constituent: Fluoride, total Analysis Run 7/8/2019 2:08 PM View: PLs - Intrawell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Intrawell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. All background values (n = 8) were censored; limit is most recent reporting limit. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2).

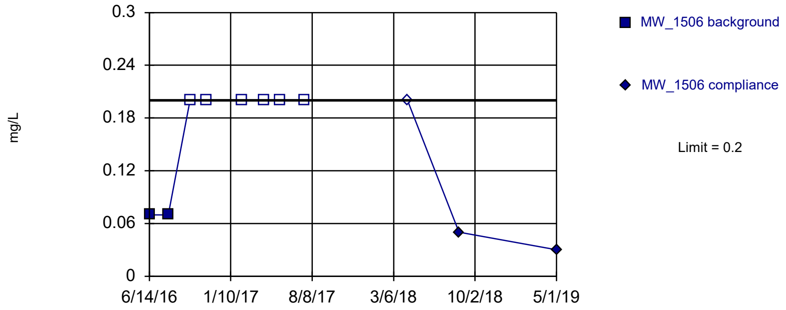
Constituent: Fluoride, total Analysis Run 7/8/2019 2:08 PM View: PLs - Intrawell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Intrawell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 8 background values. 75% NDs. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2).

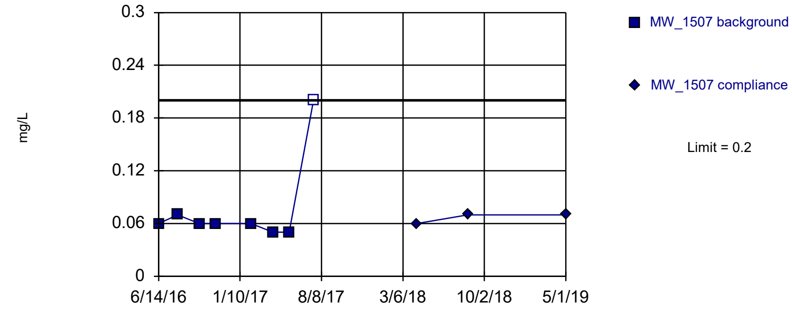
Constituent: Fluoride, total Analysis Run 7/8/2019 2:08 PM View: PLs - Intrawell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Intrawell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 8 background values. 12.5% NDs. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2).

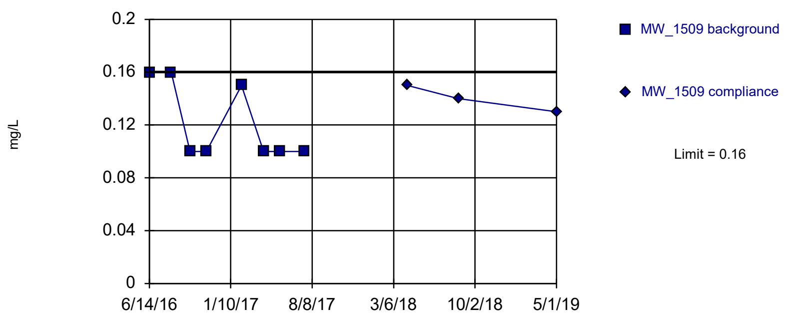
Constituent: Fluoride, total Analysis Run 7/8/2019 2:08 PM View: PLs - Intrawell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 8 background values. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2).

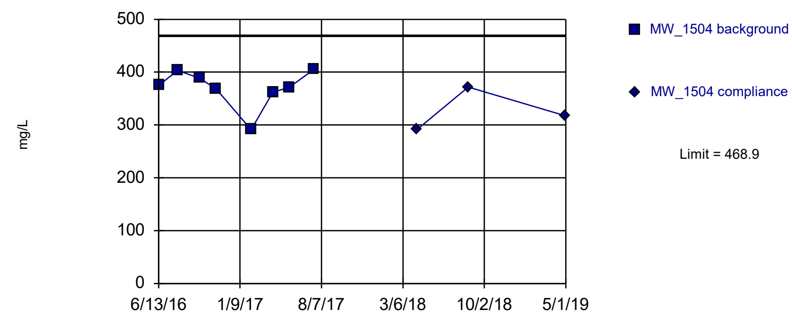
Constituent: Fluoride, total Analysis Run 7/8/2019 2:08 PM View: PLs - Intrawell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=370.6, Std. Dev.=35.86, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8152, critical = 0.749. Kappa = 2.74 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504.

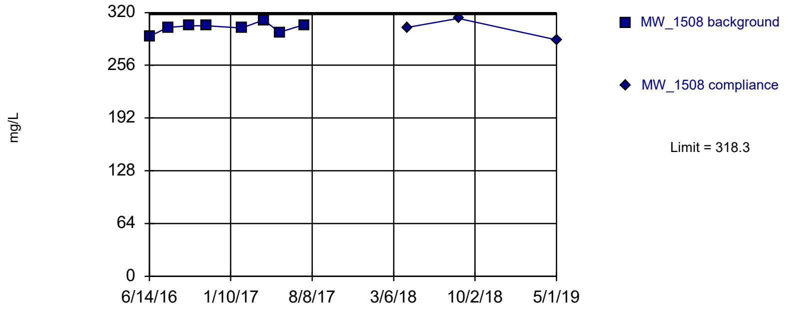
Constituent: Sulfate, total Analysis Run 7/8/2019 2:08 PM View: PLs - Intrawell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=301.8, Std. Dev.=6.042, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9509, critical = 0.749. Kappa = 2.74 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504.

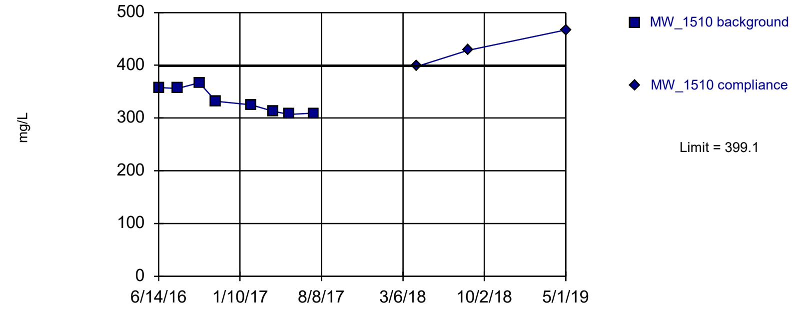
Constituent: Sulfate, total Analysis Run 7/8/2019 2:08 PM View: PLs - Intrawell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=333.4, Std. Dev.=23.98, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8854, critical = 0.749. Kappa = 2.74 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504.

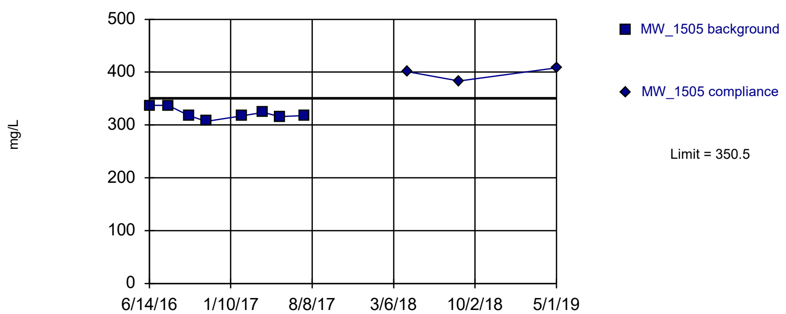
Constituent: Sulfate, total Analysis Run 7/8/2019 2:08 PM View: PLs - Intrawell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=321.6, Std. Dev.=10.56, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8719, critical = 0.749. Kappa = 2.74 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504.

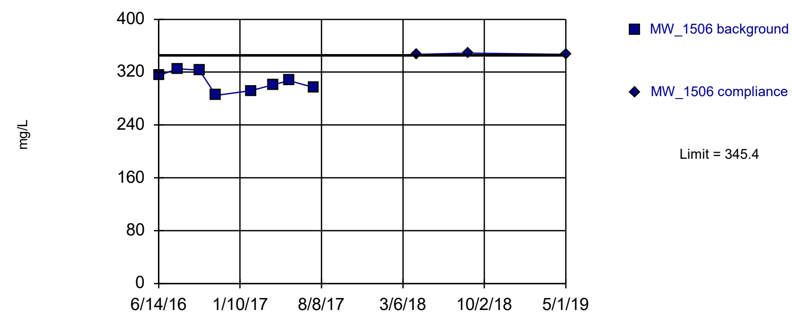
Constituent: Sulfate, total Analysis Run 7/8/2019 2:08 PM View: PLs - Intrawell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=305.6, Std. Dev.=14.51, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9536, critical = 0.749. Kappa = 2.74 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504.

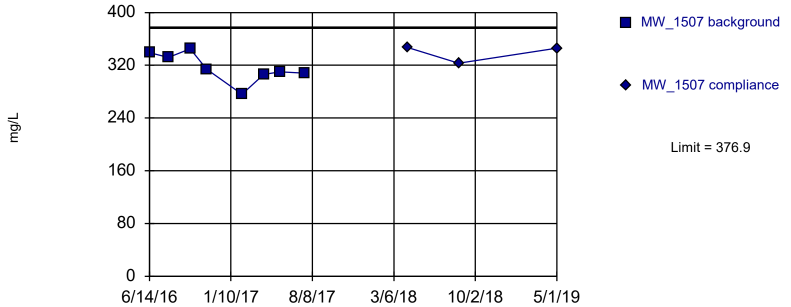
Constituent: Sulfate, total Analysis Run 7/8/2019 2:08 PM View: PLs - Intrawell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=316.3, Std. Dev.=22.13, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9344, critical = 0.749. Kappa = 2.74 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504.

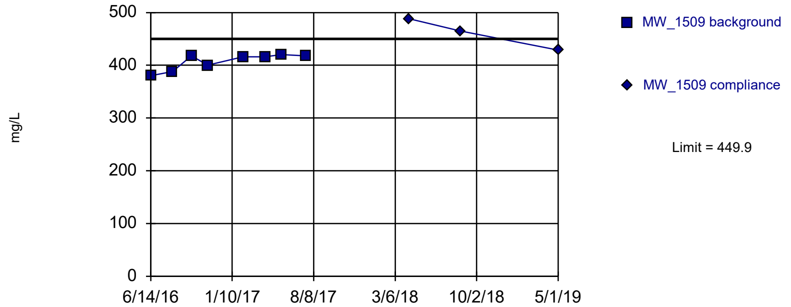
Constituent: Sulfate, total Analysis Run 7/8/2019 2:08 PM View: PLs - Intrawell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=407, Std. Dev.=15.64, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7926, critical = 0.749. Kappa = 2.74 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504.

Constituent: Sulfate, total Analysis Run 7/8/2019 2:08 PM View: PLs - Intrawell
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Trend Test Summary Table - Significant Results

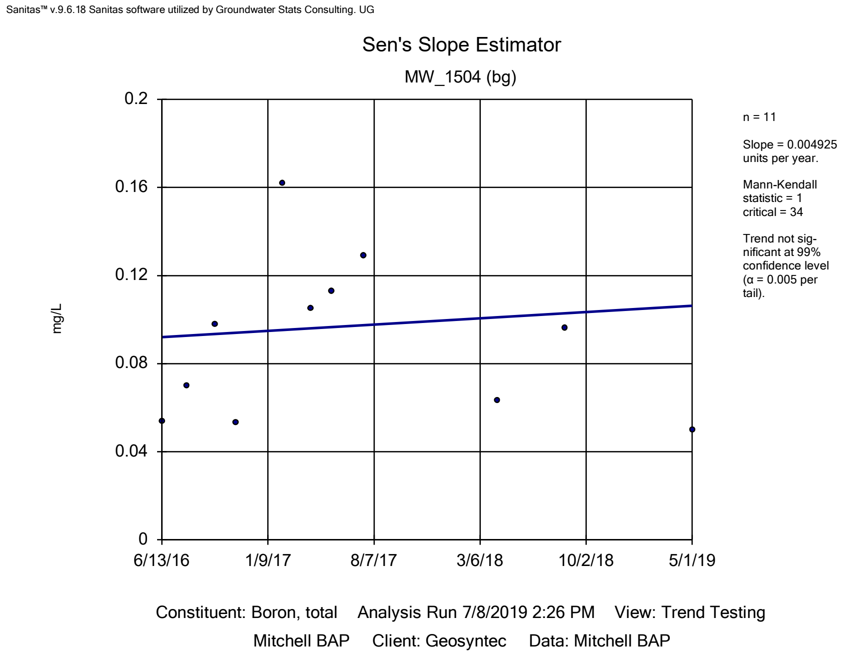
Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP   Printed 7/8/2019, 2:27 PM

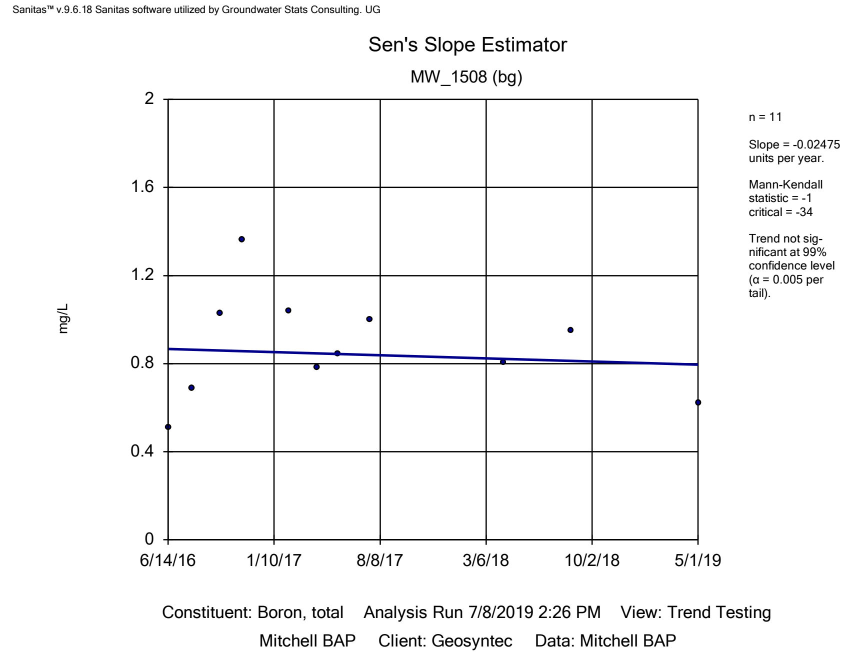
Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Boron, total (mg/L)	**MW_1505**	**-1.212**	**-42**	**-34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Boron, total (mg/L)	**MW_1507**	**-1.578**	**-43**	**-34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Calcium, total (mg/L)	**MW_1507**	**-25.59**	**-45**	**-34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Chloride, total (mg/L)	**MW_1508 (bg)**	**-18.83**	**-37**	**-34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Chloride, total (mg/L)	**MW_1505**	**-34.76**	**-51**	**-34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Chloride, total (mg/L)	**MW_1506**	**-29.93**	**-43**	**-34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Chloride, total (mg/L)	**MW_1507**	**-76.12**	**-43**	**-34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Chloride, total (mg/L)	**MW_1509**	**-30.58**	**-43**	**-34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**
pH, field (SU)	**MW_1504 (bg)**	**0.1866**	**36**	**34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**

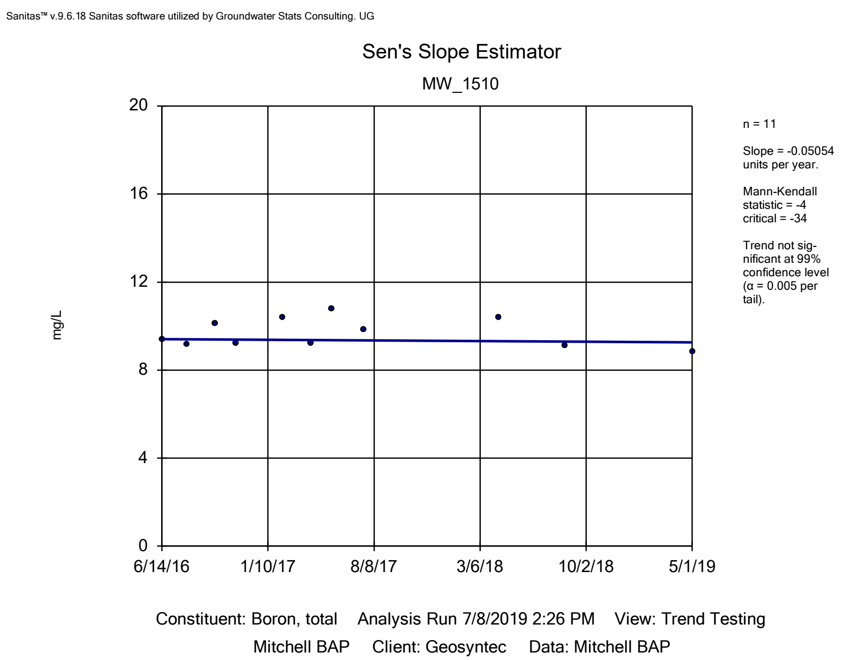
Trend Test Summary Table - All Results

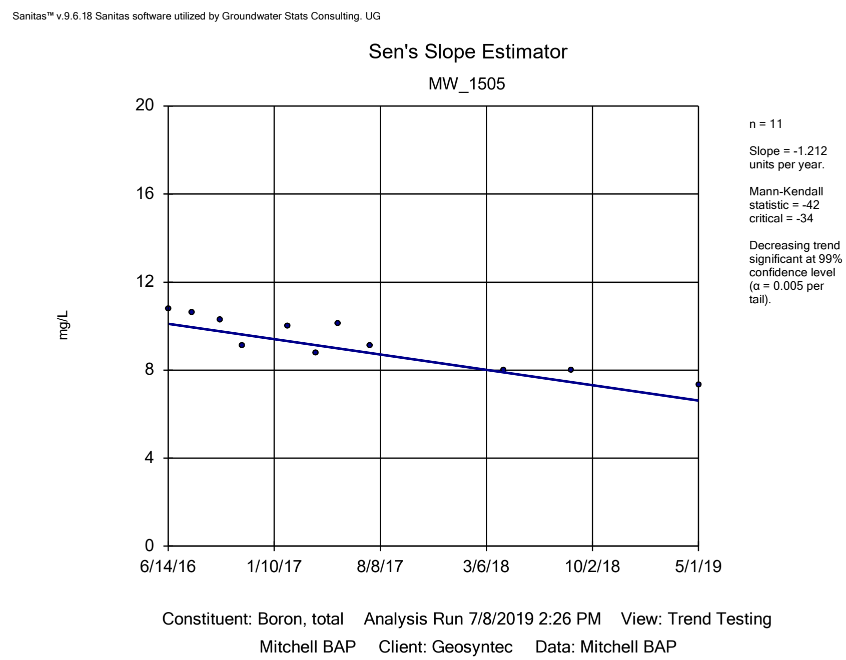
Mitchell BAP Client: Geosyntec Data: Mitchell BAP Printed 7/8/2019, 2:27 PM

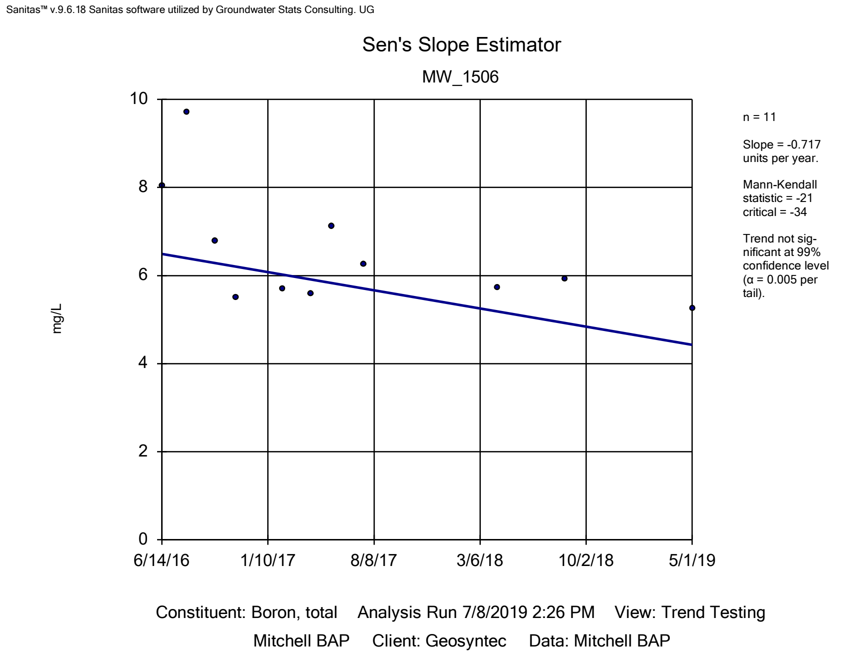
Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Boron, total (mg/L)	MW_1504 (bg)	0.004925	1	34	No	11	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	MW_1508 (bg)	-0.02475	-1	-34	No	11	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	MW_1510	-0.05054	-4	-34	No	11	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	**MW_1505**	**-1.212**	**-42**	**-34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Boron, total (mg/L)	MW_1506	-0.717	-21	-34	No	11	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	**MW_1507**	**-1.578**	**-43**	**-34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Boron, total (mg/L)	MW_1509	-2.466	-27	-34	No	11	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	MW_1504 (bg)	0	4	34	No	11	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	MW_1508 (bg)	2.104	12	34	No	11	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	MW_1510	-6.738	-13	-34	No	11	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	MW_1505	-3.288	-13	-34	No	11	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	MW_1506	-6.32	-24	-34	No	11	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	**MW_1507**	**-25.59**	**-45**	**-34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Calcium, total (mg/L)	MW_1509	-1.834	-12	-34	No	11	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	MW_1504 (bg)	-6.002	-24	-34	No	11	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	**MW_1508 (bg)**	**-18.83**	**-37**	**-34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Chloride, total (mg/L)	MW_1510	-5.016	-11	-34	No	11	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	**MW_1505**	**-34.76**	**-51**	**-34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Chloride, total (mg/L)	**MW_1506**	**-29.93**	**-43**	**-34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Chloride, total (mg/L)	**MW_1507**	**-76.12**	**-43**	**-34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Chloride, total (mg/L)	**MW_1509**	**-30.58**	**-43**	**-34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**
pH, field (SU)	**MW_1504 (bg)**	**0.1866**	**36**	**34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**
pH, field (SU)	MW_1508 (bg)	0.1505	25	34	No	11	0	n/a	n/a	0.01	NP
pH, field (SU)	MW_1509	0.1304	31	34	No	11	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	MW_1504 (bg)	-17.38	-14	-34	No	11	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	MW_1508 (bg)	1.448	7	34	No	11	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	MW_1510	21.89	5	34	No	11	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	MW_1505	21.01	17	34	No	11	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	MW_1506	13.67	16	34	No	11	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	MW_1504 (bg)	-16.52	-13	-34	No	11	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	MW_1508 (bg)	-19.31	-11	-34	No	11	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	MW_1510	0	0	34	No	11	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	MW_1505	-23.65	-4	-34	No	11	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	MW_1506	-101.4	-25	-34	No	11	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	MW_1507	-184.3	-20	-34	No	11	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	MW_1509	-51.17	-19	-34	No	11	0	n/a	n/a	0.01	NP


Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Sen's Slope Estimator
MW_1504 (bg)
mg/L
0.2
0.16
0.12
0.08
0.04
0
6/13/16
1/9/17
8/7/17
3/6/18
10/2/18
5/1/19
n = 11
Slope = 0.004925 units per year.
Mann-Kendall statistic = 1 critical = 34
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Boron, total Analysis Run 7/8/2019 2:26 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

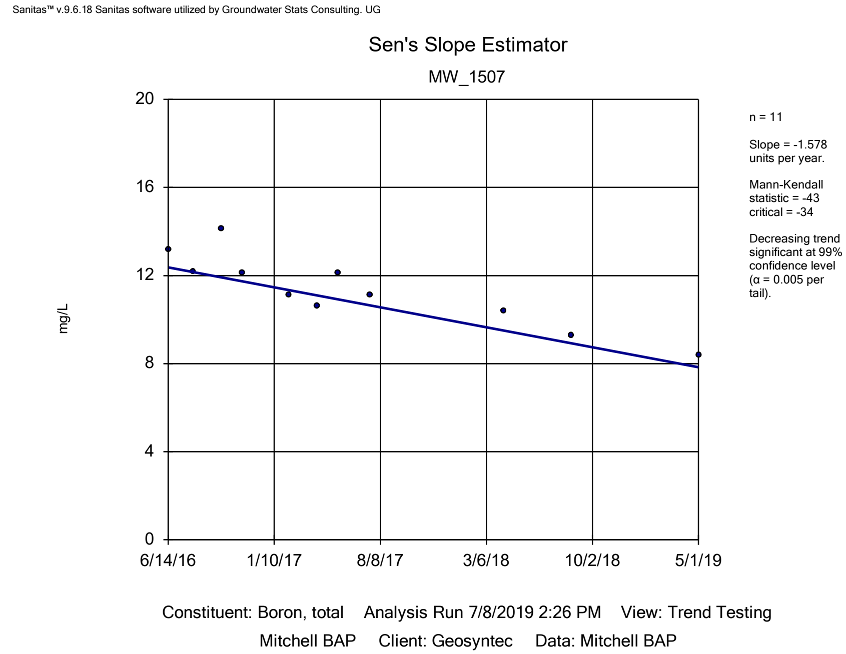

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Sen's Slope Estimator
MW_1508 (bg)
mg/L
2
1.6
1.2
0.8
0.4
0
6/14/16
1/10/17
8/8/17
3/6/18
10/2/18
5/1/19
n = 11
Slope = -0.02475 units per year.
Mann-Kendall statistic = -1 critical = -34
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Boron, total Analysis Run 7/8/2019 2:26 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP


Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Sen's Slope Estimator
MW_1510
mg/L
20
16
12
8
4
0
6/14/16
1/10/17
8/8/17
3/6/18
10/2/18
5/1/19
n = 11
Slope = -0.05054 units per year.
Mann-Kendall statistic = -4 critical = -34
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Boron, total Analysis Run 7/8/2019 2:26 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

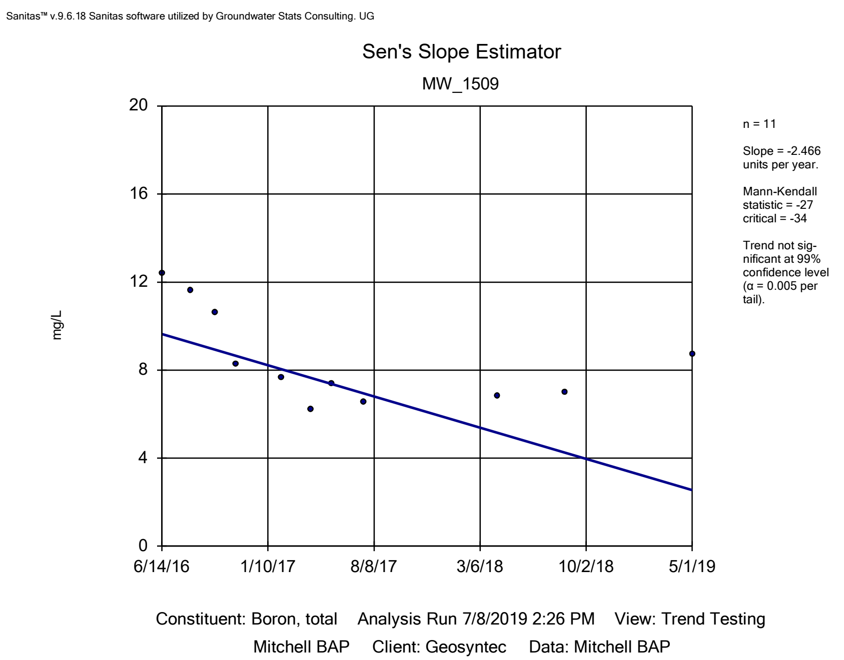

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Sen's Slope Estimator
MW_1505
mg/L
20
16
12
8
4
0
6/14/16
1/10/17
8/8/17
3/6/18
10/2/18
5/1/19
n = 11
Slope = -1.212 units per year.
Mann-Kendall statistic = -42 critical = -34
Decreasing trend significant at 99% confidence level (α = 0.005 per tail).
Constituent: Boron, total Analysis Run 7/8/2019 2:26 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP



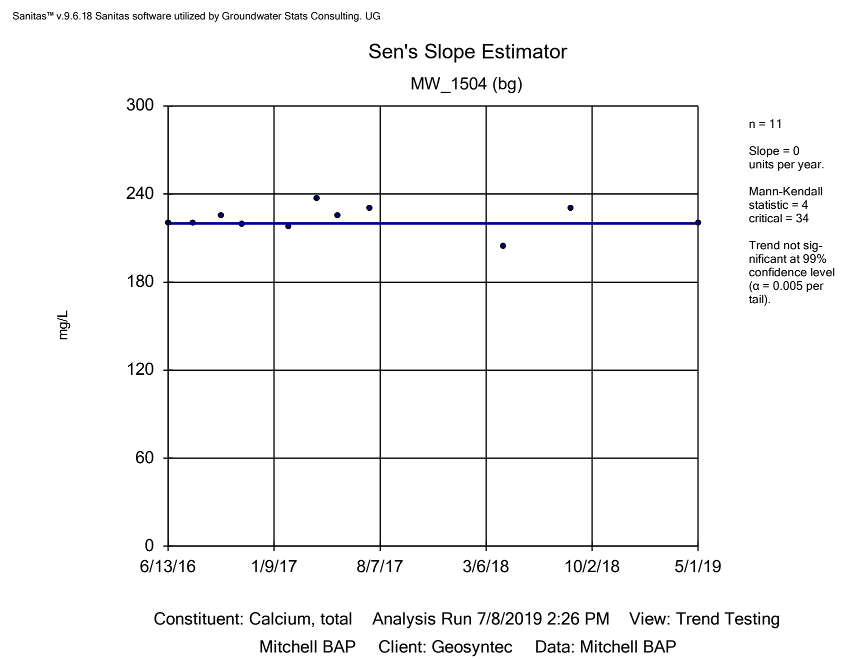
Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Sen's Slope Estimator
MW_1506
mg/L
10
8
6
4
2
0
6/14/16
1/10/17
8/8/17
3/6/18
10/2/18
5/1/19
n = 11
Slope = -0.717 units per year.
Mann-Kendall statistic = -21 critical = -34
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Boron, total Analysis Run 7/8/2019 2:26 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP



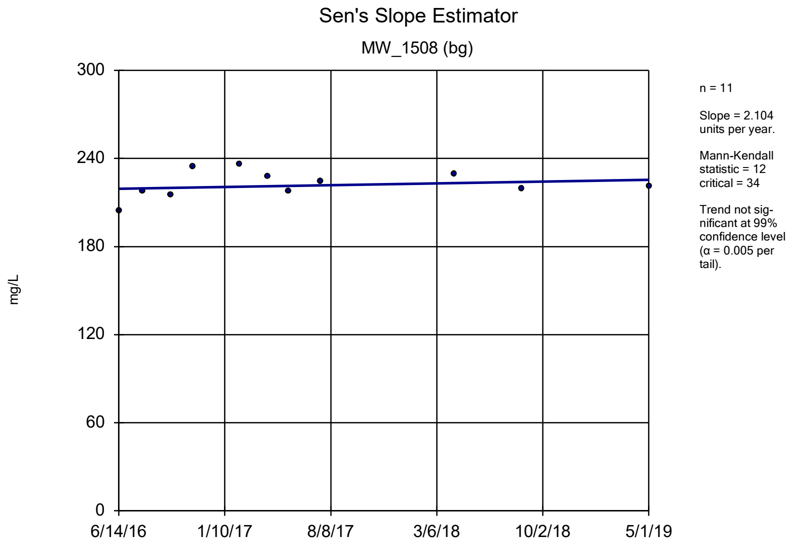
Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Sen's Slope Estimator
MW_1507
mg/L
20
16
12
8
4
0
6/14/16
1/10/17
8/8/17
3/6/18
10/2/18
5/1/19
n = 11
Slope = -1.578 units per year.
Mann-Kendall statistic = -43 critical = -34
Decreasing trend significant at 99% confidence level (α = 0.005 per tail).
Constituent: Boron, total Analysis Run 7/8/2019 2:26 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP



Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Sen's Slope Estimator
MW_1509
mg/L
20
16
12
8
4
0
6/14/16
1/10/17
8/8/17
3/6/18
10/2/18
5/1/19
n = 11
Slope = -2.466 units per year.
Mann-Kendall statistic = -27 critical = -34
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Boron, total Analysis Run 7/8/2019 2:26 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

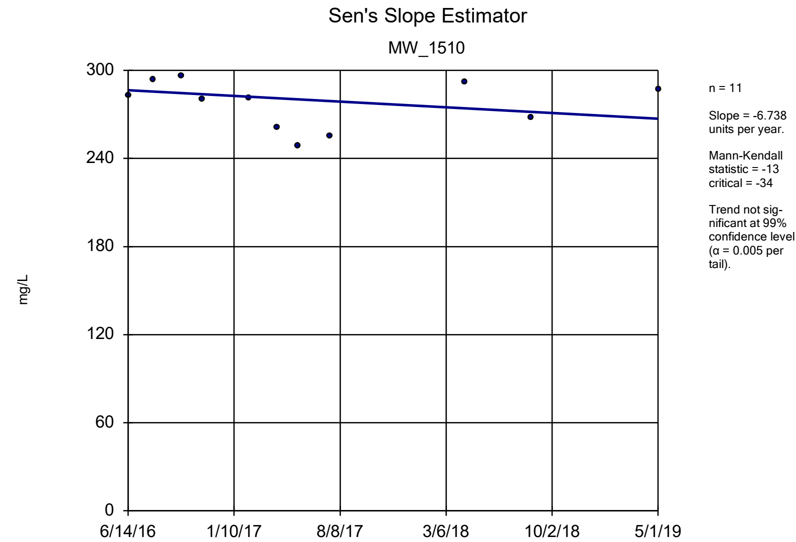


Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Sen's Slope Estimator
MW_1504 (bg)
mg/L
300
240
180
120
60
0
6/13/16
1/9/17
8/7/17
3/6/18
10/2/18
5/1/19
n = 11
Slope = 0 units per year.
Mann-Kendall statistic = 4 critical = 34
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Calcium, total Analysis Run 7/8/2019 2:26 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP



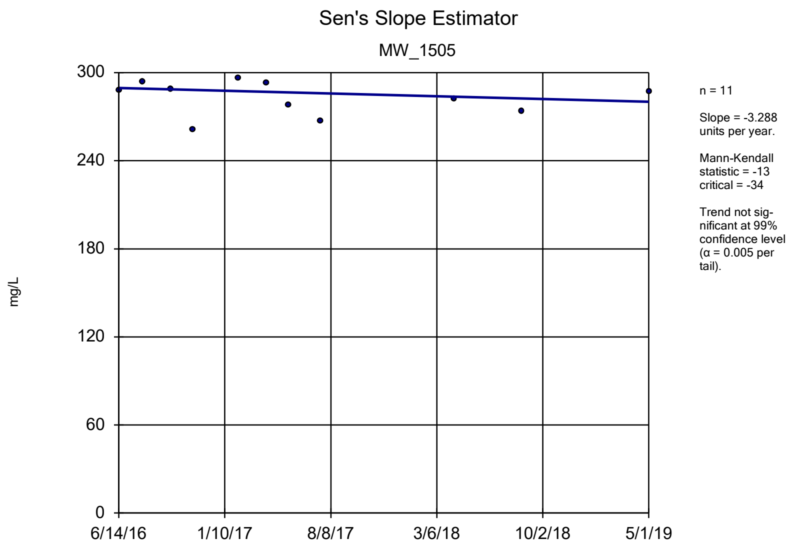
Constituent: Calcium, total Analysis Run 7/8/2019 2:26 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



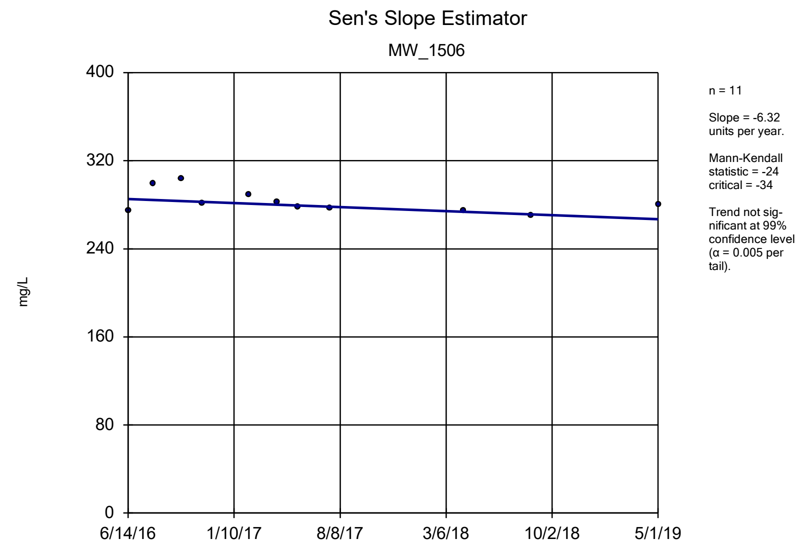
Constituent: Calcium, total Analysis Run 7/8/2019 2:26 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Calcium, total Analysis Run 7/8/2019 2:26 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

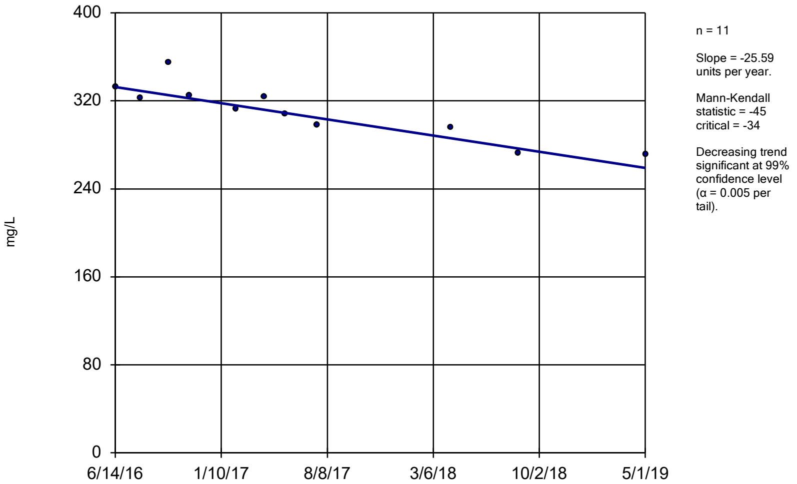


Constituent: Calcium, total Analysis Run 7/8/2019 2:26 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

MW_1507

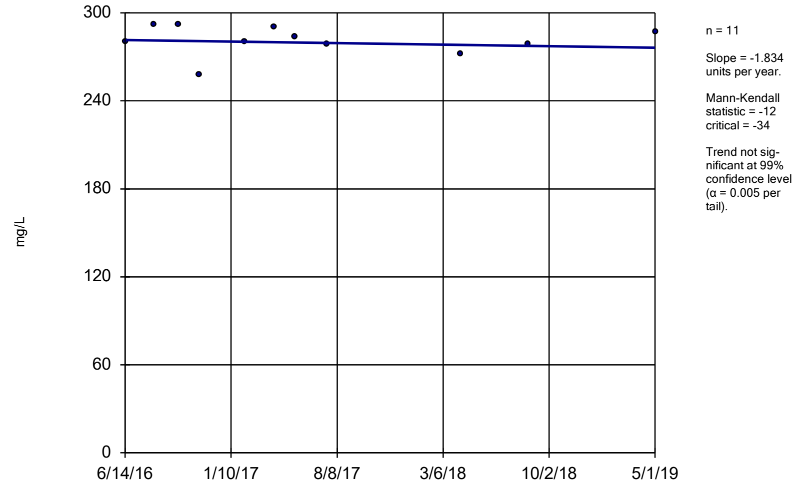


Constituent: Calcium, total Analysis Run 7/8/2019 2:26 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

MW_1509

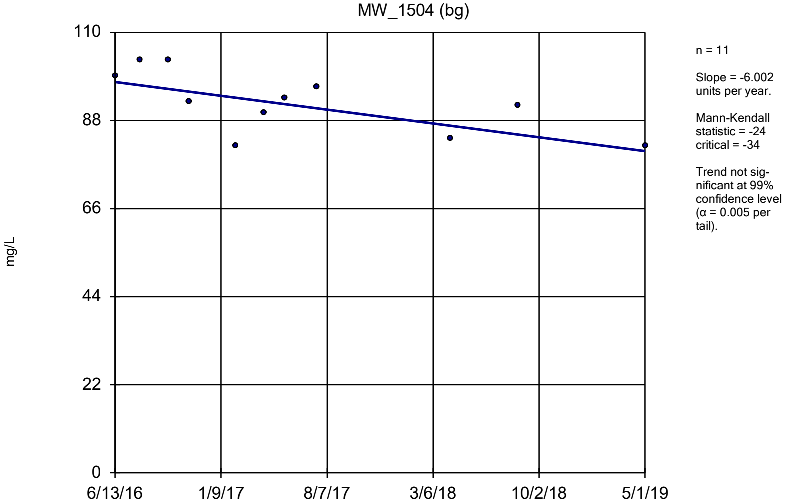


Constituent: Calcium, total Analysis Run 7/8/2019 2:26 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

MW_1504 (bg)

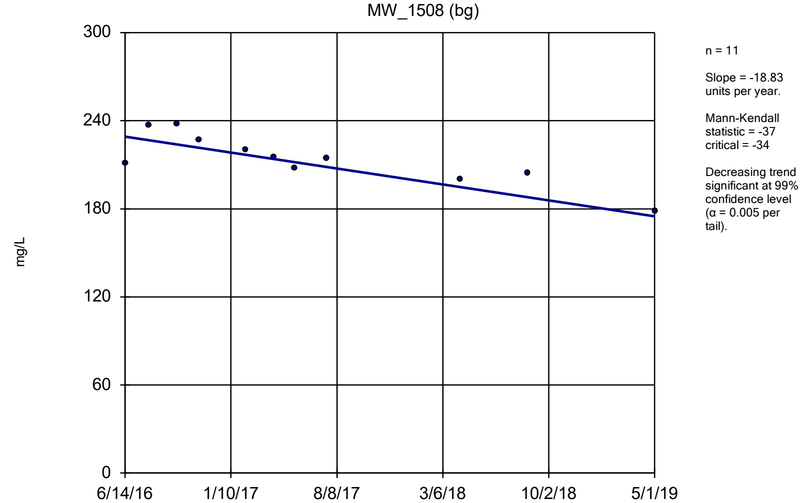


Constituent: Chloride, total Analysis Run 7/8/2019 2:26 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

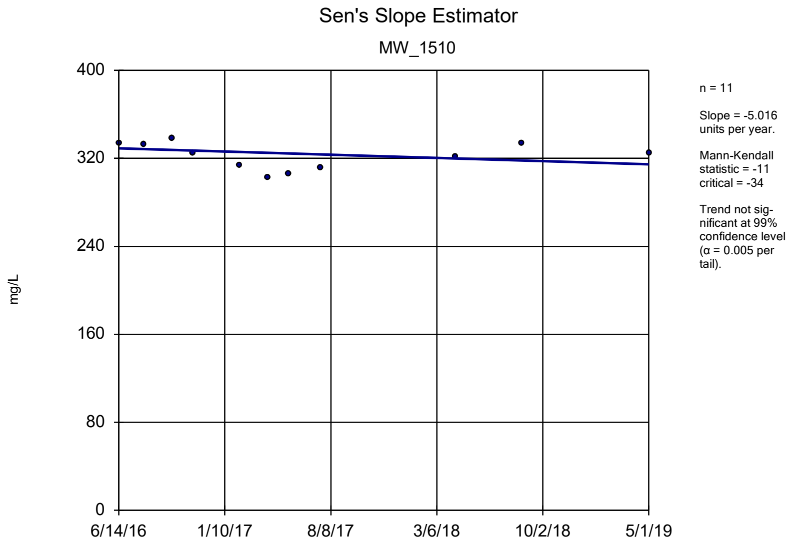
Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

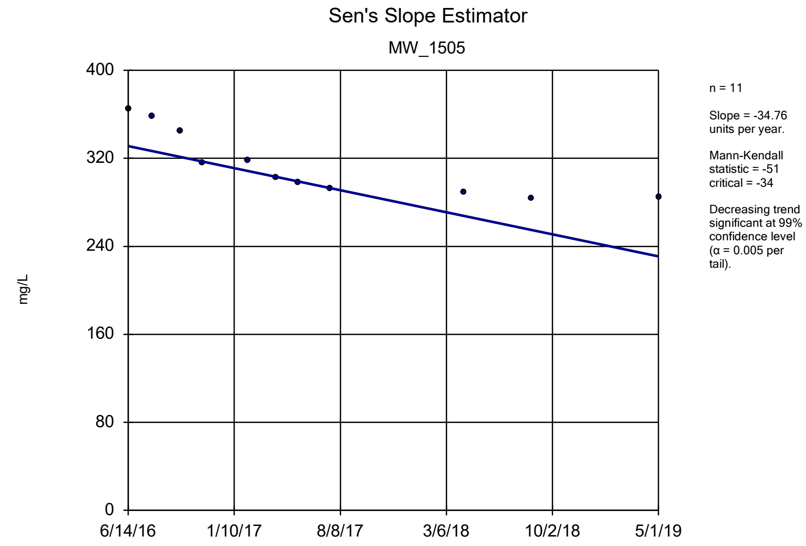
MW_1508 (bg)



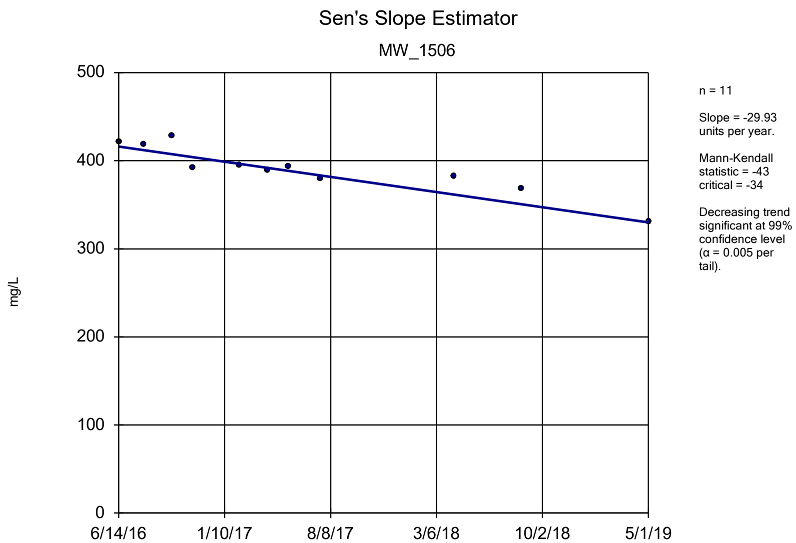
Constituent: Chloride, total Analysis Run 7/8/2019 2:26 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP



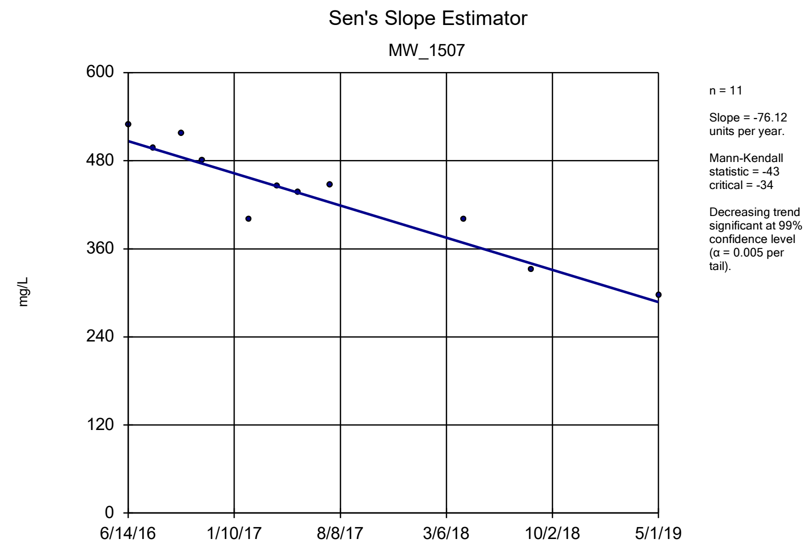
Constituent: Chloride, total Analysis Run 7/8/2019 2:26 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP



Constituent: Chloride, total Analysis Run 7/8/2019 2:26 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP



Constituent: Chloride, total Analysis Run 7/8/2019 2:26 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

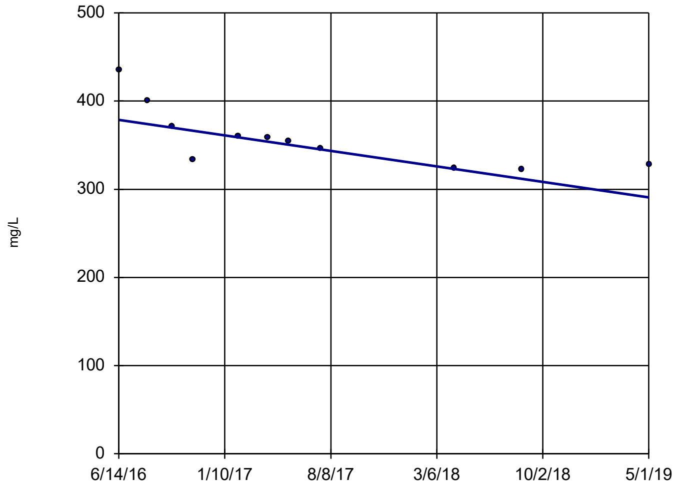


Constituent: Chloride, total Analysis Run 7/8/2019 2:26 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

MW_1509



n = 11

Slope = -30.58 units per year.

Mann-Kendall statistic = -43 critical = -34

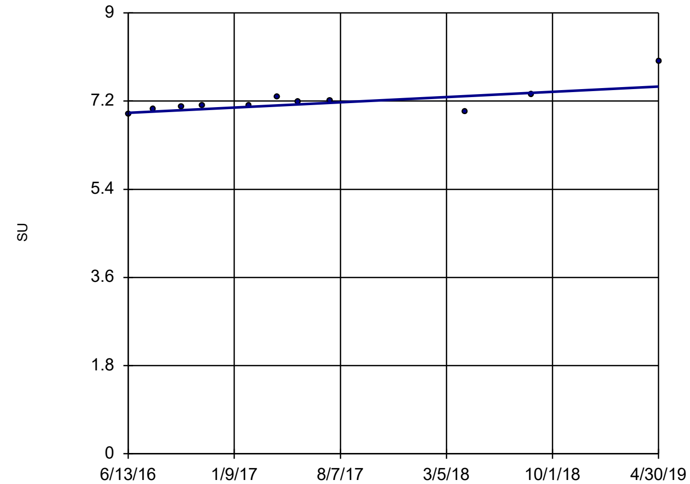
Decreasing trend significant at 99% confidence level (α = 0.005 per tail).

Constituent: Chloride, total Analysis Run 7/8/2019 2:26 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

MW_1504 (bg)



n = 11

Slope = 0.1866 units per year.

Mann-Kendall statistic = 36 critical = 34

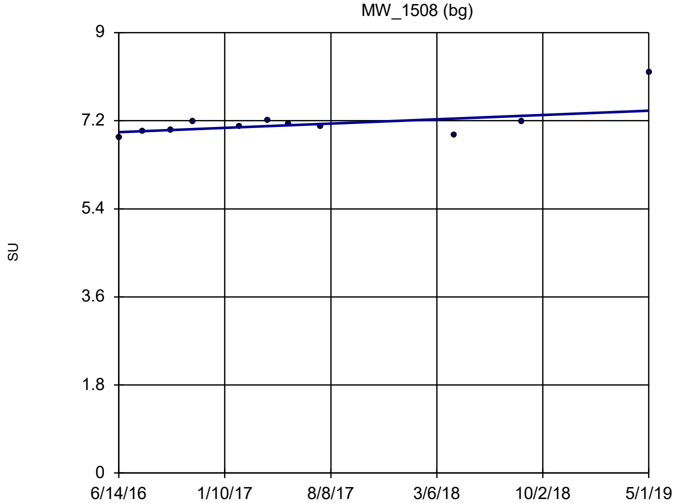
Increasing trend significant at 99% confidence level (α = 0.005 per tail).

Constituent: pH, field Analysis Run 7/8/2019 2:26 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

MW_1508 (bg)



n = 11

Slope = 0.1505 units per year.

Mann-Kendall statistic = 25 critical = 34

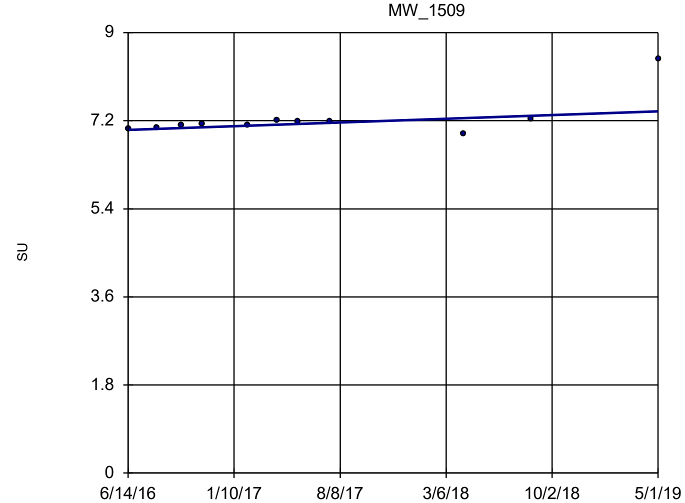
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: pH, field Analysis Run 7/8/2019 2:26 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

MW_1509



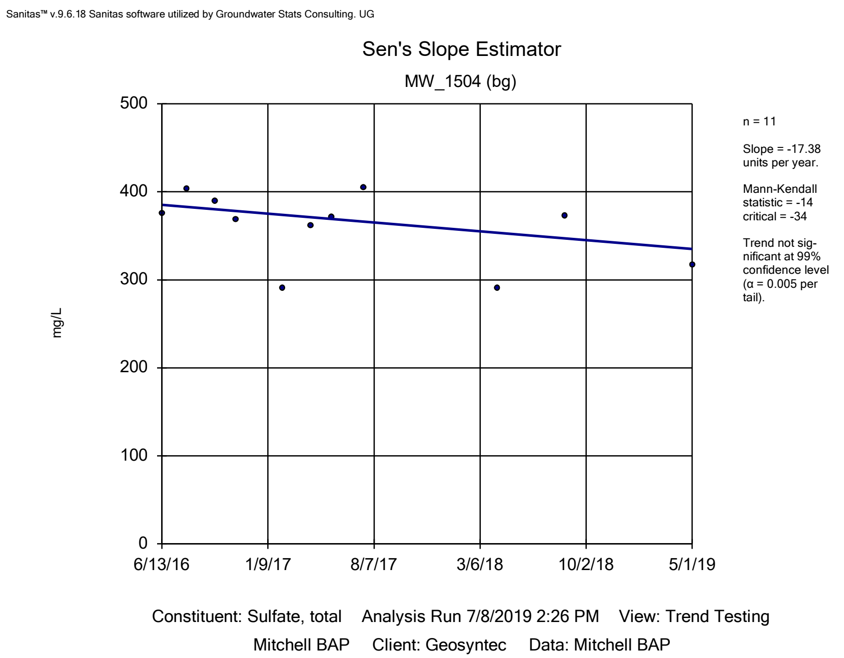
n = 11

Slope = 0.1304 units per year.

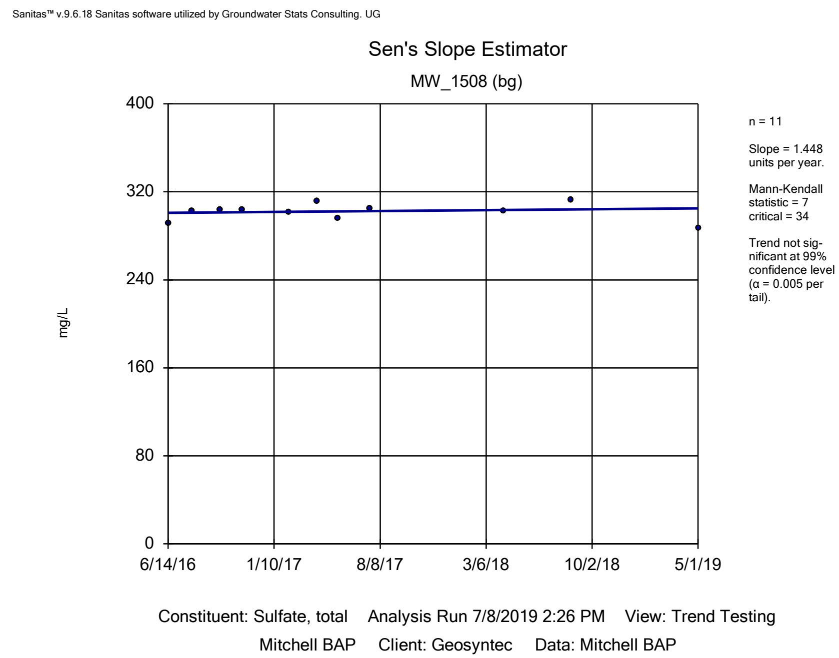
Mann-Kendall statistic = 31 critical = 34

Trend not significant at 99% confidence level (α = 0.005 per tail).

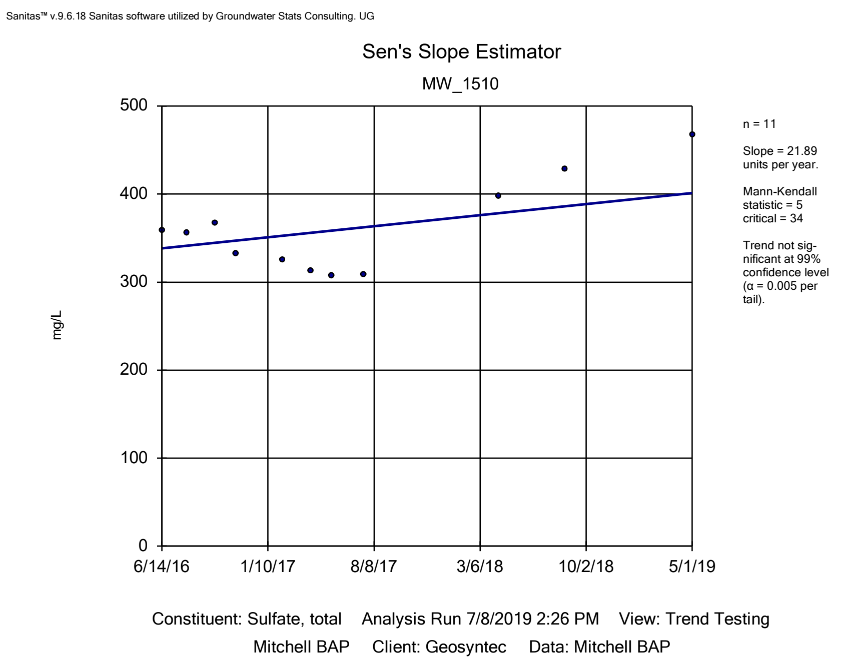
Constituent: pH, field Analysis Run 7/8/2019 2:26 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP



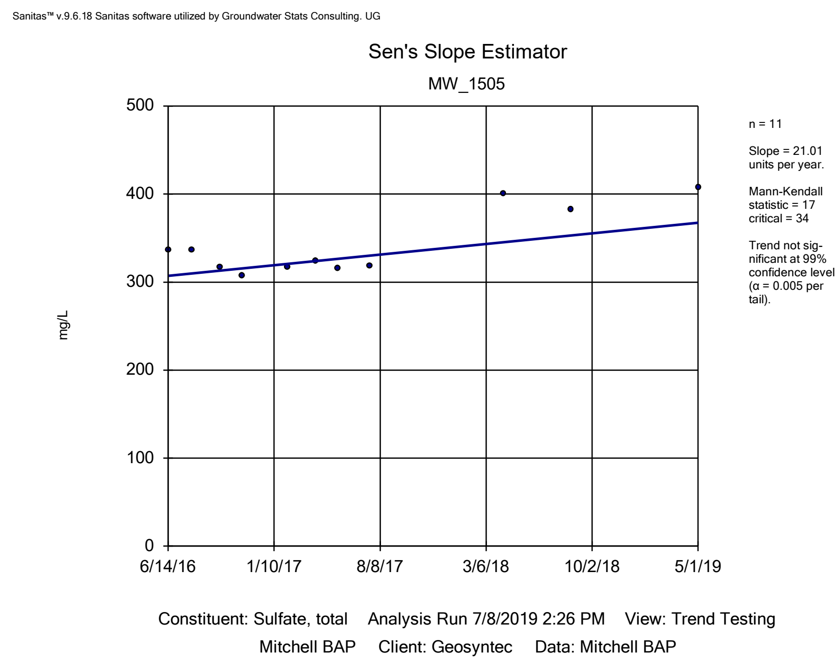
Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Sen's Slope Estimator
MW_1504 (bg)
mg/L
n = 11
Slope = -17.38 units per year.
Mann-Kendall statistic = -14 critical = -34
Trend not significant at 99% confidence level (α = 0.005 per tail).
6/13/16
1/9/17
8/7/17
3/6/18
10/2/18
5/1/19
Constituent: Sulfate, total Analysis Run 7/8/2019 2:26 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP



Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Sen's Slope Estimator
MW_1508 (bg)
mg/L
n = 11
Slope = 1.448 units per year.
Mann-Kendall statistic = 7 critical = 34
Trend not significant at 99% confidence level (α = 0.005 per tail).
6/14/16
1/10/17
8/8/17
3/6/18
10/2/18
5/1/19
Constituent: Sulfate, total Analysis Run 7/8/2019 2:26 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

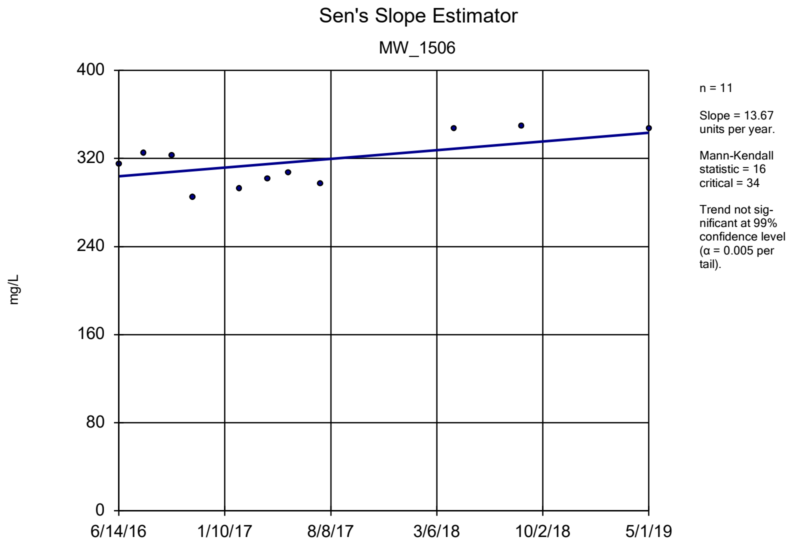


Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Sen's Slope Estimator
MW_1510
mg/L
n = 11
Slope = 21.89 units per year.
Mann-Kendall statistic = 5 critical = 34
Trend not significant at 99% confidence level (α = 0.005 per tail).
6/14/16
1/10/17
8/8/17
3/6/18
10/2/18
5/1/19
Constituent: Sulfate, total Analysis Run 7/8/2019 2:26 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP



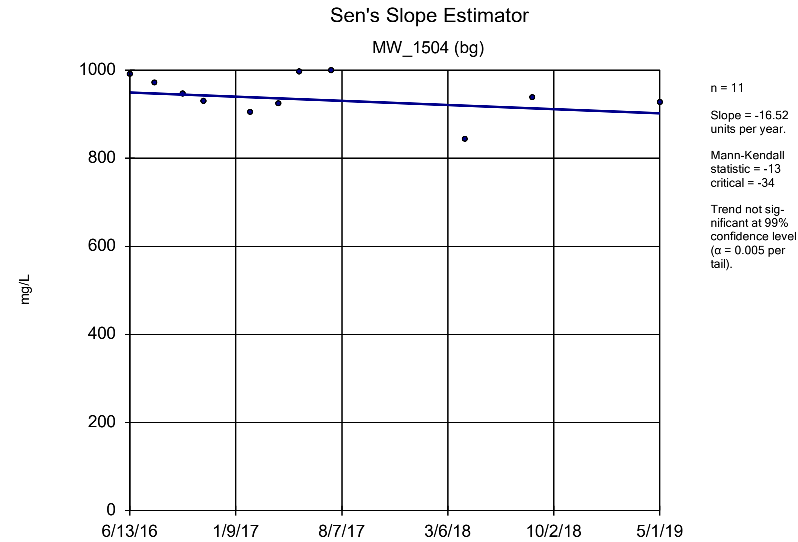
Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Sen's Slope Estimator
MW_1505
mg/L
n = 11
Slope = 21.01 units per year.
Mann-Kendall statistic = 17 critical = 34
Trend not significant at 99% confidence level (α = 0.005 per tail).
6/14/16
1/10/17
8/8/17
3/6/18
10/2/18
5/1/19
Constituent: Sulfate, total Analysis Run 7/8/2019 2:26 PM View: Trend Testing
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



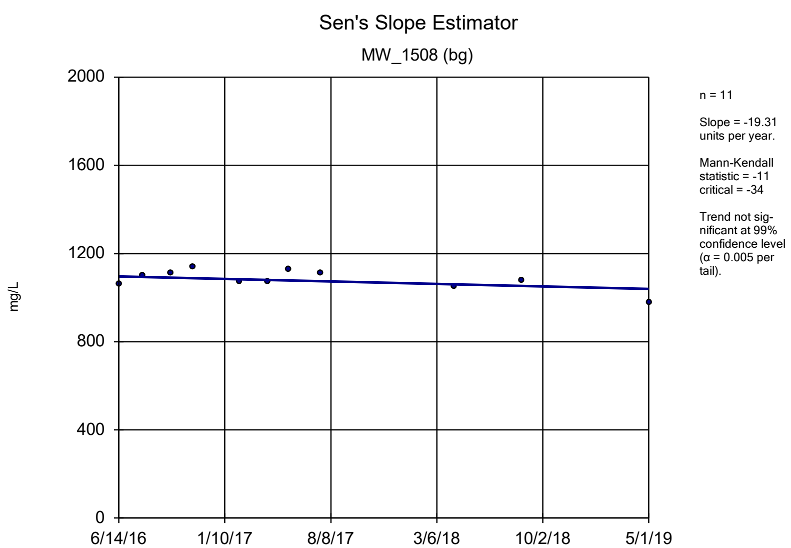
Constituent: Sulfate, total   Analysis Run 7/8/2019 2:26 PM   View: Trend Testing
Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



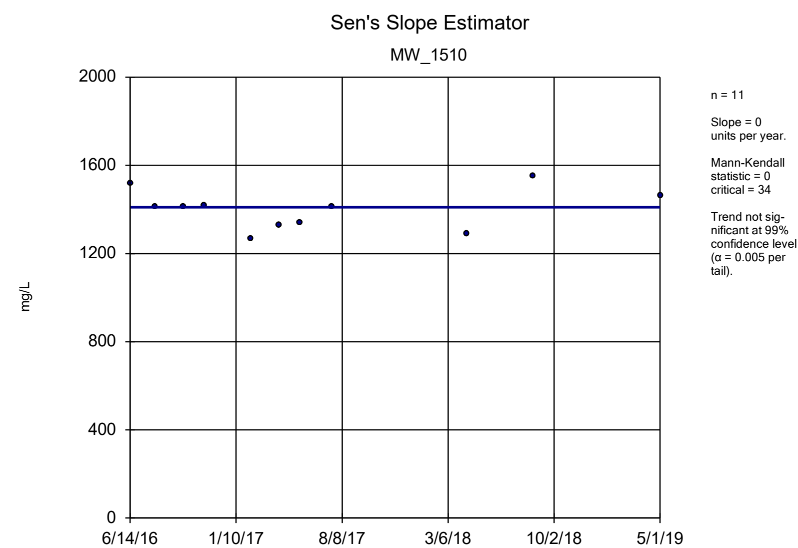
Constituent: Total Dissolved Solids [TDS]   Analysis Run 7/8/2019 2:26 PM   View: Trend Testing
Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



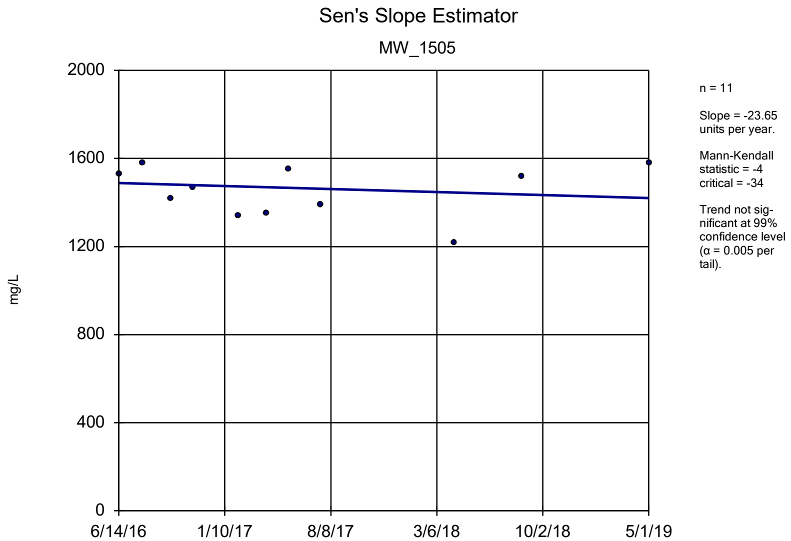
Constituent: Total Dissolved Solids [TDS]   Analysis Run 7/8/2019 2:26 PM   View: Trend Testing
Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



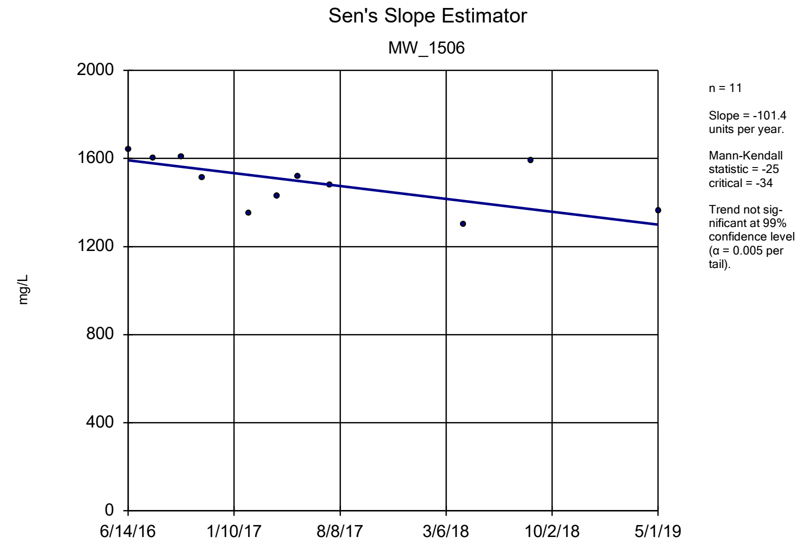
Constituent: Total Dissolved Solids [TDS]   Analysis Run 7/8/2019 2:26 PM   View: Trend Testing
Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



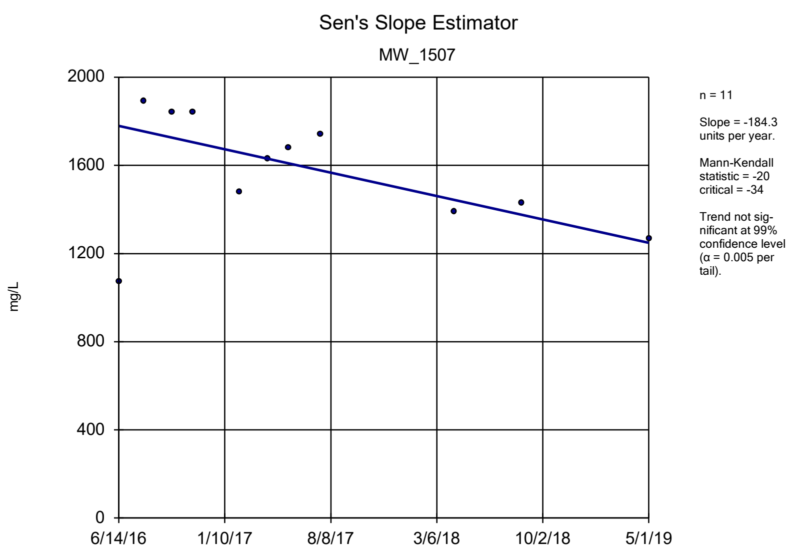
Constituent: Total Dissolved Solids [TDS]   Analysis Run 7/8/2019 2:26 PM   View: Trend Testing
Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



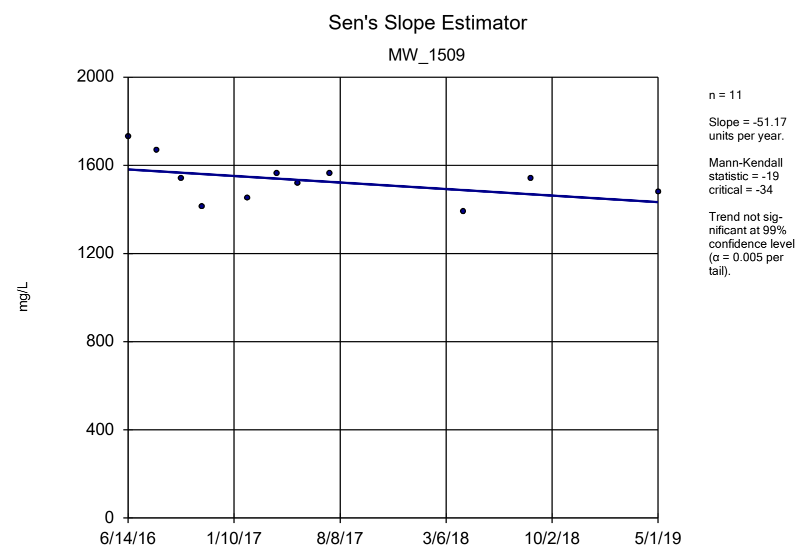
Constituent: Total Dissolved Solids [TDS]   Analysis Run 7/8/2019 2:26 PM   View: Trend Testing
Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Total Dissolved Solids [TDS]   Analysis Run 7/8/2019 2:26 PM   View: Trend Testing
Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Total Dissolved Solids [TDS]   Analysis Run 7/8/2019 2:26 PM   View: Trend Testing
Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP

Tolerance Limit Summary Table

Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP   Printed 7/10/2019, 9:44 AM

Constituent	Well	Upper Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Antimony, total (mg/L)	n/a	0.00006792	22	0.00003682	0.00001323	9.091	None	No	0.05	Inter
Arsenic, Total (mg/L)	n/a	0.001688	22	0.0007277	0.0004088	0	None	No	0.05	Inter
Barium, Total (mg/L)	n/a	0.05689	22	0.04265	0.006063	0	None	No	0.05	Inter
Beryllium, total (mg/L)	n/a	0.0001	22	n/a	n/a	36.36	n/a	n/a	0.3235	NP Inter(normality)
Cadmium, total (mg/L)	n/a	0.00009	22	n/a	n/a	0	n/a	n/a	0.3235	NP Inter(normality)
Chromium, total (mg/L)	n/a	0.002247	22	0.0008482	0.0005951	0	None	No	0.05	Inter
Cobalt, total (mg/L)	n/a	0.003646	22	0.02767	0.01392	0	None	sqrt(x)	0.05	Inter
Combined Radium 226 + 228 (pCi/L)	n/a	2.259	21	0.7496	0.3178	0	None	sqrt(x)	0.05	Inter
Fluoride, total (mg/L)	n/a	0.25	22	n/a	n/a	0	n/a	n/a	0.3235	NP Inter(normality)
Lead, total (mg/L)	n/a	0.004213	22	0.07295	0.03769	0	None	x^(1/3)	0.05	Inter
Lithium, total (mg/L)	n/a	0.0193	22	0.16	0.04606	18.18	Kaplan-Meier	x^(1/3)	0.05	Inter
Mercury, total (mg/L)	n/a	0.000008	22	n/a	n/a	68.18	n/a	n/a	0.3235	NP Inter(normality)
Molybdenum, total (mg/L)	n/a	0.001885	22	0.02673	0.007099	9.091	None	sqrt(x)	0.05	Inter
Selenium, Total (mg/L)	n/a	0.001096	22	0.01389	0.008179	18.18	Kaplan-Meier	sqrt(x)	0.05	Inter
Thallium, Total (mg/L)	n/a	0.00025	22	n/a	n/a	13.64	n/a	n/a	0.3235	NP Inter(normality)

Confidence Interval Summary Table - All Results (No Significant)

Mitchell BAP Client: Geosyntec Data: Mitchell BAP Printed 7/10/2019, 10:24 AM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Lower Compl.	Sig.	N	%NDs	Transform	Alpha	Method
Antimony, total (mg/L)	MW_1510	0.00003	0.00002	0.006	n/a	No	11	0	No	0.006	NP (normality)
Antimony, total (mg/L)	MW_1505	0.00007514	0.00003259	0.006	n/a	No	11	9.091	sqrt(x)	0.01	Param.
Antimony, total (mg/L)	MW_1506	0.00007	0.00003	0.006	n/a	No	11	0	No	0.006	NP (normality)
Antimony, total (mg/L)	MW_1507	0.0001028	0.00005539	0.006	n/a	No	11	0	No	0.01	Param.
Antimony, total (mg/L)	MW_1509	0.00003	0.00002	0.006	n/a	No	11	0	No	0.006	NP (normality)
Arsenic, Total (mg/L)	MW_1510	0.0006235	0.0003892	0.01	n/a	No	11	0	No	0.01	Param.
Arsenic, Total (mg/L)	MW_1505	0.001759	0.0003922	0.01	n/a	No	11	0	sqrt(x)	0.01	Param.
Arsenic, Total (mg/L)	MW_1506	0.001177	0.0005433	0.01	n/a	No	11	0	No	0.01	Param.
Arsenic, Total (mg/L)	MW_1507	0.003285	0.0009498	0.01	n/a	No	11	0	No	0.01	Param.
Arsenic, Total (mg/L)	MW_1509	0.0005612	0.0003625	0.01	n/a	No	11	0	No	0.01	Param.
Barium, Total (mg/L)	MW_1510	0.04714	0.04064	2	n/a	No	11	0	No	0.01	Param.
Barium, Total (mg/L)	MW_1505	0.0633	0.0459	2	n/a	No	11	0	No	0.006	NP (normality)
Barium, Total (mg/L)	MW_1506	0.06518	0.05393	2	n/a	No	11	0	No	0.01	Param.
Barium, Total (mg/L)	MW_1507	0.0905	0.06227	2	n/a	No	11	0	No	0.01	Param.
Barium, Total (mg/L)	MW_1509	0.06333	0.05409	2	n/a	No	11	0	No	0.01	Param.
Beryllium, total (mg/L)	MW_1510	0.00002	0.000008	0.004	n/a	No	11	36.36	No	0.006	NP (normality)
Beryllium, total (mg/L)	MW_1505	0.0001247	0.00001946	0.004	n/a	No	11	27.27	No	0.01	Param.
Beryllium, total (mg/L)	MW_1506	0.00004617	0.00001128	0.004	n/a	No	11	9.091	sqrt(x)	0.01	Param.
Beryllium, total (mg/L)	MW_1507	0.000145	0.00004317	0.004	n/a	No	11	9.091	No	0.01	Param.
Beryllium, total (mg/L)	MW_1509	0.00002	0.000008	0.004	n/a	No	11	63.64	No	0.006	NP (normality)
Cadmium, total (mg/L)	MW_1510	0.00001	0.000005	0.005	n/a	No	11	9.091	No	0.006	NP (normality)
Cadmium, total (mg/L)	MW_1505	0.00003	0.00002	0.005	n/a	No	11	0	No	0.006	NP (normality)
Cadmium, total (mg/L)	MW_1506	0.00004	0.00002	0.005	n/a	No	11	0	No	0.006	NP (normality)
Cadmium, total (mg/L)	MW_1507	0.00007	0.00003	0.005	n/a	No	11	0	No	0.006	NP (normality)
Cadmium, total (mg/L)	MW_1509	0.00002	0.00001	0.005	n/a	No	11	0	No	0.006	NP (normality)
Chromium, total (mg/L)	MW_1510	0.005133	0.0006327	0.1	n/a	No	11	0	ln(x)	0.01	Param.
Chromium, total (mg/L)	MW_1505	0.01277	0.001233	0.1	n/a	No	11	0	sqrt(x)	0.01	Param.
Chromium, total (mg/L)	MW_1506	0.003187	0.001035	0.1	n/a	No	11	0	No	0.01	Param.
Chromium, total (mg/L)	MW_1507	0.01602	0.005162	0.1	n/a	No	11	0	No	0.01	Param.
Chromium, total (mg/L)	MW_1509	0.001972	0.0006125	0.1	n/a	No	11	0	ln(x)	0.01	Param.
Cobalt, total (mg/L)	MW_1510	0.0002956	0.0001524	0.006	n/a	No	11	0	No	0.01	Param.
Cobalt, total (mg/L)	MW_1505	0.001303	0.0002604	0.006	n/a	No	11	0	sqrt(x)	0.01	Param.
Cobalt, total (mg/L)	MW_1506	0.0009387	0.0003901	0.006	n/a	No	11	0	No	0.01	Param.
Cobalt, total (mg/L)	MW_1507	0.003318	0.000943	0.006	n/a	No	11	0	No	0.01	Param.
Cobalt, total (mg/L)	MW_1509	0.000408	0.0001854	0.006	n/a	No	11	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	MW_1510	1.166	0.362	5	n/a	No	10	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	MW_1505	1.117	0.4851	5	n/a	No	11	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	MW_1506	1.362	0.287	5	n/a	No	11	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	MW_1507	1.727	0.5974	5	n/a	No	10	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	MW_1509	1.572	0.3911	5	n/a	No	11	0	No	0.01	Param.
Fluoride, total (mg/L)	MW_1510	0.2	0.05	4	n/a	No	11	27.27	No	0.006	NP (normality)
Fluoride, total (mg/L)	MW_1505	0.2	0.06	4	n/a	No	11	90.91	No	0.006	NP (NDs)
Fluoride, total (mg/L)	MW_1506	0.2	0.05	4	n/a	No	11	63.64	No	0.006	NP (normality)
Fluoride, total (mg/L)	MW_1507	0.07	0.05	4	n/a	No	11	9.091	No	0.006	NP (normality)
Fluoride, total (mg/L)	MW_1509	0.16	0.1	4	n/a	No	11	0	No	0.006	NP (normality)
Lead, total (mg/L)	MW_1510	0.0002496	0.00008419	0.015	n/a	No	11	0	No	0.01	Param.
Lead, total (mg/L)	MW_1505	0.001431	0.0001055	0.015	n/a	No	11	0	sqrt(x)	0.01	Param.
Lead, total (mg/L)	MW_1506	0.0007859	0.0002635	0.015	n/a	No	11	0	No	0.01	Param.
Lead, total (mg/L)	MW_1507	0.003343	0.0007325	0.015	n/a	No	11	0	No	0.01	Param.
Lead, total (mg/L)	MW_1509	0.000137	0.00001798	0.015	n/a	No	11	0	sqrt(x)	0.01	Param.
Lithium, total (mg/L)	MW_1510	0.01439	0.00779	0.04	n/a	No	11	0	No	0.01	Param.
Lithium, total (mg/L)	MW_1505	0.0128	0.006468	0.04	n/a	No	11	9.091	No	0.01	Param.
Lithium, total (mg/L)	MW_1506	0.01614	0.009135	0.04	n/a	No	11	0	No	0.01	Param.
Lithium, total (mg/L)	MW_1507	0.0191	0.01163	0.04	n/a	No	11	9.091	No	0.01	Param.
Lithium, total (mg/L)	MW_1509	0.01764	0.008523	0.04	n/a	No	11	9.091	No	0.01	Param.

Confidence Interval Summary Table - All Results (No Significant)

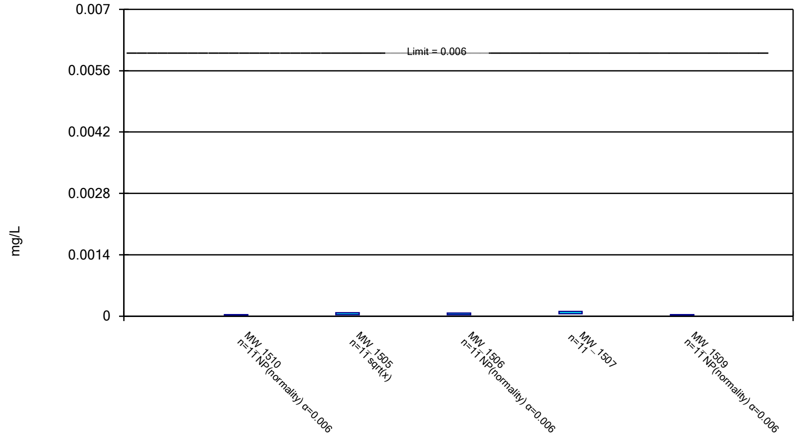
Mitchell BAP Client: Geosyntec Data: Mitchell BAP Printed 7/10/2019, 10:24 AM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Lower Compl.	Sig.	N	%NDs	Transform	Alpha	Method
Mercury, total (mg/L)	MW_1510	0.000005	0.000005	0.002	n/a	No	11	90.91	No	0.006	NP (NDs)
Mercury, total (mg/L)	MW_1505	0.000006	0.000002	0.002	n/a	No	11	63.64	No	0.006	NP (normality)
Mercury, total (mg/L)	MW_1506	0.000005	0.000002	0.002	n/a	No	11	45.45	No	0.006	NP (normality)
Mercury, total (mg/L)	MW_1507	0.00001308	0.000003549	0.002	n/a	No	11	9.091	sqrt(x)	0.01	Param.
Mercury, total (mg/L)	MW_1509	0.000005	0.000002	0.002	n/a	No	11	81.82	No	0.006	NP (NDs)
Molybdenum, total (mg/L)	MW_1510	0.001099	0.0003238	0.1	n/a	No	11	9.091	ln(x)	0.01	Param.
Molybdenum, total (mg/L)	MW_1505	0.002461	0.0007391	0.1	n/a	No	11	0	ln(x)	0.01	Param.
Molybdenum, total (mg/L)	MW_1506	0.001309	0.0005217	0.1	n/a	No	11	0	No	0.01	Param.
Molybdenum, total (mg/L)	MW_1507	0.005653	0.000975	0.1	n/a	No	11	0	sqrt(x)	0.01	Param.
Molybdenum, total (mg/L)	MW_1509	0.001037	0.0004628	0.1	n/a	No	11	9.091	No	0.01	Param.
Selenium, Total (mg/L)	MW_1510	0.0002	0.00008	0.05	n/a	No	11	0	No	0.006	NP (normality)
Selenium, Total (mg/L)	MW_1505	0.0007666	0.0003425	0.05	n/a	No	11	0	No	0.01	Param.
Selenium, Total (mg/L)	MW_1506	0.0002	0.00007	0.05	n/a	No	11	18.18	No	0.006	NP (Cohens/xfrm)
Selenium, Total (mg/L)	MW_1507	0.0004883	0.000139	0.05	n/a	No	11	0	No	0.01	Param.
Selenium, Total (mg/L)	MW_1509	0.0002	0.0001	0.05	n/a	No	11	0	No	0.006	NP (normality)
Thallium, Total (mg/L)	MW_1510	0.000057	0.00001	0.002	n/a	No	11	18.18	No	0.006	NP (Cohens/xfrm)
Thallium, Total (mg/L)	MW_1505	0.000102	0.000065	0.002	n/a	No	10	10	No	0.011	NP (normality)
Thallium, Total (mg/L)	MW_1506	0.00007	0.00005	0.002	n/a	No	11	9.091	No	0.006	NP (normality)
Thallium, Total (mg/L)	MW_1507	0.00009	0.00005	0.002	n/a	No	11	9.091	No	0.006	NP (normality)
Thallium, Total (mg/L)	MW_1509	0.000057	0.00003	0.002	n/a	No	11	9.091	No	0.006	NP (normality)

Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

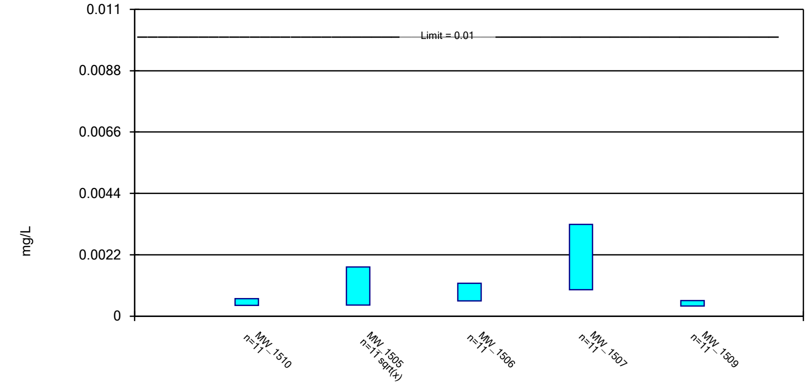


Constituent: Antimony, total Analysis Run 7/10/2019 10:22 AM View: Confidence Intervals - Appendix IV
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

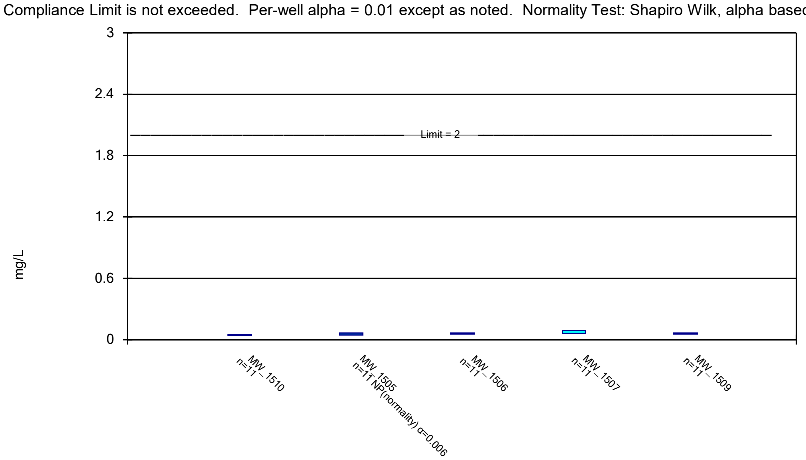


Constituent: Arsenic, Total Analysis Run 7/10/2019 10:22 AM View: Confidence Intervals - Appendix IV
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

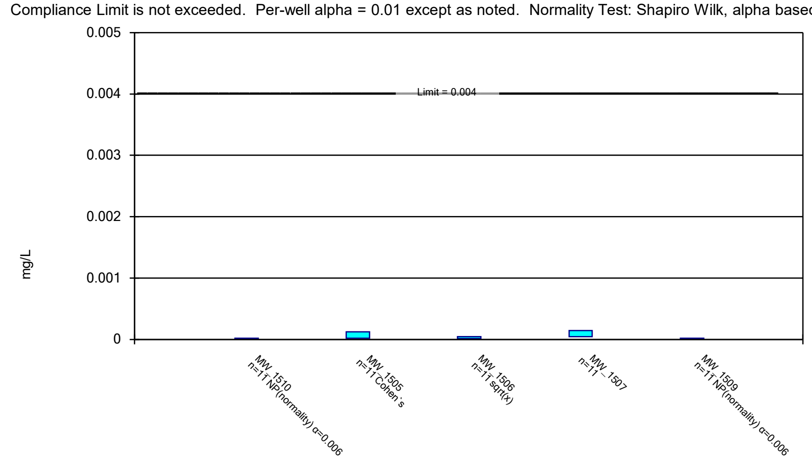


Constituent: Barium, Total Analysis Run 7/10/2019 10:22 AM View: Confidence Intervals - Appendix IV
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

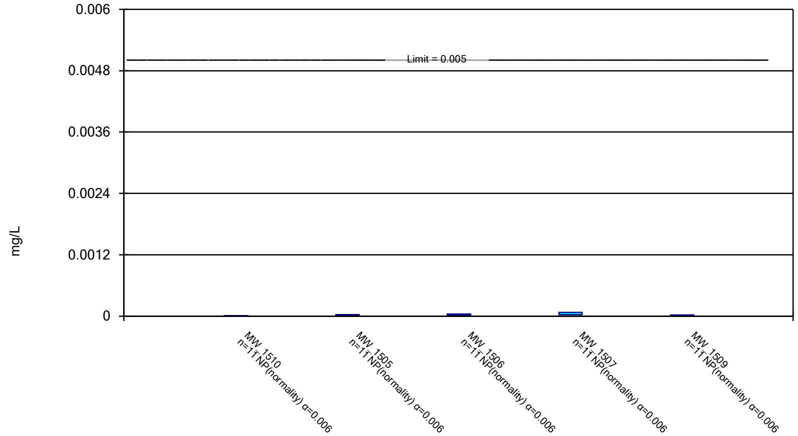


Constituent: Beryllium, total Analysis Run 7/10/2019 10:22 AM View: Confidence Intervals - Appendix IV
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.

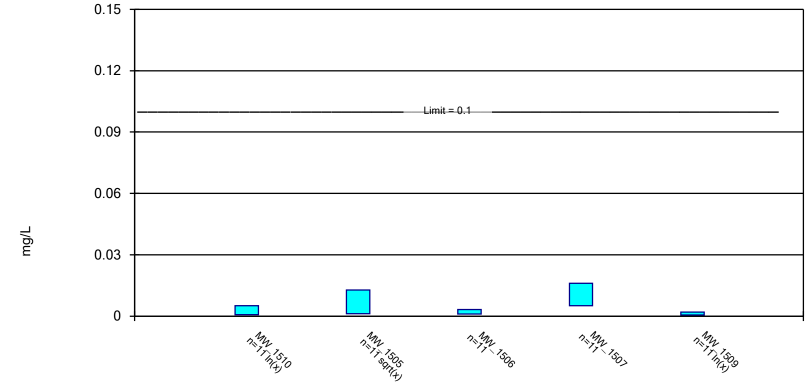


Constituent: Cadmium, total Analysis Run 7/10/2019 10:22 AM View: Confidence Intervals - Appendix IV
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

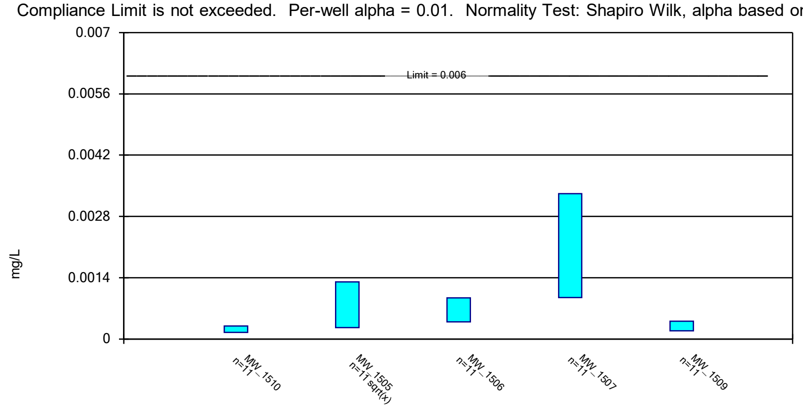


Constituent: Chromium, total Analysis Run 7/10/2019 10:22 AM View: Confidence Intervals - Appendix IV
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

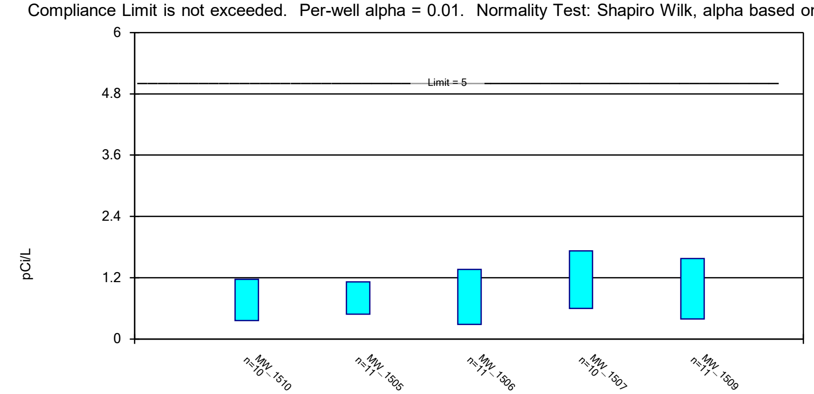


Constituent: Cobalt, total Analysis Run 7/10/2019 10:22 AM View: Confidence Intervals - Appendix IV
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

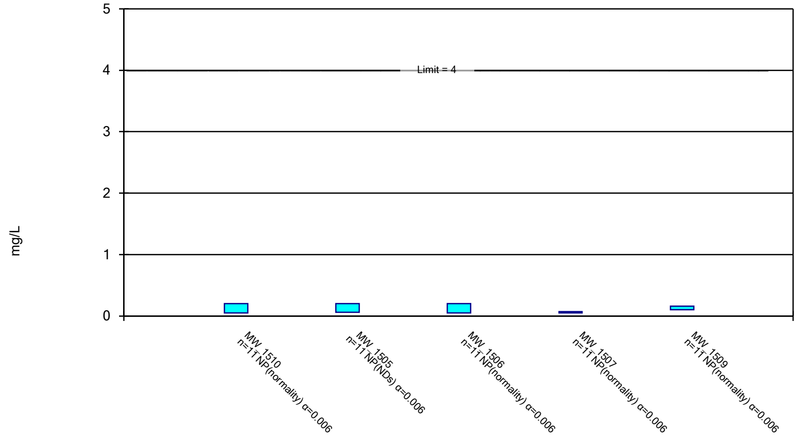


Constituent: Combined Radium 226 + 228 Analysis Run 7/10/2019 10:22 AM View: Confidence Intervals -
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.

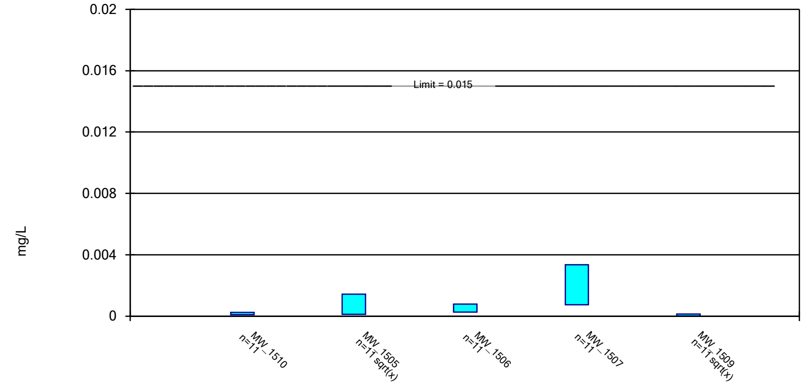


Constituent: Fluoride, total Analysis Run 7/10/2019 10:22 AM View: Confidence Intervals - Appendix IV
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

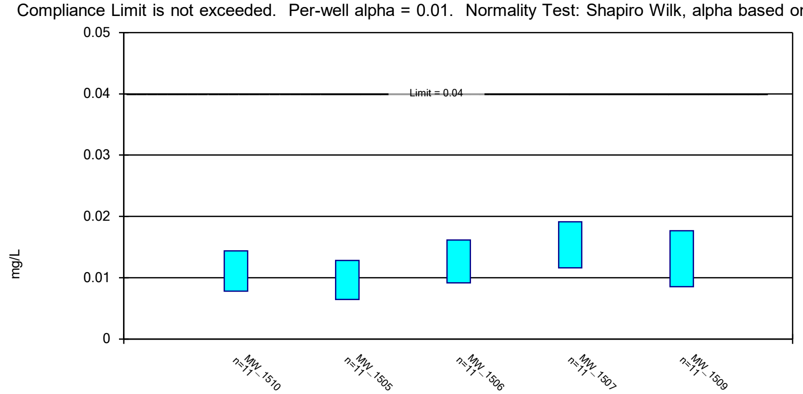


Constituent: Lead, total Analysis Run 7/10/2019 10:22 AM View: Confidence Intervals - Appendix IV
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

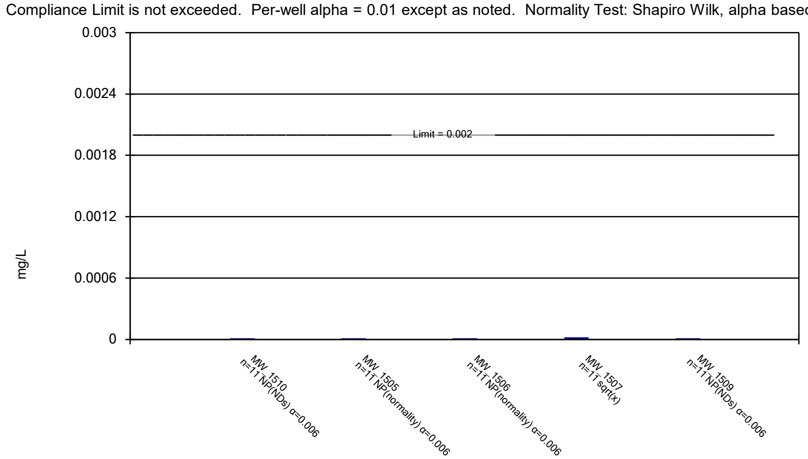


Constituent: Lithium, total Analysis Run 7/10/2019 10:22 AM View: Confidence Intervals - Appendix IV
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

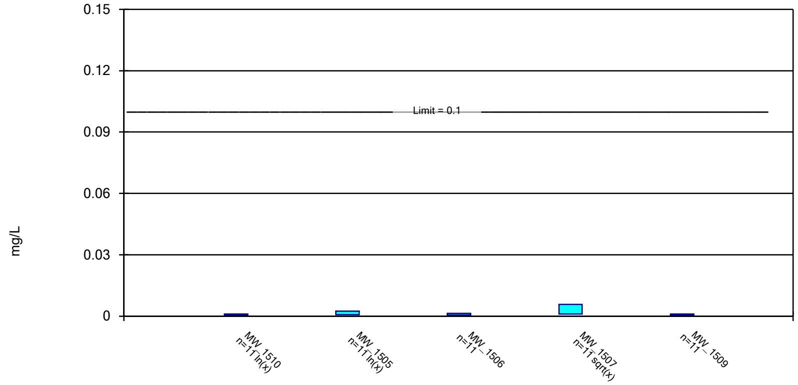


Constituent: Mercury, total Analysis Run 7/10/2019 10:22 AM View: Confidence Intervals - Appendix IV
Mitchell BAP Client: Geosyntec Data: Mitchell BAP

Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

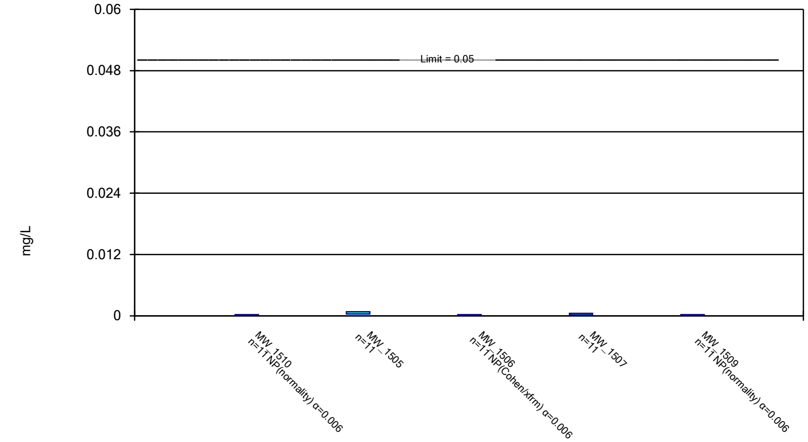


Constituent: Molybdenum, total   Analysis Run 7/10/2019 10:22 AM   View: Confidence Intervals - Appendix I
Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP

Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

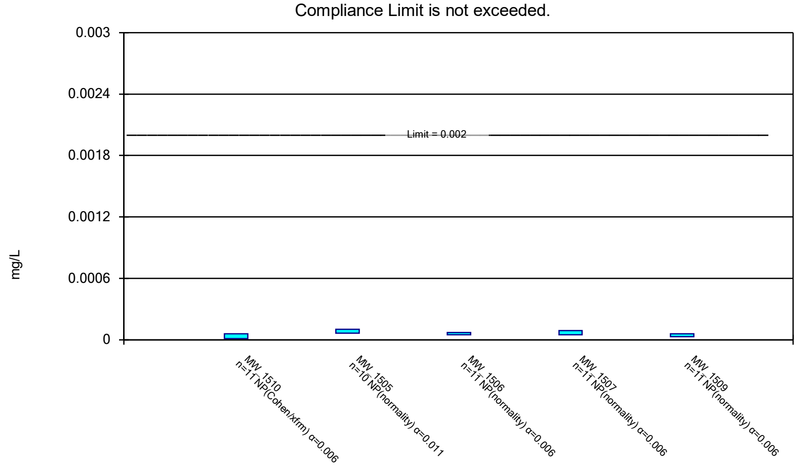


Constituent: Selenium, Total   Analysis Run 7/10/2019 10:22 AM   View: Confidence Intervals - Appendix IV
Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP

Sanitas™ v.9.6.19d Sanitas software utilized by Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.



Constituent: Thallium, Total   Analysis Run 7/10/2019 10:22 AM   View: Confidence Intervals - Appendix IV
Mitchell BAP   Client: Geosyntec   Data: Mitchell BAP

APPENDIX 3 – Alternative Source Demonstrations

Alternative source demonstrations relative to Appendix IV SSLs above the groundwater protection standard were not necessary because no SSLs above the groundwater protection standards were identified in 2019. Alternative source demonstrations are not applicable at this time.

APPENDIX 4 - Notices for Monitoring Program Transitions

No transition between monitoring requirements occurred in 2019; the CCR unit remained in assessment monitoring over the entire year. Notices for monitoring program transitions are not applicable at this time.

APPENDIX 5 - Well Installation/Decommissioning Logs

No monitoring wells installed or decommissioned in 2019. Well installation/decommissioning logs are not applicable at this time.

Annual Groundwater Monitoring Report

Kentucky Power Company

Mitchell Plant

Landfill

Moundsville, WV

January 2020

Prepared by:
American Electric Power Service Corporation
1 Riverside Plaza
Columbus, Ohio 43215

KENTUCKY POWER

An AEP Company

BOUNDLESS ENERGY

Table of Contents

I. Overview

This *Annual Groundwater Monitoring Report* (Report) has been prepared to report the status of activities for the preceding year for the landfill at Kentucky Power Company's, a wholly owned subsidiary of American Electric Power Company (AEP), Mitchell Power Plant. The USEPA's CCR rules require that the Annual Groundwater Monitoring Report be posted to the operating record for the preceding year no later than January 31st.

In general, the following activities were completed in 2019:

- Groundwater samples were collected and analyzed in June 2019 for Appendix III constituents, as specified in 40 CFR 257.94 and AEP's *Groundwater Sampling and Analysis Plan (2016)*;
- Groundwater data underwent various validation tests, including tests for completeness, valid values, transcription errors, and consistent units;
- Appendix III parameters were compared to prediction limits (intervals for pH) established from background data established previously;
- The statistical evaluation concluded that there were statistically significant increases (SSIs) over background of two Appendix III parameters;
- Because SSIs over background of Appendix III parameters were detected, an alternative source demonstration (ASD) study was conducted resulting in a November 2019 ASD report, as discussed further in Section VI of this report.
- As required by 40 CFR 257.94, groundwater samples were collected and analyzed for all Appendix III constituents during a second semiannual sampling event in October 2019.

The major components of this annual report, to the extent applicable at this time, are presented in sections that follow:

- A map, aerial photograph or a drawing showing the CCR management unit(s), all groundwater monitoring wells and monitoring well identification numbers;
- All of the monitoring data collected, including the rate and direction of groundwater flow, plus a summary showing the number of samples collected per monitoring well, the dates the samples were collected and whether the sample was collected as part of detection monitoring or assessment monitoring programs (Attached as **Appendix 1**);
- Statistical comparison of monitoring data to determine if there have been one or more SSIs over background levels (Attached as **Appendix 2**, where applicable);
- A discussion of whether any alternate source demonstration were performed, and the conclusions (Attached as **Appendix 3**, where applicable);

- A summary of any transition between monitoring programs, for example the date and circumstances for transitioning from detection monitoring to assessment monitoring (Notices attached as **Appendix 4**, where applicable);
- Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a statement as to why that happened (Attached as **Appendix 5**, where applicable); and
- Other information required to be included in the annual report such as an alternate monitoring frequency, or assessment of corrective measures, if applicable.

In addition, this report summarizes key actions completed, and where applicable, describes any problems encountered and actions taken to resolve those problems. The report includes a projection of key activities for the upcoming year.

II. Groundwater Monitoring Well Locations and Identification Numbers

A figure that depicts the PE-certified groundwater monitoring network, the monitoring well locations, and their corresponding identification is provided in Appendix 1.

III. Monitoring Wells Installed or Decommissioned

There were no monitoring wells installed or decommissioned in 2019. The network design, as summarized in the *Groundwater Monitoring Network Design Report* (2016) and as posted at the CCR web site for Mitchell Plant, did not change. That design report, viewable on the AEP CCR web site, discusses the facility location, the hydrogeological setting, the hydrostratigraphic units, the uppermost aquifer, downgradient monitoring well locations and the upgradient monitoring well locations.

IV. Groundwater Quality Data and Static Water Elevation Data, With Flow Rate and Direction and Discussion

Appendix 1 contains tables showing the groundwater quality data collected during the establishment of background quality and detection monitoring. Static water elevation data from each monitoring event also are shown in Appendix 1, along with the groundwater velocities, groundwater flow direction, and potentiometric maps developed after each sampling event.

V. Groundwater Quality Data Statistical Analysis

Statistical analysis of the detection monitoring samples taken in June 2019 was completed on September 4, 2019. The evaluation concluded that SSIs of chloride and total dissolved solids over background levels were detected in one monitoring well. A memorandum with the results of the statistical evaluation is provided in Appendix 2.

As required by 40 CFR 257.94, groundwater samples were collected and analyzed for all Appendix III constituents during a second semiannual sampling event in October 2019. A statistical evaluation of these results will be completed in 2020.

VI. Alternative Source Demonstrations

Because SSIs over background of Appendix III parameters were detected at Mitchell Plant's landfill, an ASD study was conducted resulting in a November 2019 ASD report. The report concluded that the SSIs are not due to a release from the Mitchell Landfill, but were instead attributed to natural variation in groundwater quality. The report is provided in Appendix 3.

VII. Discussion About Transition Between Monitoring Requirements or Alternate Monitoring Frequency

No transition between monitoring requirements occurred in 2019; the CCR unit remained in detection monitoring over the entire year. A statement to this effect is provided in Appendix 4. The sampling frequency of twice per year will be maintained for the Appendix III parameters (boron, calcium, chloride, fluoride, pH, sulfate and total dissolved solids).

Regarding defining an alternate monitoring frequency, the groundwater velocity and monitoring well production is high enough at this facility that no modification of the semiannual detection monitoring effort is needed.

VIII. Other Information Required

The Mitchell landfill has remained in its current status of detection monitoring. All required information has been included in this annual groundwater monitoring report.

IX. Description of Any Problems Encountered in 2019 and Actions Taken

No significant problems were encountered. The low flow sampling effort went smoothly and the schedule was met to support this annual groundwater report preparation. There were, however, dry wells encountered during sampling, but this did not affect the statistical evaluation or monitoring network at the landfill. The minimum requirement of one upgradient and three downgradient wells was still met.

X. A Projection of Key Activities for the Upcoming Year

Key activities for 2020 include:

- Detection monitoring on a semiannual schedule;
- Evaluation of the detection monitoring results from a statistical analysis viewpoint, looking for any SSIs (or decreases with respect to pH);
- Responding to any new data received in light of what the CCR rule requires;
- Preparation of the next annual groundwater report.

APPENDIX 1 - Groundwater Data Tables and Figures

Tables follow showing the groundwater monitoring data collected, the rate of groundwater flow each time groundwater was sampled, the number of samples collected per monitoring well, dates that the samples were collected, and whether each sample was collected as part of a detection monitoring or an assessment monitoring program. Figures follow showing the PE-certified groundwater monitoring network with the corresponding well identifications along with static water elevation data and groundwater flow directions each time groundwater was sampled in the form of annotated satellite images.

Table 1 - Groundwater Data Summary: MW-1101F
Mitchell - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
6/15/2016	Background	0.042	88.3	3.87	0.22	7.4	395	64.3
8/3/2016	Background	0.380	91.0	3.30	0.21	7.4	425	62.1
9/28/2016	Background	0.054	88.6	3.73	0.26	8.7	466	58.1

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1101F
Mitchell - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
6/15/2016	Background	0.21	1.64	159	0.023	0.08	0.6	0.294	0.304	0.22	0.525	0.012	<0.002 U	3.87	0.2	0.02 J
8/3/2016	Background	0.14	1.46	155	0.033	0.08	0.6	0.244	1.494	0.21	0.673	0.017	<0.002 U	4.04	0.2	<0.01 U
9/28/2016	Background	0.18	1.79	142	0.029	0.12	0.8	0.231	1.561	0.26	0.511	0.016	<0.002 U	3.39	0.3	0.02 J

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-1101R
Mitchell - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
6/15/2016	Background	0.287	6.91	8.41	1.20	8.2	741	76.4
8/3/2016	Background	0.518	5.00	10.3	1.56	8.4	750	76.4
9/28/2016	Background	0.382	6.12	13.3	1.83	8.5	43.0	43.5
11/16/2016	Background	1.80	19.4	15.2	2.29	8.6	801	32.2
2/14/2017	Background	0.501	2.23	15.4	2.40	8.6	806	32.0
4/12/2017	Background	0.360	4.02	14.4	2.17	8.7	798	39.2
5/24/2017	Background	0.380	1.91	15.1	2.41	8.7	793	28.6
7/25/2017	Background	0.415	1.76	15.8	2.61	8.7	788	28.7
10/11/2017	Detection	0.394	1.87	16.9	2.59	8.7	784	29.1
1/11/2018	Detection	- -	1.75	- -	- -	8.4	- -	28.8
4/10/2018	Detection	0.344	1.75	16.5	2.62	8.5	790	29.0
8/29/2018	Detection	0.371	2.42	16.3	2.45	9.0	783	29.7
5/1/2019	Detection	0.376	1.90	16.9	2.62	10.5	809	28.7
6/12/2019	Detection	0.371	2.03	16.2	2.38	8.8	822	27.4

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1101R
Mitchell - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
6/15/2016	Background	0.82	8.11	185	0.031	0.03	1.1	0.650	0.493	1.20	1.22	0.002	0.003 J	31.8	0.5	0.05 J
8/3/2016	Background	1.10	10.8	149	0.023	0.03	1.0	0.363	0.4776	1.56	0.674	0.012	<0.002 U	32.9	0.5	0.02 J
9/28/2016	Background	0.92	11.1	149	0.01 J	0.02	0.7	0.301	0.565	1.83	0.550	0.009	<0.002 U	26.2	0.5	0.01 J
11/16/2016	Background	0.67	14.2	125	0.01 J	0.02 J	0.595	0.143	1.808	2.29	0.292	0.026	<0.002 U	20.6	0.4	<0.01 U
2/14/2017	Background	0.69	15.3	102	0.01 J	0.02 J	0.512	0.160	1.661	2.40	0.327	0.012	<0.002 U	34.0	0.4	0.02 J
4/12/2017	Background	0.84	12.4	117	0.02 J	0.02 J	0.824	0.333	0.190	2.17	0.634	0.010	0.002 J	16.7	0.5	<0.01 U
5/24/2017	Background	0.66	15.7	102	0.01 J	0.01 J	0.526	0.299	0.759	2.41	0.298	<0.0002 U	<0.002 U	14.8	0.3	<0.01 U
7/25/2017	Background	0.62	14.5	91.3	0.01 J	0.01 J	0.377	0.126	0.977	2.61	0.235	0.009	<0.002 U	18.3	0.3	0.02 J

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-1102F
Mitchell - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
6/15/2016	Background	0.109	4.34	12.4	0.56	8.0	523	37.2
8/3/2016	Background	0.280	5.48	11.9	0.58	8.2	535	35.9
10/3/2016	Background	0.160	5.45	11.8	0.60	8.1	519	29.5
11/15/2016	Background	0.117	4.87	11.7	0.56	8.1	551	27.4
2/14/2017	Background	0.109	5.04	11.3	0.53	8.2	521	29.9
4/12/2017	Background	0.109	4.67	11.3	0.53	8.3	530	30.6
5/24/2017	Background	0.118	5.31	13.7	0.56	8.3	521	31.8
7/26/2017	Background	0.202	5.41	11.4	0.57	8.3	519	31.5
10/10/2017	Detection	0.278	4.79	12.4	0.57	8.4	526	32.3
1/11/2018	Detection	- -	4.47	- -	- -	7.9	- -	32.1
4/10/2018	Detection	0.109	4.40	13.4	0.63	8.2	539	33.2
8/28/2018	Detection	0.247	4.48	14.1	0.64	8.6	549	33.8
5/1/2019	Detection	0.126	4.69	15.2	0.66	9.5	577	37.6
6/12/2019	Detection	0.110	4.36	14.9	0.74	8.2	574	38.0

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1102F
Mitchell - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
6/15/2016	Background	0.71	9.37	214	<0.005 U	0.04	0.4	0.096	0.352	0.56	0.335	0.003	<0.002 U	28.1	0.3	<0.01 U
8/3/2016	Background	0.69	8.16	212	<0.005 U	0.02 J	0.4	0.090	0.881	0.58	0.183	0.006	<0.002 U	25.8	0.3	0.01 J
10/3/2016	Background	0.64	8.45	194	0.005 J	0.01 J	0.5	0.286	0.972	0.60	0.298	0.002	<0.002 U	23.9	0.3	<0.01 U
11/15/2016	Background	0.63	8.49	212	0.005 J	0.008 J	0.435	0.074	1.859	0.56	0.141	0.003	<0.002 U	22.9	0.3	<0.01 U
2/14/2017	Background	0.62	8.66	197	0.006 J	0.006 J	0.411	0.049	1.015	0.53	0.131	0.004	<0.002 U	21.4	0.3	0.02 J
4/12/2017	Background	0.56	7.68	191	0.005 J	0.01 J	0.399	0.079	0.1825	0.53	0.135	0.005	<0.002 U	19.3	0.3	0.01 J
5/24/2017	Background	0.60	8.76	229	0.01 J	0.02	0.807	0.203	0.3252	0.56	0.335	<0.0002 U	<0.002 U	20.0	0.4	0.01 J
7/26/2017	Background	0.54	7.58	205	<0.004 U	0.01 J	0.323	0.072	0.942	0.57	0.121	0.007	<0.002 U	34.7	0.3	0.03 J

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-1102R
Mitchell - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
6/15/2016	Background	0.339	3.49	219	2.97	8.2	1470	47.8
8/3/2016	Background	0.467	4.05	217	2.98	8.3	1450	44.9
10/3/2016	Background	0.332	5.33	213	2.96	8.3	1530	35.1

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1102R
Mitchell - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
6/15/2016	Background	2.01	2.64	292	0.02 J	0.35	0.5	0.799	0.710	2.97	0.558	0.015	<0.002 U	68.7	0.9	0.01 J
8/3/2016	Background	1.71	3.57	356	0.128	0.14	3.0	1.75	1.217	2.98	2.82	0.021	0.007 J	66.0	1.2	0.03 J
10/3/2016	Background	1.73	3.37	441	0.307	0.17	3.9	3.01	2.828	2.96	7.24	0.028	0.007	51.4	1.9	0.03 J

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-1103F
Mitchell - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
6/15/2016	Background	0.355	3.01	243	3.11	8.3	1390	0.5
8/2/2016	Background	0.402	2.99	247	3.20	8.3	1420	0.3
10/3/2016	Background	0.321	3.12	242	3.34	8.4	1380	<0.04 U
11/16/2016	Background	0.323	2.97	240	2.96	8.4	1370	0.2
2/15/2017	Background	0.303	2.82	240	3.07	8.5	1400	0.2
4/11/2017	Background	0.304	2.57	234	3.05	8.6	1400	0.4
5/23/2017	Background	0.346	2.88	237	3.23	8.5	1370	0.4
7/26/2017	Background	0.343	2.76	240	3.24	8.5	1370	0.3
10/11/2017	Detection	0.328	3.09	247	3.17	8.6	1390	0.5
4/10/2018	Detection	0.286	2.58	239	3.16	8.3	1390	0.5
8/29/2018	Detection	0.332	2.76	244	3.03	8.6	1380	0.4
5/2/2019	Detection	0.342	2.95	245	3.13	9.1	1360	0.8
6/12/2019	Detection	0.329	2.96	233	3.55	8.3	1410	0.9

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1103F
Mitchell - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
6/15/2016	Background	0.16	8.03	639	0.029	0.02	1.0	0.351	1.10	3.11	0.674	0.012	<0.002 U	10.1	0.2	0.01 J
8/2/2016	Background	0.14	7.01	704	0.026	0.01 J	0.9	0.299	0.899	3.20	0.479	0.016	<0.002 U	2.61	0.2	<0.01 U
10/3/2016	Background	0.04 J	5.80	558	0.01 J	0.03	0.4	0.180	1.026	3.34	0.313	0.016	<0.004 U	2.66	0.1 J	0.01 J
11/16/2016	Background	0.10	7.71	723	0.01 J	0.009 J	0.471	0.159	1.57	2.96	0.218	0.015	<0.002 U	2.57	0.1	<0.01 U
2/15/2017	Background	0.03 J	7.67	631	0.009 J	0.008 J	0.336	0.147	1.416	3.07	0.213	0.016	<0.002 U	2.81	0.09 J	0.03 J
4/11/2017	Background	0.07	8.46	618	0.006 J	0.006 J	0.262	0.102	2.183	3.05	0.088	0.015	<0.002 U	3.19	0.1	<0.01 U
5/23/2017	Background	0.03 J	7.85	688	0.006 J	0.007 J	0.26	0.149	1.214	3.23	0.194	0.006	<0.002 U	2.80	0.06 J	<0.01 U
7/26/2017	Background	0.02 J	6.81	562	<0.004 U	0.007 J	0.112	0.136	1.798	3.24	0.103	0.015	<0.002 U	5.46	0.07 J	0.02 J

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-1104R
Mitchell - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
6/21/2016	Background	0.431	39.4	485	1.18	7.87	2390	162

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1104R
Mitchell - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
6/21/2016	Background	0.66	4.35	182	0.57	0.18	3.4	4.36	0.153	1.18	9.41	0.014	<0.09 U	42.3	2.3	0.133

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-1502R
Mitchell - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
6/20/2016	Background	0.268	71.5	33.4	0.18	7.3	474	155
8/9/2016	Background	0.160	95.4	34.0	0.17	7.3	547	187
9/27/2016	Background	0.376	103	39.7	0.1 J	7.4	560	183
11/9/2016	Background	0.214	87.3	25.4	0.1 J	7.4	551	186
2/15/2017	Background	0.069	90.0	167	0.16	7.5	564	90.1
4/12/2017	Background	0.075	72.2	79.5	0.16	7.6	507	102
5/23/2017	Background	0.100	73.9	52.4	0.17	7.6	466	118
7/25/2017	Background	0.158	61.7	18.8	0.20	7.3	358	88.6
10/11/2017	Detection	0.132	91.0	24.5	0.1 J	7.3	535	159
1/11/2018	Detection	- -	240	- -	- -	7.0	- -	149
4/10/2018	Detection	0.051	78.3	196	0.19	7.4	616	87.6
8/29/2018	Detection	0.150	95.7	99.3	0.17	7.7	650	167
5/2/2019	Detection	0.1 J	93.6	245	0.17	8.5	702	105
6/12/2019	Detection	0.127	80.7	155	0.23	7.3	661	114

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1502R
Mitchell - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
6/20/2016	Background	0.22	0.28	30.6	<0.005 U	0.005 J	0.3	0.082	0.143	0.18	0.064	0.002	<0.09 U	3.48	8.2	0.01 J
8/9/2016	Background	0.20	0.26	34.1	<0.005 U	0.006 J	0.3	0.068	1.029	0.17	0.089	0.010	<0.002 U	8.71	7.4	<0.01 U
9/27/2016	Background	0.16	0.27	38.2	<0.005 U	0.004 J	0.4	0.076	0.429	0.1 J	0.064	0.012	<0.002 U	8.40	8.8	<0.01 U
11/9/2016	Background	0.20	0.84	44.2	0.062	0.009 J	1.44	0.507	2.497	0.1 J	0.764	0.006	<0.002 U	3.19	5.3	0.03 J
2/15/2017	Background	0.13	0.24	27.7	0.006 J	<0.004 U	1.90	0.069	2.61	0.16	0.061	0.009	<0.002 U	1.84	4.3	0.03 J
4/12/2017	Background	0.13	0.69	29.2	0.053	0.008 J	1.20	0.426	0.613	0.16	0.630	0.015	0.002 J	1.91	4.8	0.02 J
5/23/2017	Background	0.15	0.53	32.2	0.033	<0.005 U	0.918	0.238	0.647	0.17	0.364	0.002	<0.002 U	2.46	4.7	0.01 J
7/25/2017	Background	0.21	0.30	19.0	0.008 J	<0.005 U	0.196	0.082	0.6323	0.20	0.088	0.009	<0.002 U	2.47	3.2	0.03 J

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1: Residence Time Calculation Summary
Mitchell Landfill

			2019-05		2019-06	
CCR Management Unit	Monitoring Well Pair	Well Diameter (inches)	Vertical Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Vertical Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
Landfill	MW1101F/R [1]	2.0	2.4	26	2.4	25
	MW1102F/R [1]	2.0	1.4	43	1.4	45
	MW1103F/R [2]	2.0	1.8	35	1.7	35
	MW1104F/R [2]	2.0	0.8	80	0.8	76
	MW1501F/R [3]	4.0	2.2	56	2.2	56
	MW1502R [3]	4.0	NC	NC	NC	NC
	MW1503F/R [3]	4.0	1.3	93	1.3	93

Notes:
[1] - Sidegradient Well
[2] - Background Well
[3] - Downgradient Well
NC - No calculation can be generated

Legend

Compliance Sampling Location
Upgradient Sampling Location
CCR Landfill (Approximate Limits of Waste)

Notes

- Monitoring well coordinates provided by AEP.
-Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.

500 250 0 500 Feet

Site Layout
Landfill - Fish Creek Aquifer

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio | 2018/01/26

Figure **1a**

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Legend

- Compliance Sampling Location
- Upgradient Sampling Location
- CCR Landfill (Approximate Limits of Waste)

Notes

- Monitoring well coordinates provided by AEP.
-Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.

500 250 0 500 Feet

Site Layout
Landfill - Rush Run Aquifer

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio | 2018/01/26

Figure **1b**

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Legend

- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contours (Inferred)

Notes

- Monitoring well coordinates and water level data (collected on May 1-2, 2019) provided by AEP.
-Site features based on information available in the Groundwater Monitoring Network Evaluation (AMEC, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (NAVD 88).

500 250 0 500
Feet

Potentiometric Surface Map - Fish Creek
May 2019

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio | 2019/12/13

Figure
2

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Legend

- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)

Notes

- Monitoring well coordinates and water level data (collected on May 1-2, 2019) provided by AEP.
-Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (NAVD 88).

Potentiometric Surface Map - Rush Run
May 2019

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Clmbus, Ohio | 2019/12/13

Figure **3**

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Legend

- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contours (Inferred)

Notes

- Monitoring well coordinates and water level data (collected on June 12, 2019) provided by AEP.
-Site features based on information available in the Groundwater Monitoring Network Evaluation (AMEC, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (NAVD 88).

Potentiometric Surface Map - Fish Creek
June 2019

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Columbus, Ohio | 2020/01/29

Figure 4

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Mitchell\Landfill-FC\2019\AEP-Mitchell_Landfill-FC_GW_June2019.mxd. ARevezzo. 1/29/2020. Project/Phase/Task.

Legend

- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)

Notes

- Monitoring well coordinates and water level data (collected on June 12, 2019) provided by AEP.
-Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level (NAVD 88).

Potentiometric Surface Map - Rush Run June 2019

Mitchell Power Generation Plant
Marshall County, West Virginia

Geosyntec consultants

Clumbus, Ohio | 2020/01/29

Figure 5

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Mitchell\Landfill-RR\2019\AEP-Mitchell_Landfill-RR_GW_June2019.mxd. ARevezzo. 1/29/2020. Project/Phase/Task.

APPENDIX 2 - Statistical Analyses

The memorandum summarizing the September 2019 statistical evaluation follows.

Geosyntec consultants

941 Chatham Lane, Suite 103
Columbus, Ohio 43212
PH 614.468.0415
FAX 614.468.0416
www.geosyntec.com

Memorandum

Date:	September 4, 2019
To:	David Miller (AEP)
Copies to:	Justin Jent (AEP)
From:	Allison Kreinberg and Bruce Sass, Ph.D. (Geosyntec)
Subject:	Evaluation of Detection Monitoring Data at Mitchell Plant's Landfill (LF)

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257 Subpart D, "CCR rule"), the first semi-annual detection monitoring event at the Landfill (LF), an existing CCR unit at the Mitchell Power Plant located in Moundsville, West Virginia was completed on May 1-2, 2019. Based on the results, verification sampling was completed on June 12, 2019.

Eight background monitoring events were conducted at the Mitchell LF prior to these detection monitoring events, and upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. Lower prediction limits (LPLs) were also calculated for pH. Details on the calculation of these background values are described in Geosyntec's *Statistical Analysis Summary* report, dated January 15, 2018.

To achieve an acceptably high statistical power while maintaining a site-wide false-positive rate (SWFPR) of 10% per year or less, prediction limits were calculated based on a one-of-two retesting procedure. With this procedure, a statistically significant increase (SSI) is only concluded if both samples in a series of two exceeds the UPL (or are below the LPL for pH). In practice, if the initial result did not exceed the UPL, a second sample was not collected or analyzed.

Detection monitoring results and the relevant background values are compared in Table 1 and noted exceedances are described in the list below.

- Chloride concentrations exceeded the intrawell UPL of 14.1 mg/L in both the initial (15.2 mg/L) and second (14.9 mg/L) samples collected at MW-1102F. Therefore, an SSI over background is concluded for chloride at MW-1102F.

- Total Dissolved Solids (TDS) concentrations exceeded the intrawell UPL of 551 mg/L in both the initial (577 mg/L) and second (574 mg/L) samples collected at MW-1102F. Therefore, an SSI over background is concluded for TDS at MW-1102F.

In response to the exceedances noted above, the Mitchell LF CCR unit will either transition to assessment monitoring or an alternative source demonstration (ASD) for chloride and TDS will be conducted in accordance with 40 CFR 257.94(e)(2). If the ASD is successful, the Mitchell LF will remain in detection monitoring.

The statistical analysis was conducted within 90 days of completion of sampling and analysis in accordance with 40 CFR 257.93(h)(2). A certification of these statistics by a qualified professional engineer is provided in Attachment A.

Table 1: Detection Monitoring Data Evaluation
Mitchell Plant - Landfill

Parameter	Units	Description	MW-1101R		MW-1102F		MW-1502R	
			5/1/2019	6/12/2019	5/1/2019	6/12/2019	5/2/2019	6/12/2019
Boron	mg/L	Intrawell Background Value (UPL)	0.651		0.320		0.467	
		Detection Monitoring Data	0.376	--	0.126	--	0.100	--
Calcium	mg/L	Intrawell Background Value (UPL)	25.0		6.22		121	
		Detection Monitoring Data	1.9	--	4.69	--	93.6	
Chloride	mg/L	Intrawell Background Value (UPL)	18.6		14.1		213	
		Detection Monitoring Data	16.9	--	**15.2**	**14.9**	**245**	155
Fluoride	mg/L	Intrawell Background Value (UPL)	3.49		0.67		0.25	
		Detection Monitoring Data	2.62	--	0.66	--	0.17	--
pH	SU	Intrawell Background Value (UPL)	9.1		8.6		7.7	
		Intrawell Background Value (LPL)	7.8		7.5		7.1	
		Detection Monitoring Data	**10.5**	8.8	**9.5**	8.2	**8.5**	7.4
Sulfate	mg/L	Intrawell Background Value (UPL)	67.3		47.1		259	
		Detection Monitoring Data	28.7	--	37.6	--	105	--
TDS	mg/L	Intrawell Background Value (UPL)	1600		551		696	
		Detection Monitoring Data	809	--	**577**	**574**	**702**	661

Notes
UPL: Upper prediction limit
LPL: Lower prediction limit
TDS: Total dissolved solids
Bold values exceed the background value.
Background values are shaded gray.

ATTACHMENT A

Certification by Qualified Professional Engineer

CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected statistical method, described above and in the January 15, 2018 *Statistical Analysis Summary* report, is appropriate for evaluating the groundwater monitoring data for the Mitchell LF CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER

Printed Name of Licensed Professional Engineer

David Anthony Miller

Signature

DAVID ANTHONY MILLER REGISTERED 22663 STATE OF WEST VIRGINIA PROFESSIONAL ENGINEER

22663	WEST VIRGINIA	09.06.2019
License Number	Licensing State	Date

APPENDIX 3 – Alternative Source Demonstrations

The November 2019 ASD report follows.

ALTERNATIVE SOURCE DEMONSTRATION REPORT FEDERAL CCR RULE

Mitchell Plant Landfill
Marshall County, West Virginia

Submitted to

American Electric Power

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants

engineers | scientists | innovators

941 Chatham Lane, Suite 103
Columbus, Ohio 43221

November 26, 2019

CHA8462

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LIST OF ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
EPA	Environmental Protection Agency
LPL	Lower Prediction Limit
QC	Quality Control
SSI	Statistically Significant Increase
TDS	Total Dissolved Solids
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency

SECTION 1

INTRODUCTION AND SUMMARY

Statistically significant increases (SSIs) in groundwater were identified for chloride and total dissolved solids (TDS) at MW-1102F during the first semi-annual detection monitoring event of 2019. This report presents an alternative source demonstration (ASD) which documents that the SSIs should not be attributed to the Mitchell Plant Landfill.

Following completion of eight background monitoring events at the Mitchell Landfill, upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. A lower prediction limit (LPL) was also calculated for pH. Prediction limits were calculated based on a one-of-two retesting procedure. With this procedure, an SSI is concluded only if both samples in a series of two exceeds the UPL, or in the case of pH is above the LPL. In practice, if the initial result did not result in an exceedance, a second sample was not collected or analyzed.

The first semi-annual detection monitoring event of 2019 at the Landfill was performed in May 2019 (initial sampling event) and June 2019 (verification sampling event) and the results were compared to the calculated prediction limits., A summary of the detection monitoring analytical results for all constituents listed in 40 CFR Part 257 Appendix III and the calculated prediction limits to which they were compared is provided in Table 1.

1.1 CCR Rule Requirements

In accordance with the United States Environmental Protection Agency (USEPA) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments, Rule 40 CFR 257.94(e)(2) states the following:

> *The owner or operator may demonstrate that a source other than the CCR unit caused the statistically significant increase over background levels for a constituent or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. The owner or operator must complete the written demonstration within 90 days of detecting a statistically significant increase over background levels to include obtaining a certification from a qualified professional engineer verifying the accuracy of the information in the report.*

The first semi-annual detection monitoring event for 2019 was completed in May and June 2019 at the Mitchell Plant Landfill. Pursuant to 40 CFR 257.94(e)(2), Geosyntec Consultants, Inc. (Geosyntec) has prepared this ASD report, which documents that the SSIs cited above should not be attributed to the Landfill.

1.2 Demonstration of Alternative Sources

An evaluation was completed to assess possible alternative sources to which identified SSIs could be attributed. Alternative sources were identified amongst five types:

- ASD Type I: Sampling Causes;
- ASD Type II: Laboratory Causes;
- ASD Type III: Statistical Evaluation Causes;
- ASD Type IV: Natural Variation; and
- ASD Type V: Alternative Sources.

A demonstration was conducted to show that the increases in constituent concentrations were based on Type IV causes and not by a release from the Landfill.

SECTION 2

ALTERNATIVE SOURCE DEMONSTRATION

The Federal CCR Rule (40 CFR 257) allows the owner or operator 90 days from the determination of an SSI to demonstrate that a source other than the CCR unit caused the SSI. A brief description of the site geology, ASD evaluation methodology, and the proposed alternative source are described below.

2.1 Site Geology

According to the monitoring well network report, the local geology consists of sandstone units separated by sharp contacts with shale or coal seams (CEC, 2016). From top to bottom, the named sandstone units underlying the Landfill include: the Burton Sandstone, the Fish Creek Sandstone, the Rush Run Sandstone, the Jollytown Sandstone, and the Hundred Sandstone. The Burton Sandstone was not identified as a hydrostatic unit that required monitoring because the unit is not water-bearing upgradient of the Landfill.

2.2 Groundwater Monitoring History

Groundwater at the Landfill has been monitored under the West Virginia Solid Waste Management Rule (33CSR1) since 2012, which is prior to construction of the Landfill in 2013 and the initial waste placement in 2014 (CEC, 2016). Background monitoring under the Federal CCR Rule began in 2016. Wells set within both the Fish Creek Sandstone and Rush Run Sandstone are included in the monitoring network for the Federal program (CEC, 2016). The well of concern (MW-1102F) is set within the Fish Creek Formation. While there are two background wells set within the Fish Creek Formation (MW-1103F and MW-1104F), only MW-1103F consistently produced water during sampling completed under the Federal program. A site map showing the location of Fish Creek Formation monitoring wells is provided in Figure 1.

2.3 Proposed Alternative Source

An initial review of sampling and laboratory data did not identify any Type I (sampling) errors. A review of the laboratory and statistical analyses did not identify any Type II or III issues. An initial review of site geochemistry identified natural variation (Type IV) as the source of the observed chloride and TDS SSIs at well MW-1102F.

2.3.1 Comparison to Background Concentrations

Chloride and TDS at the Landfill are both monitored using intrawell prediction limits. However, a comparison of the reported concentrations for both parameters between MW-1102F and background well MW-1103F shows that concentrations at the background location have consistently been higher (Figure 2). While chloride concentrations are consistently around 250 mg/L at background well MW-1103F, chloride concentrations at downgradient well MW-1102F have not exceeded 20 mg/L. Similarly, TDS concentrations at MW-1102F are consistently several hundred milligrams per liter lower than the concentrations observed at the background location. Thus, the changes in chloride and TDS concentrations at MW-1102F likely represent natural variation in the dilution of ion-rich groundwater as it moves through the aquifer.

2.3.2 Comparison of Groundwater Chemistry to Landfill Leachate

The average concentrations of all major cations and anions are higher in the Landfill leachate than in the groundwater at MW-1102F (Table 2). These data are also shown graphically in Figure 3. Boron and sulfate concentrations are both several orders of magnitude higher in the leachate compared to the average concentration at MW-1102F, whereas the difference in chloride concentrations is less than two orders of magnitude.

A mixing model was created to illustrate how concentrations at MW-1102F would be expected to change if there were a release from the Landfill. Groundwater data at MW-1102F collected under the state program in February 2012, which is prior to waste placement, was used to represent initial conditions at the monitoring location. The sample was mixed with leachate data at varying ratios, and the output was compared to the actual groundwater concentrations at MW-1102F in July 2017, which was the last sample collected under the Federal program where data for all major cations and anions were available.

A slight increase in chloride would be expected if leachate were mixing with groundwater as shown in Figure 4. However, a greater increase in sulfate and boron would be expected, based on the multiple order of magnitude difference in initial concentrations between the leachate and the groundwater. Additionally, both boron and sulfate are conservative species that are not readily attenuated. Time series graphs for boron and sulfate at MW-1102F are provided in Figure 5. While there may be seasonal effects on boron concentrations at MW-1102F, the concentrations remain below the Federal intrawell UPL and do not appear to be consistently trending upwards as would be expected if there were a release from the Landfill. Concentrations of sulfate at MW-1102F remain below both those reported for initial sampling prior to waste placement and the Federal intrawell UPL.

Additionally, if leachate were mixing with groundwater at MW-1102F, then the concentrations of calcium and magnesium would also have increased (Figure 4). Results of the mixing calculation show that the opposite occurred: calcium and magnesium concentrations decreased between February 2012 and July 2017 (Figure 4). The relatively stable and low concentrations of boron and sulfate at MW-1102F and the lack of increases in other cations suggest that the well is not impacted by a release from the Landfill.

2.4 Sampling Requirements

As the ASD described above supports the position that the identified SSIs are not due to a release from the Mitchell Landfill, the unit will remain in the detection monitoring program. Groundwater at the unit will be sampled for Appendix III parameters on a semi-annual basis.

SECTION 3

CONCLUSIONS

This ASD has been prepared in accordance with 40 CFR 257.94(e)(2) and supports the conclusion that the SSIs for chloride and TDS observed during the first semiannual sampling event of 2019 are not due to a release from the Mitchell Landfill. The observed chloride and TDS SSIs were instead attributed to natural variation. Therefore, no further action is warranted and the Mitchell Landfill will remain in the detection monitoring program. Certification of this ASD by a qualified professional engineer is provided in Attachment A.

SECTION 4

REFERENCES

Civil & Environmental Consultants, Inc. (CEC). 2016. CCR Groundwater Monitoring System Demonstration. Mitchell Landfill – Mitchell Power Generation Plant. March.

U.S. EPA, 2015. Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities (Final Rule). Fed. Reg. 80 FR 21301, pp. 21301-21501, 40 CFR Parts 257 and 261, April.

TABLES

Table 1: Detection Monitoring Data Evaluation
Mitchell Plant - Landfill

Parameter	Units	Description	MW-1101R		MW-1102F		MW-1502R	
			5/1/2019	6/12/2019	5/1/2019	6/12/2019	5/2/2019	6/12/2019
Boron	mg/L	Intrawell Background Value (UPL)	0.651		0.320		0.467	
		Detection Monitoring Data	0.376	--	0.126	--	0.100	--
Calcium	mg/L	Intrawell Background Value (UPL)	25.0		6.22		121	
		Detection Monitoring Data	1.9	--	4.69	--	93.6	
Chloride	mg/L	Intrawell Background Value (UPL)	18.6		14.1		213	
		Detection Monitoring Data	16.9	--	**15.2**	**14.9**	**245**	155
Fluoride	mg/L	Intrawell Background Value (UPL)	3.49		0.67		0.25	
		Detection Monitoring Data	2.62	--	0.66	--	0.17	--
pH	SU	Intrawell Background Value (UPL)	9.1		8.6		7.7	
		Intrawell Background Value (LPL)	7.8		7.5		7.1	
		Detection Monitoring Data	**10.5**	8.8	**9.5**	8.2	**8.5**	7.4
Sulfate	mg/L	Intrawell Background Value (UPL)	67.3		47.1		259	
		Detection Monitoring Data	28.7	--	37.6	--	105	--
TDS	mg/L	Intrawell Background Value (UPL)	1600		551		696	
		Detection Monitoring Data	809	--	**577**	**574**	**702**	661

Notes
UPL: Upper prediction limit
LPL: Lower prediction limit
TDS: Total dissolved solids
Bold values exceed the background value.
Background values are shaded gray.

Table 2: Leachate and MW-1102F Concentration Comparison
Mitchell Plant - Landfill

	Leachate	**MW-1102F**
Boron	66.7	0.168
Calcium	342	5.21
Chloride	464	13.6
Fluoride	2.20	0.635
pH	8.7	8.3
Sulfate	8917	35.0
TDS	13140	576
Sodium	1806	228
Potassium	222	1.58

Notes:
TDS - Total dissolved solids
Average concentrations are shown for all parameters.
All concentrations except pH are shown in milligrams per liter (mg/L).
pH is reported as standard units (SU).

FIGURES

Legend

- Compliance Sampling Location
- Upgradient Sampling Location

CCR Landfill (Approximate Limits of Waste)

Notes

- Monitoring well coordinates provided by AEP.
-Site features based on information available in the Groundwater Monitoring Network Evaluation (CEC, 2016) provided by AEP.

500 250 0 500 Feet

Fish Creek Formation
Site Layout

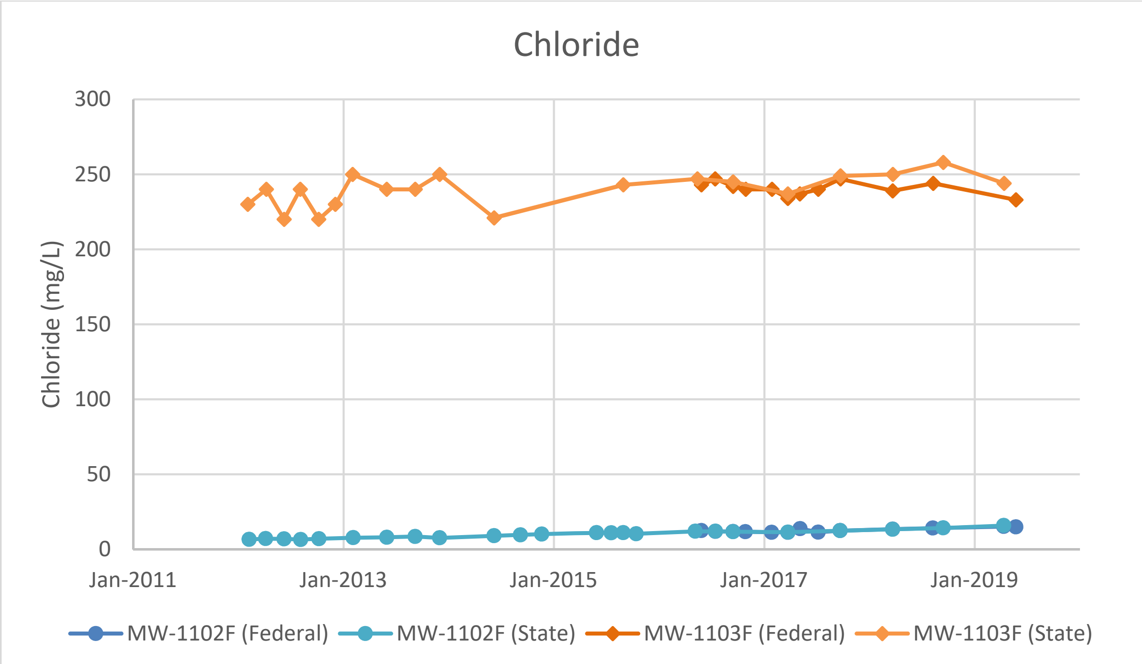
Mitchell Power Generation Plant
Marshall County, West Virginia

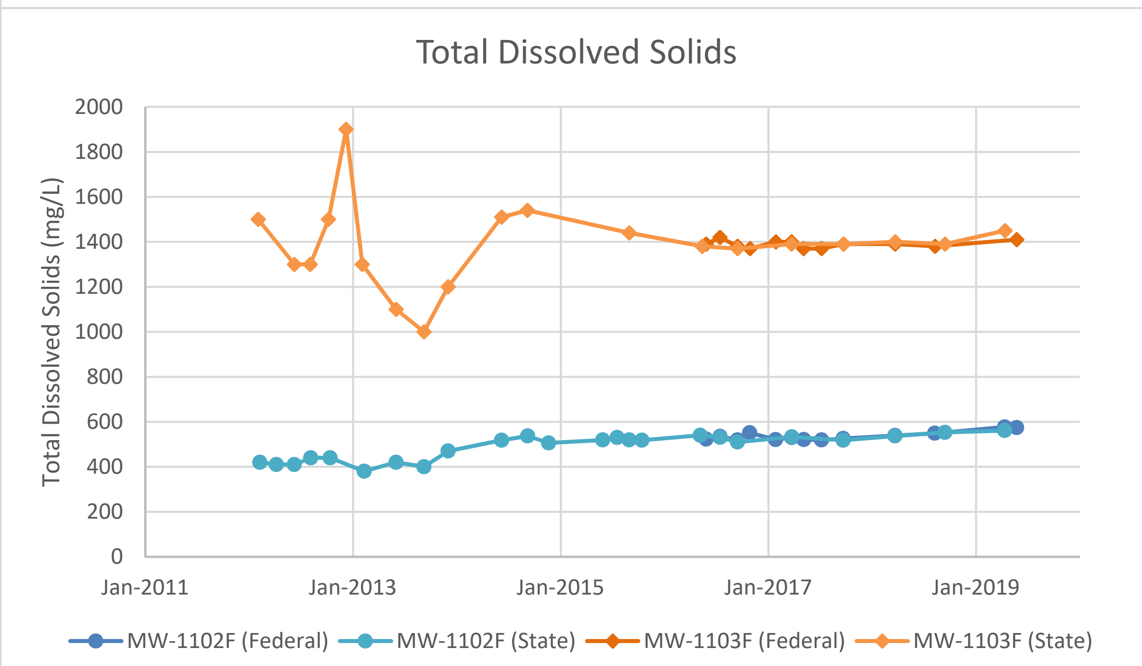
Geosyntec consultants

Columbus, Ohio | 20-Nov-2019

Figure 1

C:\Users\mmuenich\Documents\local_projects\AEP_GIS\Mitchell\MXDs\Landfill-FC\AEP-Mitchell_LF-Fish-Creek_Site_Layout.mxd. MMuenich. 1/26/2018. Project/Phase/Task.





Notes: Data are shown for both the federal and state monitoring program. MW-1103F is a background monitoring location for the Fish Creek Formation. Downgradient location MW-1102F is also screened in the Fish Creek Formation.

Chloride and TDS Time Series Graphs

Mitchell Landfill

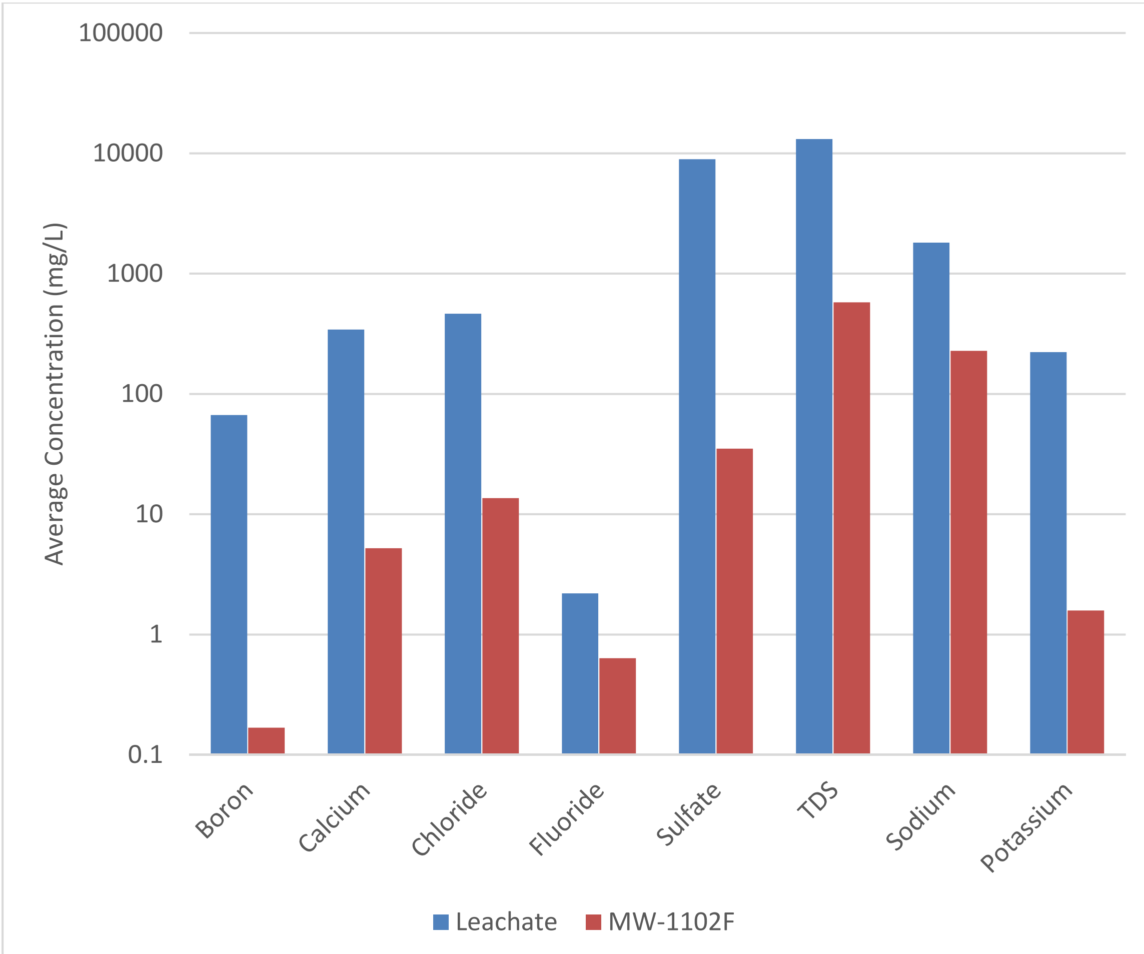
Geosyntec consultants

AMERICAN ELECTRIC POWER

Figure **2**

Columbus, Ohio

20-Nov-2019



Notes: pH is not shown, as it is measured in log scale. The average concentration for samples collected during the Federal monitoring program at MW-1102F are shown. Leachate data were collected under the state monitoring program.

Leachate and MW-1102F Concentration Comparison

Mitchell Landfill

Geosyntec consultants

AMERICAN ELECTRIC POWER

Columbus, Ohio

20-Nov-2019

Figure

3

internal info: path, date revised, author

Notes: Solid lines represent reported concentrations for MW-1120F in 2012 (prior to waste placement) and for MW-1120F and Landfill leachate in 2017. Dashed lines represent output of a mixing model for MW-1120F data from 2012 mixed with leachate at varying ratios.

Leachate and MW-1102F Mixing Model

Mitchell Landfill

Geosyntec consultants

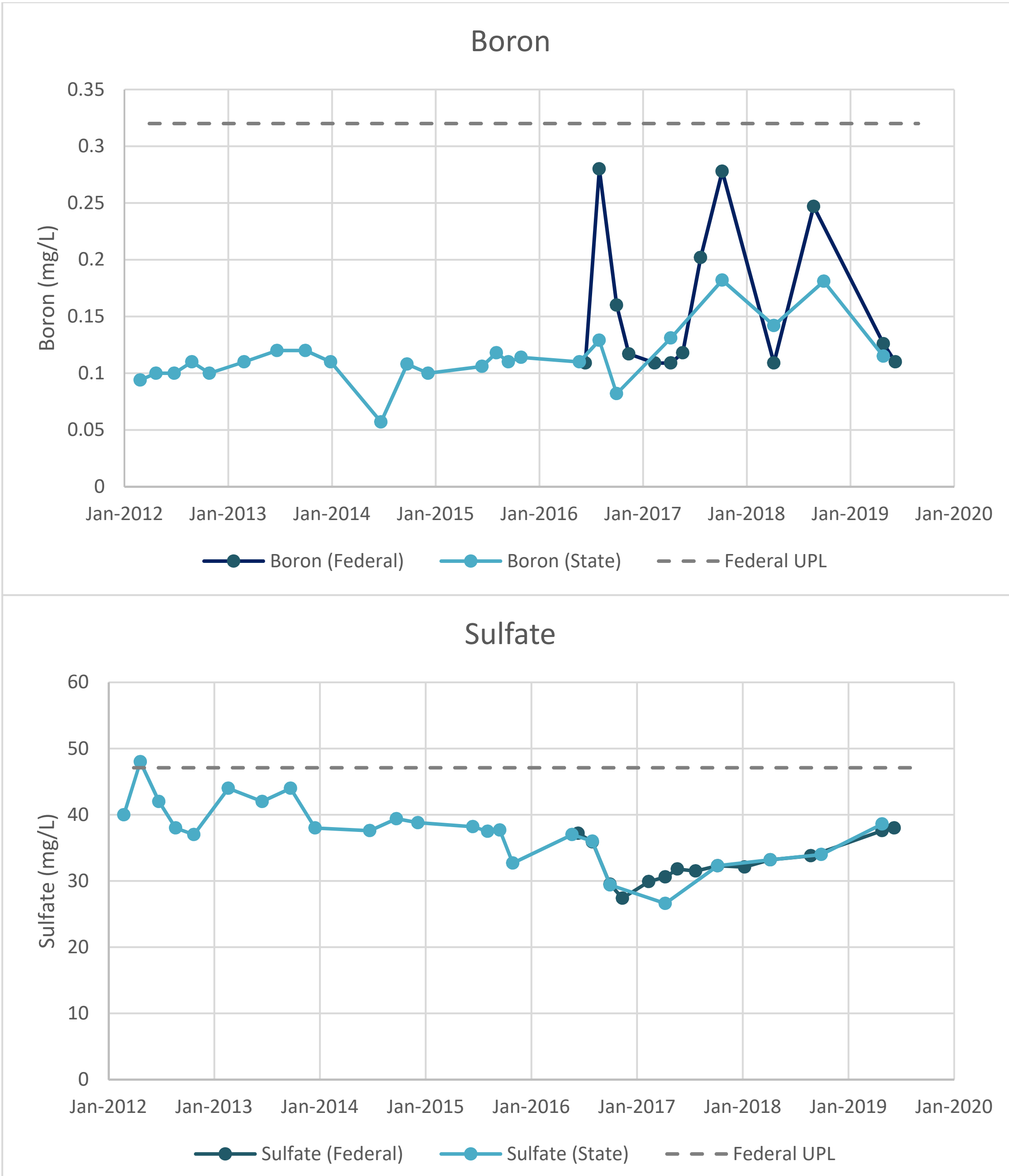
AMERICAN ELECTRIC POWER

Figure 4

Columbus, Ohio

20-Nov-2019

internal info: path, date revised, author



Notes: Data are shown for both the Federal and state monitoring program. UPLs shown were calculated for the Federal monitoring program.

Boron and Sulfate Time Series Graphs

Mitchell Landfill

Geosyntec consultants

AMERICAN ELECTRIC POWER

Figure **5**

Columbus, Ohio

20-Nov-2019

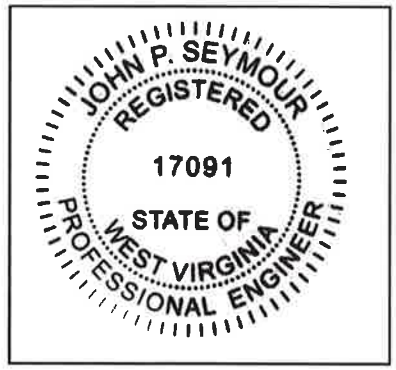
internal info: path, date revised, author

ATTACHMENT A

CERTIFICATION BY A QUALIFIED PROFESSIONAL ENGINEER

CERTIFICATION BY A QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected and above described alternative source demonstration is appropriate for evaluating the groundwater monitoring data for the Mitchell Landfill CCR management area and that the requirements of 40 CFR 257.94(e)(2) have been met.



John Seymour

Printed Name of Licensed Professional Engineer

Signature

017091

License Number

West Virginia

Licensing State

12/2/2019

Date

APPENDIX 4 - Notices for Monitoring Program Transitions

No transition between monitoring requirements occurred in 2019; the CCR unit remained in detection monitoring over the entire year. Notices for monitoring program transitions are not applicable at this time.

APPENDIX 5 - Well Installation/Decommissioning Logs

No monitoring wells installed or decommissioned in 2019. Well installation/decommissioning logs are not applicable at this time.

Appendix F

Structural Stability Assessment Required at

§ 257.73(d)

STRUCTURAL STABILITY ASSESSMENT

CFR 257.73(d)

Bottom Ash Complex

Mitchell Plant
Marshall County, West Virginia

October, 2016

Prepared for: Wheeling Power Company & Kentucky Power Company

Prepared by: American Electric Power Service Corporation

1 Riverside Plaza

Columbus, OH 43215

GERS-16-111

STRUCTURAL STABILITY ASSESSMENT
CFR 257.73(D)
MITCHELL POWER PLANT
BOTTOM ASH COMPLEX

PREPARED BY	Daniel W. Pizzino, P.E.	DATE	9/28/2016
REVIEWED BY	Mohammad A. Ajlouni, Ph.D.,P.E.	DATE	9/28/2016
APPROVED BY	Gary F. Zych, P.E. Manager – AEP Geotechnical Engineering	DATE	10/5/2016

Gary F. Zych

GARY F. ZYCH
REGISTERED
21201
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER

10/5/2016

I certify to the best of my knowledge, information and belief that the information contained in this structural stability assessment meets the requirements of 40 CFR 257.73(d)

Table of CONTENTS

1.0 OBJECTIVE 257.73(d)

This report was prepared by AEP- Geotechnical Engineering Services (GES) section to fulfill requirements of CFR 257.73(d) – document whether the design, construction, operations, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices.

2.0 NAME AND DESCRIPTION OF CCR SURFACE IMPOUNDMENT

The Mitchell Bottom Ash Pond Complex is located at the Mitchell Power Plant in Marshall County, West Virginia. The impoundment was constructed in 1977 and is comprised of a Bottom Ash Pond and a Clear Water Pond. The purpose of the pond is for the disposal of Bottom Ash produced at the Mitchell Power Plant.

The complex is surrounded by the Mitchell Power Plant on its north side, West Virginia State Route 2 on its east side, the adjacent wallboard facility and ancillary structures on its south side, and the metal cleaning tank, railroad tracks, and the Ohio River on its west side. The Bottom Ash Pond Complex is approximately 17 acres in size and consists of two impounding facilities, the Bottom Ash Pond which is approximately 10 acres, and the Clear Water Pond which is approximately 7 acres. The Bottom Ash Pond comprises the north portion of the complex and the Clear Water Pond comprises the southern portion. The Mitchell Bottom Ash Complex is regulated by the West Virginia Division of Water and Waste Management (WVDWWM) as a Hazard Class “2” Structure.

3.0 STABLE FOUNDATION AND ABUTMENTS 257.73(d)(1)(i)

[Was the facility designed for and constructed on stable foundations and abutments? Describe any foundation improvements required as part of construction.]

Based on the design drawings, the Bottom Ash Pond and Clear Water Pond were constructed partially as incised ponds and partially using raised dike construction.

Based on recent subsurface investigations, the foundation materials of the Bottom Ash Complex consist of a primarily loose to very dense sands and gravels with N-values ranging from 3 to 50. Laboratory testing concluded that foundation soils exhibit an effective cohesion (c’) of 0 and an internal friction angle (Φ) of 34. Based on the findings of the subsurface investigations the foundations materials are suitable for this CCR unit. A stability analysis was performed for the facility which includes an evaluation of the dike system including foundation materials for static, seismic conditions and liquefaction potential. The analysis demonstrates that facility has adequate factors of safety.

Operation of the impoundment is performed so as to not adversely affect the foundation and abutments. As required by the CCR rules the Bottom Ash Pond Complex is inspected at least every 7 days by a qualified person. Also as a requirement of the CCR rules, the impoundment is also inspected annually by a professional engineer. Maintenance items are addressed as they are discovered as a part of those inspections.

4.0 SLOPE PROTECTION 257.73(d)(1)(ii)

[Adequate slope protection to protect against surface erosion, wave action, and adverse effects of sudden drawdown.]

The Bottom Ash Complex was designed and constructed with inboard slopes which are lined with a geomembrane liner overlaid with 3 feet of soil fill. Above the soil fill the inboard slopes are primarily lined with vegetation with portions covered with coarse aggregate. At the portion of the pond where bottom ash removal is managed there is a layer of bottom ash built up along the inboard slopes providing further protection. The outboard slopes primarily consist of grass vegetation with portions of the outboard slope protected by coarse riprap.

Operation and maintenance of the aggregate primarily includes periodic spraying for vegetation control. Grassed slopes are mowed regularly. Any erosion or slips that may occur is repaired within a timely period.

5.0 EMBANKMENT CONSTRUCTION 257.73 (d)(1)(iii)

[Describe the specifications for compaction and/or recent boring to give a relative comparison of density.]

A recent subsurface investigation indicates that the embankment was constructed primarily of loose to very dense clayey, silty, sands that exhibit Standard Penetration Test blow counts (N-values) ranging from 7 to 67. Further laboratory testing on the embankment material was conducted. Recent borings through the embankment and laboratory testing indicate that the material is stiff and representative of a compacted earthen material. A stability analysis of the diking system was also conducted which demonstrates that the facility has a factor of safety greater than minimum values required by the CCR rule.

6.0 VEGETATION CONTROL 257.73 (d)(1)(iv)

[Describe the maintenance plan for vegetative cover.]

The vegetative areas are mowed to facilitate inspections and promote the growth of the vegetative layer; and prevent the growth of woody vegetation.

7.0 SPILLWAY SYSTEM 257.73(d)(1)(v)

[Describe the spillway system and its capacity to pass the Inflow Design Flood as per its Hazard Classification.]

The Bottom Ash Complex has been determined to be a Significant Hazard potential CCR impoundment. Based on this hazard classification the design flood is determined by section 257.82(a)(3) to be the 1000-year storm which corresponds to 7.10 inches in 24 hours for this site. An analysis was performed which demonstrates the Bottom Ash Complex can safely pass the 1/2 PMP (Probable Maximum Precipitation), which is equivalent to 13.45 inches in 6 hours and therefore exceeds the requirements of section 257.82(a)(3).

The Bottom Ash Complex is a raised dike structure with no offsite contributing drainage area. As runoff enters the Bottom Ash Pond is conveyed to the Clear Water Pond via a concrete overflow shaft and a 30-inch diameter reinforced concrete pipe to a 30-inch diameter perforated distribution pipe in the Clear Water Pond. Runoff entering the Clear Water Pond is conveyed through an overflow tower into a 36-inch diameter reinforced concrete pipe through the embankment and then a series of 36-inch diameter corrugated metal pipes which discharge into a riprap-lined channel leading to the Ohio River.

Maintenance of the conveyance structures is performed as needed based on periodic 7-day and annual inspections.

<u>8.0</u> BURIED HYDRAULIC STRUCTURES 257.73 (d)(1)(vi)

[Describe the condition of the sections of any hydraulic structure that in buried beneath and/or in the embankment.]

The principal outlet pipe from the Clear Water Pond passes though the dike near the southwestern side of the impoundment. The portion of the outlet pipe that passes though the embankment is reinforced concrete pipe and was installed in 1977 as part of the original impoundment construction. The pipe was primarily installed within natural ground through the incised portion of the dike. There are no performance issues with the outlet pipe that would indicate plugging or failure of the pipe. Given that this portion of pipe is reinforced concrete, structural integrity is not considered to be an issue. In general reinforced concrete pipes have a long service life under a range of conditions and is an appropriate design for this application.

In 2015 a two 6" cooling tower blowdown water drain lines were installed along the northern embankment of the bottom ash pond. The lines were installed within a shallow trench excavation within the crest of the embankment. The project was designed by a professional engineer and permitted through the West Virginia Department of Environmental Protection – Division of Water and Waste Management (WVDWWM).

<u>9.0</u> SUDDEN DRAWDOWN 257.73 (d)(1)(vii)

[If the downstream slope is susceptible to inundation, discuss the stability due to a sudden drawdown.]

The downstream slope of the Bottom Ash Pond is not expected to be inundated from any adjacent water bodies.

Appendix G

Safety Factor Assessment Required at

§ 257.73(e)

AEP AMERICAN ELECTRIC POWER

We power life's possibilities

CCR RULES ASSESSMENT AND CERTIFICATION
MITCHELL PLANT BOTTOM ASH COMPLEX
KENTUCKY POWER COMPANY
AEP SERVICE CORPORATION

PREPARED BY:

GEO/ENVIRONMENTAL ASSOCIATES, INC.
A SCHNABEL ENGINEERING COMPANY
KNOXVILLE, TENNESSEE

PROJECT NUMBER 15055013.00
DECEMBER 22, 2015

GA

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CCR RULES ASSESSMENT AND CERTIFICATION
MITCHELL POWER PLANT BOTTOM ASH COMPLEX
KENTUCKY POWER COMPANY
MARSHALL COUNTY, WEST VIRGINIA
DECEMBER 22, 2015

INTRODUCTION

Geo/Environmental Associates, Inc. (GA) has performed a site inspection, conducted an engineering assessment, and prepared a certification statement for the Mitchell Power Plant Bottom Ash Complex. These services were performed to meet specific requirements set forth in the Environmental Protection Agency's CCR Rules.(1) Provided in this report is a discussion of GA's findings and a certification statement pertaining to the facility. Field and laboratory data, engineering analyses, and a drawing are included in the appendices.

SITE DESCRIPTION

General

The Mitchell Bottom Ash Complex is equally owned by American Electric Power Generation Resources, Inc. and Kentucky Power Company (KPC) and it is operated by KPC to provide disposal capacity for bottom ash generated at the Mitchell Power Plant. AEPSC, based in Columbus, Ohio, provides engineering support for the Bottom Ash Complex. The Mitchell Bottom Ash Complex is located near Cresap in Marshall County, West Virginia at approximately latitude 39° 49' 30" and longitude 80° 48' 56".

The complex is surrounded by: (1) the Mitchell Power Plant on its north side, (2) West Virginia State Route 2 on its east side, (3) the adjacent wallboard facility and ancillary structures on its south side, and (4) the metal cleaning tank, railroad tracks, and the Ohio River on its west side. As shown on drawing sheet 1 in Appendix IV, the Mitchell Bottom Ash Complex consists of two impounding facilities: (1) the Bottom Ash Pond and (2) the Clear Water Pond. The Bottom Ash Pond comprises the north portion of the complex and the Clear Water Pond comprises the southern portion. The Mitchell Bottom Ash Complex is regulated by the West Virginia Division of Water and Waste Management (WVDWWM) as a Hazard Class "2" structure.

The Bottom Ash Pond is separated into ponding areas in its western and northeastern portions. In general, bottom ash is sluiced into the northeastern portion of the pond; where after, the sluice water is routed through an interior splitter dike to the western portion of the pond. Flow through the western portion of the pond is routed around three interior flow diversion dikes. The southeastern portion of the Bottom Ash Pond is above the normal operating pool (pond) level

(1) Environmental Protection Agency, 40 CFR Parts 257 and 261, "Hazardous and Solid Waste Management System; Disposal of Coal combustion Residuals from Electric Utilities; Final Rule," April 17, 2015

and is used as an excavation and loadout area for bottom ash. The Bottom Ash Pond was constructed partially as an incised pond and partially using raised dike construction. Specifically, the pool level on the east side of the pond is generally below the bottom elevation of the east dike (i.e., it is incised). The inside slopes of the Bottom Ash Pond are lined with a composite soil and PVC liner. The southern dike separates the Bottom Ash Pond and Clear Water Pond.

Overflow from the western portion of the Bottom Ash Pond is conveyed to the Clear Water Pond via a concrete overflow shaft and a 30-inch diameter reinforced concrete pipe to a 30-inch diameter perforated distribution pipe in the Clear Water Pond. The Clear Water Pond was constructed using both incised pond and diked pond construction methods. In general, the pool levels along the southern and eastern sides of the Clear Water Pond are primarily incised. Similar to the Bottom Ash Pond, the inside slopes of the Clear Water Pond are lined with a composite soil and PVC liner. Overflow from the Clear Water Pond is conveyed through an overflow tower into a 36-inch diameter reinforced concrete pipe through the embankment and then a series of 36-inch diameter corrugated metal pipes which discharge into a riprap-lined channel leading to the Ohio River.

Approximate Existing Conditions

A summary of the approximate existing conditions for the Mitchell Bottom Ash Complex is provided in List 1. A site plan view of the facility is included in Appendix IV.

LIST 1
SUMMARY OF APPROXIMATE EXISTING CONDITIONS
FOR MITCHELL BOTTOM ASH COMPLEX

Bottom Ash Pond Crest Elevation	690 feet, NAVD
Bottom Ash Pond Normal Operating Pool Level	681 feet, NAVD
Bottom Ash Pond Design Storm Level (1)	682.98 feet, NAVD
Bottom Ash Pond Bottom Level	660 feet, NAVD
Clear Water Pond Crest Elevation	675 feet, NAVD
Clear Water Pond Normal Operating Pool Level	664 feet, NAVD
Clear Water Pond Design Storm Level (2)	665.62 feet, NAVD
Clear Water Pond Bottom Level	645 feet, NAVD

Notes:

(1) The Bottom Ash Pond maximum design storm level is based on a normal operating pool elevation of 681 feet, NAVD and a pool increase of 1.98 feet during the 1/2 PMP 6-hour storm event.

(2) The Clear Water Pond maximum design storm level is based on a normal operating pool elevation of 664 feet, NAVD and a pool increase of 1.62 feet during the 1/2 PMP 6-hour storm event.

SITE INSPECTION

At the request of AEPSC, GA personnel performed a site inspection of the Bottom Ash Complex to observe and document the prevalent site conditions. Specifically, Seth W. Frank, P.E. (GA) performed a site inspection of the Bottom Ash Complex on July 14, 2015. It is GA's opinion that the Bottom Ash Complex is in good condition. Moreover, GA believes that the conditions observed, during the July 14, 2015, site inspection, are representative of the conditions modeled in the assessments and analyses provided in this report.

FIELD, LABORATORY, AND INSTRUMENTATION DATA

For reference, pertinent field and laboratory data for the Bottom Ash Complex is provided in Appendix I. The field and laboratory data were gathered during a subsurface investigation coordinated by GA in 2009. The field data includes detailed borehole logs and results of in-situ testing (i.e., standard penetration testing). Laboratory data provided in Appendix I includes: (1) grain size distributions, (2) Atterberg limits test results, (3) unconfined compressive strength test results, and (4) triaxial compressive strength test results.

AEP monitors four standpipe piezometers, at the Bottom Ash Complex facility, monthly. Results of instrumentation monitoring are collected and summarized in annual inspection reports.

Locations of the site boreholes/piezometers are shown on the Site Plan View drawing in Appendix IV.

HYDRAULICS AND HYDROLOGY

Flood routing analyses were developed for the existing conditions at the Bottom Ash Complex using the *HEC-1* computer program, developed by the U.S. Army Corps of Engineers. Flood routing parameters and the *HEC-1* output are provided in Appendix II. In accordance with the 40 CFR Parts 257 and 261 (CCR Rules), the flood routing analyses were performed using the 1/2 PMP 6-hour storm event. A summary of the flood routing results is provided in Table 1.

TABLE 1
SUMMARY OF FLOOD ROUTING ANALYSES
FOR EXISTING CONDITIONS

Pond	Crest Elevation (ft, NAVD)	Design Storm	Principal Spillway/Overflow Structure Invert Elevation/Pool at Start of storm (ft, NAVD)	Peak Inflow (cfs)	Peak Outflow (cfs)	Peak Stage (ft, NAVD)	Minimum Freeboard (ft)
Bottom Ash	690'	1/2 PMP6-hour	681'	111.08	23.83	683.51	6.49
Clearwater	675'	1/2 PMP6-hour	664'	71.44	44.76	666.50	8.50

As shown in Table 1, the as-built Bottom Ash Pond and Clearwater Pond are capable of storing/routing the 1/2 PMP 6-hour storm event, while providing at least 3 feet of freeboard for the minimum embankment crest elevations of 690 feet, NAVD and 675 feet, NAVD respectively. Note that the storm routing analyses assume a constant, peak inflow of 7.5 million gallons per day from plant processes, in addition to the storm runoff.

SLOPE STABILITY ANALYSES

General

The computer program *SLOPE/W*, developed by GEO-SLOPE International, Ltd., was used to perform slope stability analyses on two critical embankment profiles for the as-built Bottom Ash Complex. Specifically, the Morgenstern-Price limit equilibrium method was applied in the slope stability analyses. The slope stability analyses were conducted for the as-built Bottom Ash Complex Profiles SP1-SP1 and SP2-SP2. Locations of the critical profiles are shown on the drawing in Appendix IV. Section SP1-SP1 was chosen as a critical section because of its height and potential to directly release material during a failure. Section SP2-SP2 was selected as a critical section because it is the highest embankment (measured from the crest to the downstream toe) and impounds water against both the upstream face and the downstream toe. A failure at Section SP2-SP2 would likely be contained in the Clear Water Pond, but would likely release sediment/ash through the Clear Water Pond spillway causing environmental damage and potentially clogging the spillway. Slope stability loading conditions and factor of safety requirements are outlined in the CCR Rules. Where applicable, those requirements were modeled for the critical embankment profiles. A description of the slope stability analyses/assessments follows.

Static Factor of Safety Under Long Term, Maximum Storage Pool Loading Conditions

The long term, maximum storage pool loading condition was modeled in the downstream direction for the critical embankment profiles. Specifically, the Bottom Ash Pond normal operating pool elevation of 681 feet, NAVD and the Clearwater Pond normal operating pool elevation of 664 feet, NAVD were modeled in the slope stability analyses. The phreatic levels within the profiles were conservatively assumed to extend linearly from the pool on the upstream side to the toe or pool on the downstream side. Historical piezometer levels indicate phreatic levels considerably lower than those modeled.

Static Factor of Safety Under Maximum Surcharge Pool Loading Conditions

The maximum surcharge pool loading condition was modeled in the downstream direction for the critical embankment profiles. Specifically, the 1/2 PMP 6-hour design storm peak stage for the Bottom Ash Pond and the Clearwater Pond of 682.98 feet, NAVD and 665.62 feet, NAVD respectively, were modeled in the impoundments for the slope stability analyses. For the maximum surcharge pool loading condition a minimum factor of safety equal to 1.2 is required. The phreatic levels within the profiles were conservatively assumed to extend linearly from the pool on the upstream side to the toe or pool on the downstream side. Historical piezometer levels indicate phreatic levels considerably lower than those modeled. It should be noted that the existing principal spillway and overflow structures are capable of routing the excess storage in a short period of time. Therefore, it is unlikely that an elevated steady-state phreatic level will fully develop through the embankment during the maximum surcharge pool loading conditions.

Seismic Factor of Safety

The seismic loading condition was modeled in the upstream and downstream direction for the critical embankment profiles. The Bottom Ash Pond normal operating pool elevation of 681 feet, NAVD and the Clearwater Pond normal operating pool elevation of 664 feet, NAVD were modeled in the seismic slope stability analysis. Based on the *2008 Interactive Deaggregations* website provided online through the USGS Geologic Hazards Science Center, the Bottom Ash Complex facility has a peak ground acceleration of 0.046g for a seismic loading event with a mean return time of 2,475 years. Conservatively assuming soft soil ground conditions above rock, translates to a peak horizontal ground surface acceleration of approximately 0.*12* g. Using a commonly applied factor of 0.5 times the peak horizontal acceleration yields the conservative horizontal seismic coefficient of 0.06 that was applied in the slope stability analyses. As described in the previous sections, the phreatic levels within the profiles were conservatively assumed to extend linearly from the pool on the upstream side to the toe or pool on the downstream side of the embankment.

Liquefaction Assessment

The CCR Rules state that "Liquefaction analysis is only necessary in instances where CCR surface impoundments show, through representative soil sampling, construction documentation, or anecdotal evidence from personnel with knowledge of the CCR unit's construction, that soils of the embankment are susceptible to liquefaction." Based on the results of the 2009 subsurface investigation, the embankment consists primarily of dense to very dense silty, clayey sands. However, the original ground (foundation) materials consist primarily of loose to medium dense, silty sands (i.e., corrected SPT blow count – N – values ranging from 2.3 to 43.6, with median values for each boring ranging from 5.2 to 18.1). See the boring logs and summary of corrected SPT blow counts located in Appendix I. Strength loss in sands during an earthquake is generally considered unlikely when blow counts are greater than 15(2). Although the majority of blow counts occurred at lower depths of natural materials tested, for our liquefaction analyses, we conservatively assume uniform material parameters throughout the natural ground interval.

The *QUAKE/W* computer program developed by GEO-SLOPE International, Ltd., was used to perform dynamic finite element stress analyses for the two critical sections, SP1-SP1 and SP2-SP2. The dynamic analysis consisted of the following three steps/analyses: (1) an initial static analysis that determines the initial stress conditions, (2) a dynamic analysis using a scaled

(2) Engineering and Design Manual – Coal Refuse Disposal Facilities, 2nd Ed., Mine Safety and Health Administration (based on data from Seed and Harder, 1990; Castro, 1995; Wride et. al. , 1999)

earthquake record that determines potentially liquefiable zones, and (3) a Newmark Deformation analysis that determines the critical failure surface and corresponding factor of safety. The dynamic conditions were modeled using earthquake time-acceleration data for an earthquake centered in the Giles County, Virginia, area. Time-acceleration data for the Giles County earthquake was provided in *Research Report KTC-96-4 Source Zones, Recurrence Rates, and Time Histories for Earthquakes Affecting Kentucky*. The earthquake was scaled to the earthquake ground acceleration value of 0.05g, based on the *2008 Interactive Deaggregations* value described in the previous section. The phreatic levels used in the initial static analyses are conservatively applied using approximately the maximum phreatic level recorded since piezometers were installed in 2009.

End of Construction Analyses

The CCR Rules require that "End-of-Construction loading condition must be calculated for new CCR surface impoundments to ensure that the CCR surface impoundment can withstand a "first filling" of the embankment, during which time the embankment first becomes saturated and is subject to phreatic flow through the cross-section." First filling of the Bottom Ash Complex occurred in the mid to late 1970s and the embankments have developed a "measureable" steady-state phreatic surface through the critical profiles. Therefore, an End-of-Construction analysis is not necessary for the Bottom Ash Complex embankments.

Assumptions and Parameters

GA selected the strength parameters that were applied in the slope stability analyses using site specific field and laboratory data. Strength parameters are based on field and laboratory data gathered during a subsurface investigation coordinated by GA in 2009. For reference, the laboratory testing data is provided in Appendix I. A summary of material strength parameters is provided in Table 2.

TABLE 2
SUMMARY OF STRENGTH PARAMETERS USED IN SLOPE STABILITY ANALYSES

Material	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Effective Strength Parameters	
			Cohesion, c' (psf)	Friction Angle, φ' (degrees)
Soil Dike	124	134	300	29
Original Soil	120	130	0	34
Cohesive Liner	121	131	900	0

Material parameters used in the finite element liquefaction assessment are provided in Table 3. Parameters were based on site specific data and from accepted reference materials in relation to the site specific soils/conditions.

TABLE 3
SUMMARY OF MATERIAL PARAMETERS USED IN LIQUEFACTION ANALYSES

	Soil Dike (Clayey, Silty, Sand)	Original Ground (Silty Sand)	Cohesive Liner (Clay)
Damping Ratio Function[1]	Seed – Idriss	Seed – Idriss	Clay – Sun
Small Strain Shear Modulus G_{max} (psf)	121,540	166,540	QUAKE/W Function
Source[2]	GA – Triaxial Estimate	GA – Triaxial Estimate	QUAKE/W
Poisson's Ratio	0.28	0.28	0.3
Source[3]	Bowles	Bowles	Bowles
Cyclic Number Function[4]	QUAKE/W	QUAKE/W	None

Notes: (1) Damping Ratios from:
- Seed – Idriss (SHAKE91 User's Manual)
- Clay – Sun, et.al.

(2) G_{max} values estimated from results of triaxial tests performed by GA and built-in QUAKE/W function based on work by Hardin, Drnevich, Mayne, and Rix.

(3) Poisson's Ratio based on typical values described in Foundation Analysis and Design, 4th Ed., Joseph E. Bowles, P.E., S.E.

(4) Cyclic Number Function is a QUAKE/W built-in function based on work by Seed and Lee.

Summary of Results

A summary of the slope stability analysis results are provided in Table 4. *SLOPE/W* and *QUAKE/W* results showing the modeled profiles, loading conditions, areas of potential liquefaction, and critical failure surfaces are provided in Appendix III.

TABLE 4 SUMMARY OF SLOPE STABILITY ANALYSES RESULTS						
	Slope Stability Safety Factors					
Profile	Downstream Static Long-Term Maximum Storage Pool	Downstream Static Maximum Surcharge Pool	Downstream Seismic	Upstream Seismic	Downstream Liquefaction Assessment	Upstream Liquefaction Assessment
SP1-SP1	2.09	2.04	1.80	2.08	2.02	1.20
SP2-SP2	1.87	1.87	1.53	2.01	1.21	1.24

As shown in the slope stability analysis results in Table 4, and the *SLOPE/W* and *QUAKE/W* computer output in Appendix III, the factors of safety meet the requirements specified in the CCR Rules. Although the liquefaction assessment shows areas that are potentially liquefiable (see elements shaded in yellow in the *QUAKE/W* results in Appendix III), we feel that the assessment is very conservative based on parameter selection. A summary of the phreatic levels modeled in the stability analyses is provided in Table 5.

TABLE 5 SUMMARY OF PHREATIC LEVELS USED IN STABILITY ANALYSES				
	Piezometric Surface Elevation at Piezometer Location (Feet, NAVD)			
Profile	**Downstream Static Long-Term Maximum Storage Pool**	**Downstream Static Maximum Surcharge Pool**	**Seismic**	**Liquefaction Assessment**
SP1-SP1	675	677	675	669 (2) (maximum measured)
SP2-SP2	675	676.5	675	669 (2) (maximum measured)
	690 (1) (FS = 1.35)			
	682 (1) (FS = 1.5)			

(1) For reference, we included hypothetical elevated phreatic levels for Section SP2 (the more critical section for Static Stability). Specifically, we assumed the embankment was fully saturated to the crest (690 feet, NAVD) and to elevation 682 feet, NAVD, corresponding to a Factor of Safety (FS) of 1.5.

(2) 669 feet, NAVD is approximately the maximum measured piezometer level for Sections SP1 and SP2, since piezometers were installed in March of 2009.

CERTIFICATION STATEMENT

Based on the site inspections, review of construction monitoring and periodic inspection data, the results of the field and laboratory testing of the materials used in the embankment construction, and our review of the as-built embankment geometry; it is our opinion that the embankments within the Bottom Ash Complex have slope stability factors of safety that meet or exceed the requirements in the CCR Rules. Furthermore, based on our review of the as-built embankment geometries, current operating pool levels, and the existing spillway and overflow system; we believe that the facility is capable of storing/routing the runoff from the 1/2 PMP 6-hour storm event.

Accordingly, I hereby certify that the Bottom Ash Complex is generally maintained in good condition and the facility generally meets the stability requirements in the CCR Rules. It should be clearly noted that this certification is not a legal guarantee. This certification is merely a statement by a registered professional engineer that, to the best of his knowledge, the facility was generally constructed according to the approved plan and that it meets the applicable stability requirements set forth in the CCR Rules. No warranties, expressed or implied, are provided. If you have any questions regarding the information provided, please contact me at 865-584-0344.

12-22-2015

Seth W. Frank, P.E.
West Virginia R.P.E. No. 20574

Date

SETH W. FRANK
REGISTERED
20574
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER

Appendix I

Field and Laboratory Data

Geo/Environmental Associates, Inc.

Boring No. B-1

Page 1 Of 2

PROJECT: AEP Mitchell BAP	**PROJECT NO: 09-379**
Start Date: 3-4-09	Drilling Contractor: Horn and Associates
Finish Date: 3-4-09	Driller: Tom Leininger
Logged By: Seth Frank	Helper: Jared and Bradley
Location: N 485362.82 E 1599372.71NAD83	Drill Type: Dietrick D50
Ground Elevation: 692.42' NAVD88	
Notes:	Thickness of Soil:
	Depth Drilled In Rock:
	Total Depth of Boring: 51.0'

DEPTH (FEET)		SAMPLE NOS., & SPLIT SPOON RECOVERY	SOIL/BEDROCK DESCRIPTION	BLOW COUNTS AND COMMENTS
FROM	TO			
2.0	3.5	S-1 / 1.2'	SAND, brown w/green & yellow, gravel, dense, damp	15-22-19
4.5	6.0	S-2 / 1.3'	SAND, brown w/grey & yellow, gravel, very dense, damp	17-32-24
7.0	8.5	S-3 / 1.3'	SAND, clayey, silty , brown, gravel, medium dense, moist	10-11-15
9.5	9.9	ST-1 / 0.4'	SAND, clayey, silty, brown, gravel, moist	
12.0	13.5	S-4 / 1.4'	0-0.2': SAND, brown, gravel; 0.2-0.6': SAND, black (possible bottom of preexisting fill); 0.6-1.0': SAND, grey/white; 1.0-1.4': SAND- silty, brown, dense, damp	10-20-19
14.5	16.0	S-5 / 1.2'	SILT, sandy, clayey, gravel, medium dense to very stiff (qu>5tsf), damp	8-12-13
17.0	18.5	S-6 / 1.5'	SAND, brown, gravel, medium dense, damp	9-9-10
19.5	20.5	S-7 / 1.1'	SAND, gravely, brown, medium dense, damp	6-7-5
22.0	23.5	S-8 / 1.3'	SAND, brown, gravel, medium dense, damp	5-5-6

Geo/Environmental Associates, Inc.

Project Name/ Job Number: 09-379

Boring Log No.: B-1

DEPTH (FEET)		SAMPLE NO., SAMPLE INTERVAL & SPLIT SPOON RECOVERY	SOIL/BEDROCK DESCRIPTION	BLOW COUNTS AND COMMENTS
FROM	TO			
24.5	26.0	S-9 / 1.3'	SAND, brown, river rock, medium dense, wet	4-5-6
30.0	31.5	S-10 / 1.2'	GRAVEL, sandy, brown, very loose, wet	1-2-1
35.0	36.5	S-11 / 1.3'	SAND, silty, brown, gravel, loose, wet	3-4-3
39.5	42.0	ST-2 / 2.3'	SAND, gravely, brown, wet	
44.5	46.0	S-12 / 1.2'	SAND, gravely, brown, loose, wet	4-4-4
49.5	51.0	S-13 / 1.2'	SAND, brown, mottled black, medium dense, wet	5-5-5
			TRANSITION FROM DIKE TO ORIGINAL AT APPROXIMATELY 10.0'-12.0'	

Geo/Environmental Associates, Inc.

Boring No. B-2

PROJECT: AEP Mitchell BAP

PROJECT NO: 09-379

Start Date: 3-4-09

Finish Date: 3-5-09

Logged By: Seth Frank

Location: N 485698.27 E 1598947.58 NAD83

Ground Elevation: 690.72' NAVD88

Drilling Contractor: Horn and Associates

Driller: Tom Leininger

Helper: Jared and Bradley

Drill Type: Dietrick D50

Notes: Set piezometer to tip depth of 31.0'

Well dry at 31' on 3-5-09.

Piezometer Elevation: 690.59' NAVD88

Casing Elevation: 691.78' NAVD88

Thickness of Soil:

Depth Drilled In Rock:

Total Depth of Boring: 51.0'

DEPTH (FEET)		SAMPLE NOS., & SPLIT SPOON RECOVERY	SOIL/BEDROCK DESCRIPTION	BLOW COUNTS AND COMMENTS
FROM	TO			
2.0	3.5	S-1 / 1.3'	SAND, brown, gravel, medium dense, moist	6-6-6
4.5	6.0	S-2 / 1.4'	SAND, brown, gravel, medium dense, moist	5-8-9
7.0	8.5	S-3 / 1.4'	SAND, silty, brown, gravel, very dense, damp	15-22-32
9.5	11.0	S-4 / 1.4'	SAND, silty, brown, gravel, very dense, moist	15-26-31
12.0	13.5	S-5 / 1.2'	SAND, clayey, silty, brown, gravel, medium dense, damp-moist	12-15-15
14.5	14.7	ST-1 / 0.2'	SAND, clayey, silty, brown, gravel, moist	
17.0	18.5	S-6 / 1.3'	CLAY, sandy, silty, brown mottled black, gravel, medium dense – very stiff (qu = 2.5tsf), moist	6-5-10
19.5	19.5	S-7 / 0.0'		NO RECOVERY
22.0	23.5	S-8 / 1.0'	SAND, brown, gravel, medium dense, damp (estimated original ground)	4-5-6
24.5	26.0	2-9 / 1.1'	SAND, brown, gravel, loose, damp – distinct 0.2' black, sandy layer at top of sample	4-5-4
29.0	30.5	S-10 / 1.2'	SAND, brown, clean, loose, damp	1-4-3
34.5	36.5	ST-2 / 1.7'	SAND, brown, light brown, damp	

Geo/Environmental Associates, Inc.

Project Name/ Job Number: **09-379**

Boring/Well Log No.: **B-2**

DEPTH (FEET)		SAMPLE NO., SAMPLE INTERVAL & SPLIT SPOON RECOVERY	SOIL/BEDROCK DESCRIPTION	BLOW COUNTS AND COMMENTS
FROM	TO			
44.5	46.0	S-12 / 1.4'	SAND, brown, clean, loose, damp	3-3-4
49.5	51.0	S-13 / 1.5'	SAND, brown, clean, loose, moist – transition at 0.7' to clay, sandy, brown, firm (qu=1.0tsf), wet	3-2-2

TRANSITION FROM DIKE TO ORIGINAL AT APPROXIMATELY 24.5
SET PIPE AT 31.0'

51.0	to	35.0	SAND CUTTINGS
35.0	to	32.0	BENTONITE
32.0	to	31.0	SAND
31.0	to	20.8	SCREEN
20.8	to	0.3	RISER
32.0	to	14.5	SAND
19.5	to	16.5	BENTONITE
16.5	to	3.0	GROUT
3.0	to	0.0	CONCRETE WITH MAN HOLE

W/L DRY @ 50.0'

Geo/Environmental Associates, Inc.

Boring No. B-3

PROJECT: AEP Mitchell BAP | **PROJECT NO: 09-379**

Start Date: 3-3-09	Drilling Contractor: Horn and Associates
Finish Date: 3-5-09	Driller: Tom Leininger
Logged By: Seth Frank	Helper: Jared and Bradley
Location: N 485238.72 E1598811.08 NAD83	Drill Type: Dietrick D50
Ground Elevation: 691.80' NAVD88	
Notes: Set piezometer to tip depth of 31.0'	Thickness of Soil:
W/L at 23.3' below top of pipe on 3-5-09	Depth Drilled In Rock:
Casing Elevation: 691.85' NAVD88	Total Depth of Boring: 51.0'
Piezometer Elevation: 691.54' NAVD88	

DEPTH (FEET)		SAMPLE NOS., & SPLIT SPOON RECOVERY	SOIL/BEDROCK DESCRIPTION	BLOW COUNTS AND COMMENTS
FROM	TO			
2.0	3.5	S-1 / 1.2'	SAND, brown, gravel, very dense, damp	12-27-39
4.5	6.0	S-2 / 1.3'	SAND, brown, gravel, very dense, damp	14-29-30
7.0	8.5	S-3 / 1.4'	SAND, brown, gravel, dense, moist	18-23-26
9.5	9.9	ST-1 / 0.4'	SAND, brown, gravel, moist	
12.0	13.5	S-4 / 1.0'	SAND, dark brown, gravel, very dense, moist	17-29-38
14.5	16.0	S-5 / 1.1'	SAND, brown mottled grey, gravel, dense, moist	8-14-23
17.0	18.5	S-6 / 1.5'	SAND , clayey, silty, brown mottled black and grey, gravel, medium dense, moist	9-9-10
19.5	21.0	S-7 / 1.4'	SAND - gravely , brown mottled grey, medium dense, damp-moist	21-21-23
22.0	23.5	S-8 / 1.4'	SAND, brown & black, gravel, dense, moist	15-21-20
24.5	26.0	S-9 / 1.3'	SAND brown mottled black, very dense, wet	15-24-23
27.0	28.5	S-10 / 1.3'	SAND, brown, gravel, dense, very wet	8-13-23

Geo/Environmental Associates, Inc.

Project Name/ Job Number: 09-379

Boring/Well Log No.: B-3

DEPTH (FEET)		SAMPLE NO., SAMPLE INTERVAL & SPLIT SPOON RECOVERY	SOIL/BEDROCK DESCRIPTION	BLOW COUNTS AND COMMENTS
FROM	TO			
29.5	31.0	S-11 / 1.1'	SAND, silty, clayey, brown, medium dense - very stiff (qu = 3.25tsf), moist	12-15-35
32.0	33.5	S-12 / 0.2'	SAND, silty, clayey, brown, very dense, wet **split spoon blocked by rock*	19-29-29
34.5	35.5	ST-2 / 1.0'	CLAY, silty, sandy, brown, gravel, wet	
39.5	41.0	S-13 / 1.1'	SAND, brown, gravel, medium dense, wet	4-6-7
45.0	46.5	S-14 / 1.2'	SAND, brown, gravel, medium dense, wet	3-4-7
49.5	51.0	S-15 / 1.0'	SAND, brown, medium dense, wet	3-6-8

TRANSITION FROM DIKE TO ORIGINAL AT
APPROXIMATELY 29.5 - 30'
SET PIPE AT 31'

51.0	to	35.0	SAND CUTTINGS
35.0	to	32.0	BENTONITE
32.0	to	31.0	SAND
31.0	to	20.8	SCREEN
20.8	to	0.2	RISER
32.0	to	19.5	SAND
19.5	to	16.5	BENTONITE
16.5	to	3.0	GROUT
3.0	to	0.0	CONCRETE WITH MAN HOLE

Geo/Environmental Associates, Inc.

Boring No. B-4

Page 1 Of 2

PROJECT: AEP Mitchell BAP	**PROJECT NO: 09-379**
Start Date: 3-2-09	Drilling Contractor: Horn and Associates
Finish Date: 3-3-09	Driller: Tom Leininger
Logged By: Seth Frank & Robby Reynolds	Helper: Jared and Bradley
Location: N 484958.8 E 1599000.96 NAD83	Drill Type: Dietrick D50
Ground Elevation: 692.17' NAVD88	
Notes: Set piezometer to tip depth of 30.0'	Thickness of Soil:
W/L at 24.6' below top of pipe on 3/5/09	Depth Drilled In Rock:
Piezometer Elevation: 691.91' NAVD88	Total Depth of Boring: 51.0'
Casing Elevation: 692.20' NAVD88	

DEPTH (FEET)		SAMPLE NOS., & SPLIT SPOON RECOVERY	SOIL/BEDROCK DESCRIPTION	BLOW COUNTS AND COMMENTS
FROM	TO			
2.0	3.5	S-1	SAND, brown, gravel, very dense, damp	25-41-26
4.5	6.0	S-2	SAND, brown, gravel, dense, damp	12-17-23
7.0	8.5	S-3	SAND, brown, gravel, very dense, damp	19-28-30
9.5	10.0	ST-1 / 0.5'	SAND, clayey, silty, brown, gravel, damp	
12.0	13.5	S-4	SAND, silty, black / brown, gravel, dense, damp	12-17-23
14.5	16.0	S-5	SAND, black / brown, gravel, dense, damp	12-20-21
17.0	18.5	S-6	SAND, clayey, silty, brown / black, gravel, dense, damp	11-12-19
19.5	21.0	S-7	SAND, gravely , brown mottled grey, medium dense, damp-moist	8-13-13
22.0	23.5	S-8	SAND, silty, clayey, dark brown / black, dense, moist	8-13-20
24.5	26.0	S-9	SAND, gravely, brown, medium dense, moist - wet	19-17-13
27.0	28.5	S-10	SAND, brown, gravel, dense, very wet	17-24-20

Geo/Environmental Associates, Inc.

Project Name/ Job Number: 09-379

Boring/Well Log No.: B-4

DEPTH (FEET)		SAMPLE NO., SAMPLE INTERVAL & SPLIT SPOON RECOVERY	SOIL/BEDROCK DESCRIPTION	BLOW COUNTS AND COMMENTS
FROM	TO			
29.5	31.0	S-11	SAND, silty, clayey, black / dark brown, organic matter, medium dense, moist (qu = 3.25tsf)	8-11-14
34.5	36.5	ST-2 / 1.7'	SAND, brown, wet	
39.5	41.0	S-12	SAND, brown, loose, wet	2-3-4
45.0	46.5	S-13	SAND, brown, medium, wet	3-4-6
49.5	51.0	S-14	SAND, brown, medium, wet	3-6-7

TRANSITION FROM DIKE TO ORIGINAL AT APPROXIMATELY 24.5'
SET PIPE AT 30.0'

51.0	to	34.0	SAND CUTTINGS
34.0	to	31.0	BENTONITE
31.0	to	30.0	SAND
30.0	to	19.8	SCREEN
19.8	to	0.2	RISER
31.0	to	18.0	SAND
18.0	to	15.0	BENTONITE
15.0	to	3.0	GROUT
3.0	to	0.0	CONCRETE WITH MAN HOLE

Geo/Environmental Associates, Inc.

Boring No. B-5

PROJECT: AEP Mitchell BAP	**PROJECT NO: 09-379**
Start Date: 3-2-09	Drilling Contractor: Horn and Associates
Finish Date: 3-3-09	Driller: Tom Leininger
Logged By: Seth Frank & Robby Reynolds	Helper: Jared and Bradley
Location: N 484664.32 E 1598966.05 NAD83	Drill Type: Dietrick D50
Ground Elevation: 674.82' NAVD88	
Notes: Set piezometer to tip depth of 17.0'	Thickness of Soil:
Well dry at 17.0' on 3-5-09	Depth Drilled In Rock:
Piezometer Elevation: 674.43' NAVD88	Total Depth of Boring: 36.0'
Casing Elevation: 674.86' NAVD88	

DEPTH (FEET)		SAMPLE NOS., & SPLIT SPOON RECOVERY	SOIL/BEDROCK DESCRIPTION	BLOW COUNTS AND COMMENTS
FROM	TO			
2.0	3.5	S-1	SAND, silty, brown, slightly gravely, medium, dense, damp	7-10-9
4.5	6.0	S-2	SAND, silty, grey to brown, slightly gravely medium dense, damp	3-5-7
7.0	8.5	S-3	SAND, silty, brown, slightly gravely, loose, damp	4-4-3
9.5	11.0	S-4	SAND, silty, brown, dark brown, gravel, loose damp	1-2-2
12.0	13.5	S-5	Transition: SAND, black, slightly gravely, damp To SAND clayey silty, dark brown, gravel, dense, damp	12-26-3
14.5	16.0	S-6	SAND, clayey, silty, brown, river rock, dense, damp	12-15-22
17.0	18.5	S-7	SILT, clayey, brown, very stiff, damp (qu=5tsf)	7-12-13
19.5	20.5	ST-1 / 0.8'	SAND, clayey, silty, brown, gravel, damp	
24.5	26.0	S-8	SAND, clayey, silty, dark brown, gravel, loose, damp	3-4-5

Geo/Environmental Associates, Inc.

Project Name/ Job Number: **09-379**

Boring/Well Log No.: **B-5**

DEPTH (FEET)		SAMPLE NO., SAMPLE INTERVAL & SPLIT SPOON RECOVERY	SOIL/BEDROCK DESCRIPTION	BLOW COUNTS AND COMMENTS
FROM	TO			
29.5	31.0	S-9	SAND, dark brown, gravel, medium dense, damp	4-5-7
34.5	36.0	S-10	SAND, gravely, light brown, medium dense, damp	6-9-9

TRANSITION FROM DIKE TO ORIGINAL AT
APPROXIMATELY 12.0'
SET PIPE AT 17.0'

36.0	to	21.0	SAND CUTTINGS
21.0	to	18.0	BENTONITE
18.0	to	17.0	SAND
17.0	to	7.0	SCREEN
7.0	to	0.6	RISER
18.0	to	5.0	SAND
5.0	to	2.5	BENTONITE
2.5	to	0.0	CONCRETE WITH MAN HOLE

W/L DRY @ 36.0'

Geo/Environmental Associates, Inc.

Job: Mitchell Plant Bottom Ash Complex
Title: SPT Correction
Performed By: BTK
G.A. Job Number: 15055013
Date: October 29, 2015

Unit Weights: Overburden= 124 pcf

Boring	Sample No	Depth	Uncorrected N	Depth to Water (ft)	Thickness of Moist Soil (ft)	Thickness of Sat Soil (ft)	Effective Stress (psf)	N Correction	Corrected N	
B-1 (Embankment)	1	3.5	41	25	3.5	0.0	434	1.70	50+	
B-1 (Embankment)	2	6	56	25	6.0	0.0	744	1.68	50+	
B-1 (Embankment)	3	8.5	26	25	8.5	0.0	1,054	1.41	36.6	
									Median=	50+
B-1 (Natural Soil))	4	13.5	39	25	13.5	0.0	1,674	1.12	43.6	
B-1 (Natural Soil))	5	16	25	25	16.0	0.0	1,984	1.03	25.7	
B-1 (Natural Soil))	6	18.5	19	25	18.5	0.0	2,294	0.95	18.1	
B-1 (Natural Soil))	7	20.5	12	25	20.5	0.0	2,542	0.91	10.9	
B-1 (Natural Soil))	8	23.5	11	25	23.5	0.0	2,914	0.85	9.3	
B-1 (Natural Soil))	9	26	11	25	25.0	1.0	3,162	0.81	8.9	
B-1 (Natural Soil))	10	31.5	3	25	25.0	6.5	3,500	0.77	2.3	
B-1 (Natural Soil))	11	36.5	7	25	25.0	11.5	3,808	0.74	5.2	
B-1 (Natural Soil))	12	46	8	25	25.0	21.0	4,394	0.69	5.5	
B-1 (Natural Soil))	13	51	10	25	25.0	26.0	4,702	0.67	6.7	
									Median=	9.1
B-2 (Embankment)	1	3.5	12	50	3.5	0.0	434	1.70	20.4	
B-2 (Embankment)	2	6	17	50	6.0	0.0	744	1.68	28.5	
B-2 (Embankment)	3	8.5	54	50	8.5	0.0	1,054	1.41	50+	
B-2 (Embankment)	4	11	57	50	11.0	0.0	1,364	1.24	50+	
B-2 (Embankment)	5	13.5	30	50	13.5	0.0	1,674	1.12	33.5	
B-2 (Embankment)	6	18.5	15	50	18.5	0.0	2,294	0.95	14.3	
									Median=	31.0
B-2 (Natural Soil)	8	23.5	11	50	23.5	0.0	2,914	0.85	9.3	
B-2 (Natural Soil)	9	26	9	50	26.0	0.0	3,224	0.81	7.2	
B-2 (Natural Soil)	10	30.5	7	50	30.5	0.0	3,782	0.74	5.2	
B-2 (Natural Soil)	12	46	7	50	46.0	0.0	5,704	0.61	4.2	
B-2 (Natural Soil)	13	51	4	50	50.0	1.0	6,262	0.58	2.3	
									Median=	5.2
B-3 (Embankment)	1	3.5	66	25	3.5	0.0	434	1.70	50+	
B-3 (Embankment)	2	6	59	25	6.0	0.0	744	1.68	50+	
B-3 (Embankment)	3	8.5	49	25	8.5	0.0	1,054	1.41	50+	
B-3 (Embankment)	4	13.5	67	25	13.5	0.0	1,674	1.12	50+	
B-3 (Embankment)	5	16	37	25	16.0	0.0	1,984	1.03	38.0	
B-3 (Embankment)	6	18.5	19	25	18.5	0.0	2,294	0.95	18.1	
B-3 (Embankment)	7	21	44	25	21.0	0.0	2,604	0.90	39.4	
B-3 (Embankment)	8	23.5	41	25	23.5	0.0	2,914	0.85	34.7	
B-3 (Embankment)	9	26	47	25	25.0	1.0	3,162	0.81	38.2	
B-3 (Embankment)	10	28.5	36	25	25.0	3.5	3,316	0.79	28.6	
B-3 (Embankment)	11	31	50	25	25.0	6.0	3,470	0.78	38.8	
B-3 (Embankment)	12	33.5	58	25	25.0	8.5	3,624	0.76	44.0	
									Median=	39.1
B-3 (Natural Soil)	13	41	13	25	25.0	16.0	4,086	0.72	9.3	
B-3 (Natural Soil)	14	46.5	11	25	25.0	21.5	4,424	0.69	7.6	
B-3 (Natural Soil)	15	51	14	25	25.0	26.0	4,702	0.67	9.3	
									Median=	9.3
B-4 (Embankment)	1	3.5	67	25	3.5	0.0	434	1.70	50+	
B-4 (Embankment)	2	6	40	25	6.0	0.0	744	1.68	50+	
B-4 (Embankment)	3	8.5	58	25	8.5	0.0	1,054	1.41	50+	
B-4 (Embankment)	4	13.5	40	25	13.5	0.0	1,674	1.12	44.7	
B-4 (Embankment)	5	16	41	25	16.0	0.0	1,984	1.03	42.1	
B-4 (Embankment)	6	18.5	31	25	18.5	0.0	2,294	0.95	29.6	
B-4 (Embankment)	7	21	26	25	21.0	0.0	2,604	0.90	23.3	
B-4 (Embankment)	8	23.5	33	25	23.5	0.0	2,914	0.85	27.9	
B-4 (Embankment)	9	26	30	25	25.0	1.0	3,162	0.81	24.4	
									Median=	42.1
B-4 (Natural Soil)	10	28.5	44	25	25.0	3.5	3,316	0.79	34.9	
B-4 (Natural Soil)	11	31	25	25	25.0	6.0	3,470	0.78	19.4	
B-4 (Natural Soil)	12	41	7	25	25.0	16.0	4,086	0.72	5.0	
B-4 (Natural Soil)	13	46.5	10	25	25.0	21.5	4,424	0.69	6.9	
B-4 (Natural Soil)	14	51	13	25	25.0	26.0	4,702	0.67	8.7	
									Median=	8.7
B-5 (Embankment)	1	3.5	19	50	3.5	0.0	434	1.70	32.3	
B-5 (Embankment)	2	6	12	50	6.0	0.0	744	1.68	20.1	
B-5 (Embankment)	3	8.5	7	50	8.5	0.0	1,054	1.41	9.9	
B-5 (Embankment)	4	11	4	50	11.0	0.0	1,364	1.24	5.0	
									Median=	15.0
B-5 (Natural Soil)	5	13.5	29	50	13.5	0.0	1,674	1.12	32.4	
B-5 (Natural Soil)	6	16	37	50	16.0	0.0	1,984	1.03	38.0	
B-5 (Natural Soil)	7	18.5	25	50	18.5	0.0	2,294	0.95	23.9	
B-5 (Natural Soil)	8	26	9	50	26.0	0.0	3,224	0.81	7.2	
B-5 (Natural Soil)	9	31	12	50	31.0	0.0	3,844	0.74	8.8	
B-5 (Natural Soil)	10	36	18	50	36.0	0.0	4,464	0.68	12.3	
									Median=	18.1

SUMMARY OF LABORATORY TEST RESULTS

							ATTERBERG LIMITS				Project: Mitchell Bottom Ash Pond Project Number: 09-379 Date: March 18, 2009
Boring	Sample No.	Sample Type*	Depth (ft)	Natural Moisture	Dry Density	Specific Gravity	Liquid Limit	Plasticity Index	USCS	Other Test	Soil Description
B-1	S-3	SS	7.0-8.5	11.0	--	2.68	19	7	SC-SM	S	Sand, clayey, silty, brown, black, gray w/rock
B-1	S-11	SS	35.0-36.5	15.2	--	2.74	12	np	SW-SM	S	Sand, silty, black w/rock
B-2	S-5	SS	12.0-13.5	5.7	--	2.67	15	5	SP-SC	S	Sand, clayey, silty, brown, dark brown w/rock
B-2	S-10	SS	29.0-30.5	5.4	--	2.71	--	np	SP-SM	S	Sand, brown
B-2	ST-2	ST	34.5-36.5	8.7	105.5	2.70	--	np	SM	K,S,T	Sand, brown, light brown (Sand Foundation)
B-3	S-6	SS	17.0-18.5	9.2	--	2.71	17	5	SC-SM	S	Sand, clayey, silty, dark brown, brown w/rock
B-3	S-11	SS	29.5-31.0	13.0	--	2.65	17	5	SC-SM	S	Sand, clayey, silty, black, brown, w/rock &
B-3	ST-2	ST	34.5-35.5	18.5	112.1	2.62	26	9	CL	K,S,U	Clay, silty, sandy, brown w/rock
B-4	S-4	SS	12.0-13.5	7.9	--	2.69	--	np	SM	S	Sand, silty, brown, dark brown w/rock
B-4	S-12	SS	39.5-41.0	5.2	--	2.71	--	np	SP	S	Sand, brown
B-1,B-3,B-4	ST-1	ST	9.5-10.0	9.3	114.5	2.68	16	4	SC-SM	K,S,T	Sand, clayey, silty, brown w/rock
B-5	S-3	SS	7.0-8.5	7.9	--	2.70	12	np	SM	S	Sand, silty, dark brown w/rock
B-5	S-8	SS	24.5-26.0	7.8	--	2.66	16	4	SP-SC	S	Sand, clayey, silty, brown w/rock
na	B	B	na	3.6	--	2.26	--	np	SP	S	Bottom Ash

*ST-SHELBY TUBE SAMPLE, SS-SPLIT SPOON SAMPLE, B-BAG SAMPLE, J-JAR SAMPLE

**TEST RESULTS REPORTED ON OTHER SHEETS:

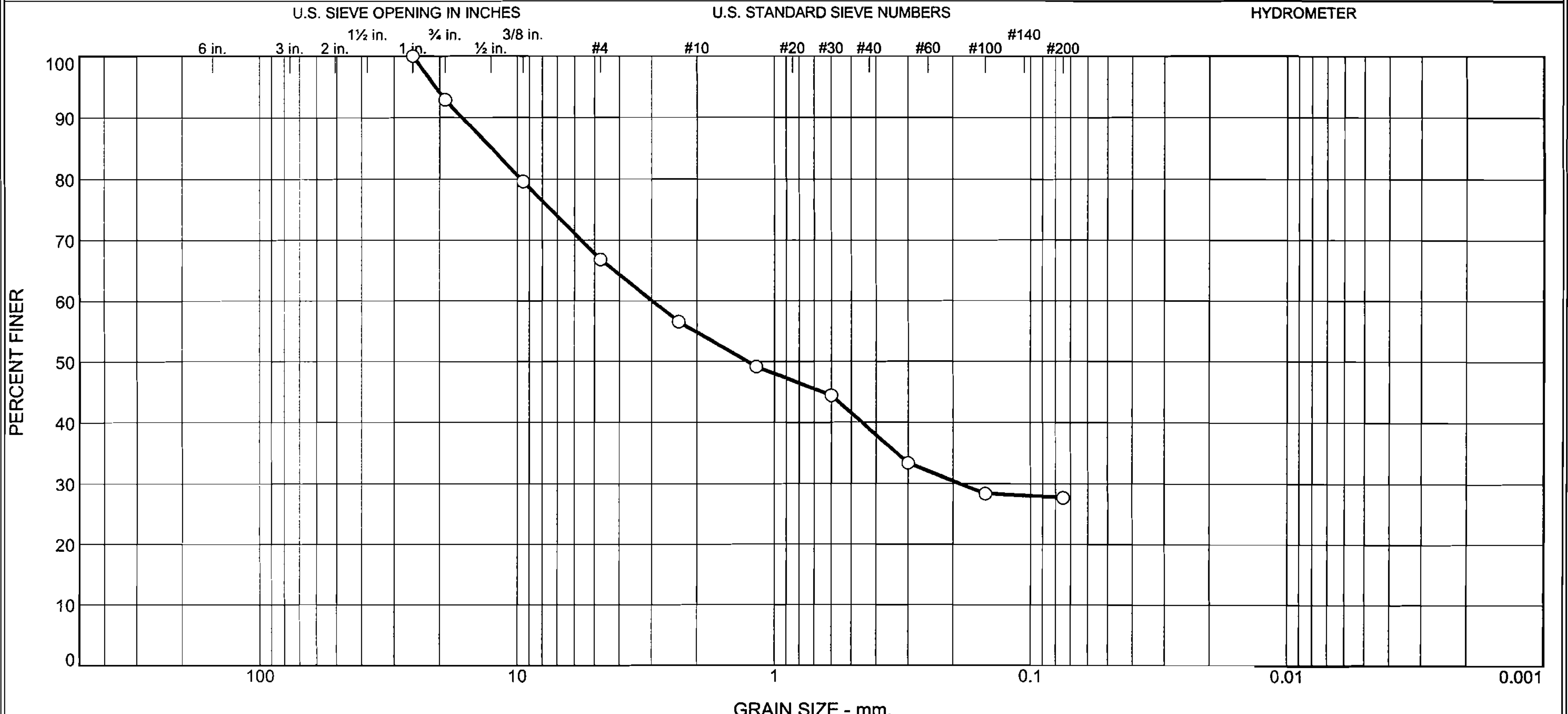
T-TRIAXIAL
S-SIEVE OR GRAIN SIZE ANALYSIS
U-UNCONFINED COMPRESSION

P-PROCTOR TEST
K-PERMEABILITY
C-CONSOLIDATION

Geo/Environmental Associates

DATA CHECKED BY ___________

Particle Size Distribution Report



	% +3"	% Gravel Coarse	% Gravel Fine	% Sand Coarse	% Sand Medium	% Sand Fine	% Fines Silt	% Fines Clay
○	0.0	7.2	26.0	12.1	15.8	11.3	27.6	

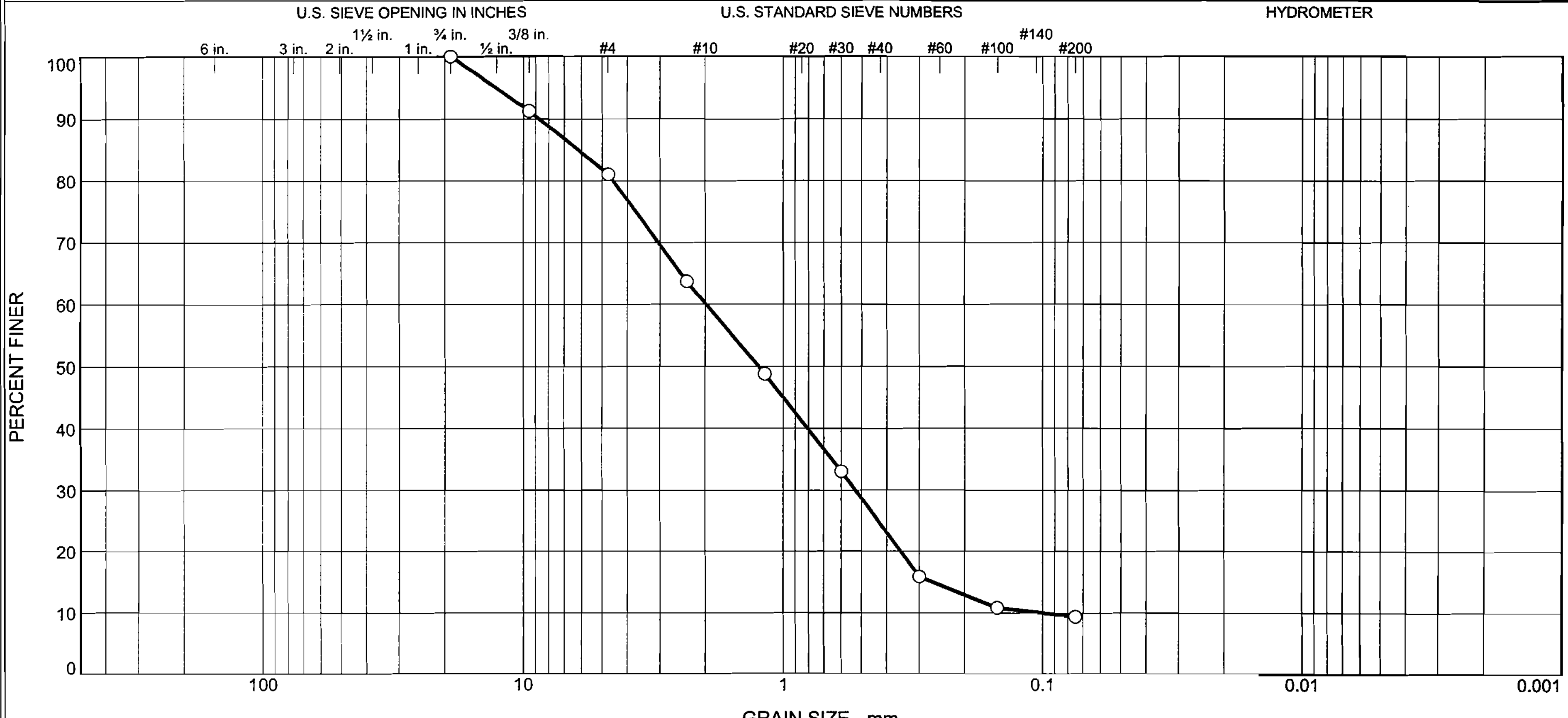
	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○		B-1 S-3	7.0'-8.5'		SC-SM	Sand, clayey, silty, brown, black, gray w/rock	11.0	19	12

Client American Electric Power
Project Mitchell Bottom Ash Pond

Project No. 09-379 Figure

Geo/Environmental Associates, Inc.
Knoxville, Tennessee

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	19.0	20.9	35.6	15.1	9.4	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○		B-1 S-11	35.0'-36.5'		SW-SM	Sand, silty, black w/rock	15.2	12	np

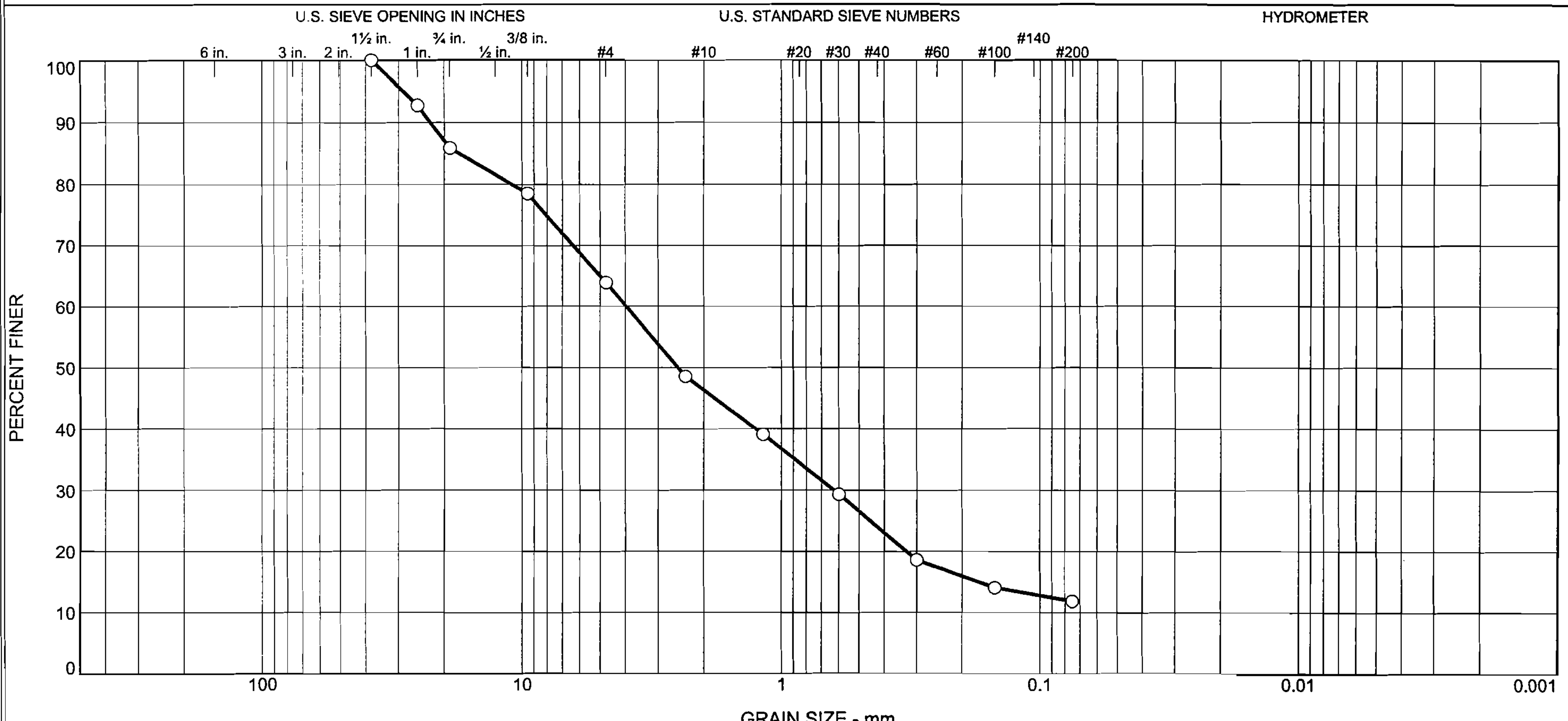
Client American Electric Power

Project Mitchell Bottom Ash Pond

Project No. 09-379 Figure

Geo/Environmental Associates, Inc.
Knoxville, Tennessee

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	14.2	21.9	17.7	22.2	12.2	11.8	

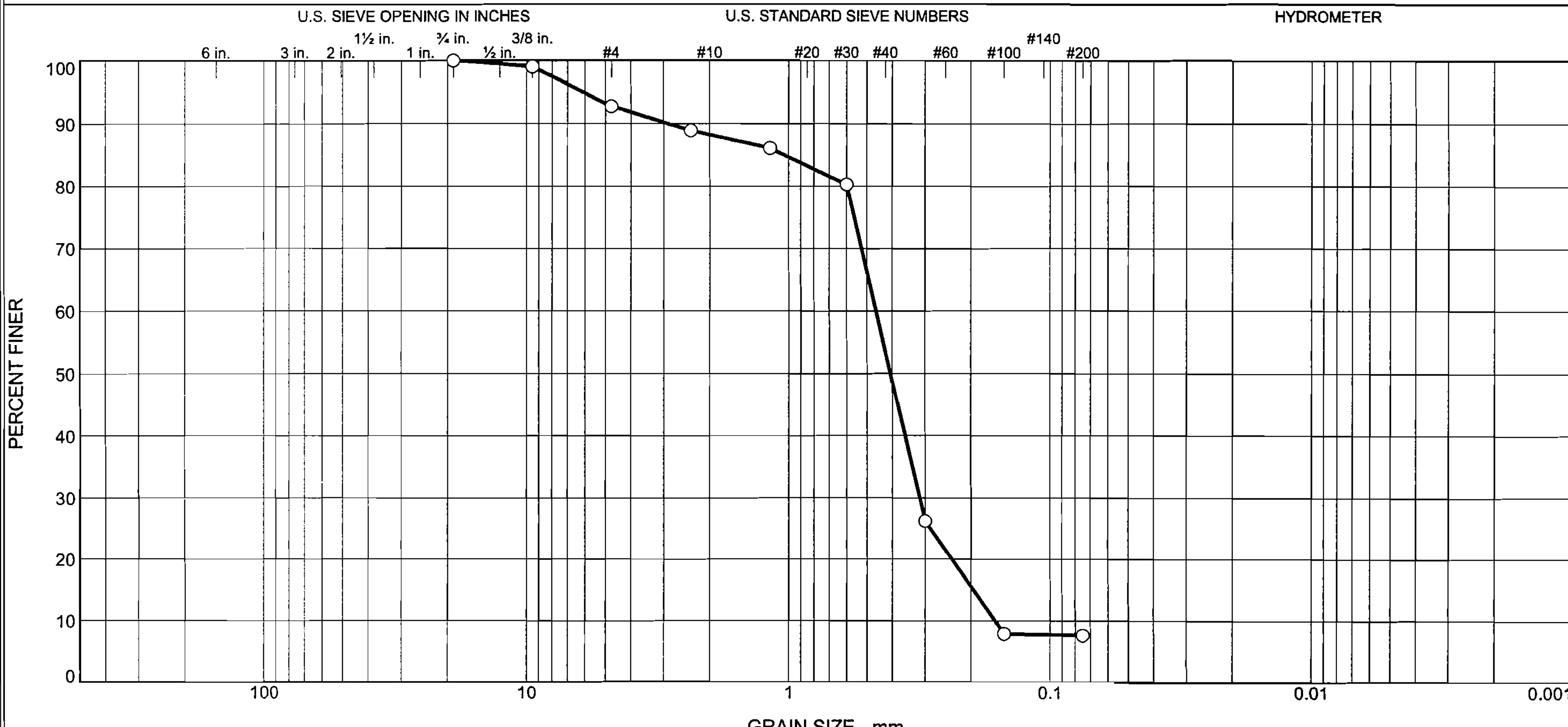
	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○		B-2 S-5	12.0'-13.5'		SP-SC	Sand, clayey, silty, brown, dark brown w/rock	5.7	15	10

Client American Electric Power
Project Mitchell Bottom Ash Pond

Project No. 09-379 Figure

**Geo/Environmental Associates, Inc.
Knoxville, Tennessee**

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	7.3	4.5	34.9	45.7	7.6	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○		B-2 S-10	29.0'-30.5'		SP-SM	Sand, brown	5.4	nv	np

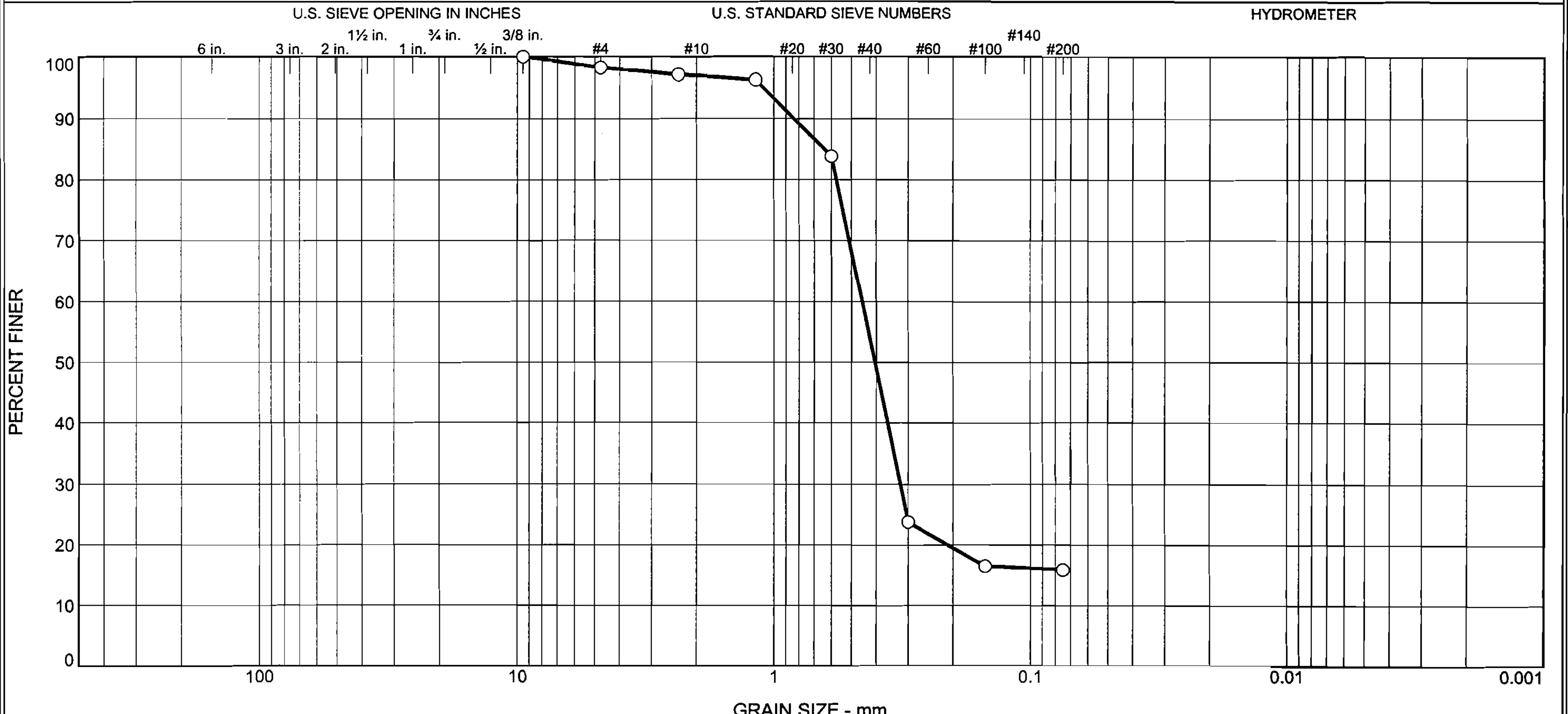
Client American Electric Power

Project Mitchell Bottom Ash Pond

Project No. 09-379 Figure

Geo/Environmental Associates, Inc.
Knoxville, Tennessee

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	1.8	1.3	43.0	38.0	15.9	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○		B-2 ST-2	34.5'-36.5'		SM	Sand, brown, light brown	8.7	nv	np

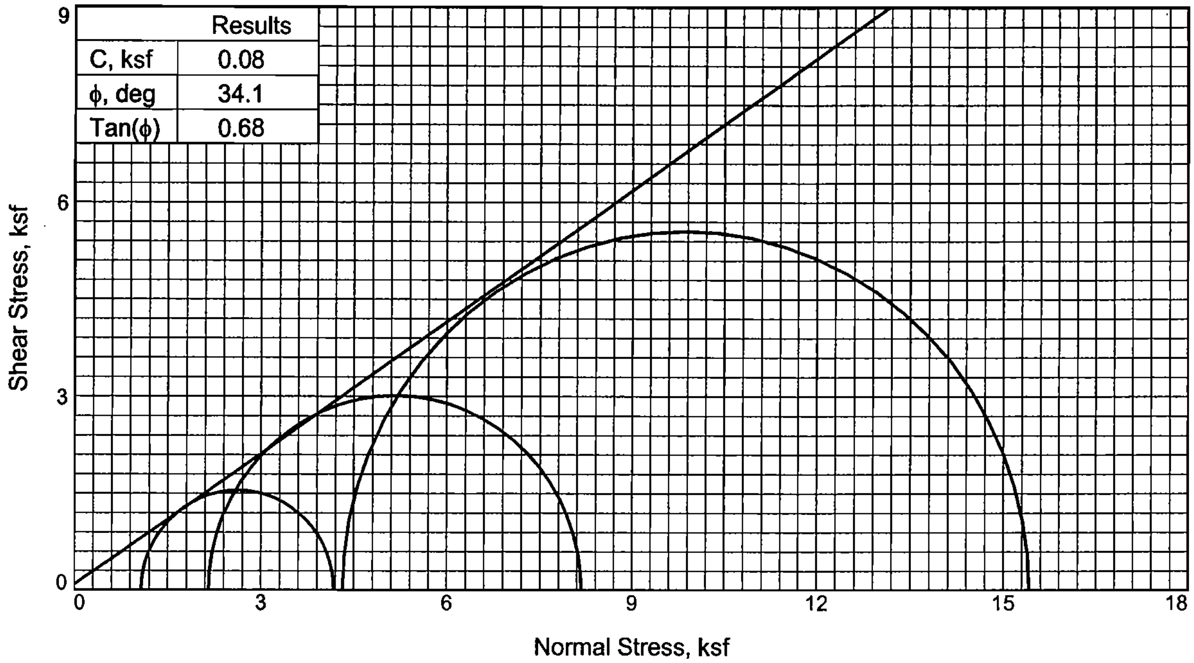
Client American Electric Power

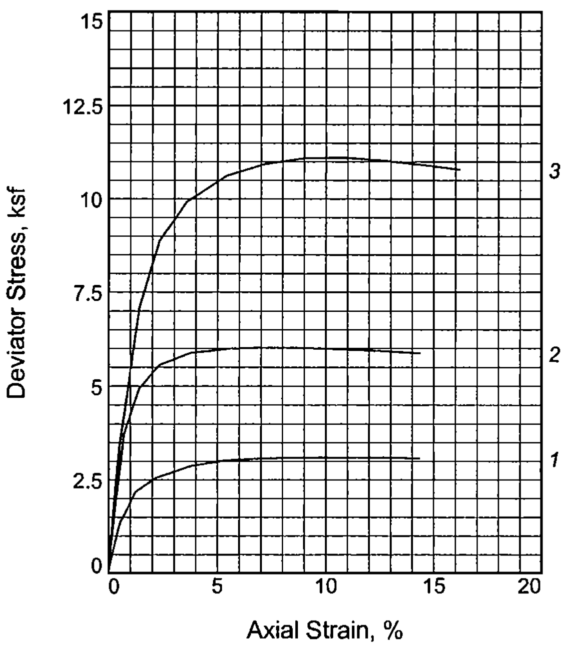
Project Mitchell Bottom Ash Pond

Project No. 09-379 Figure

Geo/Environmental Associates, Inc. Knoxville, Tennessee

○ Sand Foundation Material





Sample No.		1	2	3
Initial	Water Content, %	8.6	9.0	8.7
	Dry Density, pcf	105.3	105.8	105.5
	Saturation, %	38.7	40.9	39.3
	Void Ratio	0.6009	0.5926	0.5976
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.60	5.60	5.60
At Test	Water Content, %	21.6	21.0	20.8
	Dry Density, pcf	106.4	107.6	107.9
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.5838	0.5670	0.5618
	Diameter, in.	2.79	2.78	2.78
	Height, in.	5.58	5.57	5.56
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, psi		0.00	0.00	0.00
Cell Pressure, psi		7.50	15.00	30.00
Fail. Stress, ksf		3.1	6.0	11.1
Ult. Stress, ksf				
σ_1 Failure, ksf		4.2	8.2	15.4
σ_3 Failure, ksf		1.1	2.2	4.3

Type of Test:
Consolidated Drained

Sample Type: Shelby Tube

Description: Sand, brown, light brown

LL= nv **PI=** np

Specific Gravity= 2.70

Remarks:

Client: American Electric Power

Project: Mitchell Bottom Ash Pond

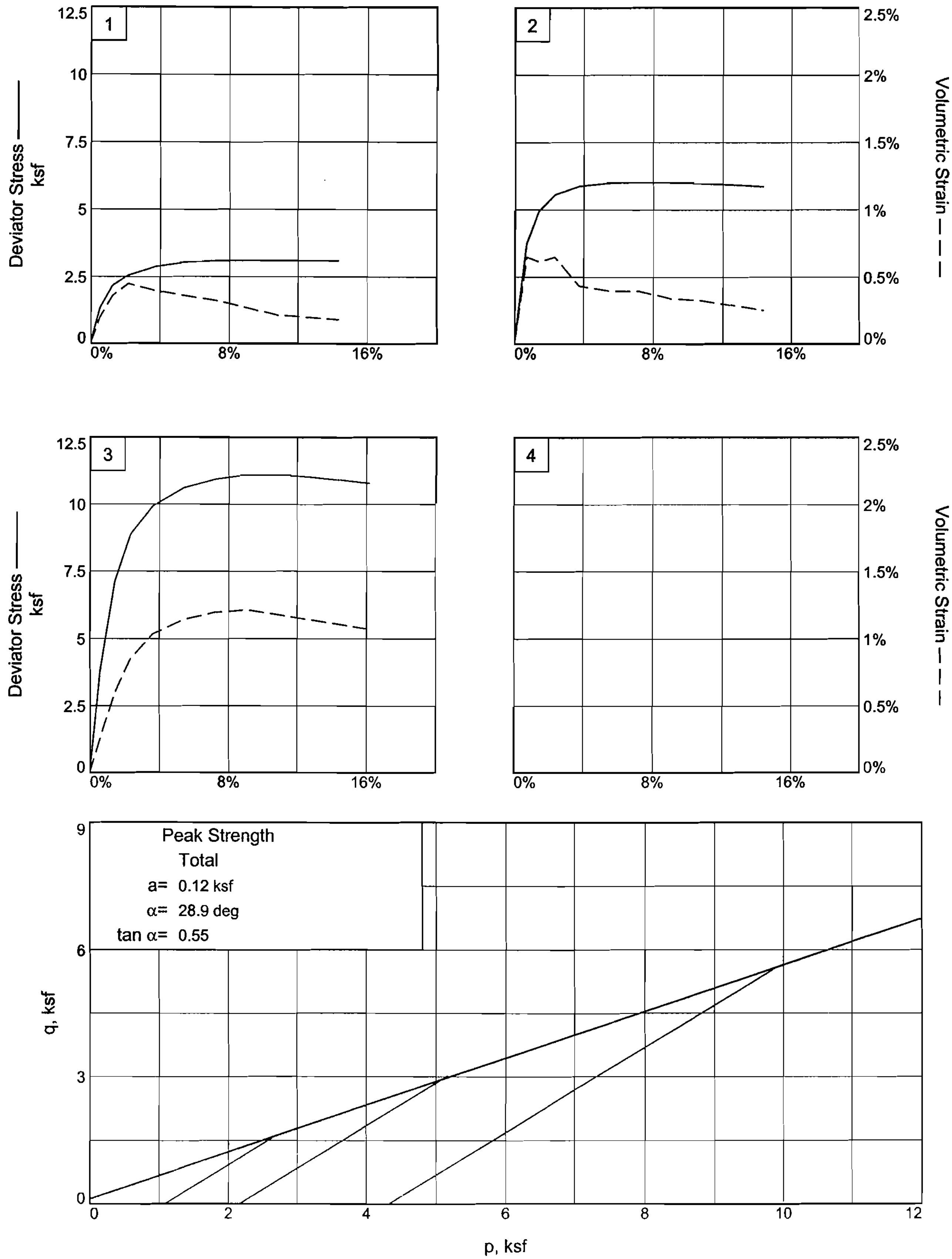
Sample Number: B-2 ST-2 **Depth:** 34.5'-36.5'

Proj. No.: 09-379 **Date Sampled:**

TRIAXIAL SHEAR TEST REPORT

Geo/Environmental Associates, Inc.

Figure 1



Client: American Electric Power
Project: Mitchell Bottom Ash Pond
Depth: 34.5'-36.5' **Sample Number:** B-2 ST-2
Project No.: 09-379 **Figure** 2

Geo/Environmental Associates, Inc.

CONSTANT HEAD PERMEABILITY TESTING
ASTM D5084-90/SW846 Method 9100 Section 2.8

PROJECT NAME : Mitchell Bottom Ash Pond | **PROJECT NUMBER** : 09-379

CLIENT : American Electric Power | **DATE** : March 13, 2009

SAMPLE LOCATION AND CONDITIONS

Sample Id. : B-2 ST-2 | **Depth of Tested Sample** : 34.5'-35.5'

Specimen : 7.5 psi Triaxial Specimen | **Remolded** : Yes

Sample Description : Sand, brown, light brown (Sand Foundation)

INITIAL SPECIMEN PROPERTIES

Length (in.):	5.6	**Volume (ft^3):**	0.0200	**Wet Density (PCF):**	114.3
Diameter (in.):	2.8	**Weight (lbs):**	2.28	**Dry Density (PCF):**	105.3
Area (ft^2):	0.0428	**Moisture (%):**	8.6		

Chamber Pressure (psi):	5	**Change in Pore Pressure (psi):**	2.0
Influent Pressure (psi):	3	**Change in Chamber Pressure (psi):**	2.0
Back Pressure (psi):	0	**"B" Factor:**	1.0

PERMEABILITY CALCULATIONS

k = Hydraulic Conductivity, (cm/sec)

L = Length of Sample, along path of flow, (cm)

Q = Quantity of flow, taken as the average of inflow and outflow, (cm^3)

A = Cross-sectional area of specimen, (cm^2)

t = Interval of time, over which the flow Q occurs, (sec)

h = Difference in hydraulic head across specimen, (cm)

$$k = \frac{QL}{Ath} = \text{cm/sec}$$

$$k = \frac{(700.0)(14.22)}{(39.73)(893)(211.01)}$$

$$= \frac{9,954.00}{7,486,400.58}$$

$$= 1.33 \times 10^{-3} \text{ cm/sec}$$

CONSTANT HEAD PERMEABILITY TESTING
ASTM D5084-90/SW846 Method 9100 Section 2.8

PROJECT NAME : Mitchell Bottom Ash Pond

PROJECT NUMBER : 09-379

CLIENT : American Electric Power

DATE : March 13, 2009

SAMPLE LOCATION AND CONDITIONS

Sample Id. : B-2 ST-2

Depth of Tested Sample : 34.5'-35.5'

Specimen : 15 psi Triaxial Specimen

Remolded : Yes

Sample Description : Sand, brown, light brown (Sand Foundation)

INITIAL SPECIMEN PROPERTIES

Length (in.): 5.6 **Volume (ft^3):** 0.0200 **Wet Density (PCF):** 115.3

Diameter (in.): 2.8 **Weight (lbs):** 2.30 **Dry Density (PCF):** 105.8

Area (ft^2): 0.0428 **Moisture (%):** 9.0

Chamber Pressure (psi): 8

Influent Pressure (psi): 6

Back Pressure (psi): 3

Change in Pore Pressure (psi): 2.0

Change in Chamber Pressure (psi): 2.0

"B" Factor: 1.0

PERMEABILITY CALCULATIONS

k = Hydraulic Conductivity, (cm/sec)

L = Length of Sample, along path of flow, (cm)

Q = Quantity of flow, taken as the average of inflow and outflow, (cm^3)

A = Cross-sectional area of specimen, (cm^2)

t = Interval of time, over which the flow Q occurs, (sec)

h = Difference in hydraulic head across specimen, (cm)

$$k = \frac{QL}{Ath} = \text{cm/sec}$$

$$k = \frac{(700.0)(14.22)}{(39.73)(942)(211.01)}$$

$$= \frac{9,954.00}{7,897,188.52}$$

$$= 1.26 \times 10^{-3} \text{ cm/sec}$$

CONSTANT HEAD PERMEABILITY TESTING
ASTM D5084-90/SW846 Method 9100 Section 2.8

PROJECT NAME : Mitchell Bottom Ash Pond — **PROJECT NUMBER** : 09-379

CLIENT : American Electric Power — **DATE** : March 13, 2009

SAMPLE LOCATION AND CONDITIONS

Sample Id. : B-2 ST-2 — **Depth of Tested Sample** : 34.5'-35.5'

Specimen : 30 psi Triaxial Specimen — **Remolded** : Yes

Sample Description : Sand, brown, light brown (Sand Foundation)

INITIAL SPECIMEN PROPERTIES

Length (in.): 5.6 — **Volume (ft^3):** 0.0200 — **Wet Density (PCF):** 114.7

Diameter (in.): 2.8 — **Weight (lbs):** 2.29 — **Dry Density (PCF):** 105.5

Area (ft^2): 0.0428 — **Moisture (%):** 8.7

Chamber Pressure (psi): 10 — **Change in Pore Pressure (psi):** 5.0

Influent Pressure (psi): 8 — **Change in Chamber Pressure (psi):** 5.0

Back Pressure (psi): 5 — **"B" Factor:** 1.0

PERMEABILITY CALCULATIONS

k = Hydraulic Conductivity, (cm/sec)

L = Length of Sample, along path of flow, (cm)

Q = Quantity of flow, taken as the average of inflow and outflow, (cm^3)

A = Cross-sectional area of specimen, (cm^2)

t = Interval of time, over which the flow Q occurs, (sec)

h = Difference in hydraulic head across specimen, (cm)

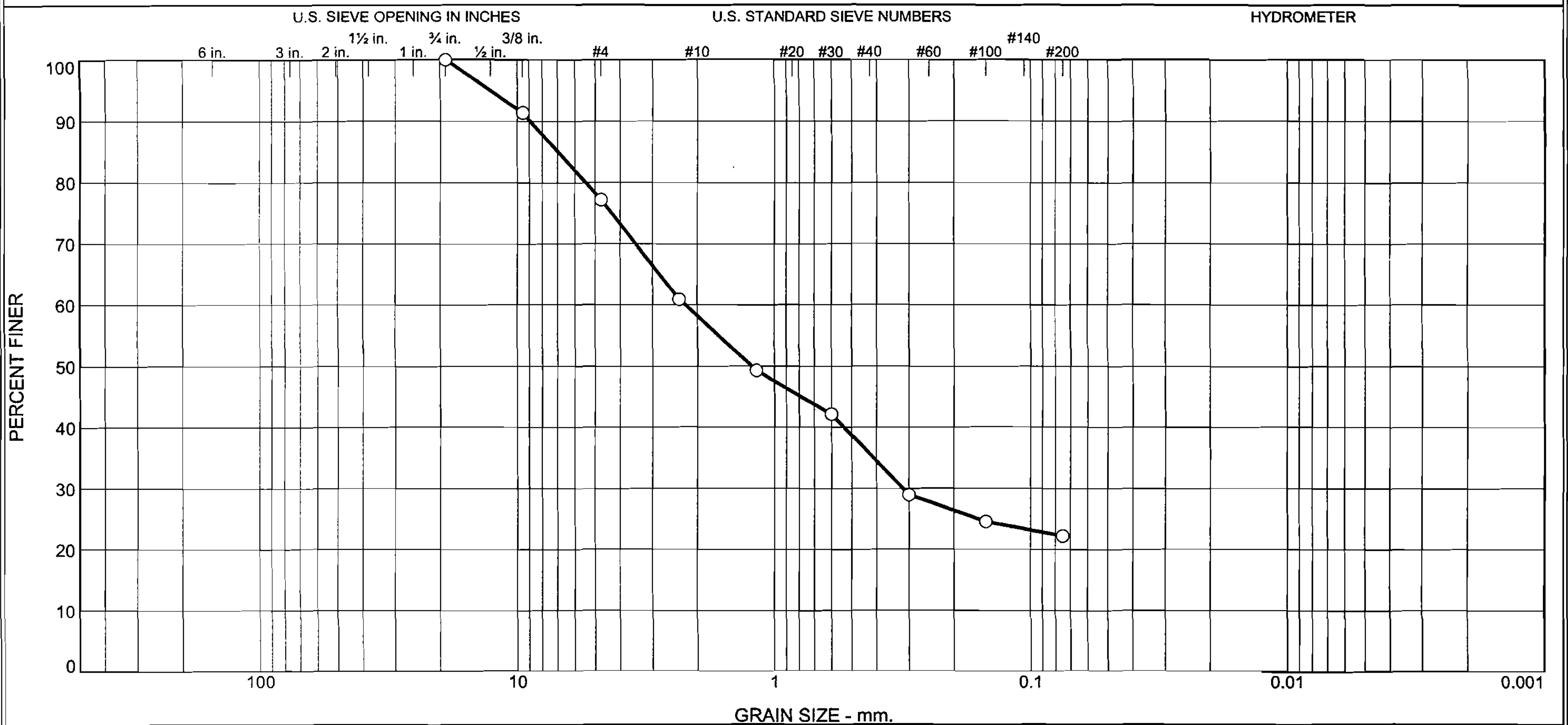
$$k = \frac{QL}{Ath} = \text{cm/sec}$$

$$k = \frac{(700.0)(14.22)}{(39.73)(735)(211.01)}$$

$$= \frac{9{,}954.00}{6{,}161{,}819.07}$$

$$= 1.62 \times 10^{-3} \text{ cm/sec}$$

Particle Size Distribution Report

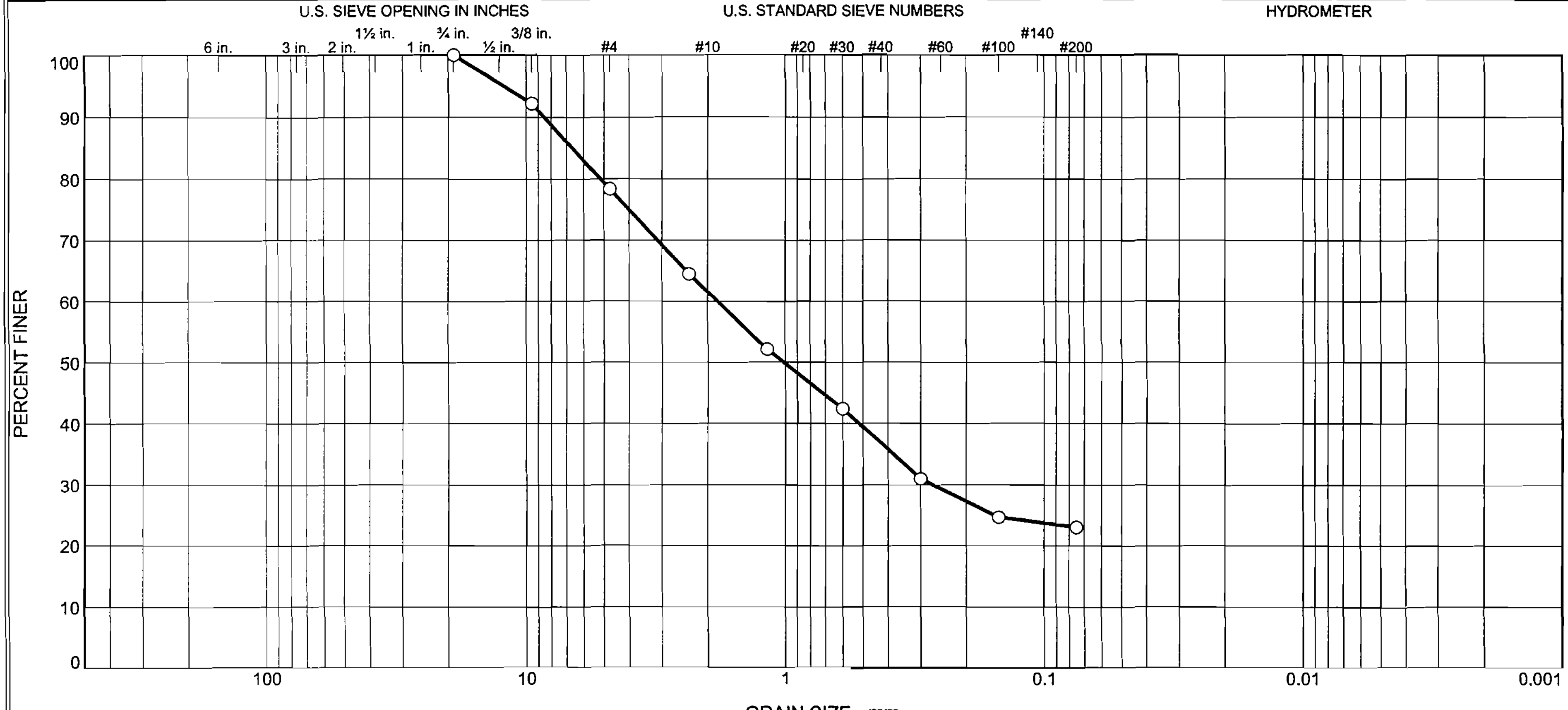


	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	22.8	19.1	22.6	13.3	22.2	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○		B-3 S-6	17.0'-18.5'		SC-SM	Sand, clayey, silty, dark brown, brown w/rock	9.2	17	12

Client American Electric Power	**Geo/Environmental Associates, Inc. Knoxville, Tennessee**
Project Mitchell Bottom Ash Pond	
Project No. 09-379	Figure

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	21.7	16.8	24.8	13.7	23.0	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○		B-3 S-11	29.5'-31.0'		SC-SM	Sand, clayey, silty, black, brown w/rock & cinders	13.0	17	12

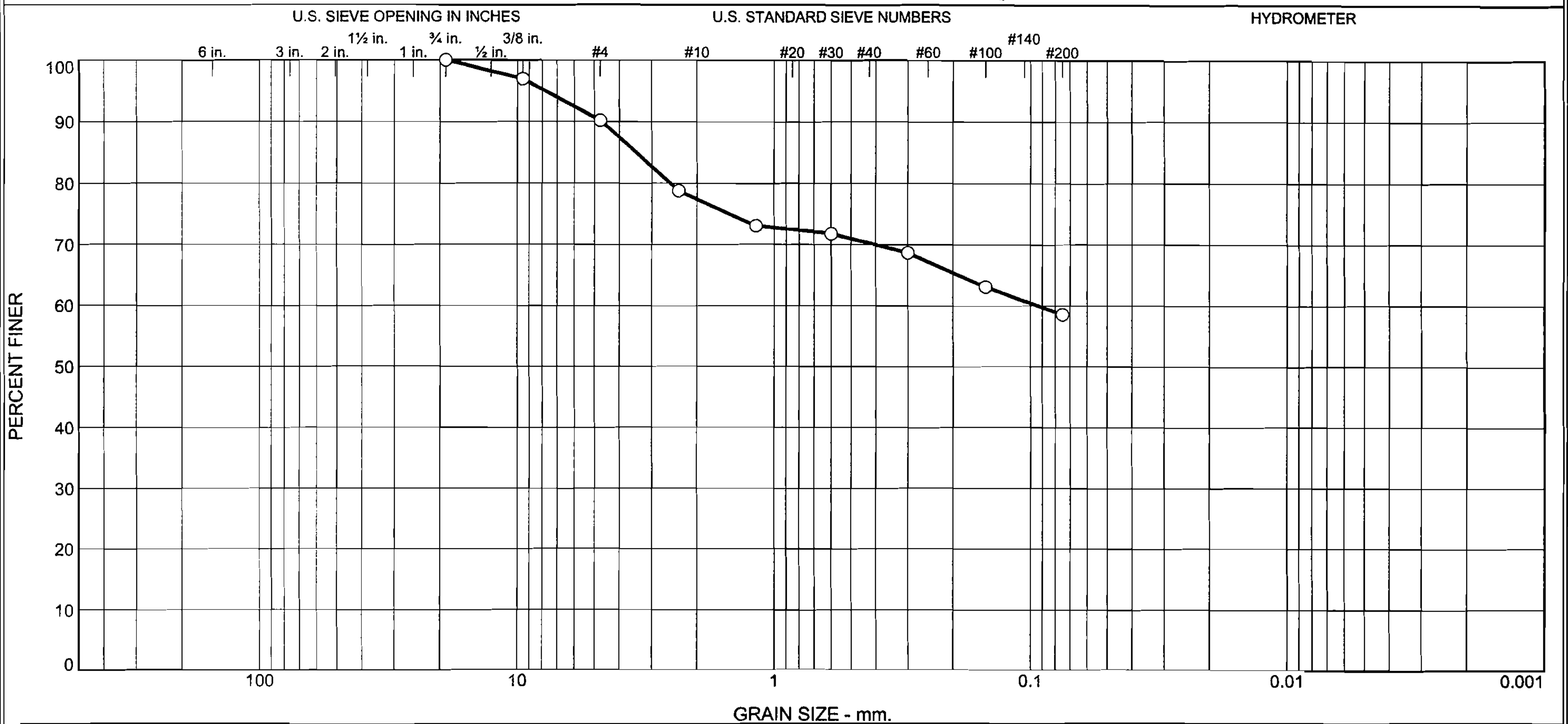
Client American Electric Power

Project Mitchell Bottom Ash Pond

Project No. 09-379 Figure

Geo/Environmental Associates, Inc.
Knoxville, Tennessee

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	9.8	12.8	7.2	11.7	58.5	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○		B-3 ST-2	34.5'-35.5'		CL	Clay, silty, sandy, brown w/rock	18.5	26	17

Client American Electric Power

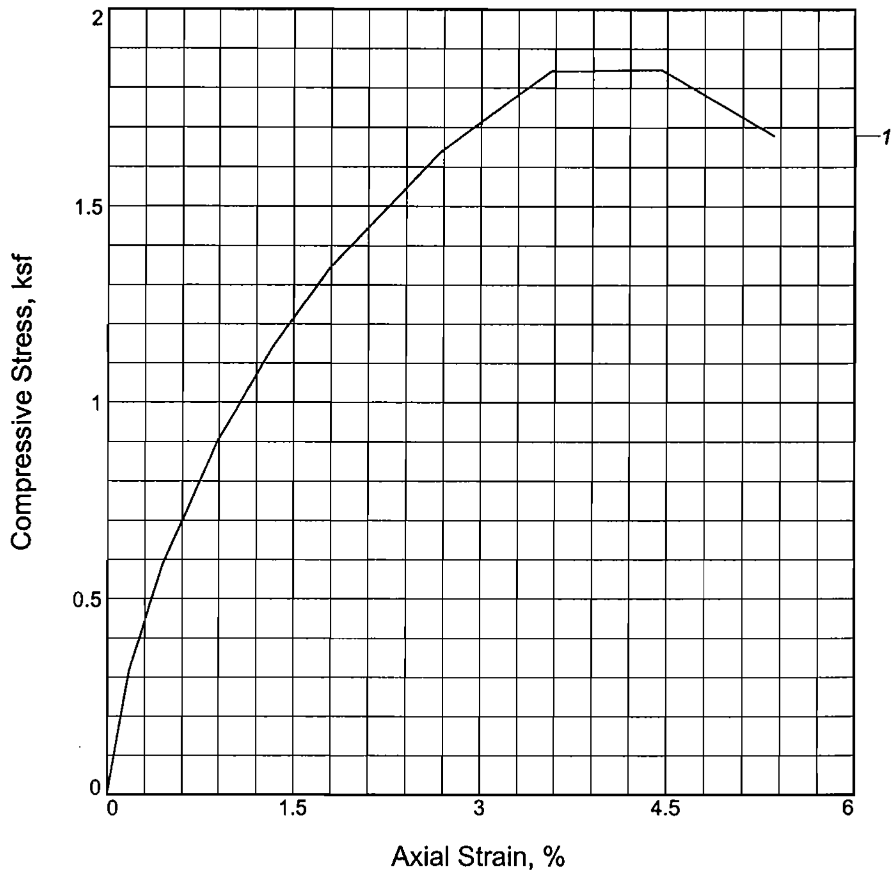
Project Mitchell Bottom Ash Pond

Project No. 09-379

Figure

Geo/Environmental Associates, Inc.
Knoxville, Tennessee

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, ksf	1.85			
Undrained shear strength, ksf	0.92			
Failure strain, %	4.5			
Strain rate, in./min.	0.01			
Water content, %	12.6			
Wet density, pcf	131.2			
Dry density, pcf	116.5			
Saturation, %	82.0			
Void ratio	0.4041			
Specimen diameter, in.	2.84			
Specimen height, in.	5.61			
Height/diameter ratio	1.98			

Description: Clay, silty, sandy, brown w/rock

LL = 26	**PL =** 17	**PI =** 9	**GS=** 2.62	**Type:** Shelby Tube

Project No.: 09-379
Date Sampled:
Remarks:

Figure _______

Client: American Electric Power

Project: Mitchell Bottom Ash Pond

Sample Number: B-3 ST-2 **Depth:** 34.5'-35.5'

UNCONFINED COMPRESSION TEST

Geo/Environmental Associates, Inc.

CONSTANT HEAD PERMEABILITY TESTING
ASTM D5084-90/SW846 Method 9100 Section 2.8

PROJECT NAME : Mitchell Bottom Ash Pond

PROJECT NUMBER : 09-379

CLIENT : American Electric Power

DATE : March 13, 2009

SAMPLE LOCATION AND CONDITIONS

Sample Id. : B-3 ST-2

Depth of Tested Sample : 34.5'-35.5'

Date Tested : 03/10/09

Remolded : no

Sample Description : Clay, silty, sandy, brown w/rock

INITIAL SPECIMEN PROPERTIES

Length (in.): 4.25 **Volume (ft^3):** 0.0159 **Wet Density (PCF):** 132.8

Diameter (in.): 2.87 **Weight (lbs):** 2.11 **Dry Density (PCF):** 112.1

Area (ft^2): 0.0449 **Moisture (%):** 18.5

Chamber Pressure (psi): 20

Influent Pressure (psi): 18

Back Pressure (psi): 15

Change in Pore Pressure (psi): 5.0

Change in Chamber Pressure (psi): 5.0

"B" Factor: 1.0

PERMEABILITY CALCULATIONS

k = Hydraulic Conductivity, (cm/sec)

L = Length of Sample, along path of flow, (cm)

Q = Quantity of flow, taken as the average of inflow and outflow, (cm^3)

A = Cross-sectional area of specimen, (cm^2)

t = Interval of time, over which the flow Q occurs, (sec)

h = Difference in hydraulic head across specimen, (cm)

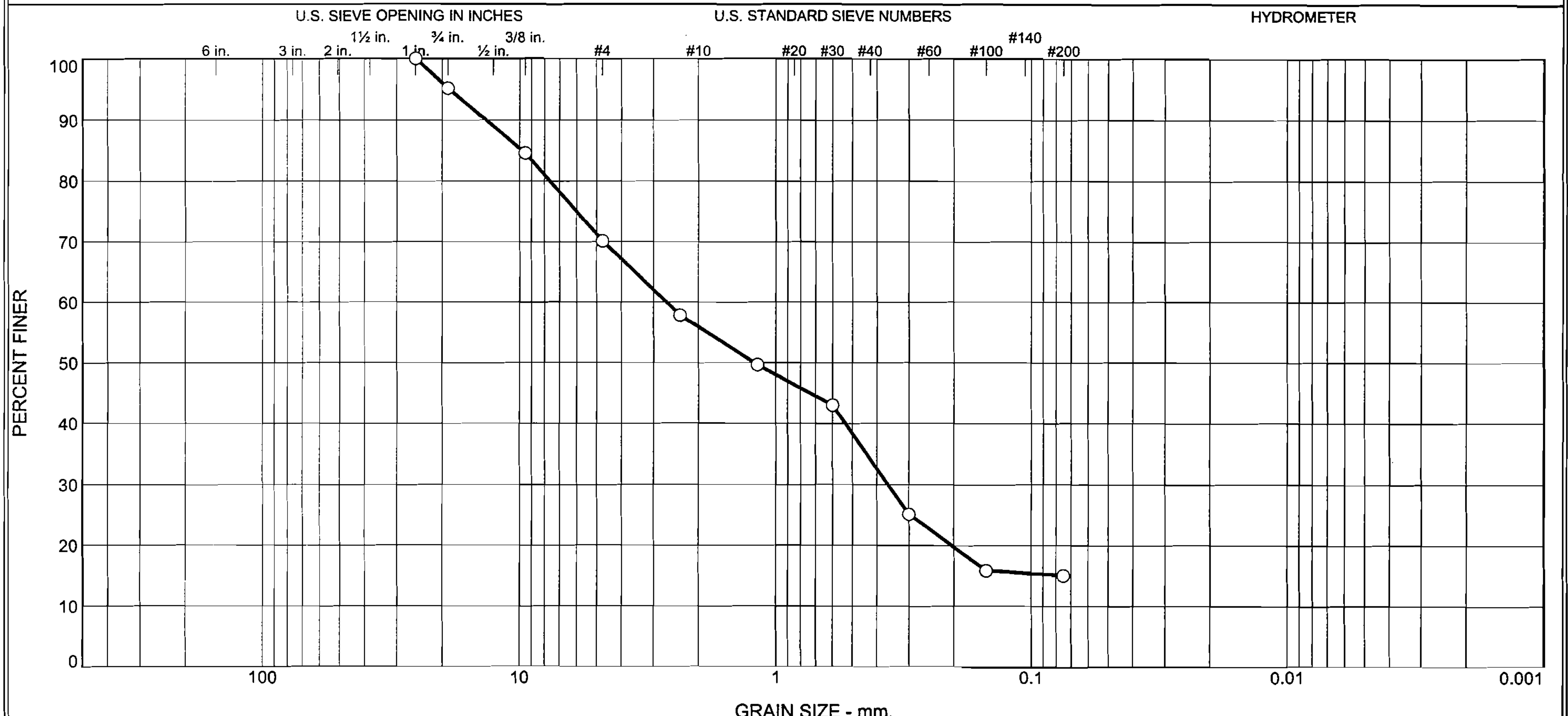
$$k = \frac{QL}{Ath} = \text{cm/sec}$$

$$k = \frac{(15.2)(10.80)}{(41.74)(155{,}400)(211.01)}$$

$$= \frac{164.16}{1{,}368{,}694{,}419.96}$$

$$= 1.20 \times 10^{-7} \text{ cm/sec}$$

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	4.8	25.1	14.2	21.8	19.1	15.0	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○		B-4 S-4	12.0'-13.5'		SM	Sand, silty, brown, dark brown w/rock	7.9	nv	np

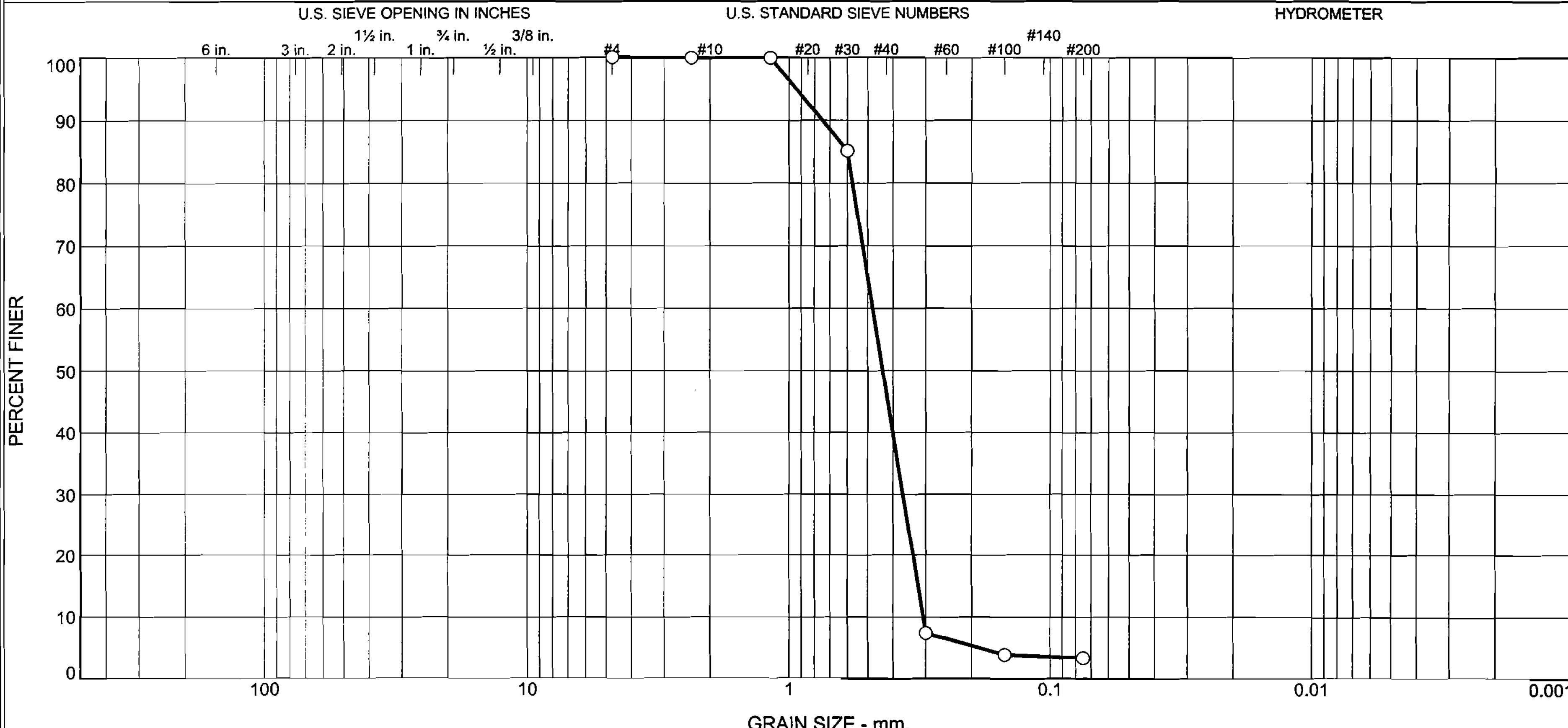
Client American Electric Power

Project Mitchell Bottom Ash Pond

Project No. 09-379 Figure

Geo/Environmental Associates, Inc. Knoxville, Tennessee

Particle Size Distribution Report



	% +3"	% Gravel Coarse	% Gravel Fine	% Sand Coarse	% Sand Medium	% Sand Fine	% Fines Silt	% Fines Clay
○	0.0	0.0	0.0	0.1	53.4	43.2	3.3	

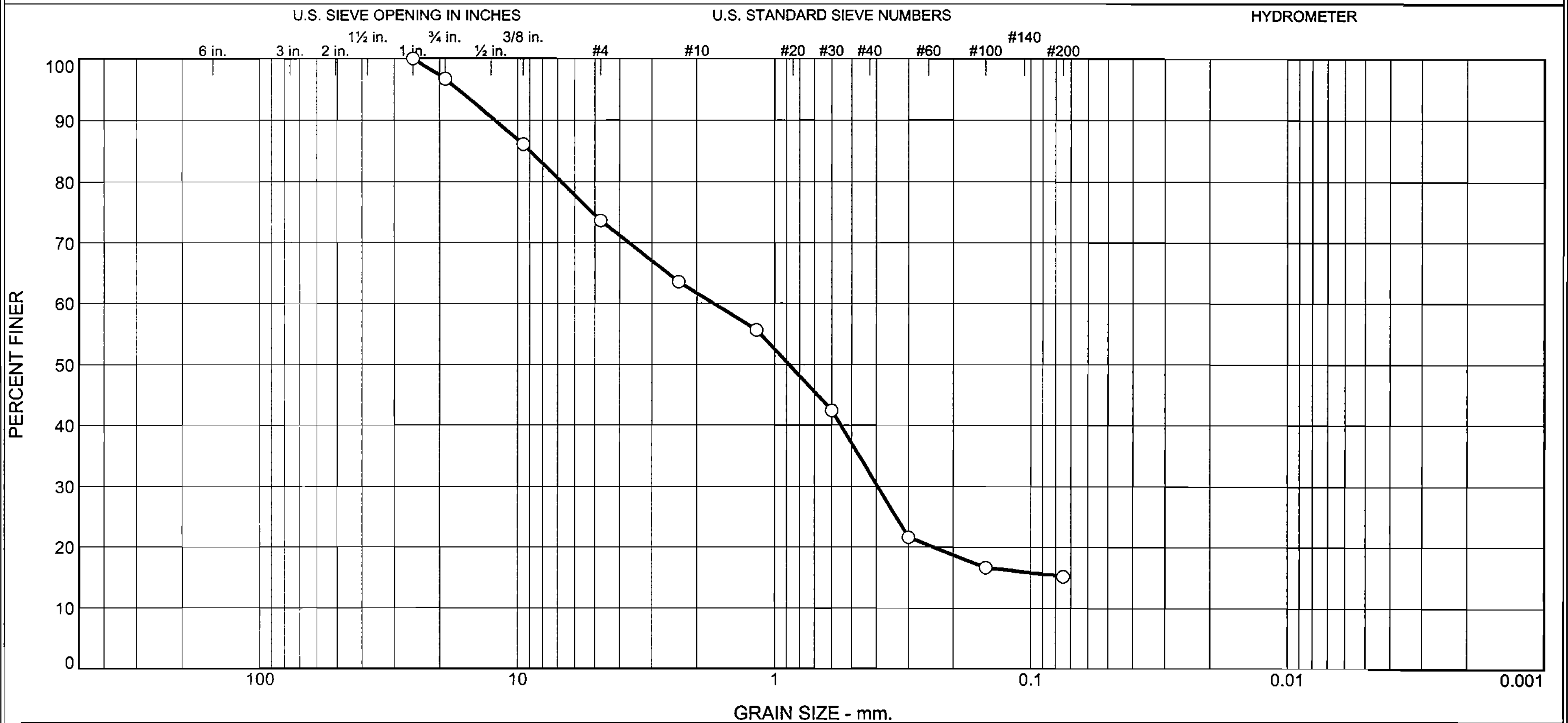
	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○		B-4 S-12	39.5'-41.0'		SP	Sand, brown	5.2	nv	np

Client American Electric Power
Project Mitchell Bottom Ash Pond

Project No. 09-379 Figure

Geo/Environmental Associates, Inc. Knoxville, Tennessee

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	3.3	23.1	12.0	29.5	16.9	15.2	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○		B-1,B-3,B-4	9.5'-10.0'		SC-SM	Sand, clayey, silty, brown w/rock	9.3	16	12
		ST-1							

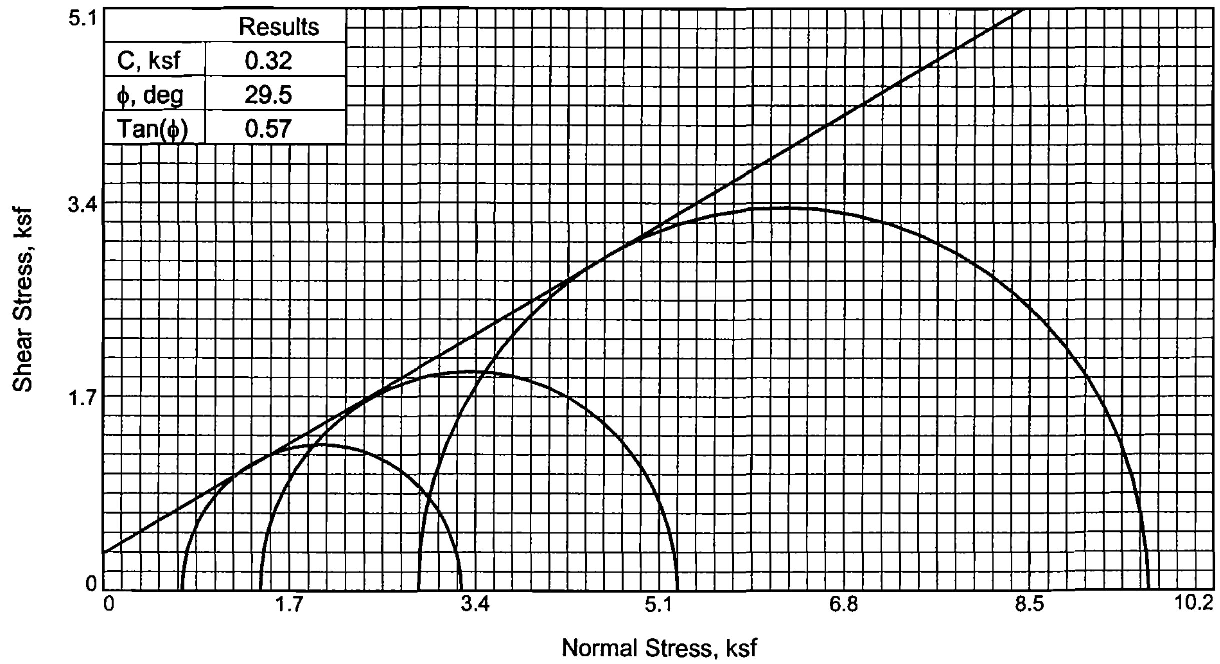
Client American Electric Power

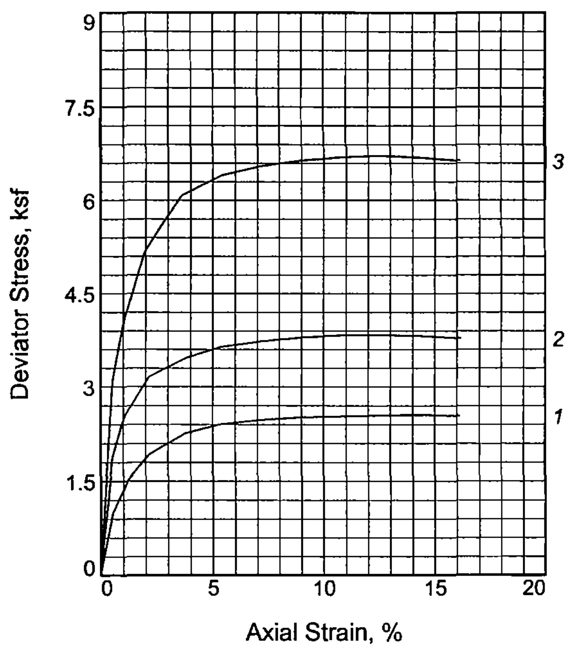
Project Mitchell Bottom Ash Pond

Project No. 09-379 Figure

Geo/Environmental Associates, Inc. Knoxville, Tennessee

○ Sand Dike Material





Sample No.		1	2	3
Initial	Water Content, %	9.2	9.3	9.3
	Dry Density, pcf	114.3	114.5	113.2
	Saturation, %	53.1	53.8	52.0
	Void Ratio	0.4632	0.4617	0.4774
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.60	5.60	5.60
At Test	Water Content, %	16.8	16.2	16.9
	Dry Density, pcf	115.5	116.6	115.1
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.4491	0.4344	0.4538
	Diameter, in.	2.79	2.78	2.78
	Height, in.	5.58	5.56	5.57
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, psi		0.00	0.00	0.00
Cell Pressure, psi		5.00	10.00	20.00
Fail. Stress, ksf		2.55	3.83	6.72
Ult. Stress, ksf				
σ_1 Failure, ksf		3.27	5.27	9.60
σ_3 Failure, ksf		0.72	1.44	2.88

Type of Test:
Consolidated Drained

Sample Type: Shelby Tubes

Description: Sand, clayey, silty, brown w/rock

LL= 16 **PL=** 12 **PI=** 4

Specific Gravity= 2.68

Remarks: Remolded specimens from B-1 ST-1, B-3 ST-1 & B-4 ST-1

Client: American Electric Power

Project: Mitchell Bottom Ash Pond

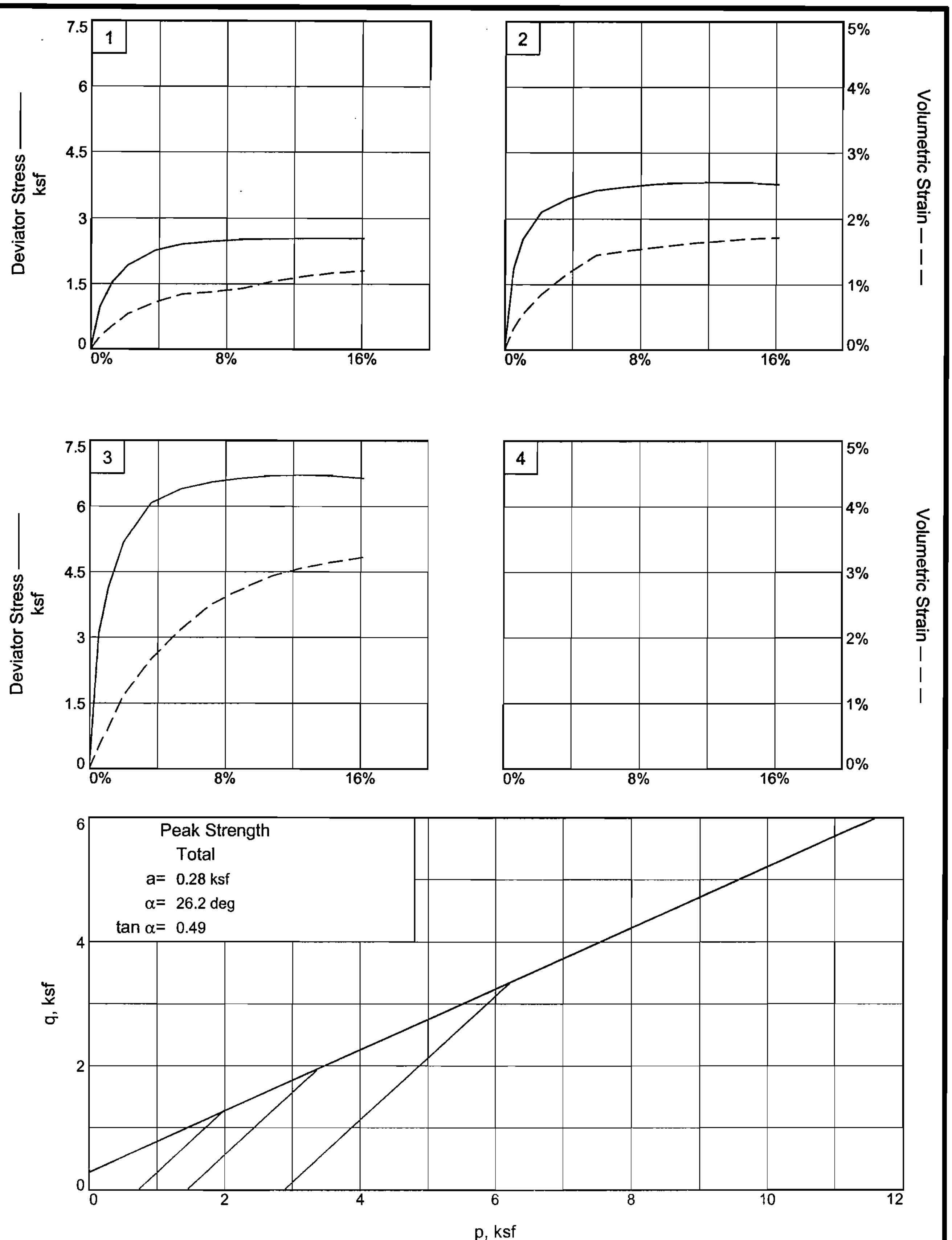
Sample Number: B-1,B-3,B-4 ST-1 **Depth:** 9.5'-10.0'

Proj. No.: 09-379 **Date Sampled:**

TRIAXIAL SHEAR TEST REPORT

Geo/Environmental Associates, Inc.

Figure 1



Client: American Electric Power
Project: Mitchell Bottom Ash Pond
Depth: 9.5'-10.0' **Sample Number:** B-1,B-3,B-4 ST-1
Project No.: 09-379 **Figure** 2

Geo/Environmental Associates, Inc.

CONSTANT HEAD PERMEABILITY TESTING
ASTM D5084-90/SW846 Method 9100 Section 2.8

PROJECT NAME : Mitchell Bottom Ash Pond

PROJECT NUMBER : 09-379

CLIENT : American Electric Power

DATE : March 16, 2009

SAMPLE LOCATION AND CONDITIONS

Sample Id. : B-1, B-3 & B-4; ST-1

Depth of Tested Sample : 9.5'-10.0'

Specimen : 5 psi Triaxial Specimen

Remolded : Yes

Sample Description : Sand, clayey, silty, brown w/rock (Sand Dike)

INITIAL SPECIMEN PROPERTIES

Length (in.): 5.6 **Volume (ft^3):** 0.0200 **Wet Density (PCF):** 124.8

Diameter (in.): 2.8 **Weight (lbs):** 2.49 **Dry Density (PCF):** 114.3

Area (ft^2): 0.0428 **Moisture (%):** 9.2

Chamber Pressure (psi): 5

Influent Pressure (psi): 3

Back Pressure (psi): 0

Change in Pore Pressure (psi): 2.0

Change in Chamber Pressure (psi): 2.0

"B" Factor: 1.0

PERMEABILITY CALCULATIONS

k = Hydraulic Conductivity, (cm/sec)

L = Length of Sample, along path of flow, (cm)

Q = Quantity of flow, taken as the average of inflow and outflow, (cm^3)

A = Cross-sectional area of specimen, (cm^2)

t = Interval of time, over which the flow Q occurs, (sec)

h = Difference in hydraulic head across specimen, (cm)

$$k = \frac{QL}{Ath} = \text{cm/sec}$$

$$k = \frac{(700.0)(14.22)}{(39.73)(2352)(211.01)}$$

$$= \frac{9{,}954.00}{19{,}717{,}821.01}$$

$$= 5.05 \times 10^{-4} \text{ cm/sec}$$

CONSTANT HEAD PERMEABILITY TESTING
ASTM D5084-90/SW846 Method 9100 Section 2.8

PROJECT NAME : Mitchell Bottom Ash Pond | **PROJECT NUMBER** : 09-379

CLIENT : American Electric Power | **DATE** : March 16, 2009

SAMPLE LOCATION AND CONDITIONS

Sample Id. : B-1, B-3 & B-4; ST-1 | **Depth of Tested Sample** : 9.5'-10.0'

Specimen : 10 psi Triaxial Specimen | **Remolded** : Yes

Sample Description : Sand, clayey, silty, brown w/rock (Sand Dike)

INITIAL SPECIMEN PROPERTIES

Length (in.):	5.6	**Volume (ft^3):**	0.0200	**Wet Density (PCF):**	125.1
Diameter (in.):	2.8	**Weight (lbs):**	2.50	**Dry Density (PCF):**	114.5
Area (ft^2):	0.0428	**Moisture (%):**	9.3		

Chamber Pressure (psi):	7	**Change in Pore Pressure (psi):**	2.0
Influent Pressure (psi):	5	**Change in Chamber Pressure (psi):**	2.0
Back Pressure (psi):	2	**"B" Factor:**	1.0

PERMEABILITY CALCULATIONS

k = Hydraulic Conductivity, (cm/sec)

L = Length of Sample, along path of flow, (cm)

Q = Quantity of flow, taken as the average of inflow and outflow, (cm^3)

A = Cross-sectional area of specimen, (cm^2)

t = Interval of time, over which the flow Q occurs, (sec)

h = Difference in hydraulic head across specimen, (cm)

$$k = \frac{QL}{Ath} = \text{cm/sec}$$

$$k = \frac{(700.0)(14.22)}{(39.73)(2662)(211.01)}$$

$$= \frac{9{,}954.00}{22{,}316{,}683.47}$$

$$= 4.46 \times 10^{-4} \text{ cm/sec}$$

CONSTANT HEAD PERMEABILITY TESTING
ASTM D5084-90/SW846 Method 9100 Section 2.8

PROJECT NAME : Mitchell Bottom Ash Pond

PROJECT NUMBER : 09-379

CLIENT : American Electric Power

DATE : March 16, 2009

SAMPLE LOCATION AND CONDITIONS

Sample Id. : B-1, B-3 & B-4; ST-1

Depth of Tested Sample : 9.5'-10.0'

Specimen : 20 psi Triaxial Specimen

Remolded : Yes

Sample Description : Sand, clayey, silty, brown w/rock (Sand Dike)

INITIAL SPECIMEN PROPERTIES

Length (in.): 5.6 **Volume (ft^3):** 0.0200 **Wet Density (PCF):** 123.7

Diameter (in.): 2.8 **Weight (lbs):** 2.47 **Dry Density (PCF):** 113.2

Area (ft^2): 0.0428 **Moisture (%):** 9.3

Chamber Pressure (psi): 10

Influent Pressure (psi): 8

Back Pressure (psi): 5

Change in Pore Pressure (psi): 2.0

Change in Chamber Pressure (psi): 2.0

"B" Factor: 1.0

PERMEABILITY CALCULATIONS

k = Hydraulic Conductivity, (cm/sec)

L = Length of Sample, along path of flow, (cm)

Q = Quantity of flow, taken as the average of inflow and outflow, (cm^3)

A = Cross-sectional area of specimen, (cm^2)

t = Interval of time, over which the flow Q occurs, (sec)

h = Difference in hydraulic head across specimen, (cm)

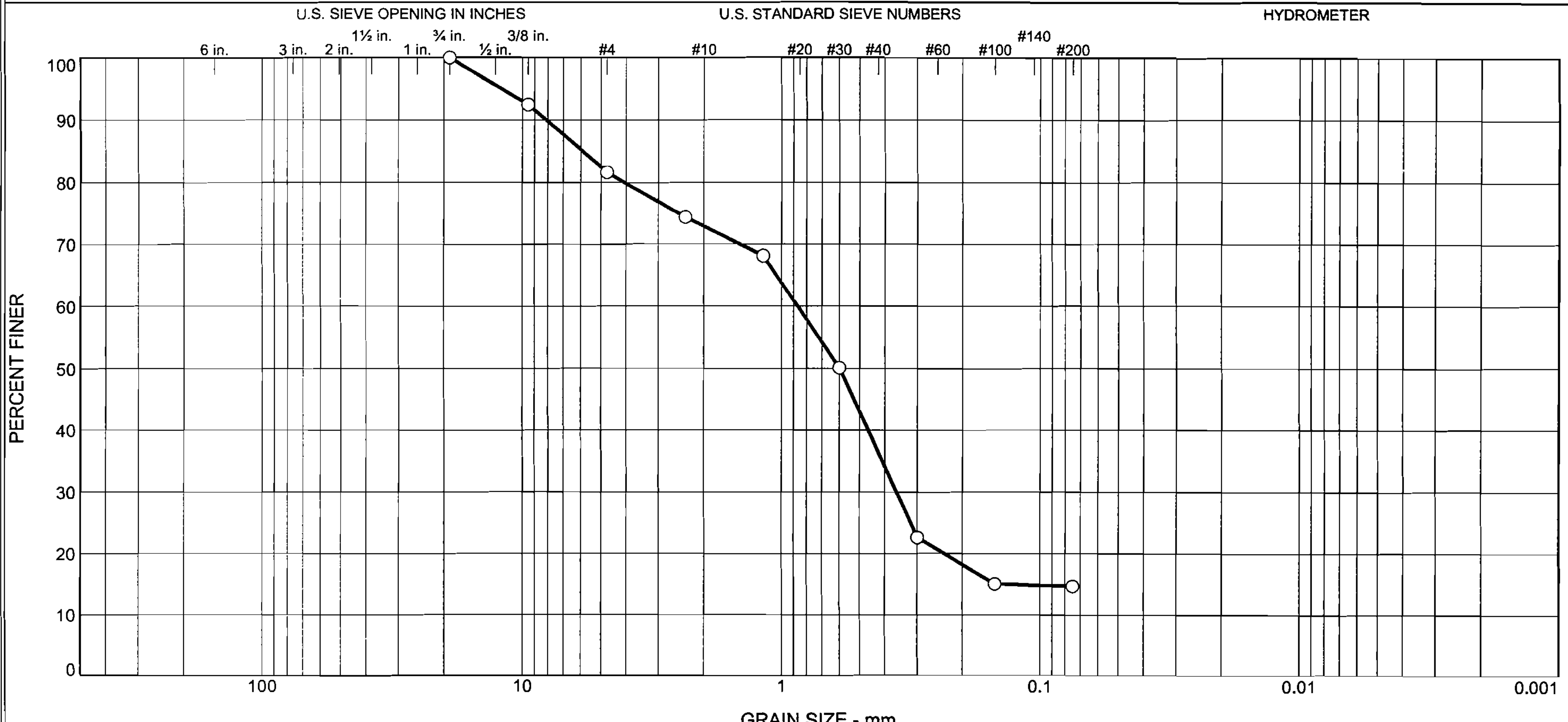
$$k = \frac{QL}{Ath} = \text{cm/sec}$$

$$k = \frac{(700.0)(14.22)}{(39.73)(1424)(211.01)}$$

$$= \frac{9{,}954.00}{11{,}938{,}000.48}$$

$$= 8.34 \times 10^{-4} \text{ cm/sec}$$

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	18.4	8.8	36.4	21.8	14.6	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○		B-5 S-3	7.0'-8.5'		SM	Sand, silty, dark brown w/rock	7.9	12	np

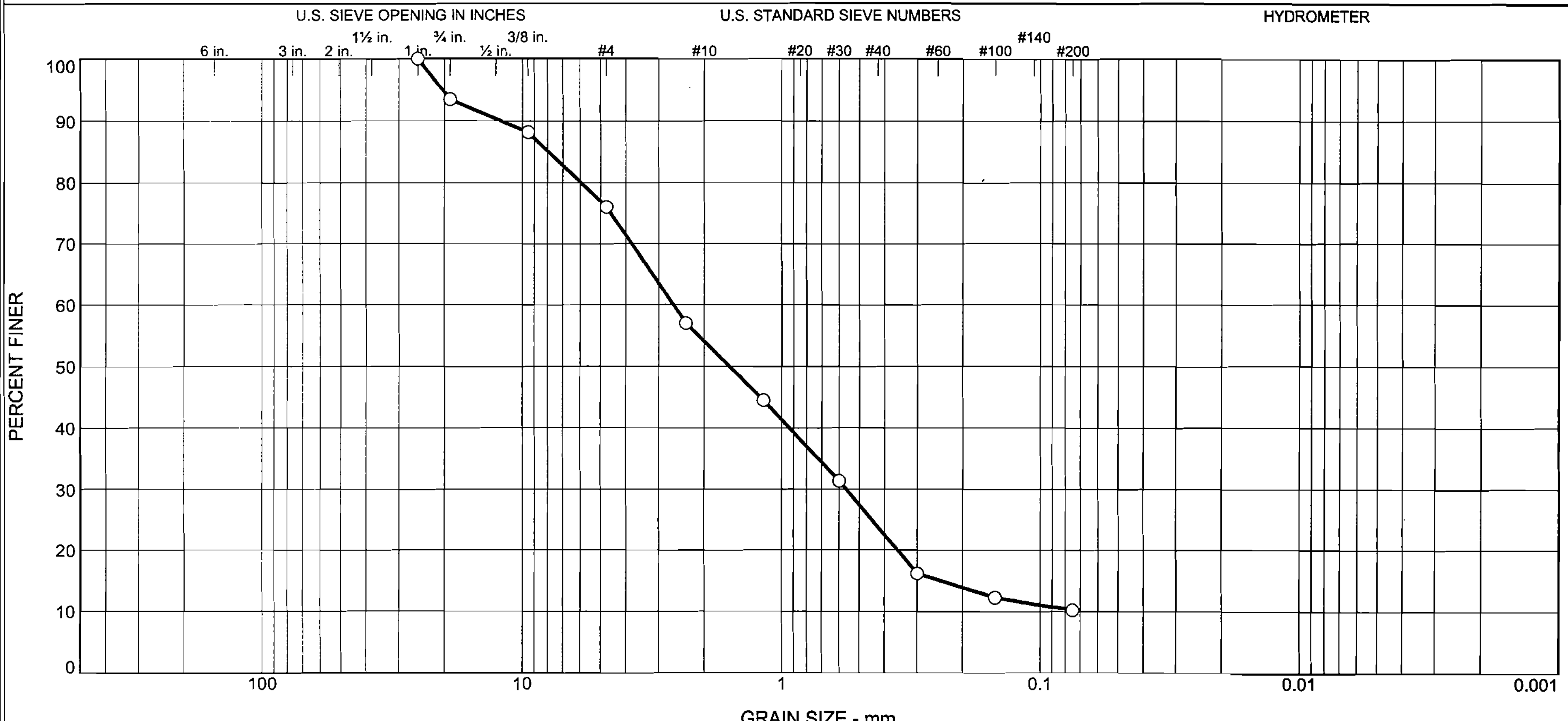
Client American Electric Power

Project Mitchell Bottom Ash Pond

Project No. 09-379 Figure

Geo/Environmental Associates, Inc. Knoxville, Tennessee

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	6.6	17.4	22.0	30.2	13.6	10.2	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○		B-5 S-8	24.5'-26.0'		SP-SC	Sand, clayey, silty, brown w/rock	7.9	16	12

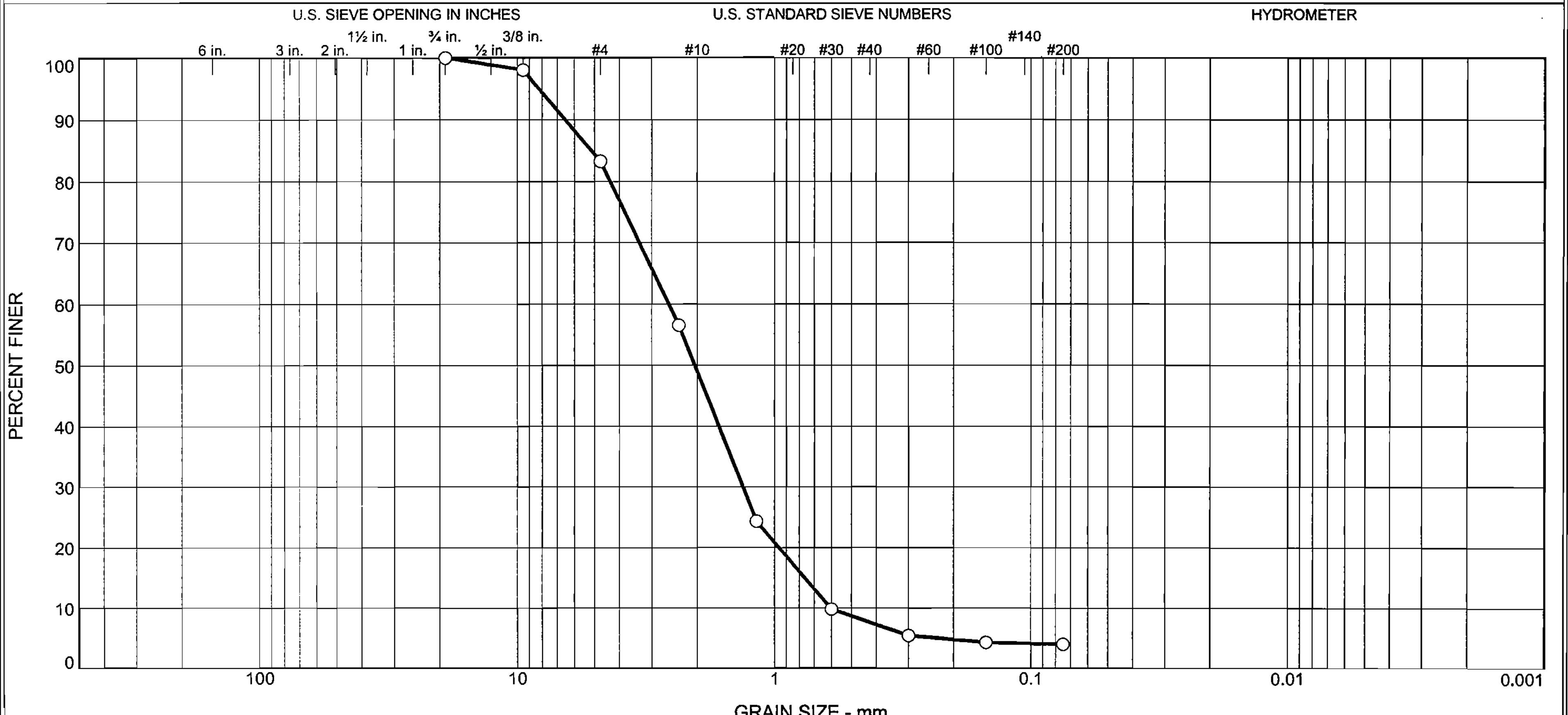
Client American Electric Power

Project Mitchell Bottom Ash Pond

Project No. 09-379 Figure

Geo/Environmental Associates, Inc. Knoxville, Tennessee

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	16.8	34.4	41.2	3.6	4.0	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○		Bucket			SP	Bottom Ash	3.6	nv	np

Client American Electric Power

Project Mitchell Bottom Ash Pond

Project No. 09-379 Figure

Geo/Environmental Associates, Inc. Knoxville, Tennessee

Appendix II

Hydraulics and Hydrology

Bottom Ash Pond

SUMMARY OF INFLOW HYDROGRAPH AND FLOOD ROUTING THROUGH MITCHELL BOTTOM ASH POND FOR ½ 6-HOUR PMP STORM EVENT

Starting Pool Elevation	=	681 ft, NAVD
Pipe Spillway Invert Elevation	=	681 ft, NAVD
Crest Elevation	=	690 ft, NAVD
Peak Inflow	=	111.08 cfs
Peak Outflow	=	23.83 cfs
Peak Storage	=	10.75 ac-ft
Maximum Impoundment Level During Storm	=	683.51 ft, NAVD
Minimum Freeboard During Storm	=	6.49 ft

```
1*****************************************                              ***************************************
 *                                       *                              *                                     *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                              *   U.S. ARMY CORPS OF ENGINEERS      *
 *           SEPTEMBER 1990              *                              *   HYDROLOGIC ENGINEERING CENTER     *
 *             VERSION 4.0               *                              *         609 SECOND STREET           *
 *                                       *                              *      DAVIS, CALIFORNIA 95616        *
 *  RUN DATE  12/21/2015  TIME  10:40:34 *                              *          (916) 756-1104             *
 *                                       *                              *                                     *
*****************************************                               ***************************************


                    X     X  XXXXXXX   XXXXX           X
                    X     X  X        X     X         XX
                    X     X  X        X                X
                    XXXXXXX  XXXX     X        XXXXX   X
                    X     X  X        X                X
                    X     X  X        X     X          X
                    X     X  XXXXXXX   XXXXX          XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM
```

```
      LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 *** FREE ***
         1          ID  ****************************************************************************
         2          ID  *      Mitchell Bottom Ash Pond       File: MBAP.inp                        *
         3          ID  *      GA Project No. 15055007.00                                           *
         4          ID  *      Storm Storage for 1/2 6-Hour PMP                                     *
         5          ID  *      Crest Elevation = 690'                                               *
         6          ID  ****************************************************************************
         7          ID  *      Analyses by: Geo/Environmental Associates, Inc.                      *
         8          ID  *                   Knoxville, TN                                           *
         9          ID  *                   Seth W. Frank P.E.                                      *
        10          ID  *                   August 2014                                             *
        11          ID  ****************************************************************************
        12          IT       5       0       0     300
        13          IO       1
        14          JR  PRECIP     0.5
        15          VS   BASIN    BASE      IN     IMP     IMP     IMP
        16          VV    2.11    2.11    2.11    2.11    6.11    7.11
        17          IN      15

        18          KK   BASIN
        19          KM   COMPUTE INFLOW HYDROGRAPH FOR MITCHELL BOTTOM ASH POND USING SCS METHOD
        20          PB       0
        21          PI   0.258   0.347   0.420   0.478   0.520   0.546   0.624   0.804   0.790   0.939
        22          PI   2.264   4.483   4.834   3.277   1.215   0.797   0.831   0.735   0.553   0.535
        23          PI   0.501   0.451   0.386   0.305
        24          BA   0.016
        25          LU       0    0.05    44.8
        26          UD     0.0

        27          KK    BASE
        28          KM   BASE FLOW
        29          IN     360
        30          QI    11.6    11.6    11.6

        31          KK      IN
        32          KM   COMBINE BASIN INFLOW AND BASEFLOW
        33          KO       1
        34          HC       2

        35          KK     IMP
        36          KM   ROUTE COMPUTED HYDROGRAPH AND BASE FLOW THROUGH CLEAR WATER POND
        37          RS       1    ELEV     681
        38          SA    4.03    4.18    4.45    4.72    6.27    7.81    8.03    8.26    8.48    8.71
        39          SQ       0    6.90   17.82   29.62   40.80   50.31   57.32   61.12   61.12   61.12
        40          SE     681     682     683     684     685     686     687     688     689     690
        41          ZZ
```

```
1***************************************                                                  ***************************************
 *                                     *                                                  *                                     *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                                                *    U.S. ARMY CORPS OF ENGINEERS     *
 *           SEPTEMBER 1990            *                                                  *    HYDROLOGIC ENGINEERING CENTER    *
 *             VERSION 4.0             *                                                  *          609 SECOND STREET          *
 *                                     *                                                  *       DAVIS, CALIFORNIA 95616       *
 *  RUN DATE  12/21/2015  TIME  10:40:34 *                                                *           (916) 756-1104            *
 *                                     *                                                  *                                     *
 ***************************************                                                  ***************************************



                           *****************************************************************************
                           *      Mitchell Bottom Ash Pond       File: MBAP.inp                        *
                           *      GA Project No. 15055007.00                                           *
                           *      Storm Storage for 1/2 6-Hour PMP                                     *
                           *      Crest Elevation = 690'                                               *
                           *****************************************************************************
                           *      Analyses by: Geo/Environmental Associates, Inc.                      *
                           *                   Knoxville, TN                                           *
                           *                   Seth W. Frank P.E.                                      *
                           *                   August 2014                                             *
                           *****************************************************************************

  13 IO          OUTPUT CONTROL VARIABLES
                       IPRNT          1  PRINT CONTROL
                       IPLOT          0  PLOT CONTROL
                       QSCAL         0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                        NMIN          5  MINUTES IN COMPUTATION INTERVAL
                       IDATE      1    0  STARTING DATE
                       ITIME       0000  STARTING TIME
                          NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE      2    0  ENDING DATE
                      NDTIME       0055  ENDING TIME
                      ICENT          19  CENTURY MARK

                 COMPUTATION INTERVAL     .08 HOURS
                      TOTAL TIME BASE   24.92 HOURS

        ENGLISH UNITS
             DRAINAGE AREA         SQUARE MILES
             PRECIPITATION DEPTH   INCHES
             LENGTH, ELEVATION     FEET
             FLOW                  CUBIC FEET PER SECOND
             STORAGE VOLUME        ACRE-FEET
             SURFACE AREA          ACRES
             TEMPERATURE           DEGREES FAHRENHEIT

               USER-DEFINED OUTPUT SPECIFICATIONS

          TABLE 1
     VS       STATION     BASIN      BASE        IN       IMP       IMP       IMP
     VV VARIABLE CODE      2.11      2.11      2.11      2.11      6.11      7.11       .00       .00       .00       .00

     JP          MULTI-PLAN OPTION
                       NPLAN          1  NUMBER OF PLANS

     JR          MULTI-RATIO OPTION
                     RATIOS OF PRECIPITATION
                    .50


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
  18 KK     *    BASIN   *
            *            *
            **************
                            COMPUTE INFLOW HYDROGRAPH FOR MITCHELL BOTTOM ASH POND USING SCS METHOD

  17 IN          TIME DATA FOR INPUT TIME SERIES
                       JXMIN         15  TIME INTERVAL IN MINUTES
                      JXDATE      1    0  STARTING DATE
                      JXTIME          0  STARTING TIME
```

SUBBASIN RUNOFF DATA

24 BA SUBBASIN CHARACTERISTICS
TAREA .02 SUBBASIN AREA

PRECIPITATION DATA

20 PB STORM 26.89 BASIN TOTAL PRECIPITATION

21 PI INCREMENTAL PRECIPITATION PATTERN

.09	.09	.09	.12	.12	.12	.14	.14	.14	.16
.16	.16	.17	.17	.17	.18	.18	.18	.21	.21
.21	.27	.27	.27	.26	.26	.26	.31	.31	.31
.75	.75	.75	1.49	1.49	1.49	1.61	1.61	1.61	1.09
1.09	1.09	.41	.40	.41	.27	.27	.27	.28	.28
.28	.25	.24	.25	.18	.18	.18	.18	.18	.18
.17	.17	.17	.15	.15	.15	.13	.13	.13	.10
.10	.10								

25 LU UNIFORM LOSS RATE
STRTL .00 INITIAL LOSS
CNSTL .05 UNIFORM LOSS RATE
RTIMP 44.80 PERCENT IMPERVIOUS AREA

26 UD SCS DIMENSIONLESS UNITGRAPH
TLAG .00 LAG

***

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)					
		(CFS)				
+ 24.	4.58		21.	15.	14.	14.
		(INCHES)	6.212	17.047	17.093	17.093
		(AC-FT)	11.	29.	29.	29.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	24.92-HR
+ (AC-FT)	(HR)				
11.	4.58	10.	7.	7.	7.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	24.92-HR
+ (FEET)	(HR)				
683.51	4.58	683.30	682.70	682.64	682.64

CUMULATIVE AREA = .03 SQ MI

```
1

               PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
                                 FLOWS IN CUBIC FEET PER SECOND,  AREA IN SQUARE MILES
                                                TIME TO PEAK IN HOURS


                                                         RATIOS APPLIED TO PRECIPITATION
 OPERATION       STATION     AREA    PLAN           RATIO 1
                                                        .50

 HYDROGRAPH AT
+                 BASIN       .02     1   FLOW          99.
                                          TIME         3.25

 HYDROGRAPH AT
+                  BASE       .02     1   FLOW          12.
                                          TIME          .08

  2 COMBINED AT
+                    IN       .03     1   FLOW         111.
                                          TIME         3.25

 ROUTED TO
+                   IMP       .03     1   FLOW          24.
                                          TIME         4.58

                                      ** PEAK STAGES IN FEET **
                                      1   STAGE      683.51
                                          TIME         4.58
```

1TABLE 1			STATION	BASIN FLOW	BASE FLOW	IN FLOW	IMP FLOW	IMP STORAGE	IMP STAGE
			PLAN	1	1	1	1	1	1
			RATIO	.50	.50	.50	.50	.50	.50
PER	DAY	MON	HRMN						
1	1		0000	.00	11.60	11.60	.00	.00	681.00
2	1		0005	3.75	11.60	15.35	.16	.09	681.02
3	1		0010	4.80	11.60	16.40	.34	.20	681.05
4	1		0015	5.00	11.60	16.60	.52	.31	681.08
5	1		0020	6.41	11.60	18.01	.72	.43	681.10
6	1		0025	6.79	11.60	18.39	.92	.55	681.13
7	1		0030	6.87	11.60	18.47	1.12	.67	681.16
8	1		0035	8.00	11.60	19.60	1.32	.79	681.19
9	1		0040	8.31	11.60	19.91	1.54	.91	681.22
10	1		0045	8.38	11.60	19.98	1.75	1.04	681.25
11	1		0050	9.28	11.60	20.88	1.96	1.17	681.28
12	1		0055	9.53	11.60	21.13	2.18	1.30	681.32
13	1		0100	9.58	11.60	21.18	2.40	1.43	681.35
14	1		0105	10.23	11.60	21.83	2.62	1.56	681.38
15	1		0110	10.41	11.60	22.01	2.84	1.69	681.41
16	1		0115	10.45	11.60	22.05	3.06	1.82	681.44
17	1		0120	10.85	11.60	22.45	3.28	1.95	681.48
18	1		0125	10.96	11.60	22.56	3.51	2.09	681.51
19	1		0130	10.99	11.60	22.59	3.73	2.22	681.54
20	1		0135	12.19	11.60	23.79	3.95	2.35	681.57
21	1		0140	12.52	11.60	24.12	4.18	2.49	681.61
22	1		0145	12.59	11.60	24.19	4.41	2.62	681.64
23	1		0150	15.36	11.60	26.96	4.65	2.77	681.67
24	1		0155	16.14	11.60	27.74	4.91	2.92	681.71
25	1		0200	16.29	11.60	27.89	5.18	3.08	681.75
26	1		0205	16.10	11.60	27.70	5.44	3.24	681.79
27	1		0210	16.04	11.60	27.64	5.69	3.39	681.83
28	1		0215	16.03	11.60	27.63	5.95	3.54	681.86
29	1		0220	18.32	11.60	29.92	6.21	3.69	681.90
30	1		0225	18.96	11.60	30.56	6.49	3.86	681.94
31	1		0230	19.08	11.60	30.68	6.76	4.02	681.98
32	1		0235	39.43	11.60	51.03	7.28	4.26	682.04
33	1		0240	45.13	11.60	56.73	8.09	4.57	682.11
34	1		0245	46.24	11.60	57.84	8.94	4.91	682.19
35	1		0250	80.51	11.60	92.11	10.08	5.36	682.29
36	1		0255	90.04	11.60	101.64	11.58	5.95	682.43
37	1		0300	91.92	11.60	103.52	13.15	6.58	682.57
38	1		0305	97.68	11.60	109.28	14.77	7.21	682.72
39	1		0310	99.18	11.60	110.78	16.41	7.86	682.87
40	1		0315	99.48	11.60	111.08	18.05	8.51	683.02
41	1		0320	75.65	11.60	87.25	19.47	9.06	683.14
42	1		0325	68.96	11.60	80.56	20.61	9.50	683.24
43	1		0330	67.65	11.60	79.25	21.65	9.91	683.32
44	1		0335	35.75	11.60	47.35	22.38	10.19	683.39
45	1		0340	26.89	11.60	38.49	22.74	10.33	683.42
46	1		0345	25.15	11.60	36.75	23.00	10.43	683.44
47	1		0350	18.39	11.60	29.99	23.18	10.50	683.45
48	1		0355	16.60	11.60	28.20	23.29	10.54	683.46
49	1		0400	16.24	11.60	27.84	23.37	10.58	683.47
50	1		0405	16.70	11.60	28.30	23.45	10.61	683.48

1TABLE 1 (CONT.)			STATION	BASIN FLOW	BASE FLOW	IN FLOW	IMP FLOW	IMP STORAGE	IMP STAGE	
			PLAN	1	1	1	1	1	1	
			RATIO	.50	.50	.50	.50	.50	.50	
PER	DAY	MON	HRMN							
51	1		0410	16.84	11.60	28.44	23.54	10.64	683.48	
52	1		0415	16.87	11.60	28.47	23.63	10.68	683.49	
53	1		0420	15.40	11.60	27.00	23.70	10.70	683.50	
54	1		0425	14.99	11.60	26.59	23.75	10.72	683.50	
55	1		0430	14.91	11.60	26.51	23.80	10.74	683.51	
56	1		0435	12.10	11.60	23.70	23.83	**10.75**	**683.51**	**Maximum impoundment stage/storage**
57	1		0440	11.32	11.60	22.92	23.82	10.75	683.51	
58	1		0445	11.17	11.60	22.77	23.80	10.74	683.51	
59	1		0450	10.86	11.60	22.46	23.78	10.73	683.51	
60	1		0455	10.78	11.60	22.38	23.75	10.72	683.50	
61	1		0500	10.77	11.60	22.37	23.73	10.72	683.50	
62	1		0505	10.24	11.60	21.84	23.70	10.70	683.50	
63	1		0510	10.10	11.60	21.70	23.67	10.69	683.50	
64	1		0515	10.07	11.60	21.67	23.63	10.68	683.49	
65	1		0520	9.29	11.60	20.89	23.59	10.66	683.49	
66	1		0525	9.08	11.60	20.68	23.54	10.64	683.48	
67	1		0530	9.04	11.60	20.64	23.49	10.62	683.48	
68	1		0535	8.03	11.60	19.63	23.43	10.60	683.48	
69	1		0540	7.75	11.60	19.35	23.36	10.57	683.47	
70	1		0545	7.70	11.60	19.30	23.29	10.55	683.46	
71	1		0550	6.44	11.60	18.04	23.21	10.51	683.46	
72	1		0555	6.10	11.60	17.70	23.12	10.48	683.45	
73	1		0600	6.03	11.60	17.63	23.02	10.44	683.44	
74	1		0605	1.55	11.60	13.15	22.89	10.39	683.43	
75	1		0610	.29	11.60	11.89	22.71	10.32	683.41	
76	1		0615	.05	11.60	11.65	22.51	10.24	683.40	
77	1		0620	.00	11.60	11.60	22.32	10.17	683.38	
78	1		0625	.00	11.60	11.60	22.13	10.09	683.37	
79	1		0630	.00	11.60	11.60	21.95	10.02	683.35	
80	1		0635	.00	11.60	11.60	21.77	9.95	683.33	
81	1		0640	.00	11.60	11.60	21.59	9.88	683.32	
82	1		0645	.00	11.60	11.60	21.41	9.81	683.30	
83	1		0650	.00	11.60	11.60	21.24	9.75	683.29	
84	1		0655	.00	11.60	11.60	21.07	9.68	683.28	
85	1		0700	.00	11.60	11.60	20.90	9.62	683.26	
86	1		0705	.00	11.60	11.60	20.74	9.55	683.25	
87	1		0710	.00	11.60	11.60	20.58	9.49	683.23	
88	1		0715	.00	11.60	11.60	20.42	9.43	683.22	
89	1		0720	.00	11.60	11.60	20.27	9.37	683.21	
90	1		0725	.00	11.60	11.60	20.11	9.31	683.19	
91	1		0730	.00	11.60	11.60	19.97	9.25	683.18	
92	1		0735	.00	11.60	11.60	19.82	9.20	683.17	
93	1		0740	.00	11.60	11.60	19.67	9.14	683.16	
94	1		0745	.00	11.60	11.60	19.53	9.08	683.15	
95	1		0750	.00	11.60	11.60	19.39	9.03	683.13	
96	1		0755	.00	11.60	11.60	19.26	8.98	683.12	
97	1		0800	.00	11.60	11.60	19.12	8.92	683.11	
98	1		0805	.00	11.60	11.60	18.99	8.87	683.10	
99	1		0810	.00	11.60	11.60	18.86	8.82	683.09	
100	1		0815	.00	11.60	11.60	18.73	8.77	683.08	

1TABLE 1 (CONT.)			STATION PLAN RATIO	BASIN FLOW 1 .50	BASE FLOW 1 .50	IN FLOW 1 .50	IMP FLOW 1 .50	IMP STORAGE 1 .50	IMP STAGE 1 .50
PER	DAY	MON	HRMN						
101	1		0820	.00	11.60	11.60	18.61	8.72	683.07
102	1		0825	.00	11.60	11.60	18.48	8.68	683.06
103	1		0830	.00	11.60	11.60	18.36	8.63	683.05
104	1		0835	.00	11.60	11.60	18.24	8.58	683.04
105	1		0840	.00	11.60	11.60	18.13	8.54	683.03
106	1		0845	.00	11.60	11.60	18.01	8.49	683.02
107	1		0850	.00	11.60	11.60	17.90	8.45	683.01
108	1		0855	.00	11.60	11.60	17.79	8.41	683.00
109	1		0900	.00	11.60	11.60	17.68	8.36	682.99
110	1		0905	.00	11.60	11.60	17.58	8.32	682.98
111	1		0910	.00	11.60	11.60	17.47	8.28	682.97
112	1		0915	.00	11.60	11.60	17.37	8.24	682.96
113	1		0920	.00	11.60	11.60	17.27	8.20	682.95
114	1		0925	.00	11.60	11.60	17.17	8.16	682.94
115	1		0930	.00	11.60	11.60	17.08	8.13	682.93
116	1		0935	.00	11.60	11.60	16.98	8.09	682.92
117	1		0940	.00	11.60	11.60	16.89	8.05	682.91
118	1		0945	.00	11.60	11.60	16.80	8.02	682.91
119	1		0950	.00	11.60	11.60	16.71	7.98	682.90
120	1		0955	.00	11.60	11.60	16.62	7.95	682.89
121	1		1000	.00	11.60	11.60	16.53	7.91	682.88
122	1		1005	.00	11.60	11.60	16.45	7.88	682.87
123	1		1010	.00	11.60	11.60	16.37	7.84	682.87
124	1		1015	.00	11.60	11.60	16.28	7.81	682.86
125	1		1020	.00	11.60	11.60	16.20	7.78	682.85
126	1		1025	.00	11.60	11.60	16.12	7.75	682.84
127	1		1030	.00	11.60	11.60	16.04	7.72	682.84
128	1		1035	.00	11.60	11.60	15.97	7.69	682.83
129	1		1040	.00	11.60	11.60	15.89	7.66	682.82
130	1		1045	.00	11.60	11.60	15.82	7.63	682.82
131	1		1050	.00	11.60	11.60	15.74	7.60	682.81
132	1		1055	.00	11.60	11.60	15.67	7.57	682.80
133	1		1100	.00	11.60	11.60	15.60	7.54	682.80
134	1		1105	.00	11.60	11.60	15.53	7.52	682.79
135	1		1110	.00	11.60	11.60	15.47	7.49	682.78
136	1		1115	.00	11.60	11.60	15.40	7.46	682.78
137	1		1120	.00	11.60	11.60	15.33	7.44	682.77
138	1		1125	.00	11.60	11.60	15.27	7.41	682.77
139	1		1130	.00	11.60	11.60	15.21	7.39	682.76
140	1		1135	.00	11.60	11.60	15.14	7.36	682.75
141	1		1140	.00	11.60	11.60	15.08	7.34	682.75
142	1		1145	.00	11.60	11.60	15.02	7.31	682.74
143	1		1150	.00	11.60	11.60	14.96	7.29	682.74
144	1		1155	.00	11.60	11.60	14.90	7.27	682.73
145	1		1200	.00	11.60	11.60	14.85	7.24	682.73
146	1		1205	.00	11.60	11.60	14.79	7.22	682.72
147	1		1210	.00	11.60	11.60	14.74	7.20	682.72
148	1		1215	.00	11.60	11.60	14.68	7.18	682.71
149	1		1220	.00	11.60	11.60	14.63	7.16	682.71
150	1		1225	.00	11.60	11.60	14.58	7.14	682.70

1TABLE 1 (CONT.)

PER	DAY MON	HRMN	STATION PLAN RATIO	BASIN FLOW 1 .50	BASE FLOW 1 .50	IN FLOW 1 .50	IMP FLOW 1 .50	IMP STORAGE 1 .50	IMP STAGE 1 .50
151	1	1230		.00	11.60	11.60	14.52	7.12	682.70
152	1	1235		.00	11.60	11.60	14.47	7.10	682.69
153	1	1240		.00	11.60	11.60	14.42	7.08	682.69
154	1	1245		.00	11.60	11.60	14.38	7.06	682.68
155	1	1250		.00	11.60	11.60	14.33	7.04	682.68
156	1	1255		.00	11.60	11.60	14.28	7.02	682.68
157	1	1300		.00	11.60	11.60	14.23	7.00	682.67
158	1	1305		.00	11.60	11.60	14.19	6.98	682.67
159	1	1310		.00	11.60	11.60	14.14	6.97	682.66
160	1	1315		.00	11.60	11.60	14.10	6.95	682.66
161	1	1320		.00	11.60	11.60	14.06	6.93	682.66
162	1	1325		.00	11.60	11.60	14.01	6.92	682.65
163	1	1330		.00	11.60	11.60	13.97	6.90	682.65
164	1	1335		.00	11.60	11.60	13.93	6.88	682.64
165	1	1340		.00	11.60	11.60	13.89	6.87	682.64
166	1	1345		.00	11.60	11.60	13.85	6.85	682.64
167	1	1350		.00	11.60	11.60	13.81	6.84	682.63
168	1	1355		.00	11.60	11.60	13.77	6.82	682.63
169	1	1400		.00	11.60	11.60	13.74	6.81	682.63
170	1	1405		.00	11.60	11.60	13.70	6.79	682.62
171	1	1410		.00	11.60	11.60	13.66	6.78	682.62
172	1	1415		.00	11.60	11.60	13.63	6.76	682.62
173	1	1420		.00	11.60	11.60	13.59	6.75	682.61
174	1	1425		.00	11.60	11.60	13.56	6.74	682.61
175	1	1430		.00	11.60	11.60	13.52	6.72	682.61
176	1	1435		.00	11.60	11.60	13.49	6.71	682.60
177	1	1440		.00	11.60	11.60	13.46	6.70	682.60
178	1	1445		.00	11.60	11.60	13.43	6.68	682.60
179	1	1450		.00	11.60	11.60	13.40	6.67	682.59
180	1	1455		.00	11.60	11.60	13.36	6.66	682.59
181	1	1500		.00	11.60	11.60	13.33	6.65	682.59
182	1	1505		.00	11.60	11.60	13.30	6.63	682.59
183	1	1510		.00	11.60	11.60	13.27	6.62	682.58
184	1	1515		.00	11.60	11.60	13.25	6.61	682.58
185	1	1520		.00	11.60	11.60	13.22	6.60	682.58
186	1	1525		.00	11.60	11.60	13.19	6.59	682.58
187	1	1530		.00	11.60	11.60	13.16	6.58	682.57
188	1	1535		.00	11.60	11.60	13.13	6.57	682.57
189	1	1540		.00	11.60	11.60	13.11	6.56	682.57
190	1	1545		.00	11.60	11.60	13.08	6.55	682.57
191	1	1550		.00	11.60	11.60	13.06	6.54	682.56
192	1	1555		.00	11.60	11.60	13.03	6.53	682.56
193	1	1600		.00	11.60	11.60	13.01	6.52	682.56
194	1	1605		.00	11.60	11.60	12.98	6.51	682.56
195	1	1610		.00	11.60	11.60	12.96	6.50	682.55
196	1	1615		.00	11.60	11.60	12.93	6.49	682.55
197	1	1620		.00	11.60	11.60	12.91	6.48	682.55
198	1	1625		.00	11.60	11.60	12.89	6.47	682.55
199	1	1630		.00	11.60	11.60	12.87	6.46	682.55
200	1	1635		.00	11.60	11.60	12.84	6.45	682.54

1TABLE 1 (CONT.)	STATION		BASIN FLOW	BASE FLOW	IN FLOW	IMP FLOW	IMP STORAGE	IMP STAGE
	PLAN		1	1	1	1	1	1
	RATIO		.50	.50	.50	.50	.50	.50
PER	DAY MON	HRMN						
201	1	1640	.00	11.60	11.60	12.82	6.44	682.54
202	1	1645	.00	11.60	11.60	12.80	6.44	682.54
203	1	1650	.00	11.60	11.60	12.78	6.43	682.54
204	1	1655	.00	11.60	11.60	12.76	6.42	682.54
205	1	1700	.00	11.60	11.60	12.74	6.41	682.53
206	1	1705	.00	11.60	11.60	12.72	6.40	682.53
207	1	1710	.00	11.60	11.60	12.70	6.40	682.53
208	1	1715	.00	11.60	11.60	12.68	6.39	682.53
209	1	1720	.00	11.60	11.60	12.66	6.38	682.53
210	1	1725	.00	11.60	11.60	12.65	6.37	682.53
211	1	1730	.00	11.60	11.60	12.63	6.37	682.52
212	1	1735	.00	11.60	11.60	12.61	6.36	682.52
213	1	1740	.00	11.60	11.60	12.59	6.35	682.52
214	1	1745	.00	11.60	11.60	12.58	6.35	682.52
215	1	1750	.00	11.60	11.60	12.56	6.34	682.52
216	1	1755	.00	11.60	11.60	12.54	6.33	682.52
217	1	1800	.00	11.60	11.60	12.53	6.33	682.52
218	1	1805	.00	11.60	11.60	12.51	6.32	682.51
219	1	1810	.00	11.60	11.60	12.49	6.31	682.51
220	1	1815	.00	11.60	11.60	12.48	6.31	682.51
221	1	1820	.00	11.60	11.60	12.46	6.30	682.51
222	1	1825	.00	11.60	11.60	12.45	6.30	682.51
223	1	1830	.00	11.60	11.60	12.43	6.29	682.51
224	1	1835	.00	11.60	11.60	12.42	6.29	682.51
225	1	1840	.00	11.60	11.60	12.41	6.28	682.50
226	1	1845	.00	11.60	11.60	12.39	6.27	682.50
227	1	1850	.00	11.60	11.60	12.38	6.27	682.50
228	1	1855	.00	11.60	11.60	12.36	6.26	682.50
229	1	1900	.00	11.60	11.60	12.35	6.26	682.50
230	1	1905	.00	11.60	11.60	12.34	6.25	682.50
231	1	1910	.00	11.60	11.60	12.33	6.25	682.50
232	1	1915	.00	11.60	11.60	12.31	6.24	682.50
233	1	1920	.00	11.60	11.60	12.30	6.24	682.49
234	1	1925	.00	11.60	11.60	12.29	6.23	682.49
235	1	1930	.00	11.60	11.60	12.28	6.23	682.49
236	1	1935	.00	11.60	11.60	12.26	6.22	682.49
237	1	1940	.00	11.60	11.60	12.25	6.22	682.49
238	1	1945	.00	11.60	11.60	12.24	6.22	682.49
239	1	1950	.00	11.60	11.60	12.23	6.21	682.49
240	1	1955	.00	11.60	11.60	12.22	6.21	682.49
241	1	2000	.00	11.60	11.60	12.21	6.20	682.49
242	1	2005	.00	11.60	11.60	12.20	6.20	682.49
243	1	2010	.00	11.60	11.60	12.19	6.19	682.48
244	1	2015	.00	11.60	11.60	12.18	6.19	682.48
245	1	2020	.00	11.60	11.60	12.17	6.19	682.48
246	1	2025	.00	11.60	11.60	12.16	6.18	682.48
247	1	2030	.00	11.60	11.60	12.15	6.18	682.48
248	1	2035	.00	11.60	11.60	12.14	6.17	682.48
249	1	2040	.00	11.60	11.60	12.13	6.17	682.48
250	1	2045	.00	11.60	11.60	12.12	6.17	682.48

1TABLE 1 (CONT.)	STATION	BASIN FLOW	BASE FLOW	IN FLOW	IMP FLOW	IMP STORAGE	IMP STAGE
	PLAN	1	1	1	1	1	1
	RATIO	.50	.50	.50	.50	.50	.50
PER DAY MON	HRMN						
251 1	2050	.00	11.60	11.60	12.11	6.16	682.48
252 1	2055	.00	11.60	11.60	12.10	6.16	682.48
253 1	2100	.00	11.60	11.60	12.09	6.16	682.48
254 1	2105	.00	11.60	11.60	12.09	6.15	682.47
255 1	2110	.00	11.60	11.60	12.08	6.15	682.47
256 1	2115	.00	11.60	11.60	12.07	6.15	682.47
257 1	2120	.00	11.60	11.60	12.06	6.14	682.47
258 1	2125	.00	11.60	11.60	12.05	6.14	682.47
259 1	2130	.00	11.60	11.60	12.05	6.14	682.47
260 1	2135	.00	11.60	11.60	12.04	6.13	682.47
261 1	2140	.00	11.60	11.60	12.03	6.13	682.47
262 1	2145	.00	11.60	11.60	12.02	6.13	682.47
263 1	2150	.00	11.60	11.60	12.02	6.13	682.47
264 1	2155	.00	11.60	11.60	12.01	6.12	682.47
265 1	2200	.00	11.60	11.60	12.00	6.12	682.47
266 1	2205	.00	11.60	11.60	11.99	6.12	682.47
267 1	2210	.00	11.60	11.60	11.99	6.11	682.47
268 1	2215	.00	11.60	11.60	11.98	6.11	682.47
269 1	2220	.00	11.60	11.60	11.97	6.11	682.46
270 1	2225	.00	11.60	11.60	11.97	6.11	682.46
271 1	2230	.00	11.60	11.60	11.96	6.10	682.46
272 1	2235	.00	11.60	11.60	11.95	6.10	682.46
273 1	2240	.00	11.60	11.60	11.95	6.10	682.46
274 1	2245	.00	11.60	11.60	11.94	6.10	682.46
275 1	2250	.00	11.60	11.60	11.94	6.09	682.46
276 1	2255	.00	11.60	11.60	11.93	6.09	682.46
277 1	2300	.00	11.60	11.60	11.93	6.09	682.46
278 1	2305	.00	11.60	11.60	11.92	6.09	682.46
279 1	2310	.00	11.60	11.60	11.91	6.09	682.46
280 1	2315	.00	11.60	11.60	11.91	6.08	682.46
281 1	2320	.00	11.60	11.60	11.90	6.08	682.46
282 1	2325	.00	11.60	11.60	11.90	6.08	682.46
283 1	2330	.00	11.60	11.60	11.89	6.08	682.46
284 1	2335	.00	11.60	11.60	11.89	6.08	682.46
285 1	2340	.00	11.60	11.60	11.88	6.07	682.46
286 1	2345	.00	11.60	11.60	11.88	6.07	682.46
287 1	2350	.00	11.60	11.60	11.87	6.07	682.46
288 1	2355	.00	11.60	11.60	11.87	6.07	682.46
289 2	0000	.00	11.60	11.60	11.86	6.07	682.45
290 2	0005	.00	11.60	11.60	11.86	6.06	682.45
291 2	0010	.00	11.60	11.60	11.85	6.06	682.45
292 2	0015	.00	11.60	11.60	11.85	6.06	682.45
293 2	0020	.00	11.60	11.60	11.85	6.06	682.45
294 2	0025	.00	11.60	11.60	11.84	6.06	682.45
295 2	0030	.00	11.60	11.60	11.84	6.06	682.45
296 2	0035	.00	11.60	11.60	11.83	6.05	682.45
297 2	0040	.00	11.60	11.60	11.83	6.05	682.45
298 2	0045	.00	11.60	11.60	11.83	6.05	682.45
299 2	0050	.00	11.60	11.60	11.82	6.05	682.45
300 2	0055	.00	11.60	11.60	11.82	6.05	682.45
	MAX	99.48	11.60	111.08	23.83	10.75	683.51
	MIN	.00	11.60	11.60	.00	.00	681.00
	AVE	5.49	11.60	17.09	14.14	6.88	682.64

*** NORMAL END OF HEC-1 ***

Clear Water Pond

SUMMARY OF INFLOW HYDROGRAPH
AND FLOOD ROUTING THROUGH
MITCHELL CLEAR WATER POND
FOR ½ 6-HOUR PMP STORM EVENT

Starting Pool Elevation	=	664 ft, NAVD
Pipe Spillway Invert Elevation	=	664 ft, NAVD
Crest Elevation	=	675 ft, NAVD
Peak Inflow	=	71.44 cfs
Peak Outflow	=	44.76 cfs
Peak Storage	=	5.65 ac-ft
Maximum Impoundment Level During Storm	=	666.50 ft, NAVD
Minimum Freeboard During Storm	=	8.50 ft

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1***************************************                                                  *************************************
 *                                      *                                                  *                                   *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                  *   U.S. ARMY CORPS OF ENGINEERS    *
 *            SEPTEMBER 1990            *                                                  *   HYDROLOGIC ENGINEERING CENTER   *
 *              VERSION 4.0             *                                                  *         609 SECOND STREET         *
 *                                      *                                                  *      DAVIS, CALIFORNIA 95616      *
 *  RUN DATE  12/21/2015  TIME  11:05:16 *                                                 *          (916) 756-1104           *
 *                                      *                                                  *                                   *
 ****************************************                                                  *************************************


                                              X     X  XXXXXXX   XXXXX          X
                                              X     X  X        X     X        XX
                                              X     X  X        X               X
                                              XXXXXXX  XXXX     X       XXXXX   X
                                              X     X  X        X               X
                                              X     X  X        X     X         X
                                              X     X  XXXXXXX   XXXXX         XXX
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THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

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          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 *** FREE ***
            1           ID  ***************************************************************************
            2           ID  *      Mitchell Clear Water Pond       File: MCWP.inp                         *
            3           ID  *      GA Project No. 01-269BA                                                *
            4           ID  *      Storm Routing for 1/2 6-Hour PMP                                       *
            5           ID  *      Crest Elevation = 675'                                                 *
            6           ID  ***************************************************************************
            7           ID  *      Analyses by: Geo/Environmental Associates, Inc.                        *
            8           ID  *                   Knoxville, TN                                             *
            9           ID  *                   Seth W. Frank P.E.                                        *
           10           ID  *                   August 2014                                               *
           11           ID  ***************************************************************************
           12           IT      15       0       0     300
           13           IO       1
           14           JR  PRECIP     0.5
           15           VS   BASIN    BASE      IN     IMP     IMP     IMP
           16           VV    2.11    2.11    2.11    2.11    6.11    7.11
           17           IN      15

           18           KK   BASIN
           19           KM   COMPUTE INFLOW HYDROGRAPH FOR MITCHELL CLEAR WATER POND USING SCS METHOD
           20           PB       0
           21           PI   0.258   0.347   0.420   0.478   0.520   0.546   0.624   0.804   0.790   0.939
           22           PI   2.264   4.483   4.834   3.277   1.215   0.797   0.831   0.735   0.553   0.535
           23           PI   0.501   0.451   0.386   0.305
           24           BA   0.008
           25           LU       0    0.05    45.5
           26           UD     0.0

           27           KK    BASE
           28           KM   BASE FLOW
           29           IN     360
           30           QI   23.83   23.83   23.83

           31           KK      IN
           32           KM   COMBINE BASIN INFLOW AND BASEFLOW
           33           KO       1
           34           HC       2

           35           KK     IMP
           36           KM   ROUTE COMPUTED HYDROGRAPH AND BASE FLOW THROUGH CLEAR WATER POND
           37           RS       1    ELEV     664
           38           SA    2.18    2.24    2.30    2.38    2.45    2.56    2.67    2.79    2.91    3.03
           39           SA    3.15    3.30
           40           SQ       0   12.15   32.67    56.9   68.98   71.79   74.50   77.12   79.65   82.10
           41           SQ   84.48   86.79
           42           SE     664     665     666     667     668     669     670     671     672     673
           43           SE     674     675
           44           ZZ
```

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1***************************************                                                ***************************************
 *                                     *                                                *                                     *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                               *   U.S. ARMY CORPS OF ENGINEERS     *
 *           SEPTEMBER 1990             *                                               *   HYDROLOGIC ENGINEERING CENTER    *
 *             VERSION 4.0              *                                               *        609 SECOND STREET           *
 *                                     *                                                *      DAVIS, CALIFORNIA 95616       *
 *  RUN DATE  12/21/2015  TIME  11:05:16 *                                              *           (916) 756-1104           *
 *                                     *                                                *                                     *
***************************************                                                ***************************************




                         ****************************************************************************
                         *      Mitchell Clear Water Pond       File: MCWP.inp                       *
                         *      GA Project No. 01-269BA                                              *
                         *      Storm Routing for 1/2 6-Hour PMP                                     *
                         *      Crest Elevation = 675'                                               *
                         ****************************************************************************
                         *      Analyses by: Geo/Environmental Associates, Inc.                      *
                         *                   Knoxville, TN                                           *
                         *                   Seth W. Frank P.E.                                      *
                         *                   August 2014                                             *
                         ****************************************************************************

   13 IO          OUTPUT CONTROL VARIABLES
                        IPRNT          1  PRINT CONTROL
                        IPLOT          0  PLOT CONTROL
                        QSCAL         0.  HYDROGRAPH PLOT SCALE

      IT          HYDROGRAPH TIME DATA
                         NMIN         15  MINUTES IN COMPUTATION INTERVAL
                        IDATE      1    0  STARTING DATE
                        ITIME       0000  STARTING TIME
                           NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                       NDDATE      4    0  ENDING DATE
                       NDTIME       0245  ENDING TIME
                       ICENT          19  CENTURY MARK

                  COMPUTATION INTERVAL     .25 HOURS
                       TOTAL TIME BASE   74.75 HOURS

         ENGLISH UNITS
              DRAINAGE AREA         SQUARE MILES
              PRECIPITATION DEPTH   INCHES
              LENGTH, ELEVATION     FEET
              FLOW                  CUBIC FEET PER SECOND
              STORAGE VOLUME        ACRE-FEET
              SURFACE AREA          ACRES
              TEMPERATURE           DEGREES FAHRENHEIT

                USER-DEFINED OUTPUT SPECIFICATIONS

        TABLE 1
      VS       STATION     BASIN      BASE       IN       IMP       IMP       IMP
      VV VARIABLE CODE      2.11      2.11      2.11      2.11      6.11      7.11       .00       .00       .00       .00

      JP          MULTI-PLAN OPTION
                        NPLAN          1  NUMBER OF PLANS

      JR          MULTI-RATIO OPTION
                      RATIOS OF PRECIPITATION
                     .50


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
   18 KK    *    BASIN   *
            *            *
            **************
                          COMPUTE INFLOW HYDROGRAPH FOR MITCHELL CLEAR WATER POND USING SCS METHOD

   17 IN          TIME DATA FOR INPUT TIME SERIES
                        JXMIN         15  TIME INTERVAL IN MINUTES
                       JXDATE      1    0  STARTING DATE
                       JXTIME          0  STARTING TIME
```

```
             SUBBASIN RUNOFF DATA

  24 BA        SUBBASIN CHARACTERISTICS
                     TAREA         .01  SUBBASIN AREA

               PRECIPITATION DATA

  20 PB              STORM       26.89  BASIN TOTAL PRECIPITATION

  21 PI          INCREMENTAL PRECIPITATION PATTERN
                     .26       .35       .42       .48       .52       .55       .62       .80       .79       .94
                    2.26      4.48      4.83      3.28      1.22       .80       .83       .74       .55       .53
                     .50       .45       .39       .31

  25 LU        UNIFORM LOSS RATE
                     STRTL         .00  INITIAL LOSS
                     CNSTL         .05  UNIFORM LOSS RATE
                     RTIMP       45.50  PERCENT IMPERVIOUS AREA

  26 UD        SCS DIMENSIONLESS UNITGRAPH
                      TLAG         .00  LAG

                                                                   ***

 W
  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR       72-HR     74.75-HR
+   (CFS)       (HR)
                         (CFS)
+      45.      3.75                33.         26.         25.         24.
                      (INCHES)    19.054      60.757     171.538     175.055
                       (AC-FT)       16.         52.        146.        149.

 PEAK STORAGE   TIME                       MAXIMUM AVERAGE STORAGE
                                   6-HR       24-HR       72-HR     74.75-HR
+  (AC-FT)      (HR)
        6.      3.75                 4.          4.          4.          4.

  PEAK STAGE    TIME                        MAXIMUM AVERAGE STAGE
                                   6-HR       24-HR       72-HR     74.75-HR
+   (FEET)      (HR)
    666.50      3.75              665.99      665.68      665.60      665.58

                        CUMULATIVE AREA =     .02 SQ MI
```

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

```
                                                     RATIOS APPLIED TO PRECIPITATION
 OPERATION       STATION     AREA    PLAN           RATIO 1
                                                        .50

 HYDROGRAPH AT
+                  BASIN       .01     1   FLOW          48.
                                           TIME        3.25

 HYDROGRAPH AT
+                   BASE       .01     1   FLOW          24.
                                           TIME         .25

  2 COMBINED AT
+                     IN       .02     1   FLOW          71.
                                           TIME        3.25

 ROUTED TO
+                    IMP       .02     1   FLOW          45.
                                           TIME        3.75

                                      ** PEAK STAGES IN FEET **
                                       1   STAGE      666.50
                                           TIME        3.75
```

1TABLE 1	STATION		BASIN FLOW	BASE FLOW	IN FLOW	IMP FLOW	IMP STORAGE	IMP STAGE	
	PLAN		1	1	1	1	1	1	
	RATIO		.50	.50	.50	.50	.50	.50	
PER	DAY MON	HRMN							
1	1	0000	.00	23.83	23.83	.00	.00	664.00	
2	1	0015	1.87	23.83	25.70	2.66	.48	664.22	
3	1	0030	3.08	23.83	26.91	5.20	.95	664.43	
4	1	0045	3.94	23.83	27.77	7.58	1.38	664.62	
5	1	0100	4.60	23.83	28.43	9.79	1.78	664.81	
6	1	0115	5.08	23.83	28.91	11.82	2.15	664.97	
7	1	0130	5.40	23.83	29.23	14.57	2.48	665.12	
8	1	0145	6.08	23.83	29.91	17.13	2.76	665.24	
9	1	0200	7.64	23.83	31.47	19.45	3.02	665.36	
10	1	0215	7.96	23.83	31.79	21.53	3.25	665.46	
11	1	0230	9.15	23.83	32.98	23.38	3.45	665.55	
12	1	0245	19.64	23.83	43.47	25.92	3.73	665.67	
13	1	0300	39.57	23.83	63.40	30.62	4.25	665.90	
14	1	0315	47.61	23.83	71.44	37.46	4.94	666.20	
15	1	0330	37.46	23.83	61.29	43.05	5.48	666.43	
16	1	0345	18.64	23.83	42.47	44.76	**5.65**	**666.50**	**Maximum impoundment stage/storage**
17	1	0400	10.37	23.83	34.20	43.51	5.53	666.45	
18	1	0415	8.74	23.83	32.57	41.56	5.34	666.37	
19	1	0430	7.72	23.83	31.55	39.72	5.16	666.29	
20	1	0445	6.10	23.83	29.93	37.99	4.99	666.22	
21	1	0500	5.53	23.83	29.36	36.37	4.84	666.15	
22	1	0515	5.15	23.83	28.98	34.98	4.70	666.10	
23	1	0530	4.67	23.83	28.50	33.77	4.59	666.05	
24	1	0545	4.05	23.83	27.88	32.69	4.48	666.00	
25	1	0600	3.26	23.83	27.09	31.80	4.38	665.96	
26	1	0615	.82	23.83	24.65	30.79	4.27	665.91	
27	1	0630	.15	23.83	23.98	29.68	4.15	665.85	
28	1	0645	.02	23.83	23.85	28.70	4.04	665.81	
29	1	0700	.00	23.83	23.83	27.87	3.95	665.77	
30	1	0715	.00	23.83	23.83	27.18	3.87	665.73	
31	1	0730	.00	23.83	23.83	26.61	3.81	665.70	
32	1	0745	.00	23.83	23.83	26.13	3.76	665.68	
33	1	0800	.00	23.83	23.83	25.74	3.71	665.66	
34	1	0815	.00	23.83	23.83	25.41	3.68	665.65	
35	1	0830	.00	23.83	23.83	25.14	3.65	665.63	
36	1	0845	.00	23.83	23.83	24.92	3.62	665.62	
37	1	0900	.00	23.83	23.83	24.73	3.60	665.61	
38	1	0915	.00	23.83	23.83	24.58	3.58	665.61	
39	1	0930	.00	23.83	23.83	24.45	3.57	665.60	
40	1	0945	.00	23.83	23.83	24.34	3.56	665.59	
41	1	1000	.00	23.83	23.83	24.26	3.55	665.59	
42	1	1015	.00	23.83	23.83	24.18	3.54	665.59	
43	1	1030	.00	23.83	23.83	24.12	3.53	665.58	
44	1	1045	.00	23.83	23.83	24.07	3.53	665.58	
45	1	1100	.00	23.83	23.83	24.03	3.52	665.58	
46	1	1115	.00	23.83	23.83	24.00	3.52	665.58	
47	1	1130	.00	23.83	23.83	23.97	3.52	665.58	
48	1	1145	.00	23.83	23.83	23.94	3.51	665.57	
49	1	1200	.00	23.83	23.83	23.93	3.51	665.57	
50	1	1215	.00	23.83	23.83	23.91	3.51	665.57	

1TABLE 1 (CONT.)		STATION	BASIN FLOW	BASE FLOW	IN FLOW	IMP FLOW	IMP STORAGE	IMP STAGE
		PLAN	1	1	1	1	1	1
		RATIO	.50	.50	.50	.50	.50	.50
PER	DAY MON	HRMN						
51	1	1230	.00	23.83	23.83	23.90	3.51	665.57
52	1	1245	.00	23.83	23.83	23.88	3.51	665.57
53	1	1300	.00	23.83	23.83	23.88	3.51	665.57
54	1	1315	.00	23.83	23.83	23.87	3.51	665.57
55	1	1330	.00	23.83	23.83	23.86	3.51	665.57
56	1	1345	.00	23.83	23.83	23.86	3.50	665.57
57	1	1400	.00	23.83	23.83	23.85	3.50	665.57
58	1	1415	.00	23.83	23.83	23.85	3.50	665.57
59	1	1430	.00	23.83	23.83	23.84	3.50	665.57
60	1	1445	.00	23.83	23.83	23.84	3.50	665.57
61	1	1500	.00	23.83	23.83	23.84	3.50	665.57
62	1	1515	.00	23.83	23.83	23.84	3.50	665.57
63	1	1530	.00	23.83	23.83	23.84	3.50	665.57
64	1	1545	.00	23.83	23.83	23.84	3.50	665.57
65	1	1600	.00	23.83	23.83	23.83	3.50	665.57
66	1	1615	.00	23.83	23.83	23.83	3.50	665.57
67	1	1630	.00	23.83	23.83	23.83	3.50	665.57
68	1	1645	.00	23.83	23.83	23.83	3.50	665.57
69	1	1700	.00	23.83	23.83	23.83	3.50	665.57
70	1	1715	.00	23.83	23.83	23.83	3.50	665.57
71	1	1730	.00	23.83	23.83	23.83	3.50	665.57
72	1	1745	.00	23.83	23.83	23.83	3.50	665.57
73	1	1800	.00	23.83	23.83	23.83	3.50	665.57
74	1	1815	.00	23.83	23.83	23.83	3.50	665.57
75	1	1830	.00	23.83	23.83	23.83	3.50	665.57
76	1	1845	.00	23.83	23.83	23.83	3.50	665.57
77	1	1900	.00	23.83	23.83	23.83	3.50	665.57
78	1	1915	.00	23.83	23.83	23.83	3.50	665.57
79	1	1930	.00	23.83	23.83	23.83	3.50	665.57
80	1	1945	.00	23.83	23.83	23.83	3.50	665.57
81	1	2000	.00	23.83	23.83	23.83	3.50	665.57
82	1	2015	.00	23.83	23.83	23.83	3.50	665.57
83	1	2030	.00	23.83	23.83	23.83	3.50	665.57
84	1	2045	.00	23.83	23.83	23.83	3.50	665.57
85	1	2100	.00	23.83	23.83	23.83	3.50	665.57
86	1	2115	.00	23.83	23.83	23.83	3.50	665.57
87	1	2130	.00	23.83	23.83	23.83	3.50	665.57
88	1	2145	.00	23.83	23.83	23.83	3.50	665.57
89	1	2200	.00	23.83	23.83	23.83	3.50	665.57
90	1	2215	.00	23.83	23.83	23.83	3.50	665.57
91	1	2230	.00	23.83	23.83	23.83	3.50	665.57
92	1	2245	.00	23.83	23.83	23.83	3.50	665.57
93	1	2300	.00	23.83	23.83	23.83	3.50	665.57
94	1	2315	.00	23.83	23.83	23.83	3.50	665.57
95	1	2330	.00	23.83	23.83	23.83	3.50	665.57
96	1	2345	.00	23.83	23.83	23.83	3.50	665.57
97	2	0000	.00	23.83	23.83	23.83	3.50	665.57
98	2	0015	.00	23.83	23.83	23.83	3.50	665.57
99	2	0030	.00	23.83	23.83	23.83	3.50	665.57
100	2	0045	.00	23.83	23.83	23.83	3.50	665.57

1TABLE 1 (CONT.)	STATION		BASIN FLOW	BASE FLOW	IN FLOW	IMP FLOW	IMP STORAGE	IMP STAGE
	PLAN		1	1	1	1	1	1
	RATIO		.50	.50	.50	.50	.50	.50
PER	DAY MON	HRMN						
101	2	0100	.00	23.83	23.83	23.83	3.50	665.57
102	2	0115	.00	23.83	23.83	23.83	3.50	665.57
103	2	0130	.00	23.83	23.83	23.83	3.50	665.57
104	2	0145	.00	23.83	23.83	23.83	3.50	665.57
105	2	0200	.00	23.83	23.83	23.83	3.50	665.57
106	2	0215	.00	23.83	23.83	23.83	3.50	665.57
107	2	0230	.00	23.83	23.83	23.83	3.50	665.57
108	2	0245	.00	23.83	23.83	23.83	3.50	665.57
109	2	0300	.00	23.83	23.83	23.83	3.50	665.57
110	2	0315	.00	23.83	23.83	23.83	3.50	665.57
111	2	0330	.00	23.83	23.83	23.83	3.50	665.57
112	2	0345	.00	23.83	23.83	23.83	3.50	665.57
113	2	0400	.00	23.83	23.83	23.83	3.50	665.57
114	2	0415	.00	23.83	23.83	23.83	3.50	665.57
115	2	0430	.00	23.83	23.83	23.83	3.50	665.57
116	2	0445	.00	23.83	23.83	23.83	3.50	665.57
117	2	0500	.00	23.83	23.83	23.83	3.50	665.57
118	2	0515	.00	23.83	23.83	23.83	3.50	665.57
119	2	0530	.00	23.83	23.83	23.83	3.50	665.57
120	2	0545	.00	23.83	23.83	23.83	3.50	665.57
121	2	0600	.00	23.83	23.83	23.83	3.50	665.57
122	2	0615	.00	23.83	23.83	23.83	3.50	665.57
123	2	0630	.00	23.83	23.83	23.83	3.50	665.57
124	2	0645	.00	23.83	23.83	23.83	3.50	665.57
125	2	0700	.00	23.83	23.83	23.83	3.50	665.57
126	2	0715	.00	23.83	23.83	23.83	3.50	665.57
127	2	0730	.00	23.83	23.83	23.83	3.50	665.57
128	2	0745	.00	23.83	23.83	23.83	3.50	665.57
129	2	0800	.00	23.83	23.83	23.83	3.50	665.57
130	2	0815	.00	23.83	23.83	23.83	3.50	665.57
131	2	0830	.00	23.83	23.83	23.83	3.50	665.57
132	2	0845	.00	23.83	23.83	23.83	3.50	665.57
133	2	0900	.00	23.83	23.83	23.83	3.50	665.57
134	2	0915	.00	23.83	23.83	23.83	3.50	665.57
135	2	0930	.00	23.83	23.83	23.83	3.50	665.57
136	2	0945	.00	23.83	23.83	23.83	3.50	665.57
137	2	1000	.00	23.83	23.83	23.83	3.50	665.57
138	2	1015	.00	23.83	23.83	23.83	3.50	665.57
139	2	1030	.00	23.83	23.83	23.83	3.50	665.57
140	2	1045	.00	23.83	23.83	23.83	3.50	665.57
141	2	1100	.00	23.83	23.83	23.83	3.50	665.57
142	2	1115	.00	23.83	23.83	23.83	3.50	665.57
143	2	1130	.00	23.83	23.83	23.83	3.50	665.57
144	2	1145	.00	23.83	23.83	23.83	3.50	665.57
145	2	1200	.00	23.83	23.83	23.83	3.50	665.57
146	2	1215	.00	23.83	23.83	23.83	3.50	665.57
147	2	1230	.00	23.83	23.83	23.83	3.50	665.57
148	2	1245	.00	23.83	23.83	23.83	3.50	665.57
149	2	1300	.00	23.83	23.83	23.83	3.50	665.57
150	2	1315	.00	23.83	23.83	23.83	3.50	665.57

1TABLE 1 (CONT.)	STATION	BASIN FLOW	BASE FLOW	IN FLOW	IMP FLOW	IMP STORAGE	IMP STAGE
	PLAN	1	1	1	1	1	1
	RATIO	.50	.50	.50	.50	.50	.50
PER DAY MON	HRMN						
151 2	1330	.00	23.83	23.83	23.83	3.50	665.57
152 2	1345	.00	23.83	23.83	23.83	3.50	665.57
153 2	1400	.00	23.83	23.83	23.83	3.50	665.57
154 2	1415	.00	23.83	23.83	23.83	3.50	665.57
155 2	1430	.00	23.83	23.83	23.83	3.50	665.57
156 2	1445	.00	23.83	23.83	23.83	3.50	665.57
157 2	1500	.00	23.83	23.83	23.83	3.50	665.57
158 2	1515	.00	23.83	23.83	23.83	3.50	665.57
159 2	1530	.00	23.83	23.83	23.83	3.50	665.57
160 2	1545	.00	23.83	23.83	23.83	3.50	665.57
161 2	1600	.00	23.83	23.83	23.83	3.50	665.57
162 2	1615	.00	23.83	23.83	23.83	3.50	665.57
163 2	1630	.00	23.83	23.83	23.83	3.50	665.57
164 2	1645	.00	23.83	23.83	23.83	3.50	665.57
165 2	1700	.00	23.83	23.83	23.83	3.50	665.57
166 2	1715	.00	23.83	23.83	23.83	3.50	665.57
167 2	1730	.00	23.83	23.83	23.83	3.50	665.57
168 2	1745	.00	23.83	23.83	23.83	3.50	665.57
169 2	1800	.00	23.83	23.83	23.83	3.50	665.57
170 2	1815	.00	23.83	23.83	23.83	3.50	665.57
171 2	1830	.00	23.83	23.83	23.83	3.50	665.57
172 2	1845	.00	23.83	23.83	23.83	3.50	665.57
173 2	1900	.00	23.83	23.83	23.83	3.50	665.57
174 2	1915	.00	23.83	23.83	23.83	3.50	665.57
175 2	1930	.00	23.83	23.83	23.83	3.50	665.57
176 2	1945	.00	23.83	23.83	23.83	3.50	665.57
177 2	2000	.00	23.83	23.83	23.83	3.50	665.57
178 2	2015	.00	23.83	23.83	23.83	3.50	665.57
179 2	2030	.00	23.83	23.83	23.83	3.50	665.57
180 2	2045	.00	23.83	23.83	23.83	3.50	665.57
181 2	2100	.00	23.83	23.83	23.83	3.50	665.57
182 2	2115	.00	23.83	23.83	23.83	3.50	665.57
183 2	2130	.00	23.83	23.83	23.83	3.50	665.57
184 2	2145	.00	23.83	23.83	23.83	3.50	665.57
185 2	2200	.00	23.83	23.83	23.83	3.50	665.57
186 2	2215	.00	23.83	23.83	23.83	3.50	665.57
187 2	2230	.00	23.83	23.83	23.83	3.50	665.57
188 2	2245	.00	23.83	23.83	23.83	3.50	665.57
189 2	2300	.00	23.83	23.83	23.83	3.50	665.57
190 2	2315	.00	23.83	23.83	23.83	3.50	665.57
191 2	2330	.00	23.83	23.83	23.83	3.50	665.57
192 2	2345	.00	23.83	23.83	23.83	3.50	665.57
193 3	0000	.00	23.83	23.83	23.83	3.50	665.57
194 3	0015	.00	23.83	23.83	23.83	3.50	665.57
195 3	0030	.00	23.83	23.83	23.83	3.50	665.57
196 3	0045	.00	23.83	23.83	23.83	3.50	665.57
197 3	0100	.00	23.83	23.83	23.83	3.50	665.57
198 3	0115	.00	23.83	23.83	23.83	3.50	665.57
199 3	0130	.00	23.83	23.83	23.83	3.50	665.57
200 3	0145	.00	23.83	23.83	23.83	3.50	665.57

1TABLE 1 (CONT.)	STATION	BASIN FLOW	BASE FLOW	IN FLOW	IMP FLOW	IMP STORAGE	IMP STAGE
	PLAN	1	1	1	1	1	1
	RATIO	.50	.50	.50	.50	.50	.50
PER	DAY MON HRMN						
201	3 0200	.00	23.83	23.83	23.83	3.50	665.57
202	3 0215	.00	23.83	23.83	23.83	3.50	665.57
203	3 0230	.00	23.83	23.83	23.83	3.50	665.57
204	3 0245	.00	23.83	23.83	23.83	3.50	665.57
205	3 0300	.00	23.83	23.83	23.83	3.50	665.57
206	3 0315	.00	23.83	23.83	23.83	3.50	665.57
207	3 0330	.00	23.83	23.83	23.83	3.50	665.57
208	3 0345	.00	23.83	23.83	23.83	3.50	665.57
209	3 0400	.00	23.83	23.83	23.83	3.50	665.57
210	3 0415	.00	23.83	23.83	23.83	3.50	665.57
211	3 0430	.00	23.83	23.83	23.83	3.50	665.57
212	3 0445	.00	23.83	23.83	23.83	3.50	665.57
213	3 0500	.00	23.83	23.83	23.83	3.50	665.57
214	3 0515	.00	23.83	23.83	23.83	3.50	665.57
215	3 0530	.00	23.83	23.83	23.83	3.50	665.57
216	3 0545	.00	23.83	23.83	23.83	3.50	665.57
217	3 0600	.00	23.83	23.83	23.83	3.50	665.57
218	3 0615	.00	23.83	23.83	23.83	3.50	665.57
219	3 0630	.00	23.83	23.83	23.83	3.50	665.57
220	3 0645	.00	23.83	23.83	23.83	3.50	665.57
221	3 0700	.00	23.83	23.83	23.83	3.50	665.57
222	3 0715	.00	23.83	23.83	23.83	3.50	665.57
223	3 0730	.00	23.83	23.83	23.83	3.50	665.57
224	3 0745	.00	23.83	23.83	23.83	3.50	665.57
225	3 0800	.00	23.83	23.83	23.83	3.50	665.57
226	3 0815	.00	23.83	23.83	23.83	3.50	665.57
227	3 0830	.00	23.83	23.83	23.83	3.50	665.57
228	3 0845	.00	23.83	23.83	23.83	3.50	665.57
229	3 0900	.00	23.83	23.83	23.83	3.50	665.57
230	3 0915	.00	23.83	23.83	23.83	3.50	665.57
231	3 0930	.00	23.83	23.83	23.83	3.50	665.57
232	3 0945	.00	23.83	23.83	23.83	3.50	665.57
233	3 1000	.00	23.83	23.83	23.83	3.50	665.57
234	3 1015	.00	23.83	23.83	23.83	3.50	665.57
235	3 1030	.00	23.83	23.83	23.83	3.50	665.57
236	3 1045	.00	23.83	23.83	23.83	3.50	665.57
237	3 1100	.00	23.83	23.83	23.83	3.50	665.57
238	3 1115	.00	23.83	23.83	23.83	3.50	665.57
239	3 1130	.00	23.83	23.83	23.83	3.50	665.57
240	3 1145	.00	23.83	23.83	23.83	3.50	665.57
241	3 1200	.00	23.83	23.83	23.83	3.50	665.57
242	3 1215	.00	23.83	23.83	23.83	3.50	665.57
243	3 1230	.00	23.83	23.83	23.83	3.50	665.57
244	3 1245	.00	23.83	23.83	23.83	3.50	665.57
245	3 1300	.00	23.83	23.83	23.83	3.50	665.57
246	3 1315	.00	23.83	23.83	23.83	3.50	665.57
247	3 1330	.00	23.83	23.83	23.83	3.50	665.57
248	3 1345	.00	23.83	23.83	23.83	3.50	665.57
249	3 1400	.00	23.83	23.83	23.83	3.50	665.57
250	3 1415	.00	23.83	23.83	23.83	3.50	665.57

1TABLE 1 (CONT.)		STATION	BASIN FLOW	BASE FLOW	IN FLOW	IMP FLOW	IMP STORAGE	IMP STAGE
		PLAN	1	1	1	1	1	1
		RATIO	.50	.50	.50	.50	.50	.50
PER	DAY MON	HRMN						
251	3	1430	.00	23.83	23.83	23.83	3.50	665.57
252	3	1445	.00	23.83	23.83	23.83	3.50	665.57
253	3	1500	.00	23.83	23.83	23.83	3.50	665.57
254	3	1515	.00	23.83	23.83	23.83	3.50	665.57
255	3	1530	.00	23.83	23.83	23.83	3.50	665.57
256	3	1545	.00	23.83	23.83	23.83	3.50	665.57
257	3	1600	.00	23.83	23.83	23.83	3.50	665.57
258	3	1615	.00	23.83	23.83	23.83	3.50	665.57
259	3	1630	.00	23.83	23.83	23.83	3.50	665.57
260	3	1645	.00	23.83	23.83	23.83	3.50	665.57
261	3	1700	.00	23.83	23.83	23.83	3.50	665.57
262	3	1715	.00	23.83	23.83	23.83	3.50	665.57
263	3	1730	.00	23.83	23.83	23.83	3.50	665.57
264	3	1745	.00	23.83	23.83	23.83	3.50	665.57
265	3	1800	.00	23.83	23.83	23.83	3.50	665.57
266	3	1815	.00	23.83	23.83	23.83	3.50	665.57
267	3	1830	.00	23.83	23.83	23.83	3.50	665.57
268	3	1845	.00	23.83	23.83	23.83	3.50	665.57
269	3	1900	.00	23.83	23.83	23.83	3.50	665.57
270	3	1915	.00	23.83	23.83	23.83	3.50	665.57
271	3	1930	.00	23.83	23.83	23.83	3.50	665.57
272	3	1945	.00	23.83	23.83	23.83	3.50	665.57
273	3	2000	.00	23.83	23.83	23.83	3.50	665.57
274	3	2015	.00	23.83	23.83	23.83	3.50	665.57
275	3	2030	.00	23.83	23.83	23.83	3.50	665.57
276	3	2045	.00	23.83	23.83	23.83	3.50	665.57
277	3	2100	.00	23.83	23.83	23.83	3.50	665.57
278	3	2115	.00	23.83	23.83	23.83	3.50	665.57
279	3	2130	.00	23.83	23.83	23.83	3.50	665.57
280	3	2145	.00	23.83	23.83	23.83	3.50	665.57
281	3	2200	.00	23.83	23.83	23.83	3.50	665.57
282	3	2215	.00	23.83	23.83	23.83	3.50	665.57
283	3	2230	.00	23.83	23.83	23.83	3.50	665.57
284	3	2245	.00	23.83	23.83	23.83	3.50	665.57
285	3	2300	.00	23.83	23.83	23.83	3.50	665.57
286	3	2315	.00	23.83	23.83	23.83	3.50	665.57
287	3	2330	.00	23.83	23.83	23.83	3.50	665.57
288	3	2345	.00	23.83	23.83	23.83	3.50	665.57
289	4	0000	.00	23.83	23.83	23.83	3.50	665.57
290	4	0015	.00	23.83	23.83	23.83	3.50	665.57
291	4	0030	.00	23.83	23.83	23.83	3.50	665.57
292	4	0045	.00	23.83	23.83	23.83	3.50	665.57
293	4	0100	.00	23.83	23.83	23.83	3.50	665.57
294	4	0115	.00	23.83	23.83	23.83	3.50	665.57
295	4	0130	.00	23.83	23.83	23.83	3.50	665.57
296	4	0145	.00	23.83	23.83	23.83	3.50	665.57
297	4	0200	.00	23.83	23.83	23.83	3.50	665.57
298	4	0215	.00	23.83	23.83	23.83	3.50	665.57
299	4	0230	.00	23.83	23.83	23.83	3.50	665.57
300	4	0245	.00	23.83	23.83	23.83	3.50	665.57
		MAX	47.61	23.83	71.44	44.76	5.65	666.50
		MIN	.00	23.83	23.83	.00	.00	664.00
		AVE	.91	23.83	24.74	24.14	3.52	665.58

*** NORMAL END OF HEC-1 ***

Appendix III

Stability Analyses

Summary of Material Parameters Used in Slope Stability and Liquefaction Analyses

Material Strength Parameters

Material	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Effective Strength Parameters	
			Cohesion, c' (psf)	Friction Angle, φ' (degrees)
Soil Dike	124	134	300	29
Original Soil	120	130	0	34
Cohesive Liner	121	131	900	0

Material Parameters Used in Liquefaction Assessment

	Soil Dike (Clayey, Silty, Sand)	Original Ground (Silty Sand)	Cohesive Liner (Clay)
Damping Ratio Function(1)	Seed – Idriss	Seed – Idriss	Clay – Sun
Small Strain Shear Modulus G_{max} (psf)	121,540	166,540	QUAKE/W Function
Source(2)	GA – Triaxial Estimate	GA – Triaxial Estimate	QUAKE/W
Poisson's Ratio	0.28	0.28	0.3
Source(3)	Bowles	Bowles	Bowles
Cyclic Number Function(4)	QUAKE/W	QUAKE/W	None

Notes: (1) Damping Ratios from:
- Seed – Idriss (SHAKE91 User's Manual)
- Clay – Sun, et.al.

(2) G_{max} values estimated from results of triaxial tests performed by GA and built-in QUAKE/W function based on work by Hardin, Drnevich, Mayne, and Rix.

(3) Poisson's Ratio based on typical values described in Foundation Analysis and Design, 4th Ed., Joseph E. Bowles, P.E., S.E.

(4) Cyclic Number Function is a QUAKE/W built-in function based on work by Seed and Lee.

Summary of Stability Analysis Results

Stability Analysis Results

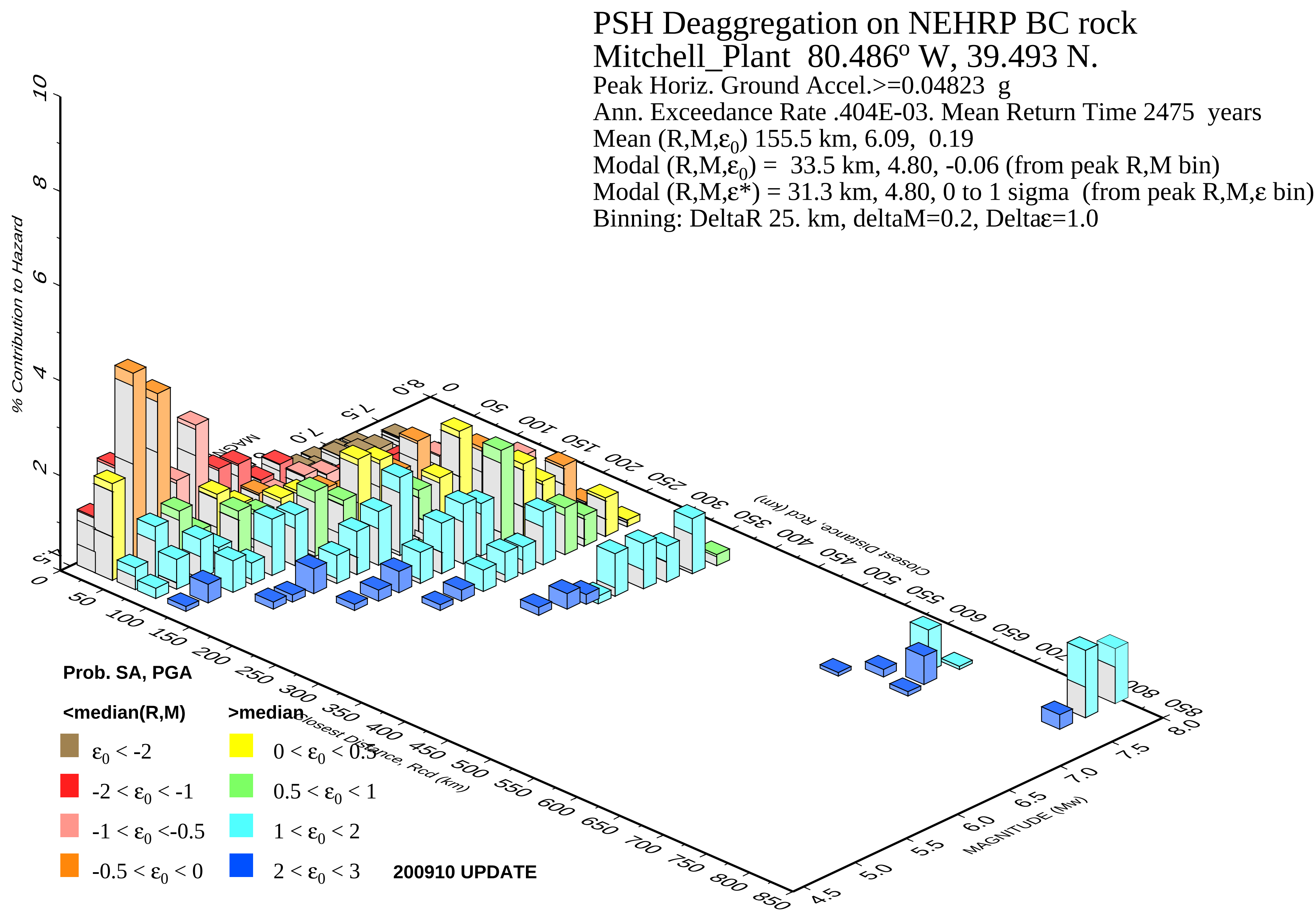
Profile	Downstream Static Long-Term Maximum Storage Pool	Downstream Static Maximum Surcharge Pool	Downstream Seismic	Upstream Seismic	Downstream Liquefaction Assessment	Upstream Liquefaction Assessment
SP1-SP1	2.09	2.05	1.80	2.08	2.02	1.20
SP2-SP2	1.87	1.86	1.53	2.01	1.21	1.24

Summary of Piezometric Levels Used

Profile	Piezometric Surface Elevation at Piezometer Location (Feet, NAVD)			
	Downstream Static Long-Term Maximum Storage Pool	Downstream Static Maximum Surcharge Pool	Seismic	Liquefaction Assessment
SP1-SP1	675	677	675	669 (2) (maximum measured)
SP2-SP2 (1)	675	676.5	675	669 (2) (maximum measured)
	690 (FS = 1.35)			
	682 (FS = 1.5)			

(1) For reference, given that section SP2 is the critical section for static stability, we included hypothetical elevated phreatic levels at the crest (690 feet NAVD) and corresponding to a Factor of Safety (FS) of 1.5.

(2) 669 is approximately the maximum measured piezometer level for Sections SP1 and SP2, since piezometers were installed in March of 2009.



GMT 2015 Oct 28 14:45:31 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on rock with average vs= 760. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

Geo/Environmental Associates, Inc.

Job Name: MITCHELL PLANT - CCR RULES A & C

Job Number: 15055013.00

Title: HORIZONTAL SEISMIC COEFFICIENT DETERMINATION FOR CONNER RUN DAM

Computed by: RWC Checked by:

Date: 11/6/15 Sheet: 1 Of: 2

GIVEN: - FIGURE 20.4 FROM "GEOTECHNICAL ENGINEERING - PRINCIPLES AND PRACTICES," (CODUTO, 1999)

- PEAK HORIZONTAL GROUND ACCELERATION = 0.04609 (ROCK) FOR ANNUAL EXCEEDANCE RATE = 0.401E⁻³; MEAN RETURN TIME = 2,475 YRS FROM "PSH DEAGGREGATION ON NEHRP BC ROCK - CONNER RUN DAM 80.805°W, 39.825N," USGS INTERACTIVE DEAGGREGATION WEBSITE.

REQ'D: DETERMINE HORIZONTAL SEISMIC COEFFICIENT FOR CONNER RUN DAM.

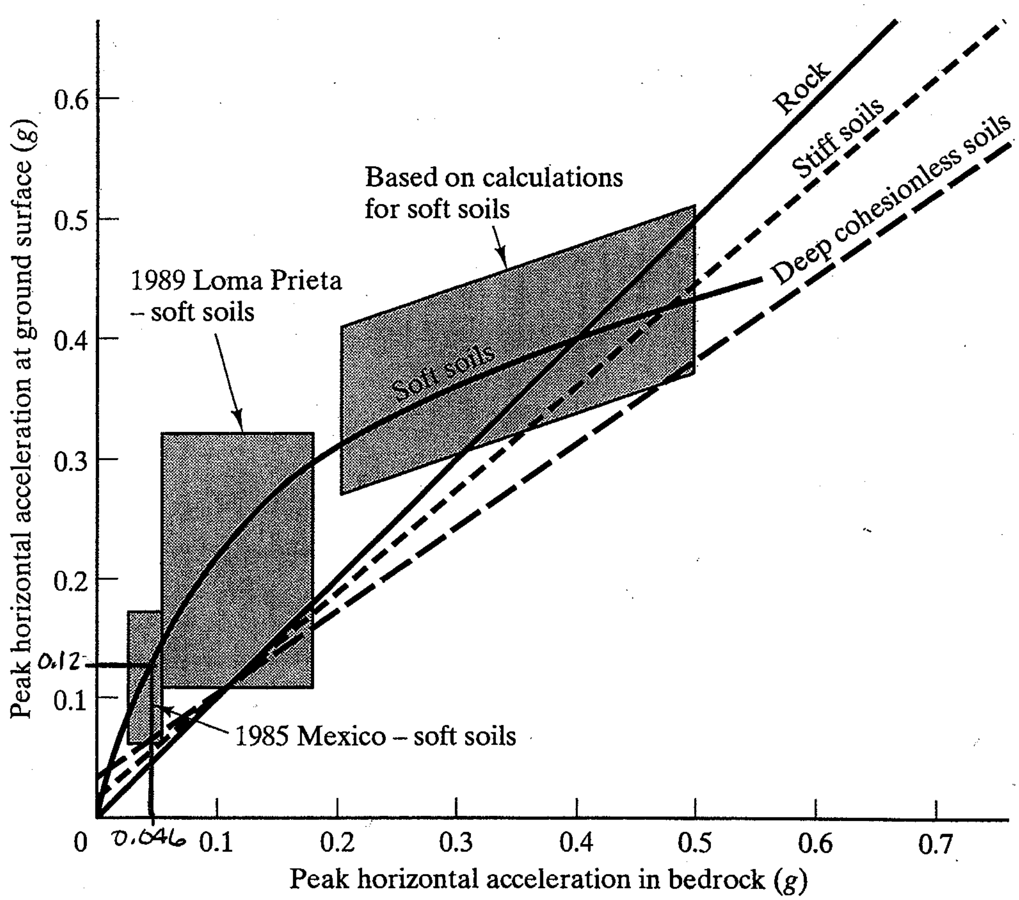


Figure 20.4 Approximate adjustment to convert peak rock acceleration to peak acceleration at the ground surface. The shaded boxes indicate observed relationships for soft soil sites during the 1989 Loma Prieta and 1985 Mexico earthquakes, along with a predicted relationship (Seed, et al., 1976, and Idriss, 1990).

GA

Geo/Environmental Associates, Inc.

Job Name: MITCHELL PLANT-CCR RULES A&C

Job Number: 15055013.00

Title: HORIZONTAL SEISMIC COEFFICIENT DETERMINATION FOR CONNER RUN DAM

Computed by: RWC Checked by:

Date: 11/6/15 Sheet: 2 Of: 2

SOLUTION: - USING FIGURE 20.4 AND DEAGGREGATION CHART, DETERMINE PEAK ACCELERATION AT GROUND SURFACE CONSERVATIVELY ASSUMING SOFT SOILS ARE PRESENT.

→ PEAK HORIZONTAL ACCELERATION AT GROUND SURFACE = 0.12g (FOR SOFT SOILS)

- USING A COMMONLY APPLIED FACTOR OF 0.5 * PGA:

HORIZONTAL SEISMIC COEFFICIENT = (0.5) (1.2) = 0.06g

GA

Geo/Environmental Associates, Inc.

Job Name: CCR Rules - Bottom Ash Ponds

Job Number: 15055013

Title: Estimation of Shear Modulus G'

Computed by: SWF Checked by: ________

Date: 10-30-15 Sheet: 1 Of: 1

- From triaxial test results estimate shear modulus for
  1) clayey/silty sand embankment soil and
  2) silty sand foundation soil

1) clayey/silty sand embankment soil

* - shear modulus G' = ratio of shear stress to shear strain

$$G' = \frac{E_s}{2(1+\nu)}$$ where E = stress-strain Modulus and ν = Poison's Ratio

See estimation of E from triaxial testing of B-1, B-3, + B-4 Shelby tube samples (remolded).

E = 316 ksf = 316000 psf

ν (from Bowles*) = 0.3

$$G' = \frac{316000}{2(1+0.3)} = \underline{\underline{121540\ psf}}$$

2) silty sand foundation soil

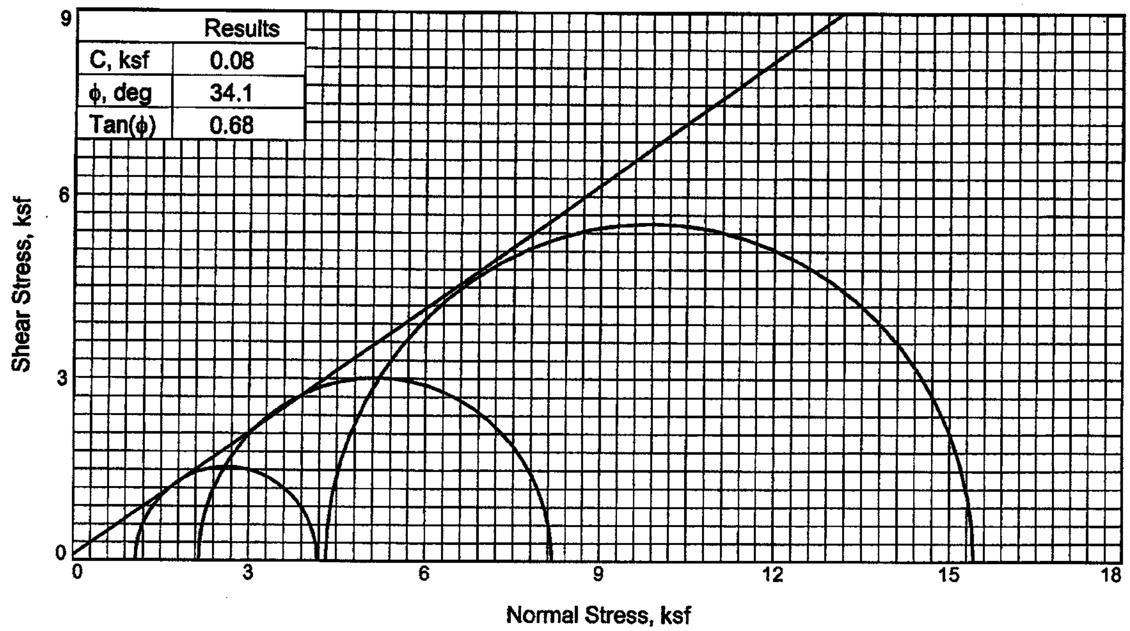
See estimation of E from triaxial testing of B-2, ST-2 shelby tube sample.

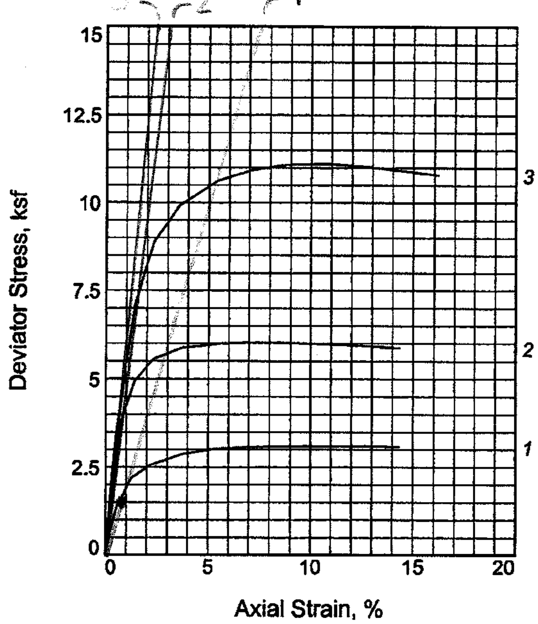
E = 433 ksf = 433000 psf

ν (from Bowles*) = 0.3

$$G' = \frac{433000}{2(1+0.3)} = \underline{\underline{166540\ psf}}$$

* Foundation Analysis and Design, 4th Edition, Joseph E. Bowles, P.E., S.E.





Modulus E (ksf) 200 500 600 Avg. 433

Sample No.		1	2	3
Initial	Water Content, %	8.6	9.0	8.7
	Dry Density, pcf	105.3	105.8	105.5
	Saturation, %	38.7	40.9	39.3
	Void Ratio	0.6009	0.5926	0.5976
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.60	5.60	5.60
At Test	Water Content, %	21.6	21.0	20.8
	Dry Density, pcf	106.4	107.6	107.9
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.5838	0.5670	0.5618
	Diameter, in.	2.79	2.78	2.78
	Height, in.	5.58	5.57	5.56
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, psi		0.00	0.00	0.00
Cell Pressure, psi		7.50	15.00	30.00
Fail. Stress, ksf		3.1	6.0	11.1
Ult. Stress, ksf				
σ_1 Failure, ksf		4.2	8.2	15.4
σ_3 Failure, ksf		1.1	2.2	4.3

Type of Test:
Consolidated Drained

Sample Type: Shelby Tube

Description: Sand, brown, light brown

LL= nv **PI=** np

Specific Gravity= 2.70

Remarks:

Client: American Electric Power

Project: Mitchell Bottom Ash Pond

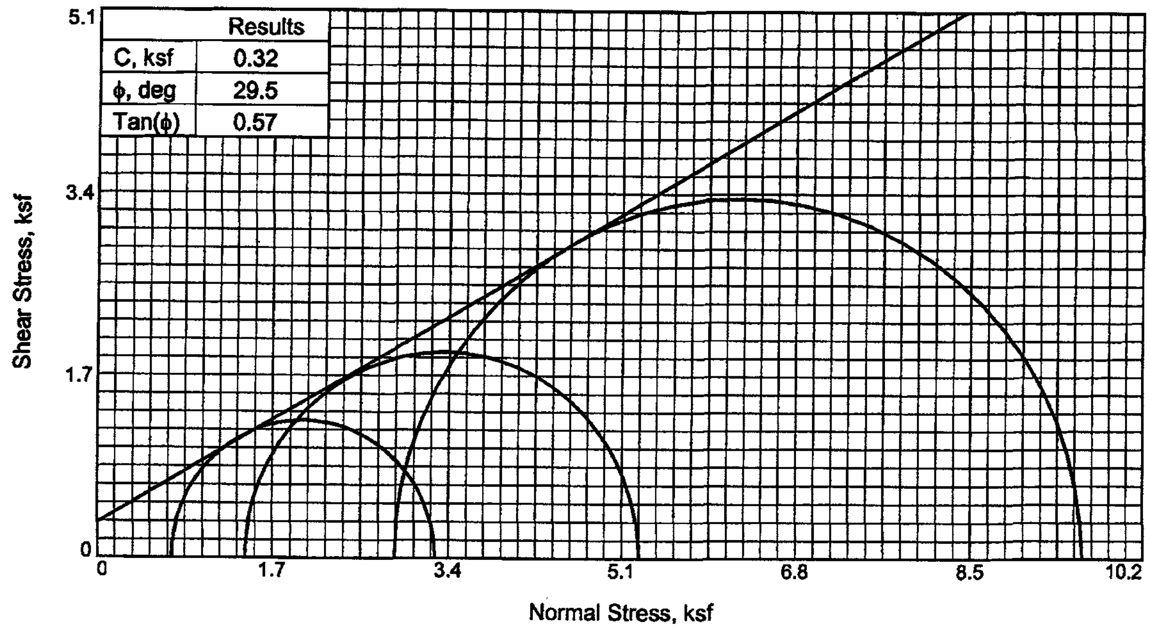
Sample Number: B-2 ST-2 **Depth:** 34.5'-36.5'

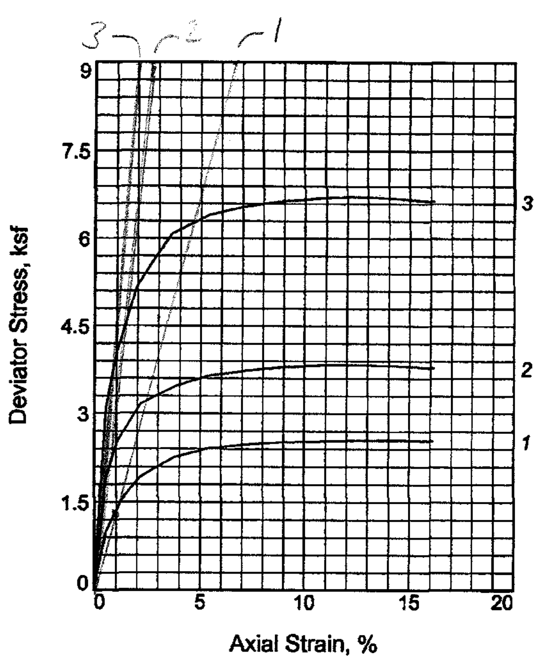
Proj. No.: 09-379 **Date Sampled:**

TRIAXIAL SHEAR TEST REPORT

Geo/Environmental Associates, Inc.

Figure 1





Modulus E (ksf)		138	360	450
Sample No.		1	2	3
Initial	Water Content, %	9.2	9.3	9.3
	Dry Density, pcf	114.3	114.5	113.2
	Saturation, %	53.1	53.8	52.0
	Void Ratio	0.4632	0.4617	0.4774
	Diameter, in.	2.80	2.80	2.80
	Height, in.	5.60	5.60	5.60
At Test	Water Content, %	16.8	16.2	16.9
	Dry Density, pcf	115.5	116.6	115.1
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.4491	0.4344	0.4538
	Diameter, in.	2.79	2.78	2.78
	Height, in.	5.58	5.56	5.57
Strain rate, in./min.		0.00	0.00	0.00
Back Pressure, psi		0.00	0.00	0.00
Cell Pressure, psi		5.00	10.00	20.00
Fail. Stress, ksf		2.55	3.83	6.72
Ult. Stress, ksf				
σ_1 Failure, ksf		3.27	5.27	9.60
σ_3 Failure, ksf		0.72	1.44	2.88

Avg. 316

Type of Test:
Consolidated Drained

Sample Type: Shelby Tubes

Description: Sand, clayey, silty, brown w/rock

LL= 16 **PL=** 12 **PI=** 4

Specific Gravity= 2.68

Remarks: Remolded specimens from B-1 ST-1, B-3 ST-1 & B-4 ST-1

Figure 1

Client: American Electric Power

Project: Mitchell Bottom Ash Pond

Sample Number: B-1,B-3,B-4 ST-1 **Depth:** 9.5'-10.0'

Proj. No.: 09-379 **Date Sampled:**

TRIAXIAL SHEAR TEST REPORT

Geo/Environmental Associates, Inc.

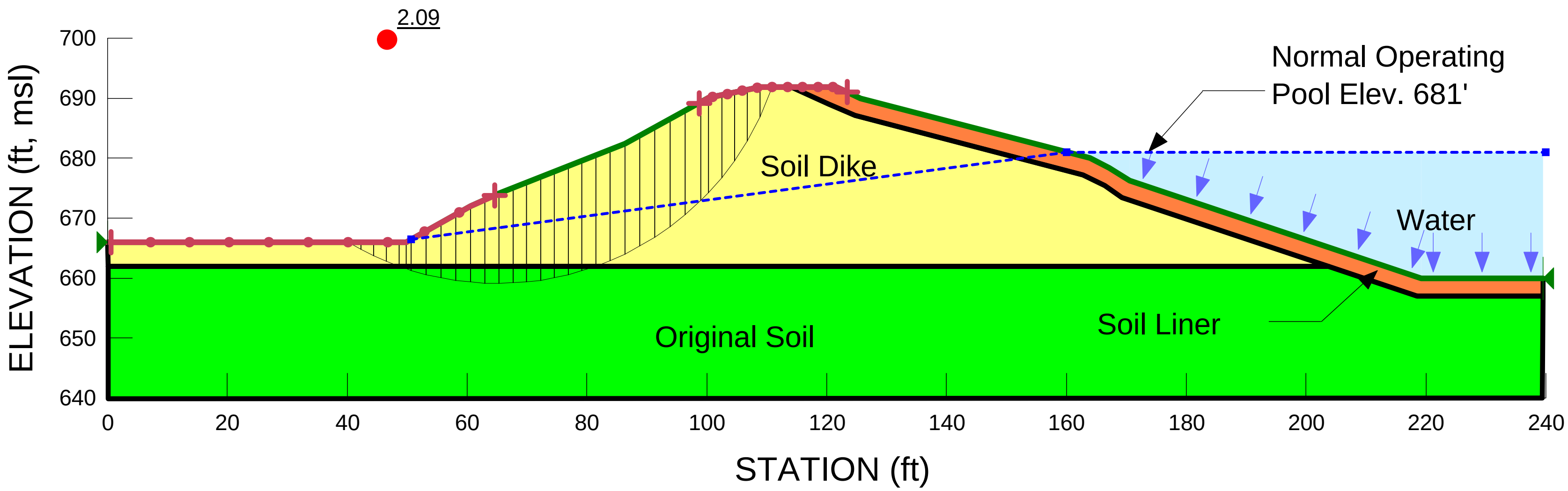
Section SP1 Stability Analyses

Title: Mitchell Bottom Ash Pond
Comments: Profile SP1-SP1 Downstream Static Stability Analysis
Maximum Longterm Pool
Name: MBAP_SP1_DS Stability Max Longterm Pool.gsz
Date: 11/4/2015
Method: Morgenstern-Price

Name: Original
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 34 °
Constant Unit Wt. Above Water Table: 120 pcf

Name: Soil Dike
Model: Mohr-Coulomb
Unit Weight: 134 pcf
Cohesion': 300 psf
Phi': 29 °
Constant Unit Wt. Above Water Table: 124 pcf

Name: Liner
Model: Mohr-Coulomb
Unit Weight: 131 pcf
Cohesion': 900 psf
Phi': 0 °
Constant Unit Wt. Above Water Table: 121 pcf

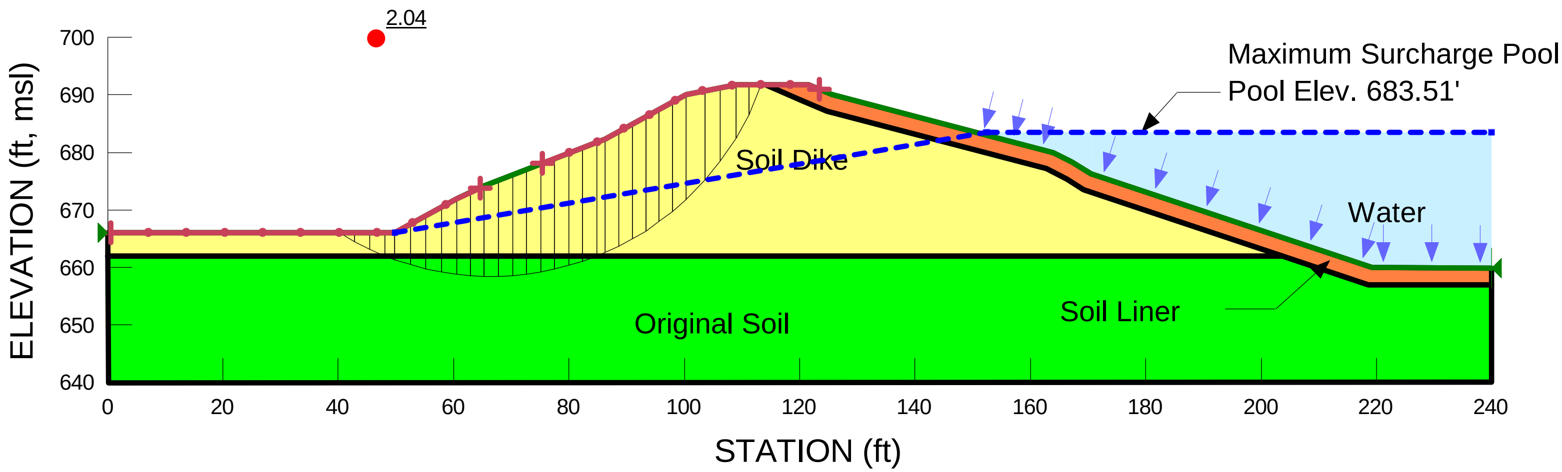


Title: Mitchell Bottom Ash Pond
Comments: Profile SP1-SP1 Downstream Static Stability Analysis
Maximum Surcharge Pool
Name: MBAP_SP1_DS Static Stability Max Surcharge Pool.gsz
Date: 12/21/2015
Method: Morgenstern-Price

Name: Original
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 34 °
Constant Unit Wt. Above Water Table: 120 pcf

Name: Soil Dike
Model: Mohr-Coulomb
Unit Weight: 134 pcf
Cohesion': 300 psf
Phi': 29 °
Constant Unit Wt. Above Water Table: 124 pcf

Name: Liner
Model: Mohr-Coulomb
Unit Weight: 131 pcf
Cohesion': 900 psf
Phi': 0 °
Constant Unit Wt. Above Water Table: 121 pcf

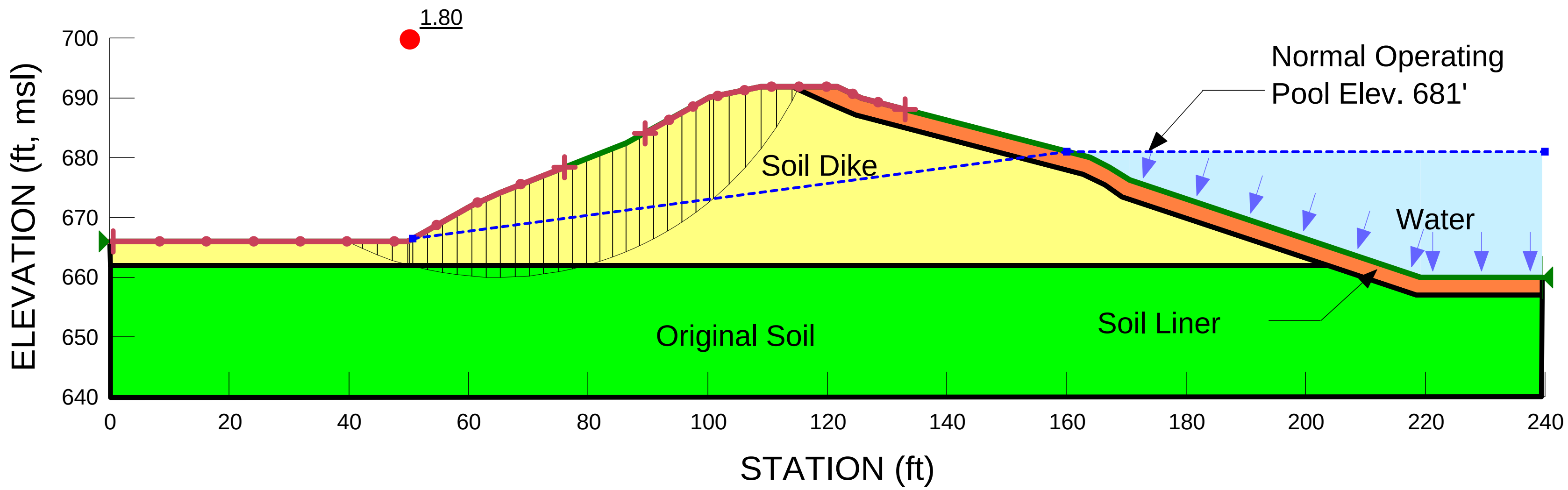


Title: Mitchell Bottom Ash Pond
Comments: Profile SP1-SP1 Downstream Pseudo-Static Stability Analysis
Maximum Longterm Pool
Name: MBAP_SP1_DS Pseudo-Static Stability Max Long-term Pool.gsz
Date: 11/6/2015
Method: Morgenstern-Price
Horz Seismic Coef.: 0.06

Name: Original
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 34 °
Constant Unit Wt. Above Water Table: 120 pcf

Name: Soil Dike
Model: Mohr-Coulomb
Unit Weight: 134 pcf
Cohesion': 300 psf
Phi': 29 °
Constant Unit Wt. Above Water Table: 124 pcf

Name: Liner
Model: Mohr-Coulomb
Unit Weight: 131 pcf
Cohesion': 900 psf
Phi': 0 °
Constant Unit Wt. Above Water Table: 121 pcf

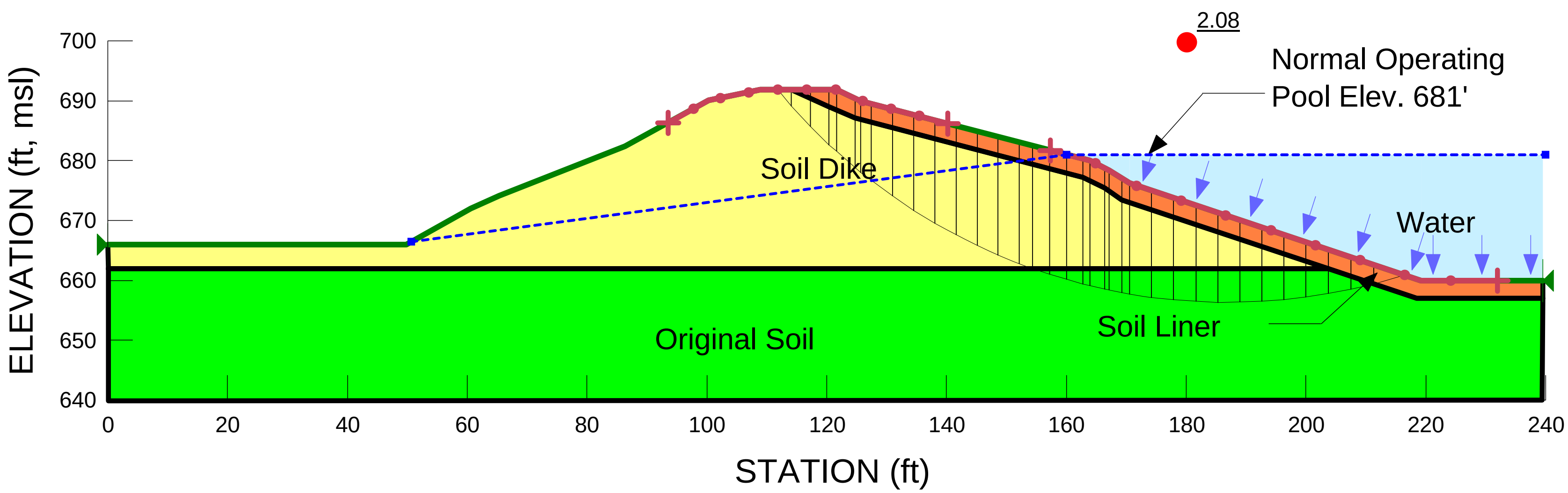


Title: Mitchell Bottom Ash Pond
Comments: Profile SP1-SP1 Upstream Pseudo-Static Stability Analysis
Maximum Longterm Pool
Name: MBAP_SP1_US Pseudo-Static Stability Max Long-term Pool.gsz
Date: 11/6/2015
Method: Morgenstern-Price
Horz Seismic Coef.: 0.06

Name: Original
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 34 °
Constant Unit Wt. Above Water Table: 120 pcf

Name: Soil Dike
Model: Mohr-Coulomb
Unit Weight: 134 pcf
Cohesion': 300 psf
Phi': 29 °
Constant Unit Wt. Above Water Table: 124 pcf

Name: Liner
Model: Mohr-Coulomb
Unit Weight: 131 pcf
Cohesion': 900 psf
Phi': 0 °
Constant Unit Wt. Above Water Table: 121 pcf

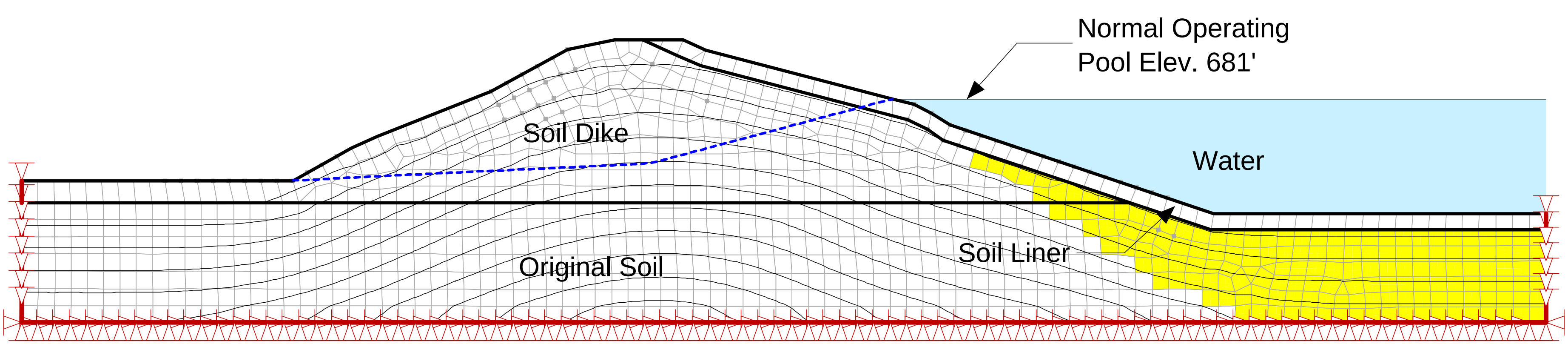


Title: Mitchell Bottom Ash Pond
Comments: Profile SP1-SP1 Upstream Liquefaction Analyis
Name: MBAP_SP1_US Liquefaction.gsz
Date: 11/9/2015
Method: Equivalent Linear Dynamic

Name: Soil Dike
Model: Equivalent Linear
Unit Weight: 124 pcf
Poisson's Ratio: 0.28
Dynamic G-Reduction Function: Seed-Idriss (sands)
Pore Water Pressure Function: Built-in Function
K-Alpha Function: Built-in Function (dense sand)
K-Sigma Function: Built-in Function (sand)
Cyclic Function: Built-in Function (dense sand)
Dynamic Damping Ratio Function: Seed-Idriss
G Modulus: 121540 psf

Name: Original
Model: Equivalent Linear
Unit Weight: 120 pcf
Poisson's Ratio: 0.28
Dynamic G-Reduction Function: Seed-Idriss (sands)
Pore Water Pressure Function: Built-in Function
K-Alpha Function: Built-in Function (med dense sand)
K-Sigma Function: Built-in Function (sand)
Cyclic Function: Built-in Function (med dense sand)
Dynamic Damping Ratio Function: Seed-Idriss
G Modulus: 166540 psf

Name: Liner
Model: Equivalent Linear
Unit Weight: 121 pcf
Poisson's Ratio: 0.3
Dynamic G-Reduction Function: Built-in Function
Pore Water Pressure Function: Built-in Function
Dynamic Damping Ratio Function: Clay-Sun, et. al.
GMax Function: Gmax Function 1

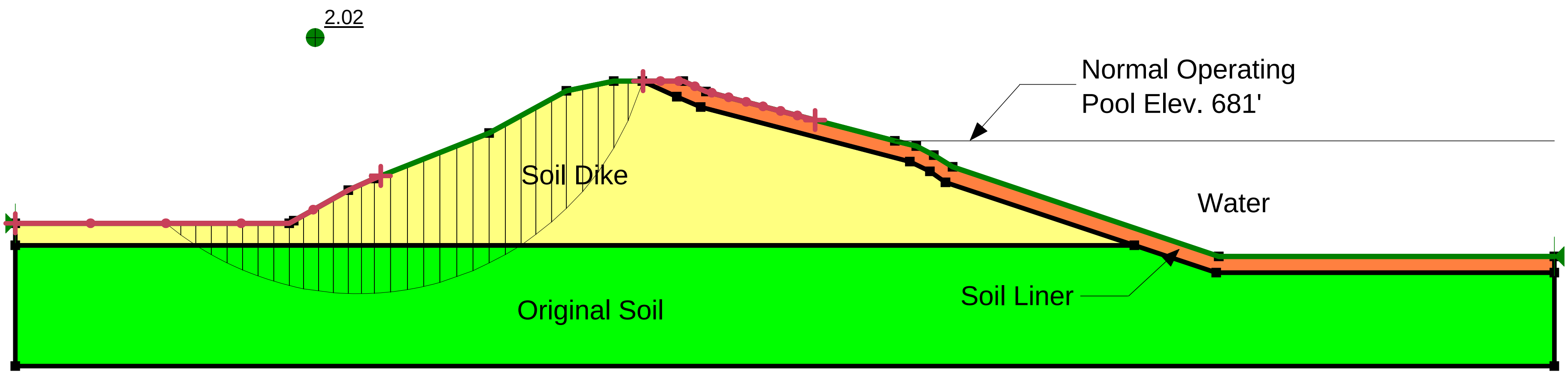


Title: Mitchell Bottom Ash Pond
Comments: Profile SP1-SP1 Downstream Liquefaction Analyis
Name: MBAP_SP1_DS Liquefaction.gsz
Date: 11/9/2015
Method: QUAKE/W Newmark Deformation

Name: Soil Dike
Model: Mohr-Coulomb
Unit Weight: 134 pcf
Unit Wt. Above Water Table: 124 pcf
Cohesion: 300 psf
Phi: 29 °

Name: Original
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 34 °

Name: Liner
Model: Mohr-Coulomb
Unit Weight: 131 pcf
Unit Wt. Above Water Table: 121 pcf
Cohesion: 900 psf
Phi: 0 °

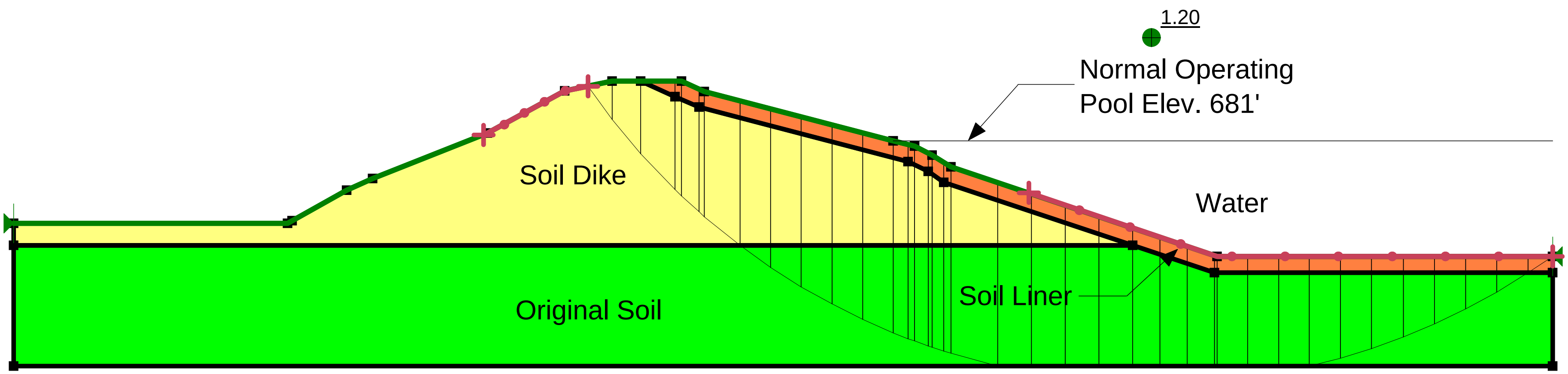


Title: Mitchell Bottom Ash Pond
Comments: Profile SP1-SP1 Upstream Liquefaction Analyis
Name: MBAP_SP1_US Liquefaction.gsz
Date: 11/9/2015
Method: QUAKE/W Newmark Deformation

Name: Soil Dike
Model: Mohr-Coulomb
Unit Weight: 134 pcf
Unit Wt. Above Water Table: 124 pcf
Cohesion: 300 psf
Phi: 29 °

Name: Original
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Unit Wt. Above Water Table: 120 pcf
Cohesion: 0 psf
Phi: 34 °

Name: Liner
Model: Mohr-Coulomb
Unit Weight: 131 pcf
Unit Wt. Above Water Table: 121 pcf
Cohesion: 900 psf
Phi: 0 °



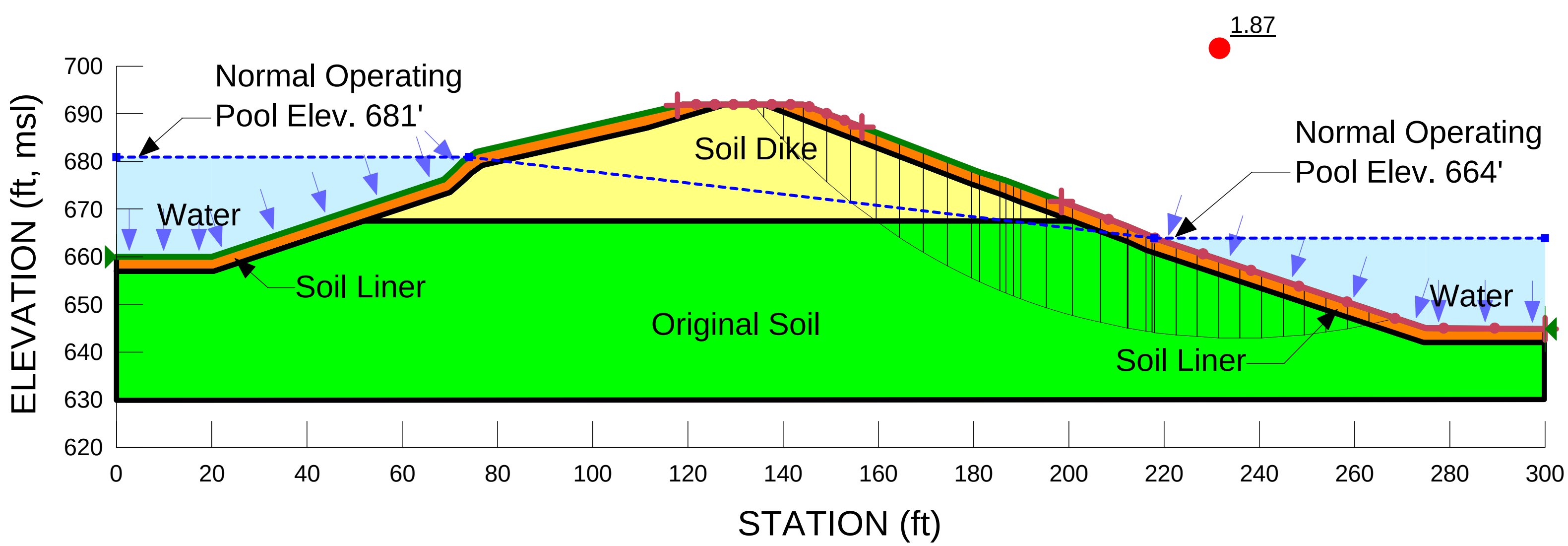
Section SP2 Stability Analyses

Title: Mitchell Bottom Ash Pond
Comments: Profile SP2-SP2 Downstream Static Stability Analysis
Name: MBAP_SP2_DS Stability Max Long-term Pool.gsz
Date: 11/4/2015
Method: Morgenstern-Price

Name: Original
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 34 °
Constant Unit Wt. Above Water Table: 120 pcf

Name: Liner
Model: Mohr-Coulomb
Unit Weight: 131 pcf
Cohesion': 900 psf
Phi': 0 °
Constant Unit Wt. Above Water Table: 121 pcf

Name: Soil Dike
Model: Mohr-Coulomb
Unit Weight: 134 pcf
Cohesion': 300 psf
Phi': 29 °
Constant Unit Wt. Above Water Table: 124 pcf

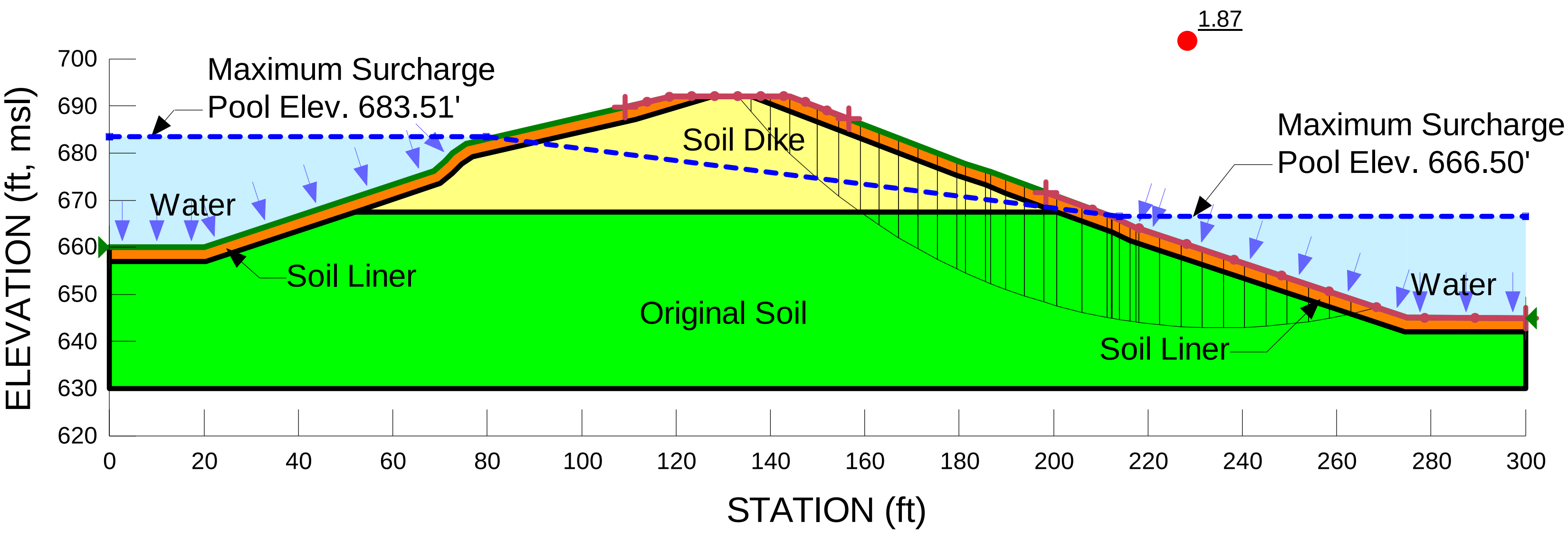


Title: Mitchell Bottom Ash Pond
Comments: Profile SP2-SP2 Downstream Static Stability Analysis
Maximum Surcharge Pool
Name: MBAP_SP2_DS Static Stability Max Surcharge Pool.gsz
Date: 12/21/2015
Method: Morgenstern-Price

Name: Original
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 34 °
Constant Unit Wt. Above Water Table: 120 pcf

Name: Liner
Model: Mohr-Coulomb
Unit Weight: 131 pcf
Cohesion': 900 psf
Phi': 0 °
Constant Unit Wt. Above Water Table: 121 pcf

Name: Soil Dike
Model: Mohr-Coulomb
Unit Weight: 134 pcf
Cohesion': 300 psf
Phi': 29 °
Constant Unit Wt. Above Water Table: 124 pcf

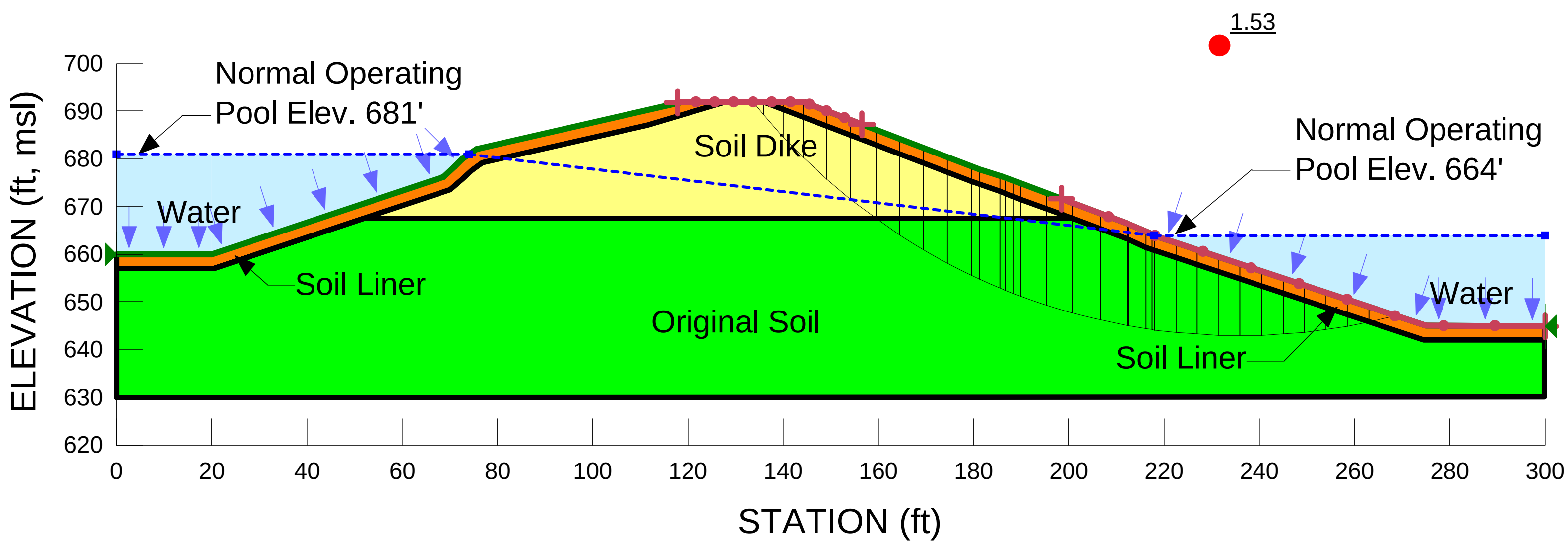


Title: Mitchell Bottom Ash Pond
Comments: Profile SP2-SP2 Downstream Pseudo-Static Stability Analysis
Name: MBAP_SP2_DS Pseudo-Static Stability Max Long-term Pool.gsz
Date: 11/6/2015
Method: Morgenstern-Price
Horz Seismic Coef.: 0.06

Name: Original
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 34 °
Constant Unit Wt. Above Water Table: 120 pcf

Name: Liner
Model: Mohr-Coulomb
Unit Weight: 131 pcf
Cohesion': 900 psf
Phi': 0 °
Constant Unit Wt. Above Water Table: 121 pcf

Name: Soil Dike
Model: Mohr-Coulomb
Unit Weight: 134 pcf
Cohesion': 300 psf
Phi': 29 °
Constant Unit Wt. Above Water Table: 124 pcf

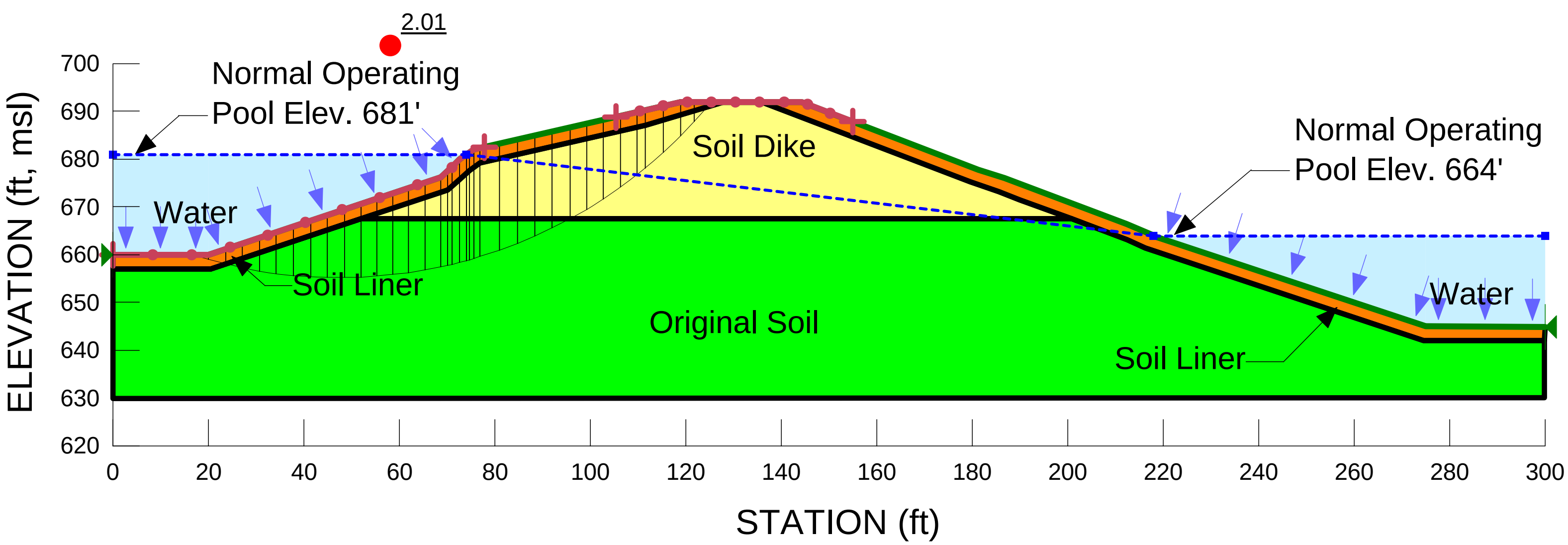


Title: Mitchell Bottom Ash Pond
Comments: Profile SP2-SP2 Upstream Pseudo-Static Stability Analysis
Name: MBAP_SP2_US Pseudo-Static Stability Max Long-term Pool.gsz
Date: 11/6/2015
Method: Morgenstern-Price
Horz Seismic Coef.: 0.06

Name: Original
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 34 °
Constant Unit Wt. Above Water Table: 120 pcf

Name: Liner
Model: Mohr-Coulomb
Unit Weight: 131 pcf
Cohesion': 900 psf
Phi': 0 °
Constant Unit Wt. Above Water Table: 121 pcf

Name: Soil Dike
Model: Mohr-Coulomb
Unit Weight: 134 pcf
Cohesion': 300 psf
Phi': 29 °
Constant Unit Wt. Above Water Table: 124 pcf

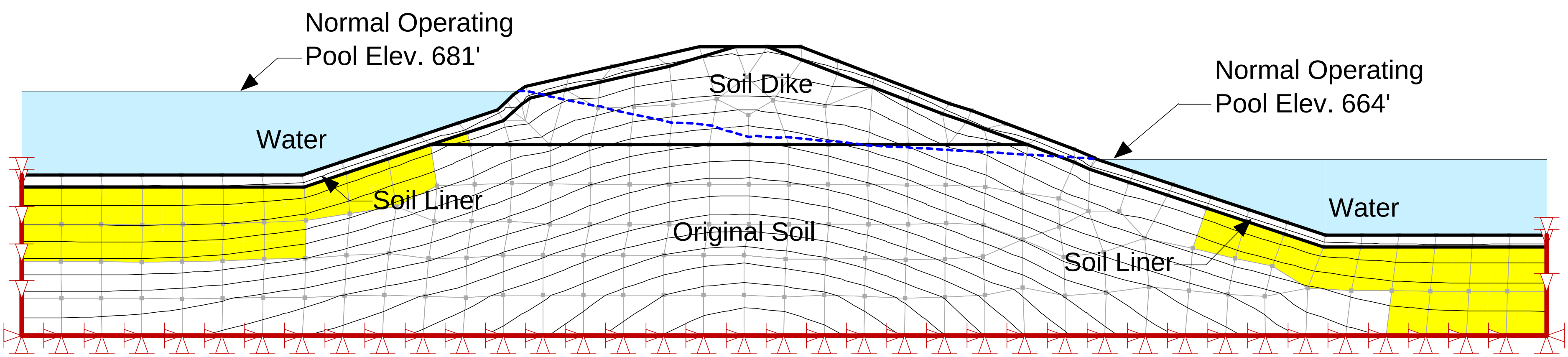


Title: Mitchell Bottom Ash Pond
Comments: Profile SP2-SP2 Downstream Liquefaction Analysis
Name: MBAP_SP2_DS Liquefaction.gsz
Date: 11/9/2015
Method: Equivalent Linear Dynamic

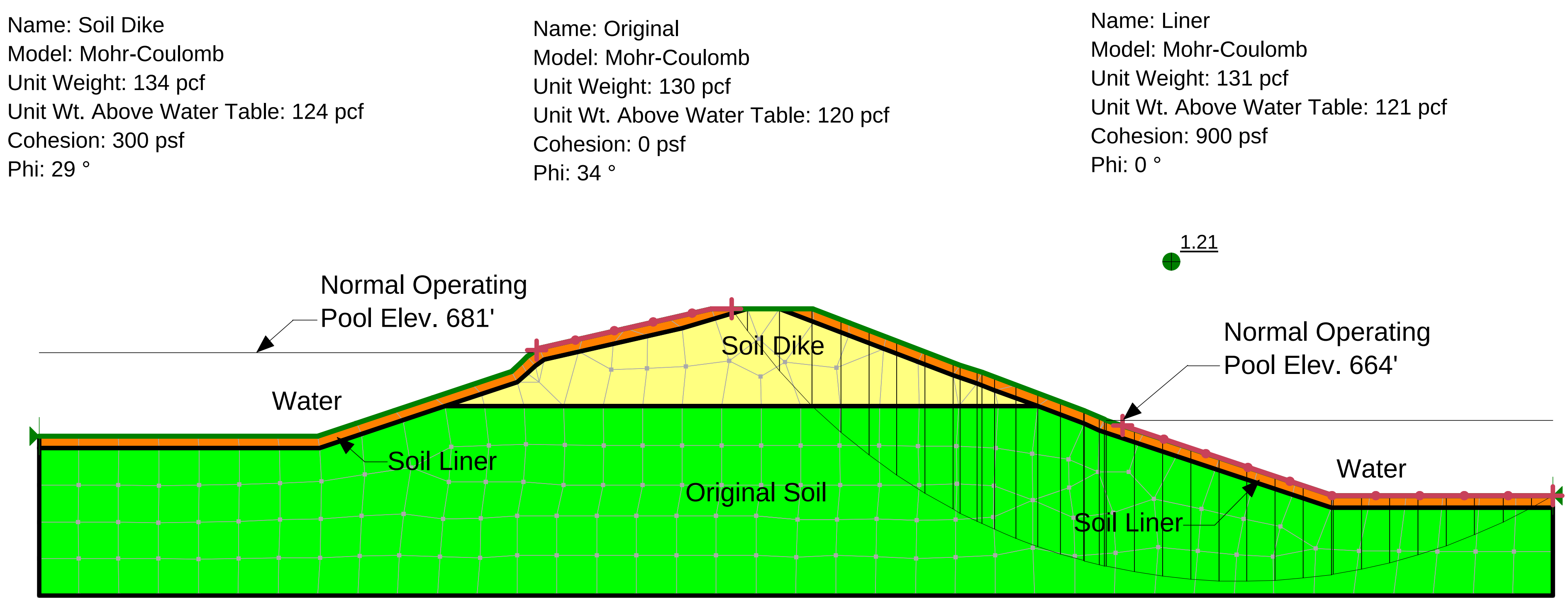
Name: Soil Dike
Model: Equivalent Linear
Unit Weight: 134 pcf
Poisson's Ratio: 0.28
Dynamic G-Reduction Function: Seed-Idriss (sands)
Pore Water Pressure Function: Built-in Function
K-Alpha Function: Built-in Funciton (dense sand)
K-Sigma Function: Built-in Function (sand)
Cyclic Function: Built-in Function (dense sand)
Dynamic Damping Ratio Function: Seed-Idriss
G Modulus: 121540 psf

Name: Original
Model: Equivalent Linear
Unit Weight: 120 pcf
Poisson's Ratio: 0.28
Dynamic G-Reduction Function: Seed-Idriss (sands)
Pore Water Pressure Function: Built-in Function
K-Alpha Function: Built-in Function (med dense sand)
K-Sigma Function: Built-in Function (sand)
Cyclic Function: Built-in Function (med dense sand)
Dynamic Damping Ratio Function: Seed-Idriss
G Modulus: 166540 psf

Name: Liner
Model: Equivalent Linear
Unit Weight: 121 pcf
Poisson's Ratio: 0.3
Dynamic G-Reduction Function: Built-in Function
Pore Water Pressure Function: Built-in Function
Dynamic Damping Ratio Function: Clay-Sun, et. al.
GMax Function: Gmax Function 1



Title: Mitchell Bottom Ash Pond
Comments: Profile SP2-SP2 Downstream Liquefaction Analysis
Name: MBAP_SP2_DS Liquefaction.gsz
Date: 11/9/2015
Method: QUAKE/W Newmark Deformation

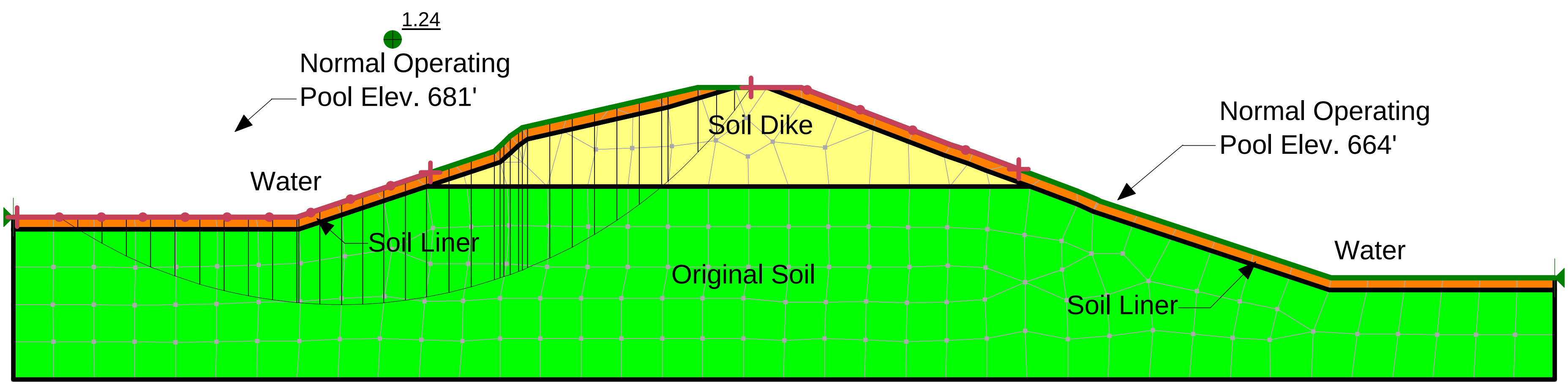


Title: Mitchell Bottom Ash Pond
Comments: Profile SP2-SP2 Downstream Liquefaction Analysis
Name: MBAP_SP2_US Liquefaction.gsz
Date: 11/6/2015
Method: QUAKE/W Newmark Deformation

Name: Soil Dike
Model: Mohr-Coulomb
Unit Weight: 134
Unit Wt. Above Water Table: 124
Cohesion: 300
Phi: 29
Phi-B: 0

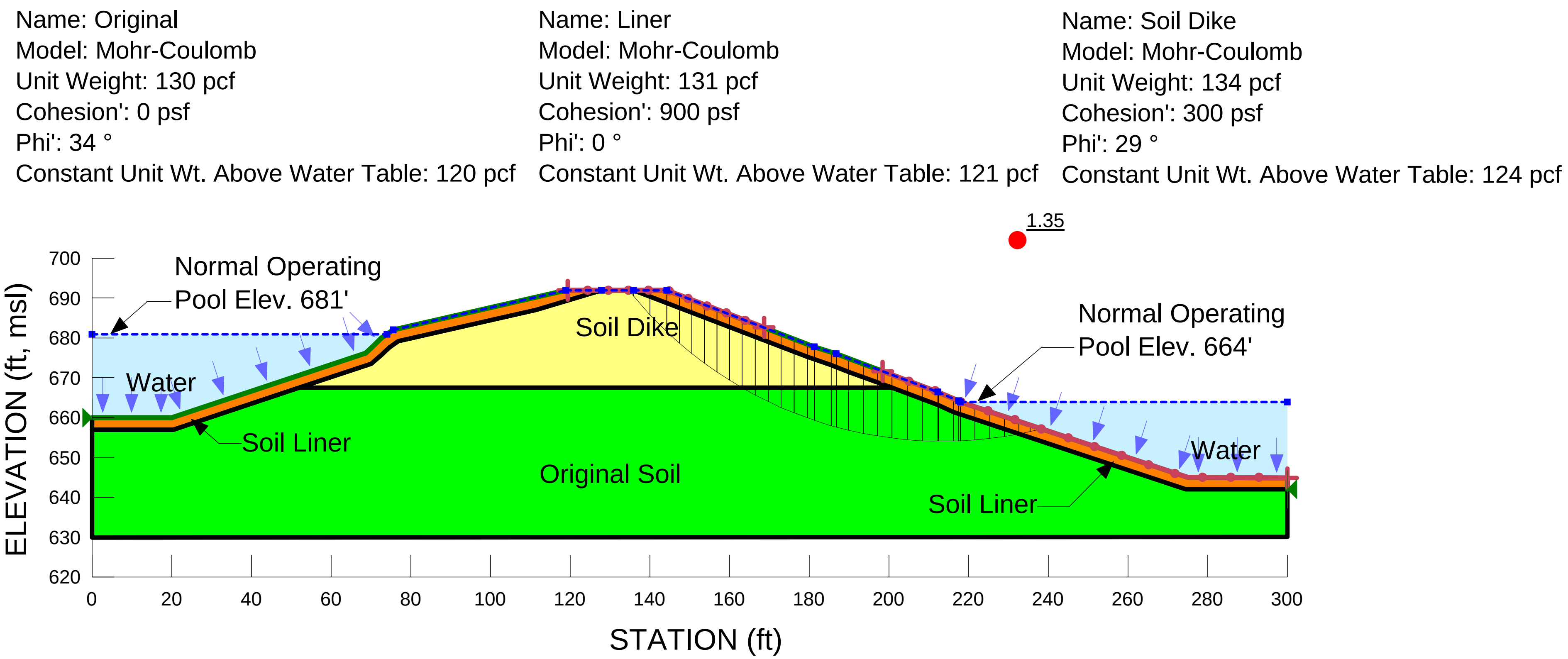
Name: Original
Model: Mohr-Coulomb
Unit Weight: 130
Unit Wt. Above Water Table: 120
Cohesion: 0
Phi: 34
Phi-B: 0

Name: Liner
Model: Mohr-Coulomb
Unit Weight: 131
Unit Wt. Above Water Table: 121
Cohesion: 900
Phi: 0
Phi-B: 0



Section SP2 Stability Analyses with Elevated Phreatic Levels

Title: Mitchell Bottom Ash Pond
Comments: Profile SP2-SP2 Downstream Static Stability Analysis - Minimum FS
Name: MBAP_SP2_DS Stability Max Long-term Pool_Critical Piezometer.gsz
Date: 11/11/2015
Method: Morgenstern-Price

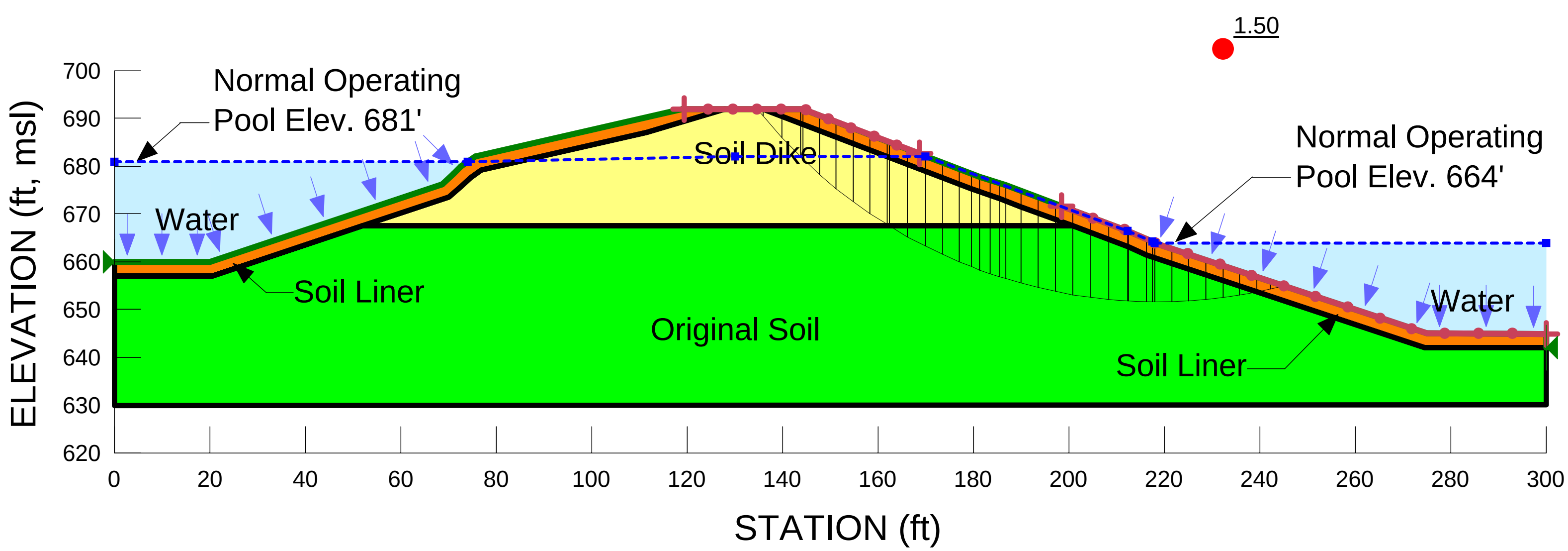


Title: Mitchell Bottom Ash Pond
Comments: Profile SP2-SP2 Downstream Static Stability Analysis - FS=1.5
Name: MBAP_SP2_DS Stability Max Long-term Pool_Critical Piezometer_1.5.gsz
Date: 11/11/2015
Method: Morgenstern-Price

Name: Original
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 34 °
Constant Unit Wt. Above Water Table: 120 pcf

Name: Liner
Model: Mohr-Coulomb
Unit Weight: 131 pcf
Cohesion': 900 psf
Phi': 0 °
Constant Unit Wt. Above Water Table: 121 pcf

Name: Soil Dike
Model: Mohr-Coulomb
Unit Weight: 134 pcf
Cohesion': 300 psf
Phi': 29 °
Constant Unit Wt. Above Water Table: 124 pcf



Appendix IV

Drawing

NOTES

1. PLAN ADAPTED FROM DRAWINGS PROVIDED BY AEPSC, DATED 11-10-10.

LEGEND

SP1 — SP1 (0+00)	SECTION LIMITS
B-1	SAMPLED BOREHOLE LOCATION
B-2	SAMPLED BOREHOLE LOCATION WITH PIEZOMETER

THESE DRAWINGS ARE PART OF A SET OF DESIGN DOCUMENTS WHICH ALSO CONTAINS A WRITTEN TEXT. THAT TEXT EXPLAINS SOME OF THE DETAILS SHOWN HEREIN AND THEREFORE THESE DRAWINGS SHOULD ONLY BE USED IN CONJUNCTION WITH THE TEXT.

DATE	REVISIONS	BY

SITE PLAN VIEW
CCR RULES ASSESSMENT

MITCHELL PLANT
BOTTOM ASH COMPLEX
MARSHALL COUNTY, WEST VIRGINIA

SCALE: AS SHOWN | DR RAR | CHK RWC | REV SWF

PREPARED FOR:

AEP SERVICE CORPORATION

PREPARED BY:

GA Geo/Environmental Associates, Inc.
3502 OVERLOOK CIRCLE • KNOXVILLE, TENNESSEE 37909 • (865) 584-0344

PROJ: 15055013.00 | DATE: 12-22-15 | SHEET 1 OF 1